

The effect of customs formalities on the lead time of hinterland transport

Martijn Thush – August 26, 2018



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Thesis for the Executive Master of Customs and Supply Chain Compliance

by

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I Executive summary

This study is concerned with the effect of customs formalities on the hinterland transport of containerized cargo. The overarching objective of this thesis was to contribute to the development of theory regarding the effects of customs formalities on logistics processes, more in particular the effect on the lead time of hinterland transport. The research objectives were to find evidence or the absence thereof of the relation between customs formalities and the lead time of hinterland transport and to identify underlying causes.

In this study the customs- and commercial procedures were dissected out to create thorough understanding and good overview of relevant processes. Based on this knowledge a conceptual model was created. Measurable variables for the lead time of customs formalities and hinterland transport were defined in support of further analysis. “Document lead time” was introduced to measure the time attribute of customs formalities and “dwell time” was introduced as a proxy variable for the lead time of hinterland transport.

With support of Rotterdam World Gateway (RWG) and the Dutch Customs Administration empirical data was collected for further analysis. This data included all the loaded inbound containers with a destination in the hinterland of terminal operator RWG for the month September 2017. The data was extracted from the audit file for the temporary storage facility of RWG and prepared for statistical analysis.

Statistical analysis was performed to answer the question if there is evidence of a relation between the document lead time and dwell time. The analysis provided evidence that containers with longer document lead times on average dwell longer at the port terminal. It was also observed that the time that containers dwell at the port terminal after completion of the customs formalities is not strongly affected by the speed at which the customs formalities were completed. Causation was explained based on the qualitative understanding of the procedures at the port terminal and the legal backgrounds thereof.

This study provides evidence that the time used for customs formalities is an important factor of influence on the variation in the lead time of hinterland transport. Since customs declarations compliant with the applicable legal requirements are to be accepted by the customs administration immediately, this means that the document lead time is driven by the actions of parties in the hinterland. The underlying cause is the time required by parties in the hinterland for lodging the customs declaration and for submitting confirmation thereof to the terminal operator. Cargo interests, directly or indirectly, through parties acting on their

behalf, influence the time that containers dwell in the port terminal and consequently the hinterland transport lead time as a whole. Additionally, the uncertainty about the actual moment that the container will be released by the terminal has the effect that containers dwell longer at the terminal.

Review of the existing body of academic literature learned that there is great attention of academics for the optimization of port terminal operations and hinterland transport but that the link with customs formalities received less attention and is mostly limited to more general statements. It also revealed that research in the domain of trade facilitation is mostly macro-economic in nature and does not provide great detail on the actual barriers it tries to overcome.

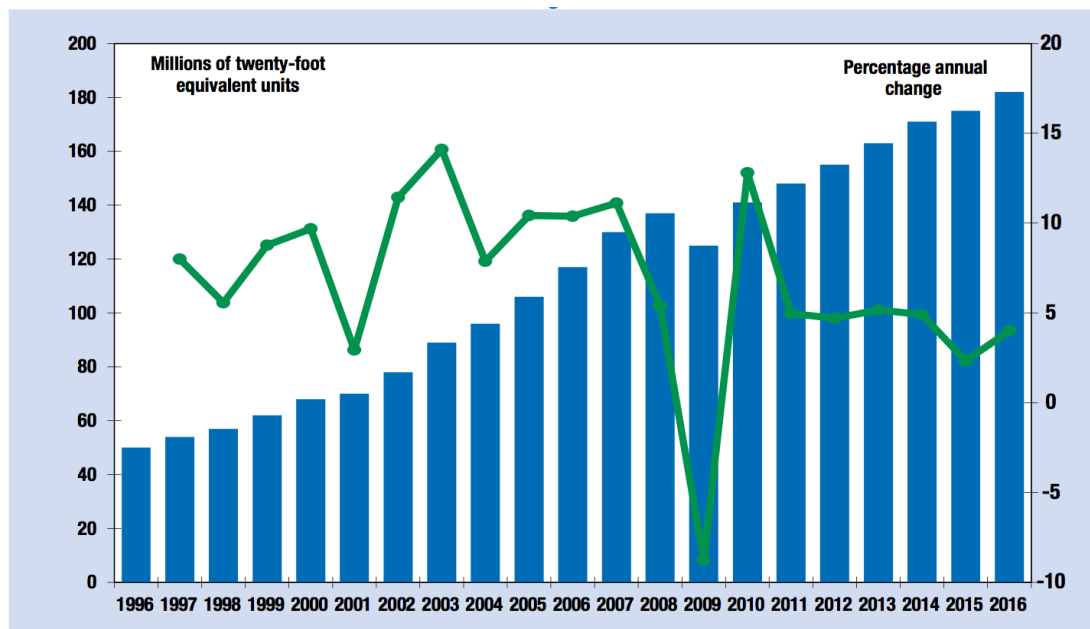
The conclusions of this study should raise awareness that customs formalities influence supply chain performance. Thereby it should also encourage researchers to include the handling of customs formalities when studying processes related to port terminal operations and hinterland transport. The findings of this study also give a more detailed view on a non-tariff barrier to trade, which can be helpful in the domain of trade facilitation. Not only the procedure itself, but also the way it is handled can form a non-tariff trade barrier to trade and is therefore relevant to the facilitation of trade.

The findings of this study could support and induce practitioners to improve business procedures and processes. Driving expeditious handling of customs formalities reduces lead times of hinterland transport and thereby improves performance of supply chains.

2 Introduction to the research thesis

This study is concerned with the relation between customs formalities and hinterland transport of containerized cargo. This introductory chapter first introduces the research topic (2.1) to give context to this study, after which it will address the problem statement (2.2). Following clarification of the problem statement, the research scope and objectives (2.3) will be presented. The last section of this chapter (2.4) includes an outline of this thesis report for convenience of the reader.

2.1 Customs formalities and hinterland transport of containers



Source: UNCTAD secretariat calculations, based on Clarksons Research, Container Intelligence Monthly, various issues, and Drewry

Figure 1; Development of global container volumes

World trade in goods has increased dramatically over the last decade, rising from about \$10 trillion in 2005 to more than \$18.5 trillion in 2014 to then fall to about \$16 trillion in 2015 (UNCTAD, 2016). Similar to the development of world trade, the global containerized trade has shown considerable growth over the same period, despite the effects of the financial crisis in 2009 (as can be observed in graph Figure 1; Development of global container volumes).

Where the maritime industry is often addressed as the backbone of the global economy, the sea ports and their hinterland connections are an indispensable part of the

logistics infrastructure just the same. This includes not only the hard but also the soft infrastructure. Besides the merchants that initiate goods movement, there is a whole range of service providers involved with transportation and associated activities and auxiliary services. An international trade transaction between two parties can initiate the involvement of a vast number of intermediaries. One can think of shipping lines, inland carriers, truckers, seaport and inland terminals, freight forwarders, banks, customs administration, customs brokers, distribution centers and warehouses. Although the parties involved may vary considerably per transaction or per container to be shipped, Oosterhout et. al (2000) give an informative overview of all parties and the relation between them. Figure 2 sets the scene for this thesis project.

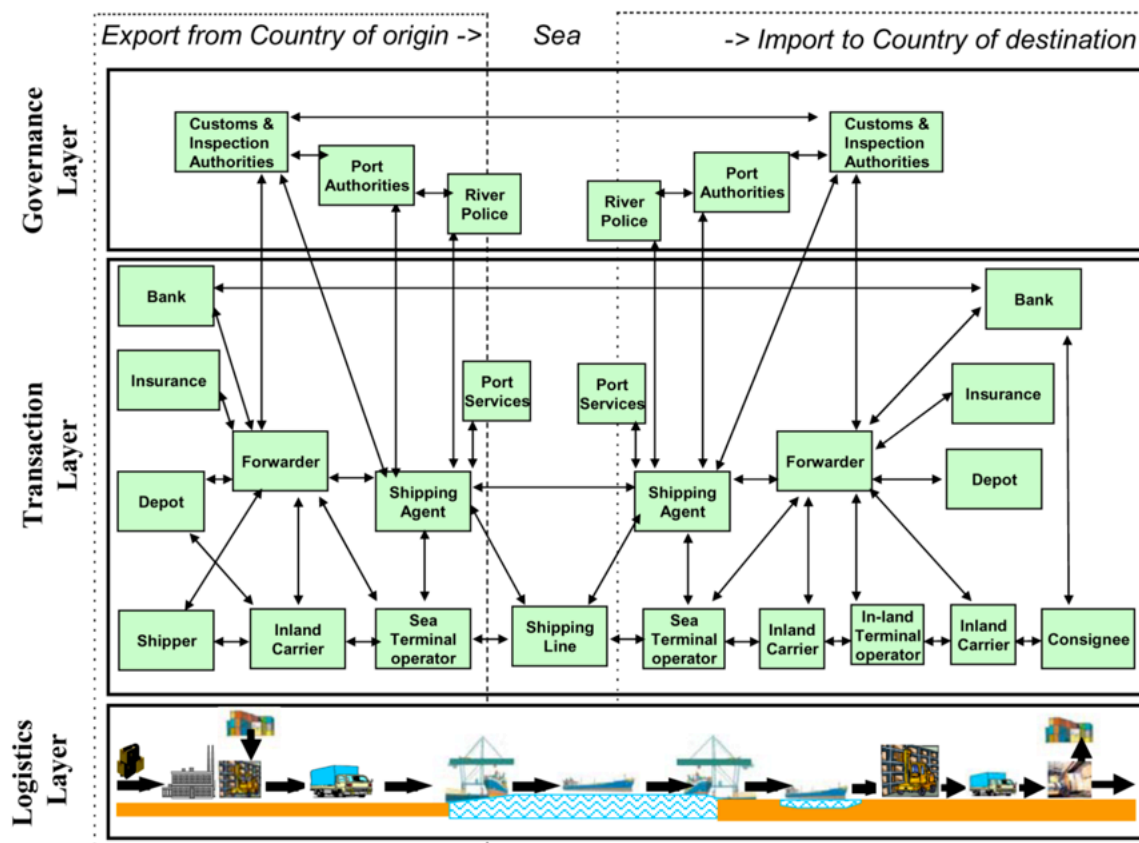


Figure 2; Layered model of global supply chains (Source: Oosterhout et. al, 2000)

The central theme of this thesis project is the effect of customs formalities on hinterland transport of containerized cargo. In particular, this thesis project will concentrate on the inbound flow of containers, from the Port of Rotterdam, at which they arrive in deep sea vessels, to the hinterland destination of the consignee.

This thesis attempts to first disentangle the integrated process of customs formalities and hinterland transport for containerized cargo and then to show how the supply chain and customs processes are intertwined. This thesis will focus on the effect of customs formalities on the lead time of hinterland transport. Customs formalities associated with the hinterland transport of containers from the deep-sea terminals to the hinterland affect the operations of economic operators and, inversely, the operations of economic operators affect customs formalities. This project concentrates on this reciprocal interdependency.

2.2 Problem statement

As can be witnessed from Figure 2, international trade is by no means simple. Cross border transactions involve a wide variety of business actors and governance executives. Business actors view the international goods flow through the lens of Supply Chain Management. Their objectives are to create value, enhance efficiency and satisfy customer needs through management of flows of material, information and resources. The Supply Chain discipline cuts across networks of upstream and downstream organizations. It is focused on the alignment with upstream and downstream organizations but takes little notion of the interaction with governance executives. Although losing time on customs formalities is particularly undesirable as it translates into reduced competitiveness, there appears to be limited attention for the time lost in supply chains by customs formalities.

Increased lead times for hinterland transport due to customs formalities do not only adversely affect the activities of logistics operators for transport and transshipment, also the trading parties are affected (buyers and sellers of goods). Increased lead times lead to higher in-transit inventory holding costs and increased delivery lead times and may incur extra logistical costs such as detention and demurrage.

Expeditious customs handling of inbound containers is beneficial to logistics operators as well as to the trading parties. Yet, as a result of fragmentation and subcontracting in the logistics sector, it is often unclear to logistics service providers and trading parties which effect customs procedures have on the lead time for hinterland transport. This limited visibility of the time lost may translate in missed opportunities.

The core of the problem is that trading parties and logistics service providers have little information on the amount of time that is lost in supply chains on customs formalities. This information deficit limits the opportunity for business actors or groups of business actors

to develop and invest in proportional improvement actions that effectively drive down the time lost.

2.3 Research scope and objectives

The overarching objective of this thesis is to contribute to the development of theory regarding the effects of customs formalities on logistics processes, more in particular the effect on the lead time of hinterland transport.

This thesis researches the presumptive notion that customs formalities affect the lead time of hinterland transport processes. The objective of this study is to find evidence -or the absence thereof- for the association between customs formalities and the lead time of hinterland transport processes and to describe this relation. This study is not focused on the procedures and time lost by customs controls, inspections and verification of declarations. Although customs controls will likely have influence on the hinterland transport lead time, the effect is not within the scope of this study. The aim is to study the process of customs formalities on entry. Next to establishing to what extent customs formalities delay hinterland transport processes, this study will analyze the interplay between business actors and customs administration to assess the underlying causes for these time effects. In particular the aim is to highlight where and how time is lost and where subsequently the lead-time for the hinterland transport is increased.

The focal construct of this research project is the lead-time of the hinterland transport process from arrival at the deep-sea terminal to arrival at the premises of the consignee. With reference to this focal construct, the research question is threefold:

- Is there evidence that customs formalities can be associated with the lead time of hinterland transport ?
- To what extent do customs formalities increase the lead time of hinterland transport (Days, hours) ?
- Is there a causal effect of customs formalities on hinterland transport lead time ?

Following the research question above, the research objective is to determine if there is evidence of a relation between customs formalities and the lead time of hinterland transport of full “inbound” containers arriving in the port of Rotterdam. In case there is evidence of

such relation between customs formalities and the lead time of hinterland transportation, the second objective is to understand, describe and explain this relation.

Research objective 1 Time effect of customs formalities

The first objective of this thesis is to determine if there is evidence of a relation between customs formalities and hinterland transport. As it is safe to say at this stage that customs formalities will normally not decrease the time required for transport of containers to the hinterland, the aim is to work out if and to which extend containers are delayed. Because customs formalities will not influence the time required for the physical transportation itself, this thesis will focus on the delay that arises during transshipment process from the sea vessel to the hinterland transport modality.

Research objective 2 Underlying causes

The second objective of this thesis is to describe and explain the relation (if there is any) to determine the underlying causes for the time lost by customs formalities, regardless if these causes are to be found within business procedures or in processes of the customs administration. In particular the focus will be to establish if customs formalities delay hinterland transport due to late submission of information to the customs administration by business actors, or due to the procedures for assessing this submitted information.

2.4 Thesis outline

For convenience of the reader the outline of the thesis is depicted in the diagram below. The diagram shows the main building blocks of the thesis. Research design and methodology will be addressed in the next chapter.

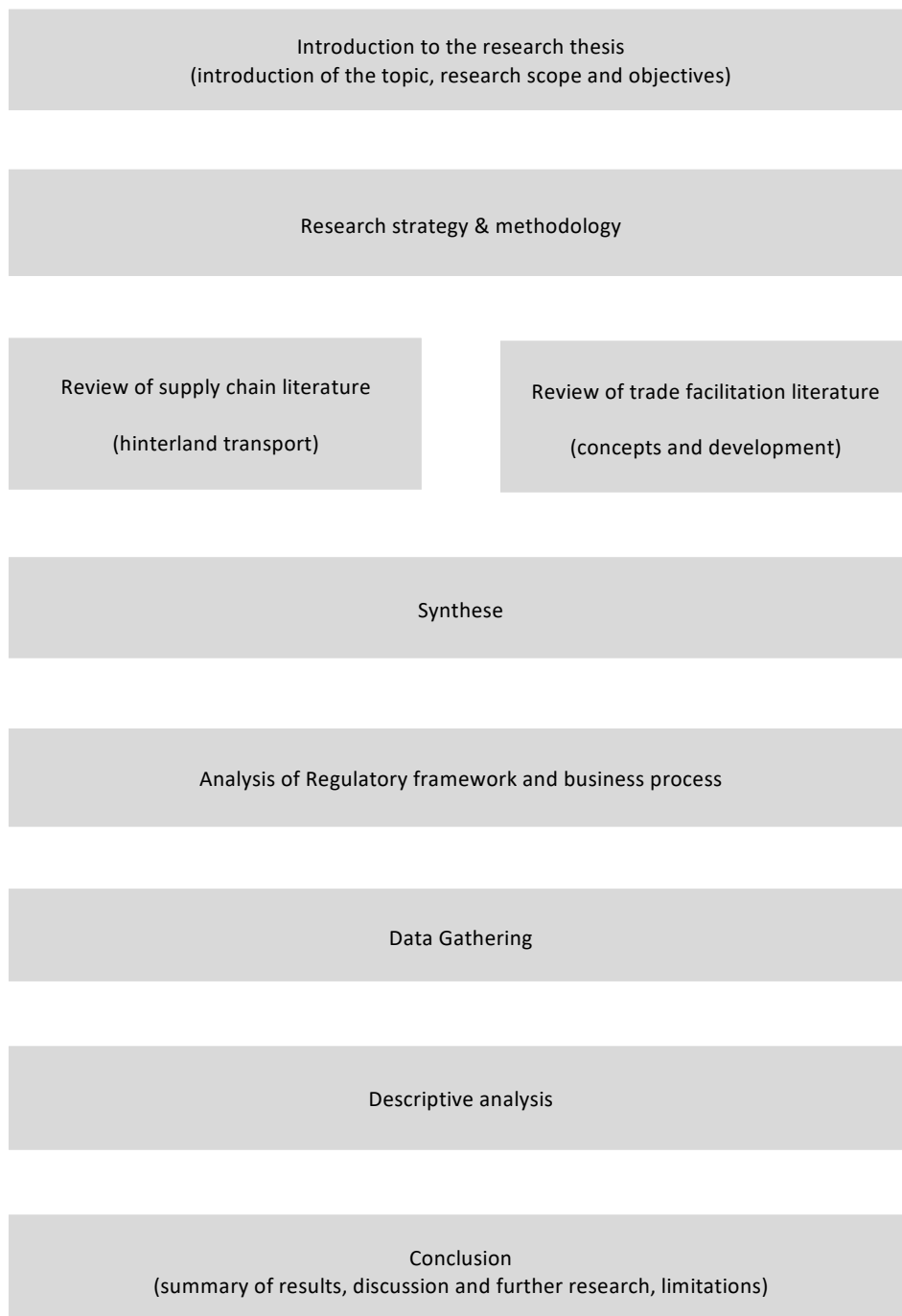


Figure 3; Thesis outline

3 Research methodology and design

The object of study for this thesis project is the process of hinterland transportation of full containers that arrive in the port of Rotterdam. This process entails the transshipment of containers that have been discharged from container vessels to the means of transport for hinterland carriage and the subsequent carriage to the consignee in the hinterland.

3.1 Research concepts

The research objective presented in section 2.3 already indicates that this research project is focused on a specific dimension of hinterland transportation: time. More in particular it is aimed at the time that passes during hinterland transportation of the container to the consignee. Within this thesis this time is referenced to as “hinterland transport lead time”. The hinterland transportation lead time starts at the moment that discharge from the container vessel is completed and ends at the moment that the container is delivered to the consignee in the hinterland.

At the heart of this thesis is the underlying presumptive notion that customs formalities cause variation in the hinterland transport lead-time. It is not the objective of this study to make statements on the actual hinterland transportation lead time itself, but it is aimed at the variation in this lead-time. This study therefor concerns itself with the relation between customs formalities and the variation in hinterland transport lead-time.

As it is safe to assume that customs formalities will not have influence on the actual transport itself, this research is focused on a sub-process of hinterland transport; the transshipment process in the port of Rotterdam. The dependent concept is narrowed to the lead-time of the transshipment process in the port of Rotterdam. Although this limitation means that the lead-time of the transport itself is excluded from the study, it is still justifiable to make statements on the variation in lead-time of the hinterland transport as a whole, since it is inconceivable that customs formalities and the lead-time of transshipment will influence the speed of hinterland transportation itself. This contraction of the dependent concept also helps to exclude the confounding variability of the transport lead-time caused by different destinations of the containers and the average speed of the modality used.

The dependent concept is the variable characteristic of the (narrowed) object of study; the lead time of the transshipment process. Within the context of this study this lead time

starts at the moment that the discharge operation of (individual) containers from the deep sea vessel in the port of Rotterdam is completed. This lead time ends at the moment that the container leaves the port terminal on the means of transport for inland carriage. This lead time is generally referred to as “Dwell Time”. The unit of measure for the time dimension of “Dwell Time” is hours.

The independent concept is the variable characteristic of “customs formalities”. In this thesis this variable characteristic is the time used to complete the customs formalities. More specific this is the time used to assign the cargo in the container to a customs procedure.

In section 5.2 the legal background of customs formalities is discussed in detail and this section also explains that containers will not be released from the container terminal before the cargo in the container has been assigned to a customs procedure and the cargo interest has informed the terminal of this fact. Legally customs declarations can only be accepted by the Dutch customs administration after the formal act of presentation. In practice this moment coincides with the actual time of arrival of the container vessel. This means that it is possible that the terminal receives confirmation that goods have been assigned to a customs procedure before the container has been discharged from the deep sea vessel. Because only the time used for completion of customs formalities after discharge of the container can delay can influence (prolongate) the hinterland transport process, the moment of discharge of the container is used as the start of the customs formalities. Within the context of this thesis the formalities are completed when all the goods in the container have been assigned to a customs procedure and the terminal operator has been informed of this fact (please find further background in section 5.2).

The independent concept is defined as “document lead-time”. This time starts at the moment that the discharge operations for a container are completed and ends at the moment that the cargo interest has informed the terminal operator that the goods in the container have been assigned to a customs procedure. The unit of measure for this concept is hours.

For better understanding of the definition of both concepts and the relation between them, Figure 5 is included. Three events on the time axis mark the moments that discharge operations for a container are completed (discharge), the moment that the cargo interest confirms to the terminal operator that the goods in a container have been assigned to a customs procedure (document receipt) and the moment that the container leaves the terminal

on the means of transport for hinterland carriage (exit). The horizontal arrows are a graphical representation of the concepts “document lead-time” and “dwell time”

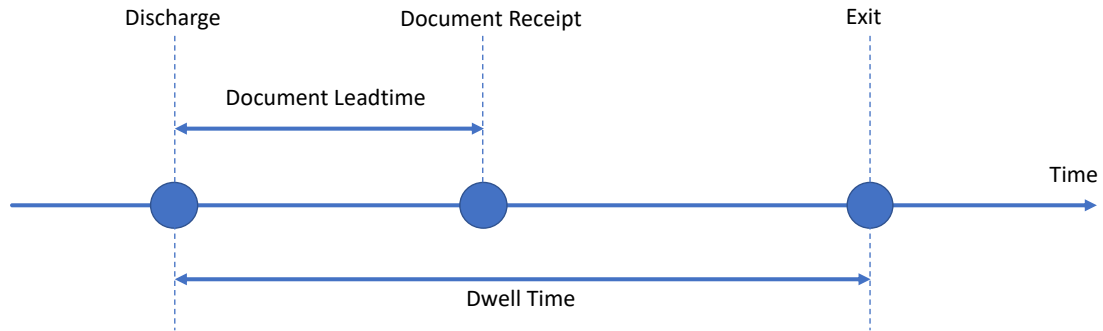


Figure 4; Definition of document lead time and dwell time

Although it is a necessary condition that the dwell time is longer than the document lead time, it is not clear if the document lead time affects the dwell time. Cargo interests or parties acting on their behalf could use the time available between document and planned exit randomly to submit the confirmation to the terminal operator that all goods in the container have been assigned to a customs procedure. In that case there would be only the necessary condition that the document lead time is shorter than the dwell time, but no probabilistic relation between the two concepts. Increase in the document lead time would not drive an increase in the dwell time. It is also possible that the moment of exit is affected by the document lead time.

3.2 Conceptual model

Based on the foregoing definition of both the dependent and independent concept, a basic conceptual model is created (Figure 5). The conceptual model depicts both concepts and the expected causal probabilistic relation between them. The expectation is that the document lead-time will affect the dwell time of the container. It is a bivariate model with two continuous variables.

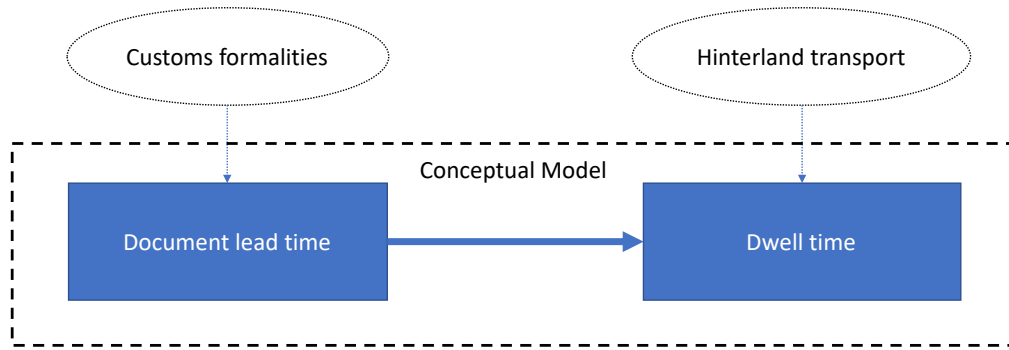


Figure 5; Conceptual model

The conceptual model comprises three different claims that will be further studied in this research project.

- Proposition 1** The document lead-time and dwell time are related
- Proposition 2** When the document lead-time increases, then it is likely that the dwell time increases
- Proposition 3** The increase in document lead-time has causal effect on the increase of dwell time.

3.3 Research strategy

The preferred research strategy for testing a probabilistic relation between two concepts (as claimed in proposition 1) is an experiment. (Dul et. al., 2008) As setting up an experiment for this thesis project is not feasible due to the cost involved, an alternative strategy was applied to perform this test. The relation between the dwell time and document lead time is observed in a group of real instances drawn from operational data of a container terminal. Each instance is defined as a full container arriving at a port terminal with a deep-sea vessel that will be subsequently transshipped to truck, barge or train for carriage to the consignee in the hinterland. Based on this data, the existence of the relation will be researched through statistical testing. In addition, the strength and direction of the association between the two variables is measured through correlation analysis and by calculation of the coefficient of determination. Finally, the linear regression equation will be calculated and interpreted to describe the probabilistic relation between the document lead-time and dwell time.

The aforementioned statistical methods can be used to establish the “truth” in propositions one and two, but not for proposition 3. The statistical evidence of association between the variables does not imply causation. Proposition 3 will be researched by the interpretation of the outcome of the statistical analysis and by vetting these outcomes through qualitative understanding of the process itself. Although this approach cannot produce conclusive and indisputable evidence of the existence or absence of causation, it will support the thesis that causation is credible or not. The underlying causes for the time lost by customs formalities will be identified on the basis of qualitative understanding of the interaction between customs formalities and hinterland transport.

The underlying causes for delays are identified based on qualitative study of business procedures and their legal background. Especially customs and supply chain processes and their legal backgrounds are evaluated to locate where delays arise in the process of hinterland transportation.

3.4 Research stages

This research project was conducted in several stages and each of these stages contributes to the conclusions in this report. This section contains an overview of the different stages of this research project and makes reference to the applicable chapters. Figure 6 presents a quick overview of the research stages and sections 3.4.1 to 3.4.5 describe the individual research stages in more detail.

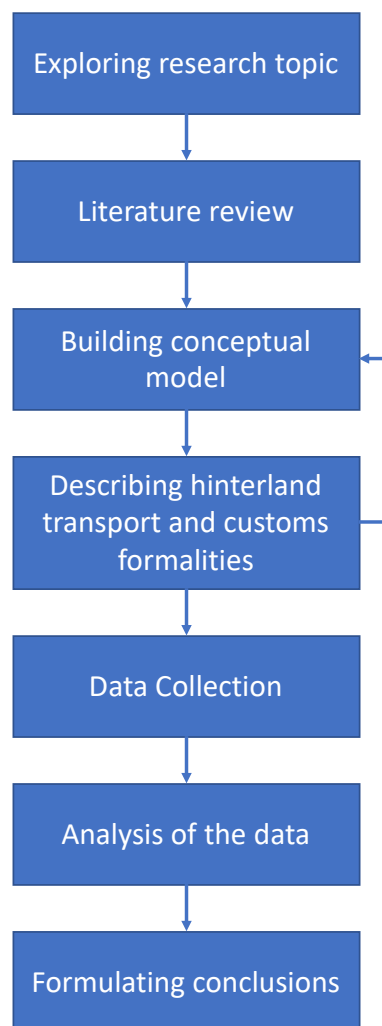


Figure 6; Research stages

3.4.1 Literature review

The first “port of call” was a review of the existing body of literature. The literature review (presented in chapter 4) sets the backdrop for this research project. The research topic was explored through review from two different perspectives.

First, the research topic was explored through review of literature originating from the supply chain domain. The review was concentrated on the developments of hinterland transport connections and the operation of port terminals. This review gave an overview of supply chain literature, focused on the hinterland connection of ports, that helped to understand what are the current developments, challenges and objectives in the supply chain knowledge domain.

Second, the research topic was explored through review of literature on trade facilitation. As trade facilitation concerns itself with removing barriers to trade, it was useful to understand what drives the trade facilitation agenda and to find out what are the current objectives and challenges of this discipline and which concepts have been developed to date.

Finally, the most important developments in both knowledge domains were summarized and the outcome of both reviews was juxtaposed to enable identification of common ground between the two disciplines and contradictory developments. This also allowed pinpointing of contradicting views and knowledge gaps between both knowledge domains. The literature review as a whole served as background to this study and helped to interpret the findings and conclusions.

3.4.2 Describing the hinterland transportation process

Following the literature review, the relevant aspects of the hinterland transport process were explored and described (reported in chapter 5). In particular the legal background of customs formalities and the legal aspects driving the procedures at the port terminal have been studied. Analysis of the backgrounds of the procedures for releasing containers by container terminal operators helped to get thorough understanding of the object of study and to sharpen the research strategy and focus the following stages of this research project. For the purpose of validation, the outcome of the desk study was discussed with an EDP auditor of Dutch Customs, the customs coordinator of RWG and a business consultant of Portbase. The knowledge gained on the background of release process at the port terminal

supported the identification of data elements that were required for further analysis of the relation between the document lead time and the time that containers dwell at the port terminal. Finally, the knowledge obtained in this stage was used in later stages to explain the results of the statistical analysis of the association between customs formalities and hinterland transport.

3.4.3 Data collection

With the research strategy in place and with improved understanding of the backgrounds of the release procedures at the port container terminals, the data elements required for the analysis of the relation between customs formalities and hinterland transport could be gathered. Through cooperation with terminal operator RWG and the Dutch Customs Administration empirical data was made available for this research project. The observational (secondary) data was drawn from an audit file that is normally used for customs supervision of the temporary storage facility of the container terminal. The process of collection and preparation of the data for analysis is further explained in chapter 6.

3.4.4 Analysis of the data

Based on the research objectives, the research strategy, the understanding of customs and business procedures and the empirical data that was collected, statistical methods were used to measure the strength and significance of the relation between customs formalities and hinterland transport and to describe the relation between the two. The analysis is reported in chapter 7.

3.4.5 Formulating conclusions based on the data analysis

Based on the findings in previous stages, conclusions were drawn and the answers to the research question were formulated. In addition, the relevance and possible application of the results, as well as the limitations of the conclusions have been addressed in chapter 8.

4 Literature review

Following the research design and strategy outlined in chapter 3, this chapter is a review of the literature that is related to the research topic. This review can draw on a comprehensive body of literature in both the supply chain management and trade facilitation domain, but the university-based literature that focusses on customs formalities in relation to hinterland transport remains meagre. Therefor this review takes a broader scope and the research topic will be viewed through the lenses of supply chain management and trade facilitation.

This literature review has a number of aims. Its principle ones are to provide an introduction to the research topic and to provide context for this study. In section 4.1 the review will be conducted through the lens of supply chain management and focus on the development and challenges of the hinterland transport process. In section 4.2 this review will focus on the definition and the drivers for trade facilitation. In section 4.3 the key findings from the supply chain and trade facilitation domain will be compared, contrasted and evaluated. The review as a whole will give understanding of the research topic, challenges in both domains and a broad overview of what has already been researched. As such, this chapter provides the wider context within which this thesis project is conducted.

4.1 Supply Chain Management

As already noted in the introduction of this report, hinterland intermodal hinterland logistics has received generous attention in the academic community, albeit from different perspectives and on different abstraction levels. In general terms, studies focus on:

- inter-port competition and the importance of hinterland transportation;
- the design of hinterland networks;
- internal efficiency of network nodes (transshipment terminals);
- coordination and planning in hinterland transport chains.

4.1.1 The importance of intermodal hinterland transport networks

Although the concept “hinterland” is used frequently in day to day speech, it is a concept that is not easily defined. The hinterland of a seaport is not a static concept with a fixed delimitation as it is dependent on other factors such as the commodity (e.g, containerized cargo or bulk) and for example the season. In general terms, the hinterland of a port can be defined as the area over which a seaport draws the majority of its business (Notteboom, 2008).

De Langen (2009) introduces the notion that a distinction can be made between captive and contestable hinterlands. The captive hinterland is the area where the port “is well established” and the captive hinterland is the area where there is more inter-port competition. Haralambides (2002) observes that port hinterlands have ceased to be captive and have extended beyond national boundaries as a result of trade liberalisation, land infrastructure development and new logistical concepts in the organization of international transport of containers.

With increasing containerization of international trade, the captive areas have changed to contestable hinterland with the implication that there is more inter-port competition in the hinterland of seaports. This increasing dynamic in the hinterland of seaports is well explained and demonstrated by De Langen (2007).

Over time the increased use of containers in international logistics networks expanded the hinterland reach of sea ports. (Notteboom 2008). As a result of this development, the service area of individual sea ports started overlapping and European sea ports are ever more competing for cargo from the same regional areas. The expanding hinterland coverage changed the competitive environment from seaports; markets changed from being monopolistic to oligopolistic to competitive. Notteboom argues that “... the competitive battle among ports will increasingly be fought ashore. Hinterland connections are thus a key area for competition and coordination among actors.” The competitiveness of ports is no longer merely dependent on the strengths and weaknesses of the port itself, it also depends on the network of which the port is part. The success of a seaport is increasingly determined by the ability to establish and maintain good quality hinterland connections. Behdani et al. (2016) build on previous research and confirm that hinterland accessibility and connectivity are increasingly crucial factors as container transport volumes grow.

Albeit from a different perspective, the importance of good hinterland connections was also underlined by Veenstra et al. (2012). They name “unstable hinterland connections” as one of the factors that created congestion in port facilities when container volumes increased in the years 2004/2005.

The notion that the hinterland network is an increasingly important factor in inter-port competition, directly or indirectly induced academics to conduct further research in this field. This research focused on the design of hinterland transport networks and coordination and planning in hinterland transport chains

4.1.2 Design of hinterland transportation network

Notteboom (2008) observes that “...the success of a port depends on the ability to integrate the port effectively in the networks of business relationships that shape efficient supply chains, and to exploit synergies with other nodes and other players in the hinterland network”. Van der Horst et al. (2008) argue for the need to analyze the coordination in hinterland transport. In general (not specific to different modalities) they identify that coordination problems in the hinterland chains arise because of an imbalance between the costs and the benefits of coordination, a lack of willingness to invest, strategic considerations of the actors involved and risk-averse behaviour. They present a scope change for actors in the chain as one of the possible mechanisms to enhance coordination. This scope change includes more hierarchical coordination and vertical integration in the transport chain. An example of this vertical integration is a seaport terminal operating company that invests in inland transport and inland terminals. In line with this suggested enhancement for hinterland transport coordination, Roso et al. (2009) observe that “ports have shown interest in starting inland terminals in order to control and optimize a larger part of the intermodal transport chain.” Through investments in inland connections, terminals have local presence and can exert control over hinterland transport operations and have figuratively moved the terminal gate to the hinterland. A form of vertical integration is the dry port, which can be defined as an inland intermodal terminal directly connected to seaport(s) with high capacity transport mean(s), where customers can leave/pick up their standardized units as if directly to a seaport (Leveque et al. 2002). The theory entails that the shipper or forwarder see the dry port as an adequate interface with the port and the shipping lines. In that sense, the dry port goes beyond the conventional utilization of an inland terminal. Roso et al. (2009) argue that as a

result of consolidated goods flow between the sea port and the dry port there is room for other traffic modes to be used. They come to the conclusion that dry ports enable sea ports to secure market in the hinterland, increase the throughput without physical port expansion and provide better services to shippers and transport operators.

Veenstra et al. (2012) explore the relation between the concepts of extended gate and dry port. They observe that in practice dry ports do not live up to the premise of Leveque et al. (2002) but more often function as normal inland ports without centralized control over the goods flow between the seaport terminal and inland terminal. Veenstra et al. (2012) signal that one of the main challenges is the modal split requirement for new terminals in Rotterdam. Through analysis they come to the conclusion that utilization of more scheduled barge and train services must be accompanied by more control over the flow of containers into the hinterland in order to uphold the performance perceived by sea vessel- and hinterland mode operators. Subsequently they address that another important issue is the identification of the party that assumes responsibility for transportation between the port and the inland terminal. When the sea port terminal operator coordinates the movement of goods between the port and the inland terminal this also implies that the terminal either assumes responsibility directly or asks a third party to assume responsibility. Finally, they name the availability of “the right information” as a crucial condition for efficient hinterland networks. All in all, they conclude that the extended gate concept is in theory not fundamentally different from the dry port, but that the extended gates should fulfill the initial ambition of the dry port concept in practice. Against the background of the research project at hand it is worth mentioning that one of the elements of the future vision of Veenstra et al. (2012) on hinterland networks is that inspection and supervision regimes of Customs and other government inspection agencies will be moved into the hinterland and that the administrative processes in the port itself need to be “completely optimized”.

The dry port and extended gate concept are primarily based on vertical integration of activities in the intermodal transport chains. These concepts introduce a centralized coordination of intermodal transport services in the hinterland. With synchro modal freight transport, cross-modality, also known as horizontal integration, is added. Cross-modality includes the use of multiple modalities alongside each other in order to take advantage of the complementary nature of the different modalities. Cross modal transport services allow trade-off between service and cost aspects (Behdani et al. 2016). Both horizontal and vertical integration of intermodal transport services are depicted in Figure 7 below.

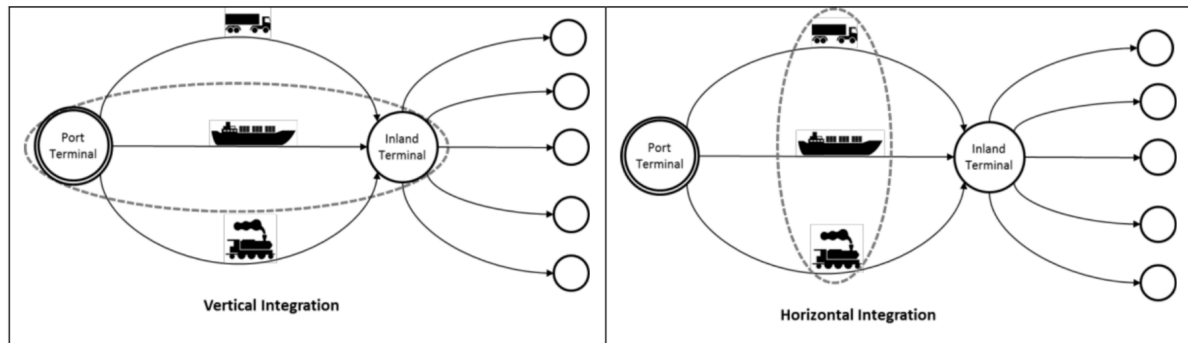


Figure 7; Integrated view of freight transport planning (Behdani et. al, 2016)

Synchromodality includes vertical integration to synchronize moving and stationary resources (terminals and means of transport) as well as horizontal integration to synchronize the operation of multiple modalities (truck, barge train) as a “single transport service”. Behdani et al. (2016) note that: “the additional level of integration in this service is expected to improve the performance of the whole transport system and results in increased utilization of transport means. It also stimulates the optimal use of all modes of transport, which might lead to a stronger position for intermodal freight transport”. The integration also calls for new business models and commercial propositions, because one party in the transport chain will act as integrator for the service. An example is the concept of terminal haulage in which the Sea port terminal coordinates transport to and from the hinterland. Behdani et al. (2016) also present a mathematical model for operational schedule design that is expected to assist the planning function to determine an optimal schedule of multiple transport modalities in intermodal transport services within a fixed timeframe.

From the literature it is clear that the need for efficient hinterland transport networks is recognized and that the ability to integrate the port in efficient hinterland networks is seen as a competitive strength. Although the hinterland network and service design received much attention from the academic community, actual implementation of true intermodal networks and services is lagging behind. The cited studies indicate that there is a need for better integrated intermodal services with more centralized coordination to synchronize terminal and hinterland transport operations and to use the most efficient mix of modalities. Academics propose concepts like dry port, extended gate and synchro modality, all of which are focused on strengthening and integration of transport services. It appears that the research is predominantly positioned to address the challenges of logistics service providers in the supply chain and to lesser extend pay attention to the viewpoint of consignors and consignees. The availability of up to date information for planning and coordination to

transport and transshipment operators is seen as a prerequisite for the operation of effective and efficient hinterland networks. In the literature in the supply chain domain there is little attention for the integration of logistic activities with customs formalities.

4.1.3 Internal efficiency of network nodes

Driven by growth in world trade, transshipment of containers in seaports has also grown considerably. In the years from 2005 to 2015 the total transshipment volume for containers in the port of Rotterdam has grown with 25% despite the global crisis that started in 2007 (source: <http://monitor.topsectorlogistiek.nl>, visited 14 July 2017). In response to the growing volumes, terminal operators, shipping lines and port authorities are investing in new technologies to improve operational efficiency of container terminals. Another aspect that calls for increasing efficiency in port terminals is the increased capacity of container vessels. Over time the vessel size has increased, resulting in larger call sizes at ports. Since these large vessels can only berth in ports with adequate draft and port facilities, the number of calls per voyage has been reduced and consequently the drop size per call has increased. As a result, larger ships spend more time in a port than smaller ships. (Gharehgozli et al., 2016).

Crainic and Kim (2007) consider that the three main activities in port terminals are: berthing and loading and unloading of vessels, receiving and delivery operations for trucks and trains and finally container handling and storage operations in the yard. Cranic and Kim (2007) give an overview of strategic planning issues for container terminals in the investment phase and corresponding models for operational planning and control.

Strategic planning for investments in port terminals includes planning issues related to the number of berths (quay length), the size of storage space and the equipment to install. First, container vessels have high investment and operational costs and waiting time is expensive. Consequently, strategic planning will involve balancing the turnaround time of ships with the berth construction and operation costs. The second important strategic planning issue is the number of quay cranes to be installed. Throughput rate is to be balanced with the investment in capital intensive quay cranes. Finally, strategic planning involves planning of the required container storage space. Available storage space will influence the height of storage stacks. When the space becomes smaller the container stacks will be higher,

resulting in lower productivity in the container yard. Consequently, the investment in storage space must be balanced with productivity of the transfer operations in the container yard.

Following the elements of strategic planning of port terminals, academics have given attention to models for operational planning and control. Amongst others, these models address berth allocation and quay crane planning, stowage planning, and storage planning. Various models for the berth allocation problem minimize the sum of ship handling and waiting times whilst taking into account different variables, such as service costs of ships, tidal constraints, fuel consumption of the vessel. The quay crane assignment problem is optimized with models that maximize crane production through reduction of the number of crane setups and travel times. For the quay crane scheduling problem models were developed to produce optimal schedules that can maximize the throughput of containers and minimizing the loading / unloading time (makespan) whilst satisfying constraints arising from the physical infrastructure (e.g. the cranes are on the same track and require a minimum distance between them) or from other planning aspects.

From the work of Crainic and Kim (2007) Cochrane (2008) and Gharehgozli et al. (2016) becomes clear that in the past decade the academic community has produced a sheer avalanche of academic literature on operations research models and methods for the optimization of container terminals. This research is predominantly driven by growing container volumes, inter port and terminal competition and the introduction of bigger deep-sea container vessels. The literature provides models and methods to maximize the demand satisfied, enhance operational efficiency, avoid of congestion and waiting time in the port. Operational challenges are mostly addressed in isolation, and the main focus of the solutions and recommendation provided is on internal processes of the terminal itself.

Interestingly enough, Ypsylantis (2016) takes a different perspective and challenges the general view that the operational performance of container terminals is purely reliant on endogenous factors. In his study, he singles out the time that containers dwell in the port terminal. He aims to determine the main drivers of container dwell times and to propose measures to reduce them. Ypsylantis (2016) challenges the general view, expressed in previous studies¹, that dwell times can be treated as a purely endogenous capacity performance criterion. Contrary to previous studies, Ypsilantys (2016) argues that dwell

¹ Little and Graves (2008), Chu and Huang (2005), Steenken et al. (2004), Cochrane (2008)

times are affected by exogenous factors. He proposes that shippers' preferences affect the dwell time at the sea terminal. He identifies shipper effects, such as; selection of deep sea and inland carriers by the shipper, value and time criticality of the cargo, supply chain design and information availability, as candidate determinants for container dwell time.

For the data used in the study, statistical analysis of transactional data shows that the identity of the shipper has effect on the dwell time. In addition, Ypsylantis motivates that three possible determinants, directly connected to the shipper, also have a significant effect on the dwell time, being modality for inland transportation, the time of booking with the inland carrier and time criticality of the container. Shippers that place orders for inland carriage in advance of container discharge at the seaport more often realize shorter dwell times at the sea port.

Ypsilantis (2016) concludes that it follows from previous literature that container dwell times can be reduced through improved operational performance of the container terminal but adds his own conclusion that dwell times can also be reduced by motivating other actors such as shippers, shipping lines, inland carriers and inland terminals "to act towards this enhancement".

In conclusion it is clear that, driven by growing volumes of containers to be moved, increased vessel capacity and inter port and terminal competition, the academic community produced operations research models and methods to support planning and coordination on strategic, tactical and operational level. Research over the last decade is mainly focused on problems and challenges in isolation and the solutions and recommendations are logically focused on aspects that can be controlled by terminal operators themselves. Examples are optimized berth planning, quay crane allocation and sequencing, methods to organize container stacks etc. Recent literature calls for more integration of models and methods and addresses that the performance of port terminals does not only depend on endogenous factors but that exogenous factors are also determinants for operational performance.

4.2 Trade facilitation

4.2.1 Definition of trade facilitation

Trade facilitation is by no means a new phenomenon. The preamble of the General Agreement on Tariffs and Trade (WTO, 1947) makes note of the desire to reduce tariffs and other barriers to trade for the purpose of making full use of the resources of the world and the

expanding of production and exchange of goods. These “other” barriers to trade are the non-tariff barriers that hinder or restrict cross border trade.

Various studies and publications (Wilson et al. 2005, Grainger 2007, Grainger 2014, EU 2015) make an effort to define trade facilitation. Grainger (2007) explains that “trade facilitation looks at how procedures and controls governing the movement of goods across national borders can be improved to reduce associated cost burdens and maximize efficiency while safeguarding legitimate regulatory objectives”. The EU defines: “Trade facilitation involves measures to simplify, modernize and harmonize import, export and transit rules and procedures, as well as - importantly - customs requirements, all intended to ease trade flows.” Although the nuances in definitions vary to some extent, the common denominator is that trade facilitation seeks to simplify and harmonize customs procedures associated with movement of goods in international trade to improve the trade environment.

4.2.2 Drivers of trade facilitation

Following 1994, when the revised General Agreement on Tariffs and Trade superseded the original agreement, the international tariffs on trade have fallen. From 1 January 1995 onwards, developed countries cut their tariffs on industrial products with 40%, from an average of 6.3% to 3.8%. The value of industrial products that receive duty free treatment increased from 20% to 44%¹. Granger (2011) observes this as turning point in international trade policy. Stimulated by substantially reduced tariffs, trade policy is increasingly focused on the non-tariff barriers to trade. Both Engman (2005) and Grainger (2011) discuss developments that drive the increasing attention for trade facilitation.

Next to falling tariffs and the pressure from international trade negotiations, Granger (2011) identifies two other systemic factors that underlie the renewed attention for trade facilitation.

Firstly, growing volumes of trade and increased political pressure to accommodate tighter security in the wake of the 9/11 terror attacks, presented new operational challenges to border agencies. This development called for more effective application of border controls without impeding the movement of global trade. New standards for control (SAFE

¹ https://www.wto.org/english/thewto_e/whatis_e/tif_e/agrm2_e.htm, accessed 20 July 2017

Framework of standards, AEO, C-TPAT) that have been implemented since, recognize the need for collaborative control agreements with business that are incentivized through trade facilitation. At large, these collaborative control agreements entail that economic operators that can demonstrate effective compliance management are considered trusted partners of the customs administration and receive benefits that simplify procedures or expedite cross border transactions.

Secondly, an argument for trade facilitation is the desire to improve national competitiveness. Grainger (2011) reasserts WTO publications that non-tariff barriers will place business stakeholders at a disadvantage. Table 1 summarizes the developments that drive trade facilitation based on Engman (2005) and Grainger (2011)

With respect to the last factor, national competitiveness, academic literature proclaiming positive impact of trade facilitation is very abundant. Engman (2005) draws on an anthology of previous research and finds that all the studies surveyed indicate a positive relation between trade facilitation and trade.

Developments driving trade facilitation (combined from Engman (2005) and Grainger (2011))
Reduction of tariff levels, increasing the focus on non-tariff barriers to trade
Reduced transportation costs, lean production and reduced inventory levels have made companies dependent on more frequent and reliable delivery of small batches of intermediary inputs.
Pressure stemming from international trade negotiations and the Trade Facilitation Agreement
Customs administrations respond with collaborative control agreements in combination with trade facilitation to confront operational challenges resulting from larger trade volumes and political pressure to accommodate tighter security controls
Heightened visibility of trade transaction costs by multinationals, increasing the pressure from the business community on border control agencies
Recognition of trade facilitation as an instrument to increase national competitiveness

Table 1; Developments driving trade facilitation

4.2.3 Non-tariff barriers to trade

As follows from the definition of trade facilitation it is aimed at reducing the none tariff barriers to international trade. This objective cannot be achieved without identification

and understanding of the barriers that it tries to overcome. Most of the academic literature on trade facilitation is economically flavoured and seeks to identify the macro economic impact of trade facilitation or the determinants for customs related transaction costs.

Verwaal and Donker (2003) study the relation between customs related transaction costs, firm size and trade intensity. The study identifies the determinants of customs related transaction costs and the effect of transaction costs on the intensity of international trade of firms.

Empirical results show that the size of the firms has no significant effect on customs-related transaction costs. Different from the size of the firm the cross-border transaction frequency and size of the individual transaction do have significant effect on customs related transaction costs. This supports the idea that the scale in which a firm is engaged in cross border transactions is an important determinant of customs related transaction costs. Economy of scale can strongly reduce customs related transaction costs.

Further results show that a simplification such as monthly filing or increased use of information technology are effective methods to reduce customs related transaction costs. Furthermore, the results of the study show that customs related transaction costs repress the international trade activities of firms.

The researchers suggest that firms can reduce the burden of customs related transaction costs by consolidating shipments, the use of simplified customs procedures and the advanced use of information technology. For customs authorities, they indicate that the facility of simplified procedures are an effective method to reduce customs related transaction costs but that the conditions to obtain licenses for these simplifications favour larger firms. Although this study gives good insight in determinants for trade barriers proxied by transaction costs, it does not specify which customs related activities or operational frustrations do make up these costs. It does not help to understand what is the actual barrier to trade.

The OECD (OECD, 2013) published a policy paper that sheds some light on the barriers to trade. This paper synthesizes earlier work of the OECD to increase understanding of the trade costs across the entire trade chain. Although trade costs are not synonym to actual trade barriers, they can be seen as a quantitative proxy of process “frustrations”.

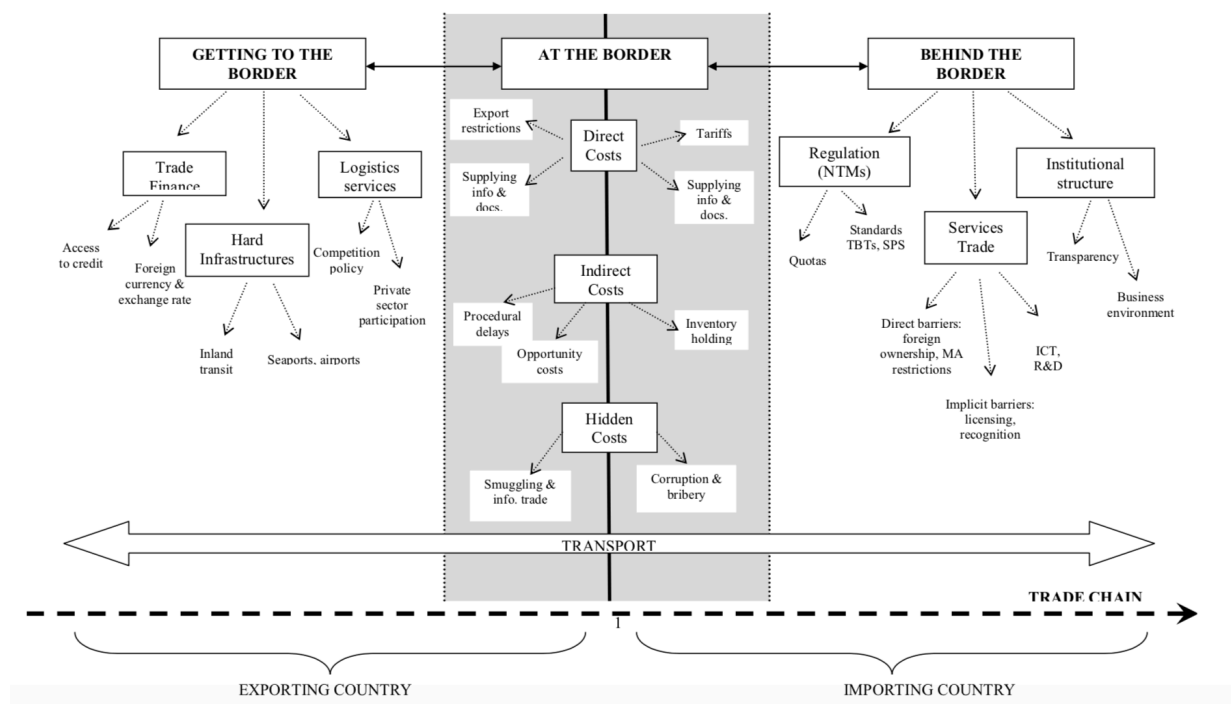


Figure 8; Trade cost diagnostics (Source: OECD, 2013)

Figure 8 above provides a narrative storyline of what the hurdles are for traders in the international trade chain, sequentially from exporter to the importer. The figure distinguishes three stages in the trade chain, being “getting to the border”, “at the border” and “behind the border”. The middle stage “at the border” includes the tariff barrier and the non-tariff barriers that trade facilitation seeks to reduce. The direct costs consist of duties to be paid (tariff barrier) as well as all costs that can be directly related to customs formalities such as lodging declarations, providing certificates of origin, legalization of documents etc. (non-tariff barrier). The indirect transaction costs are associated with the time required for border crossing. It includes all procedural delays, inventory holding costs and opportunity costs induced by the time required for customs formalities. Goods, such as perishable products can be depreciated because of stoppage at the border, or traders can lose business opportunities. Business opportunities may be lost because capital is tied up in pipeline stocks diverting it from other productive application.

The OECD estimates that direct trade transaction costs amount between 2% and 15% of the value of the traded goods, whereas the indirect trade transaction costs range between 1% and 24%. Although the range of both estimations is quite broad, the OECD indicates that simulations learned that indirect costs “would be by far the greatest contributors (up to 80%)

to the welfare gains associated with a reduction in overall trade costs at the border” (OECD, 2013).

From the OECD policy paper we can learn that the non-tariff trade barriers at the border consist of (1) work that is needed to collect the relevant data, process relevant information, produce all documents, and to communicate the relevant information and documents to customs to satisfy all legal requirements, (2) time that the goods are delayed as a result of the formalities at the border, and (3) money to cover for the risk of predation, theft, bribery and “facilitation payments”. The factor time “time” would be the greatest contributor to cost reductions at the border.

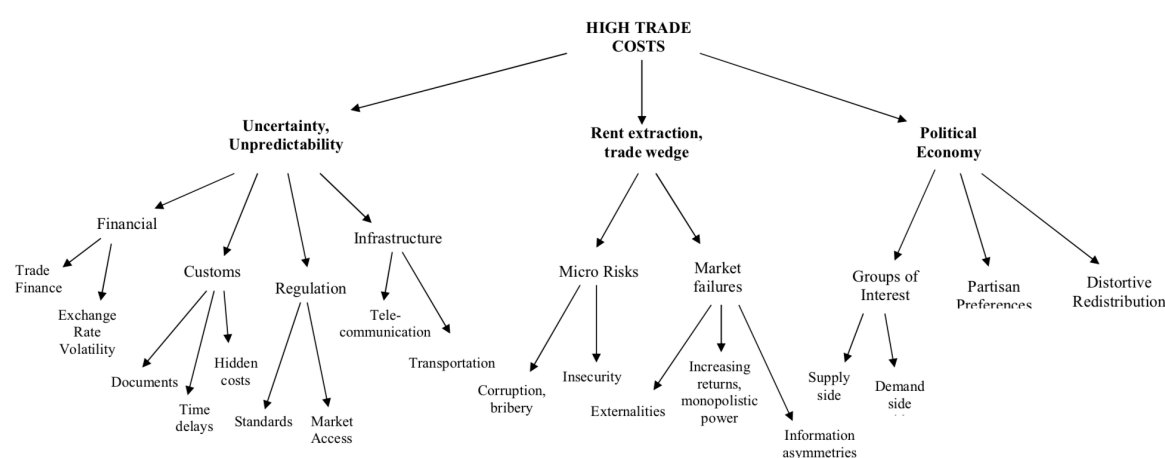


Figure 9 From cost components to trade diagnostics (Source: OECD, 2013)

Another important element of the conclusion is that trade transaction costs in a single supply chain are interrelated. The OECD states as an example that “improvements in hard infrastructure such as railroads cannot translate into time savings if not accompanied by efficient logistics services, professional customs officials, and adequate competition in transport services.” Targeting specific cost elements in isolation could give rise to a shift between cost elements rather than achieving the objective to reduce the total trade transaction costs. Consequently, the OECD calls for a holistic approach when addressing trade costs and facilitating trade.

The OECD presents a diagnostics framework (See Figure 9 above) to identify the most binding constraints. This framework should help policy makers to find the primary and underlying causes of trade transaction costs. The framework helps to narrow down cost drivers along the trade chain that should receive most priority and that can be directly targeted with measures of trade facilitation. The framework is essentially a top-down

sequence of questions to locate the problem area where trade facilitation would bring the biggest return.

Grainger (Grainger, 2014) observes that most of the research in the field of customs and trade compliance is limited to macro-economic models and international surveys. Over time a significant body of literature has been produced by proponents of trade facilitation that seek to encourage wider economic development through trade facilitation. This macro-economic approach is helpful to raise awareness for the importance of trade facilitation, but due to the lack of operational context and detail it is difficult to use these research findings to plan and implement meaningful improvements to facilitate trade.

Grainger (2014) continues with a more “bottom-up operations-informed approach” to trade and customs compliance costs at sea ports. He reflects upon the valid legislation and administrative practices and attributes compliance costs to three categories, being: (1) the initial setup and authorization costs (2) transaction type costs and (3) the costs associated with physically presenting and inspecting goods. Subsequently he provides a descriptive account of which trade and customs related accounts in each category.

Veenstra (2015) argues that disruptions in the physical and administrative operations of ocean shipping are a barrier to trade since they cause delay, uncertainty and additional costs. Veenstra presents a descriptive account of “ocean shipping transactions” and characterizes the frictions in international trade transactions within the methodological framework of transaction cost economics. Against the backdrop of this theory of transaction costs economics, Veenstra observes that international trade transactions related to ocean shipping are almost completely market based due to a low degree of asset, site and human specificity. Site specificity refers to “core technology” that is crucial to the transaction. Asset specificity refers to the degree to which the assets are specific to the transaction. Human specificity refers to special knowledge that is required for the transaction. Because the the specificity of the named aspects is low, the links between the various actors are predominately contracting relationships between firms, instead of internal firm procurements. Veenstra cites Williamson (1981) arguing that the benefit of this market relationships is that scale economies in assets can be fully utilized and that uncorrelated demand can be aggregated. Inversely, drawbacks can be sub optimization in parts of the transaction, costly conflict resolution, poor access to relevant information for settlement of disputes or measurements of performance. Veenstra studies the different elements of the trade transaction in more detail and measures the magnitude of the frictions manifested as

uncertainties (time) and additional costs. In particular he focusses on pre- and on carriage, container release at the port terminal, and the formalities related to supervision. Based on a “first estimate”, Veenstra concludes that the uncertainties that follow from these processes (delays, additional time required for supervision) by far outweigh the additional costs. Insofar this conclusion echoes the conclusion of the OECD discussed previously in this chapter. Veenstra argues that the reduction of the lead time of containers in the transport chain can be achieved by (1) reducing the delay of vessels in the port (2) Reducing the time containers spend in the port (3) improved information provision by customs on the release status of containers in the port. In addition, Veenstra returns to the theory transaction cost economics and concludes that removal of time frictions is also the basis for partial network integration initiatives that can be observed in practice.

In conclusion, it becomes clear that the concept of trade facilitation has been around for decades. Already in 1947 it was noted that reduction of tariffs and non-tariff barriers to trade could lead to more global economic prosperity. Nations have successfully reduced the average level of duties to be paid to stimulate international trade. Amongst a handful of other reasons this development has led to an increased focus on the possibility of reducing non-tariff barriers to trade. Macro-economic studies have underpinned the case for trade facilitation but have proven to be of limited value to shape the trade facilitation agenda itself. Self-evidently macro-economic analysis falls short of operational detail that is required to enhance understanding of the barriers to trade in an operational environment. Further research produced the understanding that the indirect costs at the border are related to delays and uncertainties and outweigh the direct costs associated with formalities at the border. Whereas the OECD presents a framework to dissect primary and underlying causes for high trade costs, other researchers call for an operations informed bottom-up approach to identify the non-tariff barriers to trade. Existing literature makes a first assessment of the magnitude of frictions at the border, but more detailed and comprehensive research of the actual non-tariff barriers at the border could not be found.

4.3 Synthesis

Within the context of this research assignment literature from the trade facilitation and supply chain domain was reviewed to shed light from different sources on the streamlining of the container flow into the hinterland. Table 2 (page 38) is the juxtaposition

of the literature from both research domains that was reviewed. Although both domains seek to ease trade and goods flow, differences in objectives, drivers, research focus, solutions and audience are easily distinguished.

Studies in the supply chain management domain mostly take the perspective of logistic service providers. Researchers seek to cure competitive deficiencies of logistic service providers in hinterland transport networks. As we have seen this research is propelled by growing volumes of containers, growing capacity of deep sea vessels, congestion and efficiency problems. Literature proposes collaborative arrangements to integrate processes of commercial parties in the hinterland, concepts for network and service design and operation research models to optimize planning in transshipment in nodes.

It appears that the researchers are more concerned with the challenges of logistics service providers than with the opportunities for consignors and consignees. The impact of customs formalities and the interaction with government actors in the hinterland transport process is scarcely acknowledged within the realm of supply chain management. In the supply chain literature, there is little attention for the impact of customs formalities on hinterland transport.

Following from the broader scoped objectives of trade facilitation, literature from this domain is predominantly focused on macro-economic effects. It seeks to initiate regulatory reform to reduce frictions at the border to stimulate international trade. Through macro-economic research, academics have propped up the advantages of reducing the non-tariff barriers to trade. Different sources make the analysis that the indirect costs are associated with time and uncertainty of border formalities rather than with the direct costs that can be associated with the administrative work in connection with customs formalities. Although trade facilitation has made its way up on the agenda of policy makers, there is hardly any literature that gives a better view on the operational obstacles caused by customs formalities related to cross border trade. While the rationale for trade facilitation is compelling, lack of detailed understanding of the actual operational problems is preventing the conversion of intentions to facilitate trade into practice.

From the criticism above it becomes clear that there is a disconnect between the two knowledge domains. Whereas the supply chain domain fails to take account of customs formalities in the supply chain, the trade compliance domain fails to integrate the operational detail from the supply chain knowledge domain. The solutions of the supply chain are wasted when containers are delayed by lengthy customs formalities while conversely substandard

supply chain processes will cancel out the positive effects of trade facilitation. This disconnect demonstrates the need for a more holistic and integral approach in which the knowledge and solutions of both domains are combined to one and calls for better understanding of the integration of supply chain processes with customs formalities.

	Supply Chain Management	Trade facilitation
Objective	<ul style="list-style-type: none"> Increasing the ability to integrate the port effectively in the networks of business relationships that shape efficient supply chains, and to exploit synergies with other nodes and other players in the hinterland network. 	<ul style="list-style-type: none"> To reduce tariffs and other barriers to trade for the purpose of making full use of the resources of the world and the expanding of production and exchange of goods
Drivers	<ul style="list-style-type: none"> Growing container volumes. Increasing vessel capacity. Inter port competition. Recognition that hinterland accessibility and connectivity are increasingly crucial factors as container transport volumes grow. 	<ul style="list-style-type: none"> Increasing focus on non-tariff barrier to trade following the reduction of tariffs. Introduction of collaborative control agreements. Pressure stemming from international trade negotiations and the Trade Facilitation Agreement. Heightened visibility of trade transaction costs by multinationals, increasing the pressure from the business community on border control agencies. Recognition of trade facilitation as an instrument to increase national competitiveness
Research focus	<ul style="list-style-type: none"> Efficient utilization of assets in ports, such as quays, cranes, stacks etc. Coordination of different operators and activities in the hinterland. Optimized utilization of transport modalities (modal split). 	<ul style="list-style-type: none"> Macro-economic analysis to underpin the case for trade facilitation. Development of frameworks to explain non-tariff barriers to trade.
Solutions and concepts	<ul style="list-style-type: none"> Planning algorithms to advance efficient utilization of assets in ports. Horizontal and vertical integration of logistic services in the hinterland. Service network design Concepts such as: Dry port, Extended gate, Synchromodality. 	<ul style="list-style-type: none"> Development of diagnostics framework to identify the most binding constraints and underlying causes
Audience	<ul style="list-style-type: none"> Business community, actors in the logistics sector 	<ul style="list-style-type: none"> Government policy makers

Table 2; Comparison literature in Supply Chain and Trade Facilitation domain

5 Regulatory framework and business process

This chapter describes the customs regulatory framework and business processes for containerized cargo arriving at the port of Rotterdam. The aim of this chapter is to untangle the strands of customs procedures and business processes and to subsequently model the integrated process to the extent necessary for the achievement of the research objectives.

5.1 Regulatory framework for customs formalities

This section focuses on the legislation that forms the regulatory framework for customs formalities on entry and import of containerized cargo into the EU customs Union. Before turning to the legislative acts regulating the customs formalities on entry, this section first reviews the legal basis for these acts, starting with the primary law of the European Union.

Figure 10 depicts that Union law is based on primary and secondary legislation. Primary legislation includes the Union Treaties, general principles that are established by the Court of Justice of the European Union (CJEU) and international agreements. Secondary legislation includes all the acts that implement the policies in the treaties and which enable the EU to exercise its powers.

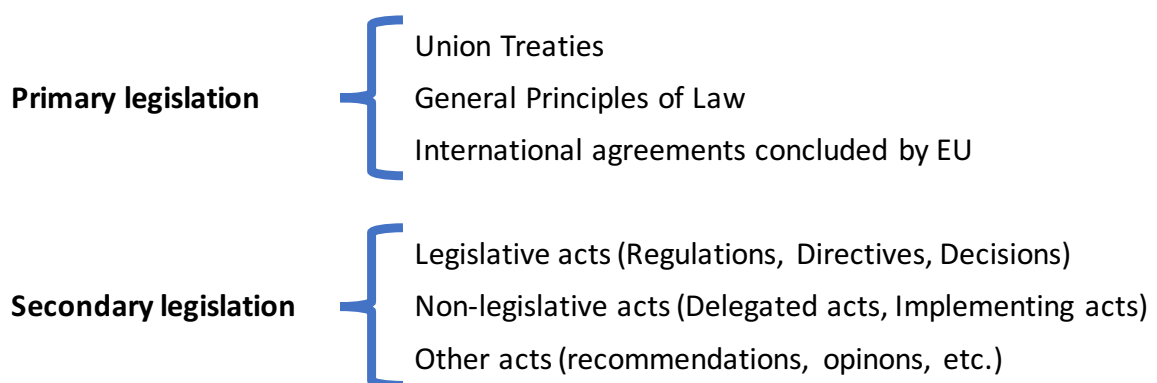


Figure 10; The sources and hierarchy of EU Law (European Customs Code, Tom Walsh)

The legal foundations of the European Union are the Treaty on European Union (TEU) and the Treaty on the Functioning of the European Union (TFEU). With the treaty of the European Union, the contracting parties have established the European Union (hereafter: the Union), on which the Member States have conferred the competences to attain objectives they have in common (TEU Article 1).

One of the common objectives of the Union is to “work for the sustainable development of Europe based on balanced economic growth and price stability, a highly competitive social market economy, aiming at the full employment and social progress, and a high level of protection and improvement of the quality of the environment. It shall promote scientific and technological advance”. The internal market is presented as a means to this end. (TEU Article 3).

The internal market comprises an area without internal frontiers in which the free movement of goods, persons, services, and capital is ensured (TFEU Article 26). Since the free movement of goods applies to all goods, including goods imported from non-EU countries, there is a need to harmonize the rules for trading with countries outside the internal market to overcome distortion of competition resulting from variation in rules for trading with third countries. To achieve this necessary harmonization, article 28 TFEU establishes the Customs Union and additionally this article sets out the principal elements of this Customs Union. The main features of this Customs Union are the prohibition to levy customs duties or charges with equivalent effect on trade between Member States and the adoption of a common customs tariff for trade with third countries.

The TFEU determines the areas of, delimitation of, and arrangement for exercising the competences conferred on the Union. It arranges the division of competences between the Member States and the Union and emphasizes that competence is granted to the Union on a limited basis and that the residual power remains with the Member States. When it comes to the Customs Union, article 3 TFEU provides that the customs union falls within the exclusive competence of the Union. This means that only the Union may legislate and adopt legally binding acts in this policy area and that Member States may only act where they are specifically empowered by the Union to do so (Article 2 TFEU). While the constitutional treaties are silent on the issue of which law should take priority in case of conflict, the European Court of Justice (ECJ) has filled this gap with case law (cases Van Gend den Loos, Costa, Simmenthal). The ECJ identified the Union as independent legal order, supreme over the national legal systems of the Member States. The ECJ reasoning on supremacy of EU law

is best explained in the Costa case. The court ruled in this case: “Such a measure cannot be inconsistent with that legal system. The executive force of Community law (now Union) cannot vary from one State to another in deference to subsequent domestic laws without jeopardizing the attainment of the objectives of the Treaty... The obligations undertaken under the Treaty establishing the Community (now Union) would not be unconditional but merely contingent if they could be called into question by subsequent legislative acts of the signatories...”

Figure 10 depicts that international agreements are part of EU primary legislation. The Union may conclude agreements with one or more third countries or international organisations and the agreements concluded by the Union are binding upon the institutions of the Union and on its Member States (TFEU article 216). This means that international agreements are an integral part of the Unions legal order and have to be respected by the Institutions and the Member States of the Union. Where rules in international agreements are sufficiently clear and precise, they do not need to be transposed into secondary legislation to allow application. Examples are preferential trade agreements and the TIR convention. Where international agreements are less precise and allow larger margins of choice by contracting parties, transposition into secondary legislation is needed. Different mixed methods for the implementation of international agreements can be distinguished, depending on the nature of the international agreement or the intentions of the contracting parties. Against the backdrop of this study no relevant directly applicable international agreements have been identified.

Secondary legislation of the Union is adopted through the law-making processes of the Union and enables the Union to exercise the powers conferred on it. To exercise the exclusive competence in the policy area of the Customs Union (TFEU article 3), the institutions of the Union adopt secondary legislation, including regulations, directives, decisions, recommendations and opinions (TFEU Article 288). A regulation has general application and it is binding in its entirety and directly applicable in all Member States. A regulation does not require further implementation to take effect.

Within the policy area of the customs union the Union has adopted regulation (EU) No 952/2013, the Union Customs Code (UCC hereafter). This legislative act, that has a legal basis in the primary law of the Union and enshrines the basic legislation on the principles and functioning of the customs union, has been adopted by the Council and the European Parliament through the ordinary legislative procedure as set out in Article 294 TFEU.

The TFEU provides in article 290 and 291 that a legislative act may delegate to the commission the power to adopt non-legislative acts to supplement or amend non-essential elements of the legislative act. This provision helps to prevent that the legislative system is clogged up with matters of detail. Through multiple articles, as listed in article 284 of the UCC, the power to adopt non-legislative acts is delegated to the commission. On the basis of this delegation the commission has adopted Commission Delegated Regulation No 2015/2446 (UCC DA hereafter). In addition to the UCC DA, the commission adopted Commission Delegated Regulation No 2016/341, including transitional rules for the time that relevant IT systems are not yet operational (Hereafter UCC TDA).

The power to adopt implementing acts is conferred on the commission through the UCC (Article 281). Based on this conferral of power the commission adopted Commission Implementing Regulation No 2015/2447. The preamble of this regulation reads: “to specify the procedural rules for some of its elements, in the interest of clarity, precision and foreseeability”

As explained, customs law in the EU is to a large extent enshrined in the Union legal order. National (customs) law primarily contains provisions for implementation of Union customs law, insofar Member States are specifically empowered by the Union to do so. In the Netherlands the legal framework “Algemene douanewet” (hereafter ADW) ensures the embedding of Union customs law in the national legal order. The ADW contains inter alia provisions on the functioning and authorities of the Dutch Customs Administration, sanctions, penalties and where required detailed rules for implementation of the UCC. Further detailed implementation of the ADW is to be found in the “Algemeen Douanebesluit” (hereafter ADB) and in the “Algemene Douane Regeling” (hereafter ADR).

5.2 Customs formalities on entry and import

Where the previous section discussed the overarching legal framework, it is now time to turn to the actual formalities on entry and import in more detail. For convenience of the reader, Figure 11 depicts the major building blocks of the customs formalities on entry. As can be seen in the diagram, customs formalities can be dissected in five main building blocks. These building blocks will be addressed in subsequent sections.



Figure 11; Overview of customs procedures for containers arriving

5.2.1 Entry Summary Declaration

Over the last two decades the focal point of customs policy in the EU has shifted from the traditional fiscal objectives towards safety and security objectives. As can be read in the preamble of the UCC (28) a common risk management framework is introduced to minimize the risks to the Union, its citizens and its trading partners. Mandatory pre-notification of goods entry in the Union is an important input for the assessments of risks to the achievement of the common objectives of the customs administrations of the EU member states.

The Union Customs Code prescribes that goods being carried into the territory of the Customs Union shall be covered by an Entry Summary Declaration (UCC article 127). This entry summary declaration is the act whereby a person informs the customs authorities in the prescribed form and manner and within a specific time limit, that goods are to be brought into the territory of the Union (UCC article 5). This declaration is to be lodged prior to entry of goods into the territory of the union and is intended to enable the customs authorities to conduct risk analysis.

The obligation to lodge the entry summary declaration rests with the carrier (UCC article 127). Within the context of this customs formality this is the person who brings the goods, or who assumes responsibility for the carriage of the goods, into the customs territory of the Union. Notwithstanding this obligation of the carrier, other the other persons named in UCC article 127 may lodge the entry summary declaration instead.

The entry summary declaration for containerized cargo must be lodged at latest 24 hours before commencement of loading of the container on the vessel on which it will be brought into the customs territory of the Union (Article 105 UCC DA). The entry summary declaration contains all necessary data for analysis of safety and security risks (UCC Article 127).

Within the UCC, “risk” is defined as the likelihood and the impact of an event occurring with regard to the entry which would prevent correct application of Union or national measures, compromise the financial interests of the Union and its member states, or pose a threat to the safety and security of the Union and its residents, to human or plant health, to the environment or to consumers. (UCC article 5)

The risk analysis before entry is based on the data provided in the entry summary declaration and is carried out by the customs office of first entry, primarily for safety and security purposes (UCC article 128).

In practical terms this means that, when goods are brought into the territory of the customs union by a vessel that is calling at more than one port in this territory, the ENS is to be lodged at the customs office of first entry. This customs office of first entry is responsible for the risk analysis on the entry of the goods listed in the entry summary declaration. The risk assessment, that is conducted for safety and security purposes, can have four different outcomes, being the risk levels A to C (as explained in Table 3) or no identified risk.

Risk type	Risk treatment	Reference
A	“Do not load” message to carrier and declarant	UCC DA Article 187 (3)
B	The customs office of first entry shall take prohibitive action	UCC DA Article 187 (4b)
C	Goods are subject to customs control at the customs office where the container is to be discharged	UCC DA Article 187 (4c)

Table 3; Risk treatments based on ENS

In case the customs office of first entry identifies a risk for the goods carried on the arriving container vessel, it should pass on the results of the risk analysis to the relevant customs offices, so that these goods could be subject to customs control upon their arrival (risk type B) in the territory of the customs union or upon scheduled discharge (risk type C).

For containerized cargo that is brought into the Union by sea, the customs authorities shall complete the risk analysis within 24 hours of the receipt of the entry summary declaration. The Customs authorities shall register the entry summary declaration upon its receipt and shall notify the party that has lodged the declaration of its registration immediately and shall communicate a master reference number and the date of registration to that person (UCC IA Article 185).

The results of the risk analysis are uploaded in the Import Control System (ICS). This is the EU system for lodging, handling and processing of entry summary declarations in advance of the arrival of goods. The basic steps in the process are depicted in Figure 12, which is retrieved from the website of the Dutch Customs Administration¹.

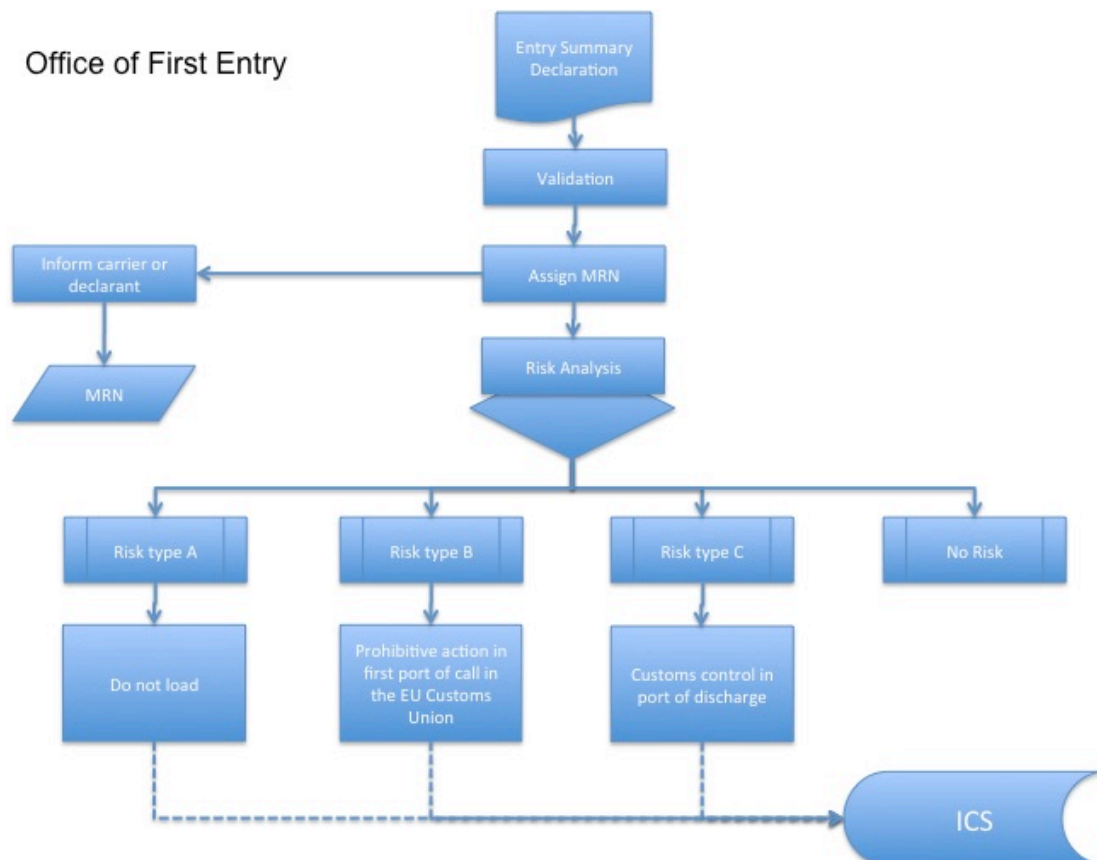


Figure 12; Risk analysis at the customs office of first entry (www.belastingdienst.nl)

¹ The “syntax” of the flow diagram is not completely accurate, but in this instance it is only included to give a general overview of the process at the customs office of first entry.

Article 38 (6) UCC and Article 24 (3) UCC DA state that "where an AEO lodges a temporary storage declaration or a customs declaration in accordance with Article 171 of the Code, the customs office competent to receive that temporary storage declaration or that customs declaration shall, where the consignment has been selected for customs control, notify the AEO of that fact. That notification shall take place before the presentation of the goods to customs. That notification shall not be provided where it may jeopardise the controls to be carried out or the results thereof." This notification that goods have been selected for control is sent 72 hours in advance of the expected time of arrival.

In the table below the relevant legal provisions for entry summary declarations are listed for convenience of the reader.

Entry Summary Declaration	
Source	Articles
UCC	5, 9, 127 - 132
UCC IA	182 – 188
UCC DA	24 (2), 104 – 113

Table 4; Relevant legal provisions for ENS

5.2.2 Entry in the customs territory

To allow correct application of customs legislation, article 2:1 ADW and ADR 2:0 provide that, at minimum 2 hours in advance of the arrival of the vessel in the port resorting under the customs office where the goods will be presented, the estimated time of arrival shall be electronically notified to that customs office. This pre-arrival notification for the sea going vessel includes the information of the IMO/FAL1 general declaration and shall additionally state the estimated time of arrival.

Based on article 133 of the UCC a second notification is to be made upon arrival. The operator of the sea going vessel shall notify the customs of first entry upon arrival of the means of transport. This second notification includes the actual time of arrival (ATA). This ATA notification can be reported under reference to the temporary storage declaration provided that this declaration has been lodged prior to the actual time of arrival of the vessel.

In the port of Rotterdam the port community system Portbase is used to facilitate the electronic notifications (Portbase “Melding Schip 2.0”).

No ATA notification shall be required when the goods have temporarily left the customs territory of the Union while moving between two points in that territory provided that they have been carried by direct route without a stop outside the customs territory.

In the table below the relevant legal provisions for arrival notifications have been listed.

(Pre-) Arrival notification	
Source	Articles
UCC	133, 136
UCC IA	189
ADW	2:1
ADR	2:0

Table 5; Relevant legal provisions for (pre-) arrival notification

Goods entering the territory of the customs union are subject to customs supervision (safety, security, fiscal) until their customs status is determined. As soon as their customs status is established as Union goods, the goods will no longer be subject to customs supervision. Non-Union goods will remain under customs supervision until their customs status is changed to Union goods, or they are taken out of the customs territory of the Union or until they are destroyed.

In the Table 6 below the relevant legal provisions for arrival notifications have been listed.

Customs Status	
Source	Articles
UCC	5, 22-24, 153-157
UCC IA	194-216
UCC DA	119-133

Table 6; Relevant legal provisions for customs status

From their time of entry in the customs territory of the Union, the goods may be subject to customs controls (UCC Article 134), whereas supervision means: “action taken in general by the customs authorities with a view to ensuring that customs legislation and, where appropriate, other provisions applicable to goods subject to such action are observed”.

Within this context “Customs controls” means the specific acts performed by the customs authorities in order to ensure compliance with the customs legislation and other legislation governing the entry, exit, transit, movement, storage and end-use of goods moved between the customs territory of the Union and countries or territories outside that territory, and the presence and movement within the customs territory of the Union of non-Union goods and goods placed under the end-use procedure”

Subsequently, the person who brings the goods in the territory of the union shall convey them without delay, by the route specified by the customs authorities and in accordance with their instructions, if any, to the customs office designated by the customs authorities, or to any other place designated or approved by those authorities (UCC Article 135). In the context of this research project, this is a temporary storage facility of the container terminal operator.

5.2.3 Presentation, unloading and examination

Goods brought into the customs territory of the Union and that will be discharged, unloaded or trans-shipped shall be presented to customs immediately upon their arrival at the designated customs office or any other place designated or approved by the customs authorities (UCC Article 139).

"Presentation of goods to customs" within the context of this research project means the notification to the customs authorities of the arrival of goods at the temporary storage

facility (UCC DA Article 115). Article 144 UCC introduces the legal fiction that the goods are in temporary storage from the moment that the goods have been presented to customs.

For container vessels the act of presentation of goods by the carrier at temporary storage facility may be done in one instance for all the containers that are to be unloaded from the vessel. The carrier or a party acting on his behalf shall perform the presentation of the goods. Notwithstanding this obligation the presentation can also be effected instead by the holder of an authorisation for the operation of storage facilities.

The act of presentation shall be effected through digital means of communication (Algemene Douane Regelening article 2.2). In practice this “digital” notification of arrival is submitted through the Rotterdam Port Community System Portbase.

Article 140 provides that containers shall only be unloaded from the vessel with approval of customs administration. Provided that risk analysis did not indicate immediate safety or security risks, the Dutch Customs Administration tacitly allows unloading of the container¹.

The customs administration may at any time require the goods to be unloaded and unpacked for the purpose of examining them or taking samples (UCC Article 140).

In the table below the relevant legal provisions for arrival notifications have been listed.

Presentation, unloading and examination	
Source	Articles
UCC	139-143 (144)
UCC IA	190
UCC DA	115
ADR	2:2

Table 7; Relevant legal provisions for presentation, unloading and examination

¹ Source: www.belastingdienst.nl, handboek douane “binnenbrengen via zee”, accessed September 21 2017

5.2.4 Temporary storage

As indicated previously, arriving goods are in temporary storage by legal fiction from the moment that they have been presented to customs. Temporary storage means the situation of non-Union goods temporarily stored under customs supervision in the period between their presentation to customs and their placing under a customs procedure or re-export. A temporary storage facility is a customs approved place, where non-Union goods are placed in storage under customs supervision prior to being released for free circulation, placed under a customs procedure, re-exported or abandoned to the state.

The facility in which the goods are stored must be authorised by the customs authorities as a temporary storage facility (UCC 144 and 148) and the conditions under which the authorization is permitted are set out in the authorization. Authorization for temporary storage will be granted only to persons who satisfy the conditions in UCC article 148 (2). Two of these conditions are that the holder of the authorization provides necessary assurance of the proper conduct of the operations and keeps appropriate records in a form approved by the customs authorities. These records shall contain all the information and particulars as set out in UCC DA Article 116. Amongst others, this information includes reference to the temporary storage declaration and reference to the “corresponding” end of temporary storage. The holder of the authorization shall ensure that the goods will not be removed from customs supervision. The Unamar arrest (C140/104) the ECJ made clear that the holder of the authorization is responsible to fulfil the obligations arising from the storage of good in temporary storage and that a customs debt is incurred when the goods are removed from customs supervision.

Non-Union goods presented to customs shall be covered by a temporary storage declaration¹.

Article UCC 145 provides that the temporary storage declaration may also be used for the purpose of the notification of arrival referred to in UCC Article 133 and for presentation of the goods to customs referred to in UCC article 139. In practice this means that, in case the Port of Rotterdam is the first port of call in the customs territory in of the European Union,

¹ In Dutch practice this is often referred to as SATO (Summiere Aangifte Tijdelijke Opslag) or SAL (Summiere Aangifte Lossen)

the temporary storage declaration is also used for the purpose of the notification of arrival and for presentation of the goods to customs. In case the port of Rotterdam is not the first port of call and the customs office of first entry is located in another member state, the temporary storage declaration is used for presentation of the goods to the customs office but not for notification of arrival in the Union.

The temporary storage declaration is the act whereby the declarant indicates that goods are in temporary storage. This declaration references to the Entry Summary Declarations that were lodged prior to the loading of the containers on the vessel at the port of origin. The declaration for temporary storage can be lodged at the latest at the moment of presentation of the goods.

Storage in the temporary storage facility starts from the time of the presentation of goods to customs and can last up to no more than 90 days. If the goods in temporary storage are not placed under a customs procedure within this time limit, this will incur a customs debt pursuant to article UCC article 79.

The carrier, a person acting on his behalf or the holder of the license of the temporary storage facility, which is mostly the terminal operator, can lodge the temporary storage declaration.

Temporary storage	
Source	Articles
UCC	5, 11, 17, 144-152
UCC IA	191-193
UCC DA	115-118

Table 8; Relevant legal provisions for temporary storage

5.2.5 Placing the goods under a customs procedure or re-export

From the definition of temporary storage, it follows that temporary storage of goods ends at the moment that the goods are placed under a customs procedure or re-exported (UCC art. 5: 17). Non-union goods arriving at a port within the customs union territory can be placed under any of following procedures in accordance with the UCC:

- release for free circulation;
- special procedures; or
- re-export

Without discussing the substance of the different customs procedures, this section is focused on the process of placing goods under customs procedures, also referred to as customs formalities (UCC art. 5: 8).

For all goods intended to be placed under a customs procedure, except for the free zone procedure, a customs declaration appropriate for the particular procedure must be lodged (UCC Art. 158). In general, this declaration may be lodged by any person who is able to have the goods presented to customs and who is able to provide all of the information which is required for the application of the provisions governing the customs procedure in respect of which the goods are declared (UCC Art. 170). UCC art. 172 provides that customs declarations that are compliant with the provisions applying to all customs declarations shall be accepted immediately. The date on which the declaration is accepted is, unless provided otherwise, the date used for the application of the provisions governing the customs procedure. In case the declarant is authorized to use a simplified declaration, the moment of acceptance is the moment the goods are entered in the records. This moment of entry in the records is the deemed acceptance through legal fiction. A customs declaration which has been accepted may be verified by the customs authorities. This verification can inter alia entail examining of the declaration and supporting documents and examination of the goods (UCC art. 188). Where the conditions for placing the goods under the procedure are fulfilled and provided that any restriction has been applied and the goods are not subject to any prohibition the customs authorities will release the goods as soon as the particulars in the customs declaration have been verified or are accepted without verification. This release of

goods is the act whereby the customs authorities make the goods available for the purposes specified for the customs procedure under which they are placed.

The moment that the customs declaration is accepted is of particular importance. From the moment that the declaration is accepted, the provisions of the customs procedure in respect of which the declaration was lodged apply. This acceptance thereby also marks the end of temporary storage of the goods. Except for the cases where the customs declaration takes form of an entry in the declarants' record¹, the customs authorities will notify the declarant of the acceptance of the customs declaration and will provide him with a Master Reference Number (MRN) for that declaration and the date of acceptance (UCC IA Art. 226).

5.2.6 Conclusion

The preceding sections provide an overarching view on customs formalities for containerized goods arriving at the port. In this section the formalities that have been discussed in previous sections will be sifted through to isolate the event(s) or action(s) important for further analysis. The aim is to point out relevant steps or events from which can be measured to which extend containers are delayed by customs procedures. Figure 13 on page 55 presents an overview and sequence of customs formalities.

Goods that are brought into the territory of the customs union are from their time of entry subject to customs supervision and may be subject to customs controls until their customs status is established. The goods are (shall be) under customs supervision for as long as is necessary to establish their customs status. When the goods have not been established to be Union goods, the goods will have the non-Union status. Goods with a non-Union status remain under customs supervision until the status is changed to the Union status, the goods have been taken out of the customs territory of the Union or destroyed. Union goods shall not be under supervision, except for situations where the goods are assigned to the end-use procedure.

At the moment of arrival of the container vessel at the port terminal, the arriving non-Union goods that will be unloaded or transshipped must be presented to the customs

¹ In UCC IA Art. 226 also oral declarations are accepted, but this is not applicable for containerized cargo.

administration. From the moment that the goods have been presented to the customs administration, the goods are in temporary storage by legal fiction.

Operation of the temporary storage facility requires authorization from the customs authorities. The container terminal operator is the holder of the authorization and the person storing the goods in a place approved by the customs authorities. As holder of the authorization the terminal operator shall ensure that the goods are not removed from customs supervision whilst the goods are in temporary storage.

The temporary storage of goods ends when the goods are placed under a customs procedure or re-exported. For all goods intended to be placed under a customs procedure, except for the free zone procedure, a customs declaration appropriate for the particular procedure must be lodged. From the moment that this declaration is accepted, the provisions of the customs procedure in respect of which the declaration was lodged apply. This acceptance thereby also marks the moment from which the goods are no longer in temporary storage. From the moment that the goods have been assigned to a customs procedure, the condition that the goods shall be stored in the temporary storage facility (UCC Art. 147 (1)) no longer applies. At the moment that the goods are assigned to a customs procedure or re-exported, the license holder of the temporary storage facility can allow movement of the goods out of the temporary storage facility. The opposite applies as well: for as long as the declaration for the subsequent customs procedure is not accepted, the terminal will keep the container in the temporary storage facility because removal of the container from the facility would count as unlawful removal from customs supervision which would incur a customs debt.

The next sections will describe the business procedure for the release of containerized cargo from the container terminal.

Overview and sequence of customs formalities

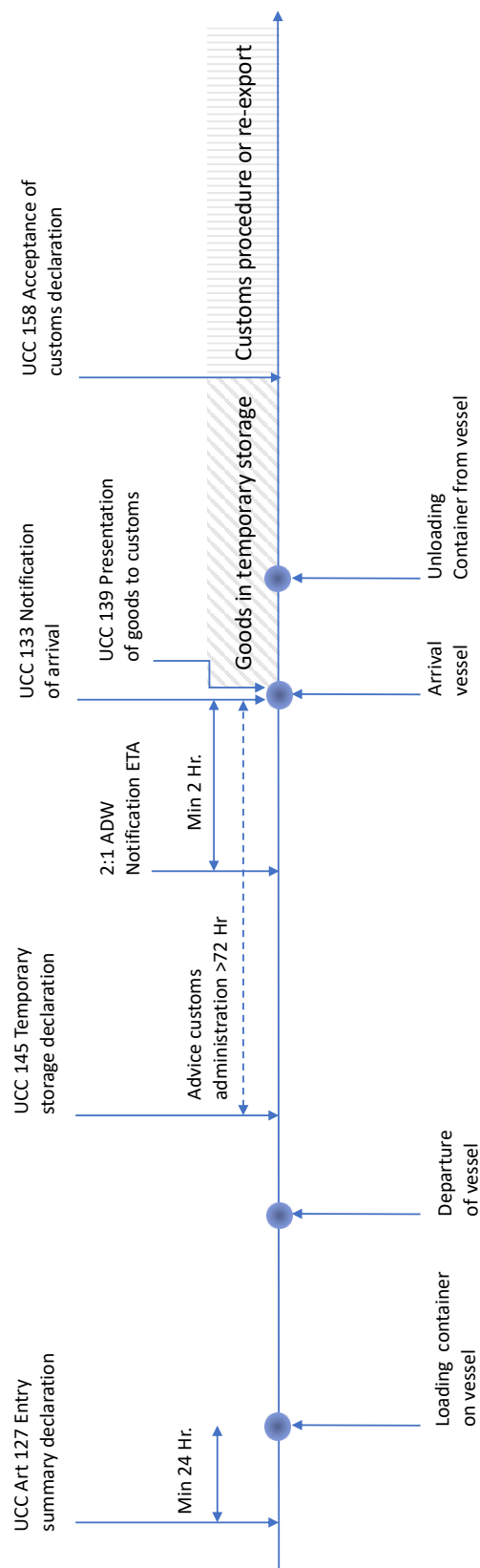


Figure 13; Overview and sequence of customs formalities

5.3 Business process for hinterland transport

After fleshing out the customs formalities for the inbound flow of containerized cargo in the previous section, this section will focus on the business procedures relating to hinterland transport. More in particular, this section will concentrate on the logistics process of hinterland transport, with the objective to sharpen the insight in hinterland transportation processes, to the extent necessary for the realization of the objectives of this study.

When taking note of both practice and research (e.g. Van der Horst et. al, 2008 and Verwaal et. al , 2008) it is clear that there are many actors involved in the process of hinterland transport. One can think of terminal operating companies, forwarders, hinterland transport providers and customs brokers. The layered supply chain model presented by Oosterhout et al. (2000) gives a good impression of which parties can be involved with moving the container from the port terminal to the final consignee.

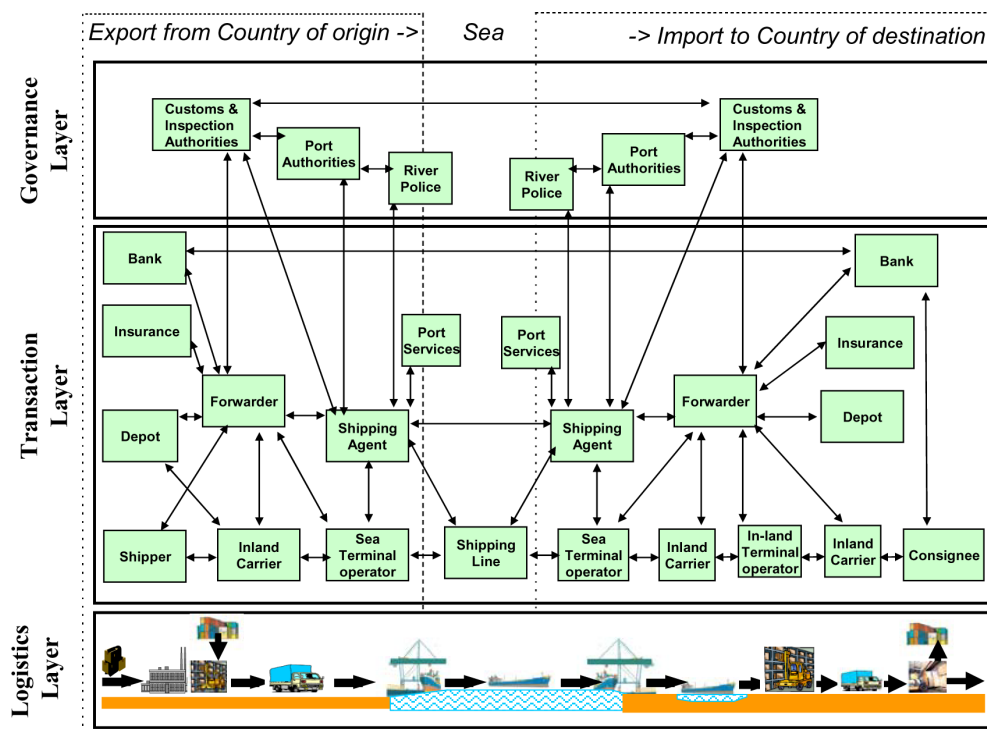


Figure 14; Layered model of global supply chains (Source: Oosterhout et. al, 2000)

However, by definition models are a simplification of reality, as is the case with this model too. In reality, it is easy to notice that for different transactions a different network of participants is collaborating. The cooperation between different parties is governed by

various factors, such as the delivery terms agreed between buyers and sellers, contractual relations between different actors, the modality used for hinterland transport.

In the light of the research project before us, we take a closer look at the hinterland activities in the “logistics” layer. In the previous chapter customs formalities for arriving containers have been mapped out. From this overview the conclusion can be drawn that customs formalities do not affect the lead-time of inland carriage itself, but that they do influence the moment that inland carriage can commence. This fact is the reason for a closer look at the procedures at the terminal.

Whilst container terminal processes can be different, the physical processes of the terminals for inbound containers are largely the same. After arrival and berthing of the container vessel at the quay of the terminal, the stevedore, or more precisely the container terminal operator, discharges the containers from the vessel. Following the discharge from the deep sea vessel, the container is moved into a stack where it will be stored until the container is collected by the party performing the inland carriage. Based on pre-notification of inland carriers, containers are moved from the stack to the area’s where the inland carriers collect the containers. After positive identification of the inland carrier, the terminal operator will load the container on the means of transport for inland carriage. The large container terminals all offer the possibility to transship containers to either truck, train or barge.

The terminal operator will only allow an inland carrier to collect the container from the terminal when there is a “customs release” and a “commercial release” for that container. Containers will not be released from the terminal before the port terminal operator is satisfied that the goods are assigned to a customs approved treatment or use and that the goods are not blocked by customs for safety and security purposes. This is the “customs release” from the perspective of the terminal operator, which was analyzed in more detail in the previous section from the legal perspective. To understand the “commercial release”, a closer look at business of the terminal operator is needed.

The port terminal operator is employed by the person responsible for discharge of the containers from the arriving deep sea vessel. This can be either the carrier or the cargo interest. Port terminal operators that handle containers are normally contracted by the carrier.

Niessen (2017) answers the question if transshipment falls within or outside the definition of a contract of carriage. Under transport law, the contract of carriage covers the time that the goods are in custody of the carrier. This is the time between the moment that the goods are taken over by the carrier and the moment of delivery. During this period the carrier

is responsible and liable for any loss, damage or delay. Delivery within the legal definition is the bilateral act where the carrier surrenders control over the cargo to the cargo interest who in turn accepts control over the cargo. Delivery and discharge of containers is mostly not coextensive; the containers that have been discharged are normally stored on the terminal for some time before delivery to the cargo interest takes place.

Where the contract of carriage is subject to the H(V)R¹, the carrier is only mandatorily liable during period from the time that the goods are loaded on, to the time that they are discharged, from the ship. This period is also referred to as the “tackle to tackle period”. This follows from the fact that the H(V)R only apply during this period. The rules however do not attach to the time before loading and after discharge during which the goods are in custody of the carrier. During this period the carrier is not subject to the mandatory liability regime of the H(V)R. During this period the performance of the contract of carriage is subject to national law. Carriers in most cases exclude any liability with the “before-and-after- clause” where so permitted under national law. Where the contracts of carriage also include a Himalaya clause, the port terminal operator can also rely on the before-and-after clause, provided that the transshipment services fall within the scope of the contract of carriage.

With the knowledge that the contract of carriage is operative until the moment that the container is delivered to the cargo interest by the terminal operator who acts on behalf of a sea carrier, we now take a closer look at the contract of carriage.

5.3.1 Contract of carriage

In most cases where goods require transport by sea, they have been sold by a seller to a buyer. In these cases, the contract of carriage is ancillary to the contract of sale. Depending on the delivery terms agreed in the contract of sale, the buyer or the seller (or parties acting on their behalf) will assume the role of “shipper” and enter into a contract of carriage with the carrier.

¹ The Hague (Visby) Rules. The Hague Rules; The Brussels Convention for the Unification of Certain Rules of Law relating to Bills of Lading of 25 August 1924. The Hague-Visby Rules; the Hague Rules as amended by the Brussels Protocol of 23 February 1968.

Since the contract of carriage has direct influence on the procedure to release containers from the port terminals, this section will focus on the contracts used for carriage of containers.

Containers are predominately shipped through liner services. This means that ships sail advertised schedules and call at the same ports in the same sequence during every “rotation”.

In the realm of contemporary container shipping, the contract of carriage for containers is attested by either a bill of lading or a sea waybill. These two documents both serve as evidence of a contract of carriage and have similar function, but there are differences as well. These differences affect the commercial release by the carrier at the container terminal in the port of discharge. Therefore it is necessary to understand the use and functioning of both the sea waybill and the bill of lading.

5.3.2 Bill of Lading

As indicated before, it is the shipper, who may be the buyer or the seller depending on the terms of sale or parties on their behalf, who enters into contract with the carrier. The Bill of Lading is a common used document of carriage in the container shipping industry.

This (liner) Bill of Lading can take different forms since most shipping lines use their own standard documents. Nonetheless the main functions of the bill of lading are the same throughout the container shipping industry. Each bill of lading will have the following three basic functions. The bill of lading is:

- the receipt for the goods shipped;
- the evidence of the contract of carriage;
- a document of title;
- a means for identification of the person entitled to take delivery

The first and original function of the bill of lading is that it is the receipt for the goods, issued by the carrier. The bill of lading will therefore include statements on the cargoes received for shipment by the carrier, such as the description of the goods, quantity, container numbers, seal numbers and the apparent order and condition of the goods. These qualifications are effectively made by the shipper during the booking process and accepted by

the carrier. Because third parties that take delivery of the container can rely on these statements, it is normally in the interest of the carrier for the bill of lading of the goods to say as little as possible about the goods shipped. It is therefore that it is common that qualifications such as “said to contain” (STC) or “full container load” (FCL) or “Shippers load stow and count” (SLAC) are inserted to indicate that the container was packed by the shipper and that the carrier was unable to check the contents of the container. In the business of container shipping the carrier will usually only acknowledge without reservation the receipt of the container and the apparent good condition of the container itself.

The second function of the bill of lading is that it evidences the contract of carriage. It is not on itself the contract of carriage, but merely the “excellent” evidence of it. The actual contract can be made before the goods are delivered in the hands of the carrier or an agent acting on his behalf, typically during the booking process. However, when the bill of lading is in the hands of an endorsee it provides conclusive evidence on the particulars of the cargo. The freight clauses on the B/L are binding on the carrier and on the third party holder of the B/L even when the amount of freight is not mentioned. Examples of this clause are “Freight Payable at Destination” or “Freight Prepaid”. Freight clauses are of particular importance in relation to the release procedure in the port of destination, because the carrier can demand to be paid before surrendering control over the goods.

The third function of the bill of lading is that it is a document of title. As a document of title the B/L “embodies the exclusive right to take delivery of goods” and it can also be used for the symbolic transfer of control over and ownership of goods for as long as the goods have not been delivered by the carrier. It is the duty of the carrier to surrender control over the goods to the holder of the Bill of lading when he surrenders the original and duly endorsed Bill of Lading to the carrier. A straight B/L is named to the consignee directly and is non negotiable (transferable). A B/L “to the order of” or “to bearer” can be transferred by endorsement. The function of “document of title” is of importance to the release procedure in the port of destination because the carrier will not surrender control over the goods when the B/L has not been tendered by the party entitled to take delivery of the goods.

The fourth function of the B/L is the identification of the party that is entitled to take delivery of the cargo. The consignee can be identified by endorsement of the original B/L. The carrier can deliver the goods to the first party that surrenders the original B/L that is duly endorsed to the party that presents the B/L.

Another aspect with significant importance to the release procedure of the terminal operator is the right of the carrier to exercise a lien over the cargo of others. (Girvin, 2011). The carriers' lien is the right of the carrier to retain the cargo in his possession that belongs to another. It is usual for Bills of Lading that express provisions for the right of lien are included. As a typical example the Conlinebill 2016 includes: "The Carrier shall have a lien on all cargo for any amount due under this contract and the costs of recovering the same and shall be entitled to sell the cargo privately or by auction to satisfy any such claims." By result, the carrier will only notify the port terminal operator that the container may be released after freight and ancillary charges such as demurrage and detention have been collected in full.

The B/L is mostly used in combination with international contracts of sale where buyers and sellers agree "cash against documents" (CAD). In these cases the undertakes that he will present a set of documents, including the B/L, to the buyer or to a bank appointed by the buyer. When the buyer or the bank appointed by the buyer establishes that the documents are in conformity with the contract of sale and pays for the goods, the B/L is transferred to the buyer and becomes the owner of the goods to which the B/L relates (Zwitser, 2012).

5.3.3 Sea Waybill

The Sea Waybill is similar to the Bill of lading, but not the same. It fulfills three out of the four functions of the Bill of lading. The sea waybill is used in maritime commerce as a receipt for goods loaded aboard the carrying vessel in the port of origin. Next to the function of a receipt, the sea waybill also evidences the contract of carriage and it identifies the person to whom delivery of the goods is to be made by the carrier in accordance with that contract¹. Unlike the bill of lading, the sea waybill is not a negotiable document nor is it a document of title.

Because the sea waybill is a non-negotiable and because it is not a document of title, the document cannot be used in transactions in which payment is made through documentary credit or in transactions where cargo is sold during transit. Only the party that is identified as the consignee or parties acting on behalf of the consignee can take delivery of the cargo. It is

¹ UK Carriage of goods by sea Act 1992.

not uncommon to find that parties to the international contract of sale do not require a negotiable document of title. This can be the case for transactions between parties with a long-standing relation or for intra-group transactions of multi-national companies (Girvin, 2011).

The upside of the use of the sea waybill is the advantage that there is no need for the consignee to surrender the sea waybill to the carrier in order to take delivery of the container in the port of discharge. It suffices for the consignee to positively identify himself as the party identified as such in the sea waybill. There is no risk that the vessel arrives in advance of the documents.

Just as Bills of Lading, Sea Waybills normally include express conditions on the carriers' right of lien. Although the content of the clauses varies for different carriers, the effect on the release procedure is normally the same as for situations where a B/L is issued. The carrier will retain possession for as long as not all freight and ancillary charges have been collected in full.

5.3.4 Commercial release of containers

After discussion of the relation between the carrier and the port terminal operator and after discussion of the two most common contracts of carriage in the business of container shipping, one can now understand the background of the commercial release that is submitted by the carrier to the operator of the container terminal that acts as his servant.

The port terminal operator performs stevedoring duties as a servant to the carrier. The carrier will only submit the commercial release message to the port terminal operator when freight and ancillary charges have been disbursed in full and when a duly endorsed original B/L is surrendered by the holder. For containers shipped with a Sea Waybill the consignee does not need to present the original copy of the bill in order to obtain delivery. The table below briefly recapitulates the requirements for the commercial release.

Document	Freight collected	Document surrendered	Consignee Identified
Bill of Lading	Yes	Yes	Yes
Sea Waybill	Yes	No	Yes

Figure 15; Requirements for commercial release

Days before arrival of the container vessel in the port of discharge, the notify party on the Sea Waybill or B/L will receive a pre-arrival notice. The notify party can be the consignee itself or a party acting on behalf of the consignee, such as a forwarding agent. This notice of pre-arrival will include notification of freight and ancillary charges due.

As soon as freight and ancillary charges have been collected in full by the ships agent in the port of discharge, and the B/L has been surrendered by the cargo interest, he will send the container release message to the notify party. This message includes all the particulars necessary for the pick up of the container from the terminal, including the release code. This release code, in praxis often referred to as pincode, is also communicated to the terminal operator.

The inland carrier will report at the gate the container number and the release code. When the release code received from the inland carrier matches the release code from the ships agent, the container will be released from the terminal, provided that the other criteria for release have been met as well. This process is depicted in Figure 16 below.

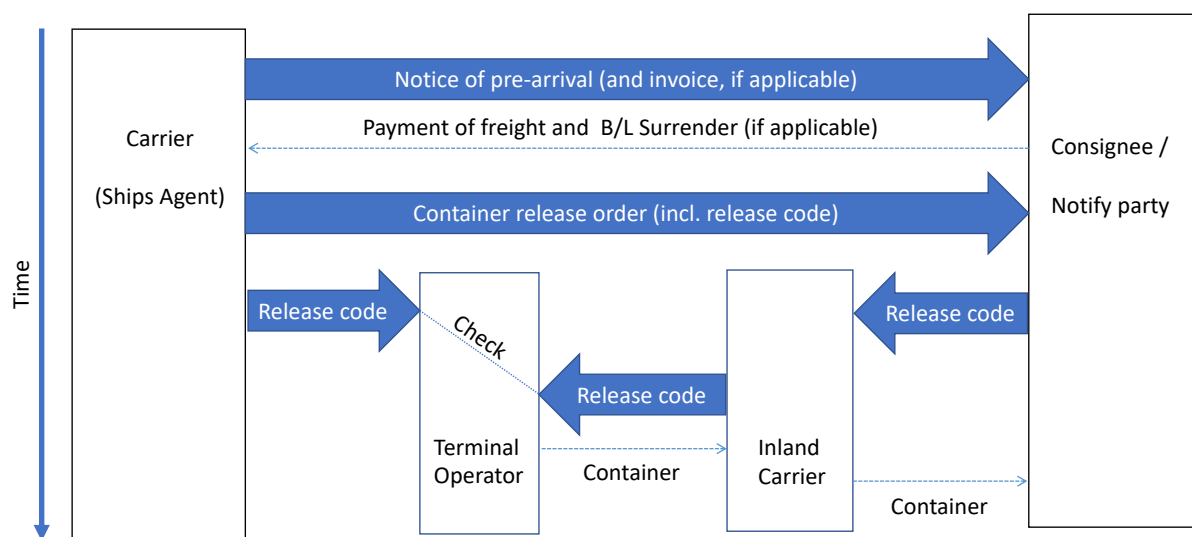


Figure 16; Procedure for commercial release

5.3.5 Conclusion

The sections of this chapter dealt with the business procedures of port terminal operators. In particular the requirements for the commercial release were brought in focus. It was identified that, for arriving containers, transshipment at the port terminal is executed under the contract of carriage. The carrier contracts the port terminal operator for stevedoring duties. To understand the backgrounds of the commercial release of containers, the contract of carriage was studied in more detail. Through discussion of the two most common contracts of carriage for carriage of goods by sea, the commercial requirements for release were brought to the foreground.

5.4 Planning hinterland transport

Planning of hinterland transport is dependent on various aspects. Aside from the selection of the transport modality, planning of hinterland transport is in general dependent on availability of resources for the transport itself, the availability and release status of the container that is to be collected and the assignment of a time slot for pick up by the terminal operator to the hinterland transport operator.

The procedure¹ at RWG and other Rotterdam based terminals is that hinterland transport operators must pre-announce pick up of containers and that time slots for pick up of containers are confirmed by the terminal operator.

For trains and barges, the hinterland transport operators must notify the loading list to the terminal at latest 12 hours prior to the estimated time of arrival (ETA) of the barge or train. Pick up of individual containers on the loading list will be cancelled by the terminal in case the “required conditions” for pick up of the container have not been fulfilled 2 hours prior to ETA of the train or barge. In practical terms this means that when the container is not released 2 hours before ETA of the means of transport for inland carriage that the terminal will cancel pick up of the container. These cancellations subsequently cause transport capacity to be unused.

¹ <https://rwgservices.rwg.nl/Information/OperationalInformation> , accessed on August 16 2018. The information is included in annex B

For trucks, transport operators can plan 2-hour slots for pick-up through the truck appointment system. In case the container is not released one hour before the start of the planned slot, the appointment will be cancelled by the terminal.

In response to the terminal procedures for pick up of containers, hinterland transport operators in the majority of cases first await the container to be released after which they start planning the pick up of the container from the terminal. This sequence can also be witnessed in the diagram of the Rotterdam Port Community System operator “Portbase” that is included in annex C. Use of this sequence in practice could also be validated through discussion with the operations manager of an inland terminal that also operates a barge service between the port of Rotterdam and the inland terminal in Hengelo (CTT). Before adding inbound containers to loading lists, CTT awaits the confirmation that the containers are released.

5.5 Conclusion

This chapter untangles the process by which inbound containers are released from the terminal into the custody of the hinterland carrier. The release of containers is governed by the terminal operator against the background of operational aspects, customs law and the obligations and liabilities that arise from the contract of carriage (Figure 17 on page 67).

In summary, the release of containers from a port terminal is based on six criteria:

1. The container is available on the terminal
2. The B/L has been surrendered by the cargo interest to the carrier (with B/L)
3. Freight and ancillary charges due have been disbursed in full
4. The party entitled to take delivery of the cargo has been identified
5. Absence of a customs block for inspection or found conform after inspection
6. The cargo has been assigned to a customs approved treatment or use.

Criteria 2, 3 and 4 have been discussed in section 5.3 and find their background in the contract of carriage by sea. The carrier will require that these requirements are fulfilled to his satisfaction prior to the release of the container from the terminal. Delivery without fulfillment of these criteria would leave the carrier without the effective remedy to unpaid freight and would create liability against the legitimate cargo interest as a result of releasing

the cargo to parties that are not entitled to take the delivery. The criterion that the B/L must be surrendered by the cargo interest is only applicable where a B/L is used as contract of carriage by sea.

Criteria 5 and 6 have been discussed in section 5.2 and are rooted in Customs Law. Temporary storage of arriving goods ends when the goods have been assigned to a customs procedure or when they are re-exported. As the holder of the authorization of the temporary storage facility, the terminal operator would make himself liable to a customs debt through non-compliance in case goods liable to import duty would be removed from the temporary storage facility (customs supervision) before these have been assigned to a customs procedure. The conditions set out in the authorization for the temporary storage facility include the obligation to administer the reference to the customs procedure for all cargo released from the temporary storage facility.

Procedures of the terminal operator prescribe that hinterland transport operators must pre-announce pick up of containers and that time slots for pick-up are assigned by the terminal operator. When containers are not released before the planned pick up, the pick up reference is cancelled by the terminal operator. In pursuit of efficiency hinterland transport operators therefor often await the confirmation of the container release before planning pick up of containers. Due to the longer cut-off time of 12 hours for barges and trains this has greater impact on these modalities.

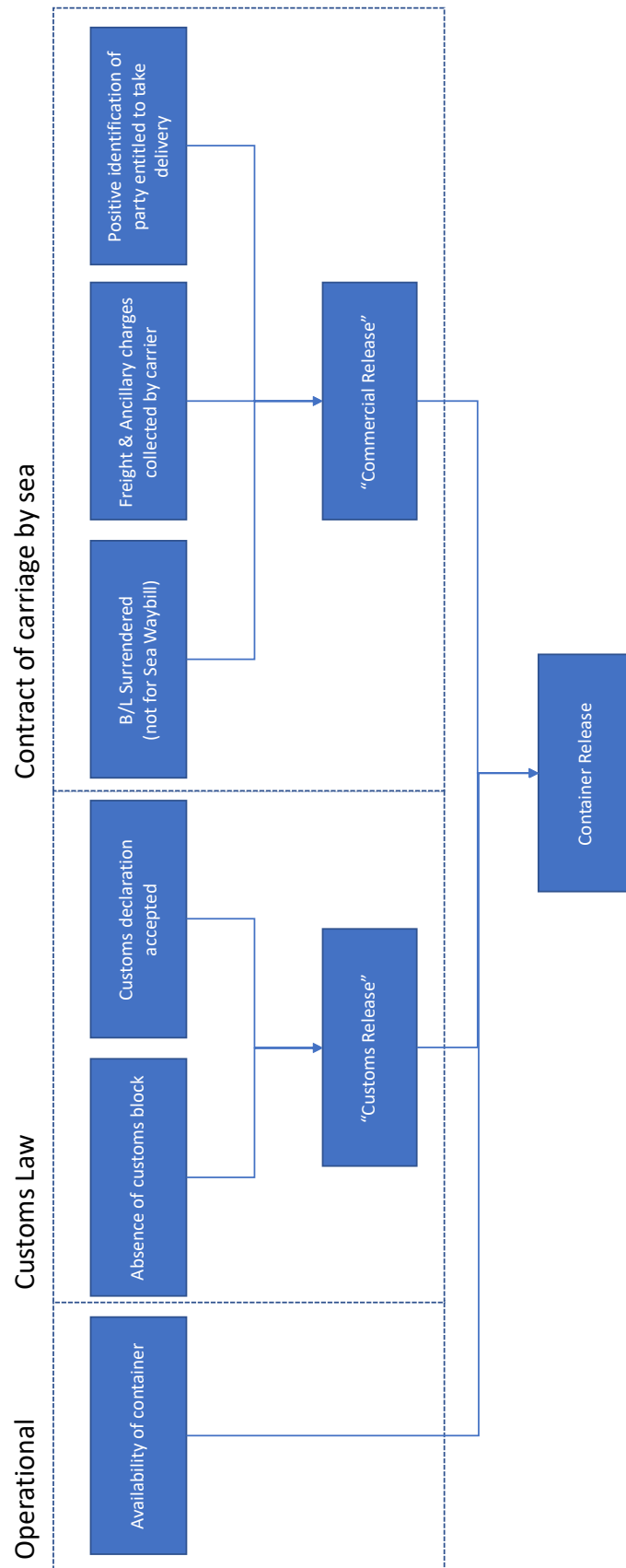


Figure 17; Overview of container release criteria

6 Data Collection

With better understanding of the customs regulatory framework and business procedures that govern the release of containers from the terminal, this chapter now turns to the collection of research data.

For this research project a dataset has been drawn from transactional data of port terminal operator RWG. Through cooperation with the terminal operator and the Dutch Customs administration, empirical data was made available for this thesis project.

In two sessions with the Customs Administration and RWG the research question was introduced and discussed. Subsequently the terminal procedures for arriving containers were discussed step by step, building a good understanding of relevant terminal operations and creating a good insight in the structure of the transactional data of the terminal.

Similar to other terminal operators, RWG controls its terminal operations with a Terminal Operating System (TOS). This information system holds all transactional data and is used for control of terminal operations of RWG.

A condition set out in the authorization for operation of the temporary storage facility is that RWG keeps appropriate records in a form approved by Dutch Customs. To fulfill this requirement, RWG produces a monthly audit file from the information in the TOS that includes all information and the particulars that enable the Dutch Customs administration to supervise the operation of the temporary storage facility. In particular, this audit file includes the identification of the goods stored on the terminal, their customs status and their movements. The information for the monthly audit file is extracted from the TOS of RWG.

With permission of RWG, part of the data contained in this audit file from September 2017 was used as the data source for this thesis project. The Dutch Customs Administration assisted with making the appropriate extraction of records containing the relevant attributes for this thesis project. With use of the process mining application “Celonis”, data was selected from the audit file to isolate the containers arriving by sea carriage that were, after being discharged and stored on the terminal, released from the terminal into the custody of an inland carrier. By making this selection all other transactions such as for export containers, transshipment to other vessels etc. could be excluded from the data file. In total 21.758 unique “passage keys” were selected and extracted from the audit file, of which each represents the passage of one container. Thus, the dataset includes information for all 21.758

containers that arrived at RWG by sea carriage and were released to an inland carrier in September 2017. The dataset includes the following attributes for each container passage:

- the actual time that the individual container is discharged from the vessel
- the modality used for inland carriage
- the “type” of customs procedure
- the actual time that the customs documentation was received by the terminal
- the actual time that the container left the terminal for inland carriage

This study concentrates on the effect of variation in the lead time of customs formalities on the time that containers dwell at the port terminal. The target population for this research is not related to container terminals, since the independent variable (document lead time) is driven by individual cargo interests and not by container terminals. The target population consists of all the arriving full containers in the port of Rotterdam destined to consignees in the hinterland.

The sample includes all full containers that arrived at the terminal of RWG in the month September 2017. Although one could contest that the selection method for the sample reduces the external validity of the research results, it is also possible to contest that this has limited effect. It is unlikely that the selection criteria “container terminal” and “September 2017” have influence on the document lead time for individual containers from a large group of cargo interests and as a matter of principal all individual containers from different cargo interests had an equal chance to be selected.

The initial format of the data provided could not be analyzed with standard applications such as Excel and SPSS because the file included multiple records for each passage key – attribute combination. To overcome this obstacle the data was imported and processed in Microsoft Access. Within this database application it was possible to transpose the initial data to the final “research file” with 21.758 records in which each record includes a unique passage key and all corresponding attributes. The output was subsequently verified against the initial file and found to be correct.

As a result of the fact that the data in the research file is initially captured by RWG for the purpose of customs supervision on the temporary storage facility, the quality of the data is of good standard. Internal cross checks of the data in the file did not reveal incomplete records or inconsistency (e.g. containers leaving the terminal before they have been

discharged from the vessel). One aspect that stood out during verification is that for many arriving containers the customs documentation is already provided by the cargo interest to the terminal before the container is discharged from the vessel. This could imply that, contrary to UCC art. 172, the customs declarations were accepted by the Customs Administration prior to the presentation of the goods to customs. This observation was recognized by both the Customs Administration and RWG. This anomaly is the result of the fact that within the customs administration the presentation of goods and acceptance of customs declarations are managed in different administrative systems. The datafile however proved to be correct on this point because it reflects the actual situation.

As an example for the data file the first 20 of in total 21.758 records of the file have been included in appendix A. The table below describes the meaning of the different fields per record in the datafile.

Field Name	Description
Passage Key	Unique numeric identifier for each container passage
ZIBI	Date and time when container discharge from the vessel is completed (detailed for each container)
LUAF	Date and time when container physically leaves the terminal for inland carriage
Modality	Modality for inland carriage (<u>T</u> ruck, <u>B</u> arge, <u>R</u> ail)
MDBI	Date and time when customs document was assigned to that specific passage key. Documents were received prior to discharge of the container. In case the documents were received prior to the moment that the container is discharged, this field will show the same time as the time of container discharge (MDBI=ZIBI). This field is blank if the documents were received after discharge of the container.
MUDA	Date and time when customs documents were received (for all containers for which the documents were received after discharge of the container). This field is blank for all passage keys where the documents were received prior to discharge of the container.
Documentreceipt	Combination of the fields MDBI and MUDA. This field shows the date and time that the customs documents were received. For all passages for which documents were received prior to discharge, this field will show the same date and time as ZIBI.
Document type	RTO document type identifying the customs procedure used (Release for free circulation, external transit, etc.)

7 Descriptive analysis

Drawing on the research objectives laid down in section 2, the knowledge of the research subject gained in the section 4 and 5 and the research data that has been collected, this chapter is dedicated to the analysis of the collected data in pursuit of the objectives of this study.

As defined in chapter 2 the first objective is to establish the time effect of customs formalities on the lead time of the hinterland transport process. In chapter 3 the conceptual model was introduced and the two variables were explained. Both variables are continuous and measured in hours.

After a first exploration of the information in the dataset in section 7.1, this chapter will return to the propositions presented in chapter 3. Statistical inference testing will be used to ascertain if there is, or if there is not, a relation between document lead time or dwell time.

7.1 First exploration of the dataset

The first exploration of the two variables is performed by creating histograms of the document lead time and dwell time (Figure 18 and Figure 19). The mean dwell time in sample n is 86,83 hours and the mean document lead-time in the sample is 69,26 hours. In addition, a scatterplot is made (Figure 20), showing all individual containers as data points. It is clearly recognizable that the condition $dwell\ time \geq document\ lead\ time$ applies to all individual instances in the sample as expected. The container terminal did not release containers before the cargo interest notified the terminal that the goods were assigned to a customs procedure.

The total sample includes 21.758 arriving containers of which 14.168 containers have a document lead time of 0 hours. For these containers the terminal was notified that the goods were assigned to a customs procedure prior to discharge of the container. In these cases the document lead time does not prolongate the container dwell time. The container cannot be delayed by document lead time because the document lead-time is 0. The remaining 7.590 have a document lead time that is greater than 0. In Table 9 the mean dwell time in n is shown for cases with document lead time 0 and for cases with the document lead time greater than 0. The containers in the sample with a document lead time greater than 0 on average dwell 32 hours longer at the terminal.

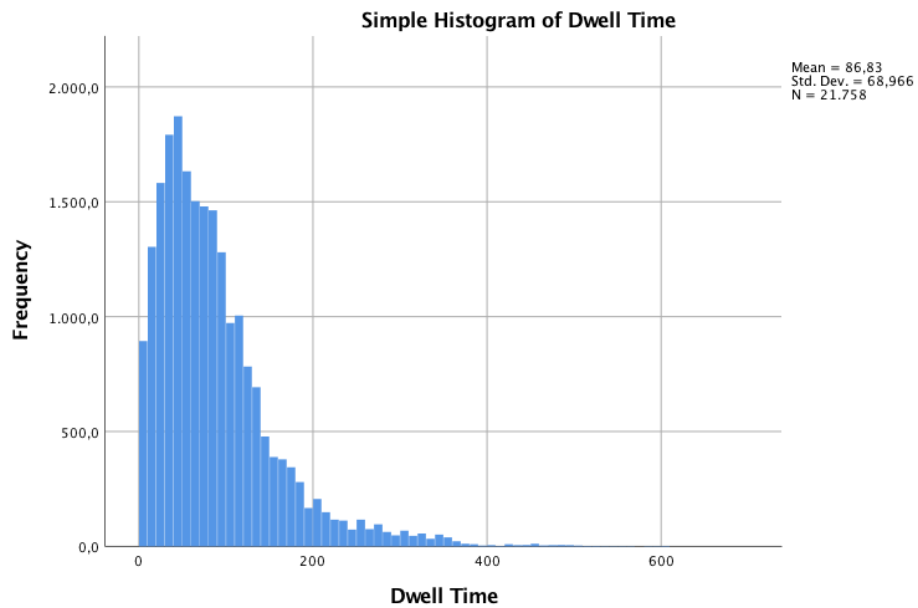


Figure 18; Histogram of container dwell time

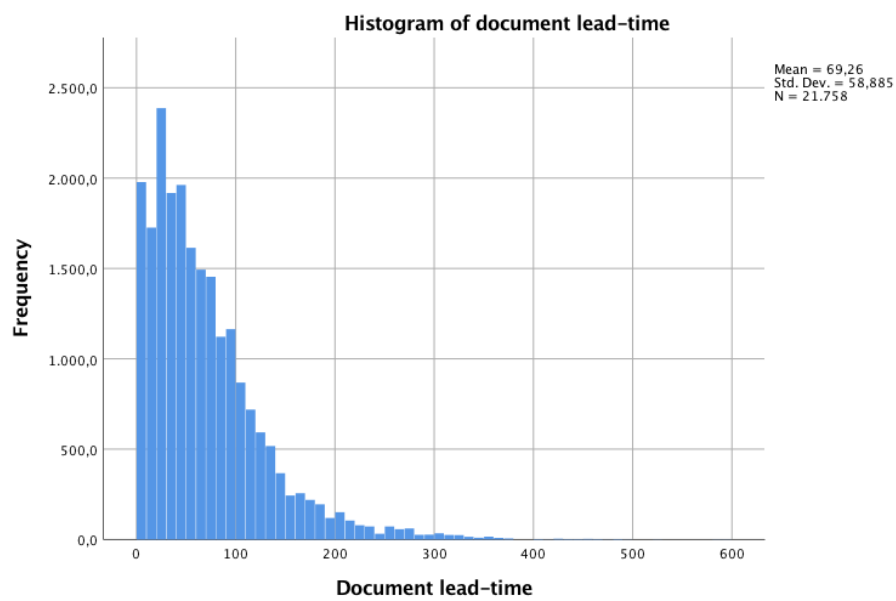


Figure 19; Histogram of Document lead time

Dwell Time			
Document Lead Time	Mean	n	Std. Deviation
Lead time = 0	75,47	14168	60,049
Lead time > 0	108,03	7590	78,829
Total	86,83	21758	68,966

Table 9; Mean Dwell time

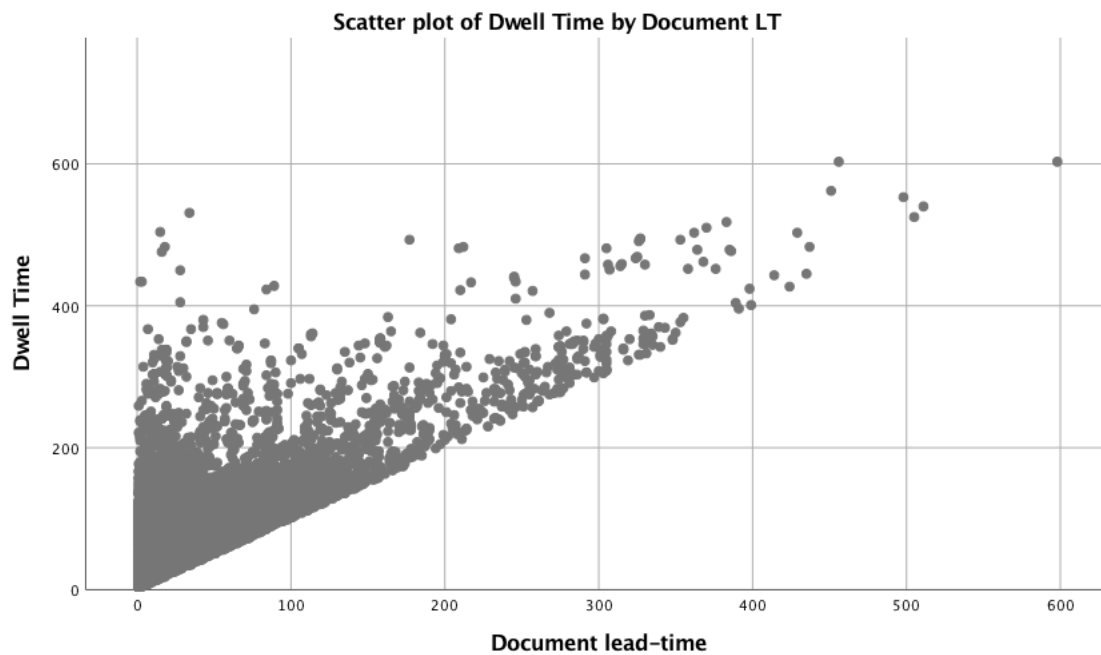


Figure 20; Scatterplot of Document Lead time and Dwell Time

7.2 Association between document lead time and dwell time

The first question to answer is: is there evidence of a linear relationship between the variables document lead-time and dwell time at the 0,001 level of significance? To answer this research question a statistical inference test is performed.

The ‘strength’ of the relation between document lead time and dwell time in the population N is expressed with Pearson’s correlation coefficient ρ . The strength of the correlation coefficient in sample n is expressed with r . The probability for a type I error, a false claim that there is an association between the variables when there is none, is expressed by α . The hypothesis for testing are defined as stated below:

$$H_0: \rho = 0 \text{ (no correlation)}$$

$$H_a: \rho \neq 0 \text{ (correlation exists)}$$

$$n = 7.590, \alpha = 0,001$$

The test is performed by first calculating Pearson's correlation coefficient for sample n and then to test if the probability of a type 1 error is below 0,001. The calculation of correlation coefficient r was calculated with SPSS.

X = Document Lead time (hours)

Y = Dwell time (hours)

$$r = \frac{\sum XY - n\bar{X}\bar{Y}}{\sqrt{\sum X^2 - n\bar{X}^2} \sqrt{\sum Y^2 - n\bar{Y}^2}}$$

The correlation coefficient r for sample n is 0,720, indicating that there is a strong correlation between the variables of the cases within the sample. With a test statistic it is calculated if H_0 should be accepted or rejected at the significance level α of 0,001.

$$t = \frac{r}{\sqrt{\frac{1-r^2}{n-2}}} = \frac{0,720}{\sqrt{\frac{1-0,5184}{7590-2}}} = 90,37$$

The calculated value for t is greater than critical value (3,291), which leads to the conclusion that the null hypothesis is to be rejected and consequently that there is evidence of a linear relationship ρ between the Document Lead time and Dwell time in population N at the level of 0,1 % of significance.

7.3 Describing the relation between document lead time and dwell time

Within section 7.2 it was confirmed that there is a strong association between the document lead time and the time that containers dwell at the port terminal. In this section this association will be further explained by linear regression analysis. This analysis seeks to explain the impact of changes in the document lead time on the dwell time. With a simple linear regression model the linear relation between the document lead time and dwell time is described by a linear function, assuming that the changes in dwell time are caused by changes in document lead time. The population regression model is formulated as below.

$$y = \beta_0 + \beta_1 \cdot x + \varepsilon$$

Whereas:

y = dwell time in hours
 β_0 = *population y intercept*
 β_1 = *population slope coefficient*
 x = *document lead time*
 ε = *random error term*

The assumption is that the random error values are statistically independent and that these values are normally distributed for any given document lead time and have constant variance. Self-evidently this model assumes that the underlying relationship between the dwell time and document lead time is linear. The scatter plot of the data (Figure 20) gives no indication to assume otherwise.

The sample regression line estimates the population regression line for which the formulation is similar to the formulation of the population regression model.

$$\hat{y}_i = b_0 + b_1 \cdot x_i$$

The error term ε_i is not included in the formulation for the sample regression line because the individual random error terms in the sample have a mean of 0. b_0 is the estimated dwell time when the document lead time is 0. b_1 is the estimated change in dwell time (hours) per hour increase of document lead time. The value for b_1 is found through the least squares equation.

$$b_1 = \frac{\sum(x - \bar{x}) \cdot (y - \bar{y})}{\sum(x - \bar{x})^2}$$

The values for b_0 are subsequently found through :

$$b_0 = \bar{y} - b_1 \cdot \bar{x}$$

The computation of the function for the regression line has been performed with use of SPSS. Based on this calculation the sample regression line to estimate the population regression line is formulated as:

$$\text{Estimated Dwell time [hour]} = 61,33 \text{ [hour]} + 0,937 \cdot \text{document lead time[hour]}$$

This means that 61,33 hours of the total dwell time is not explained by the document lead time and that for each hour of increase in the document lead time the estimated dwell time increases with 0,937 hours. The p value is below 0,000 which means that the fit of the regression line is a statistically significantly better than the fit of a y-intercept only model.

A statistical measure for the “goodness of fit” of the regression line is the coefficient of determination, also referred to as R-squared. This coefficient can be calculated based on the sums of squares. The regression line sum of squares is the sum of squared differences between individual data points and the regression line. The total sum of squares is the sum of the squares of the differences between between the individual data points and the mean dwell time.

$$\text{coefficient of determination} = \frac{\text{regression line sum of squares}}{\text{total sum of squares}}$$

The coefficient of determination was computed with SPSS. Within the sample 0,52 (r-squared) of the variation in the dwell time is explained by the variation of the document lead time. Bearing in mind all the external factors that can influence the dwell time, that is a clear indication that the document lead time is an important factor to explain the variation in container dwell time.

7.4 The difference between the document lead time and dwell time.

As can be seen in Figure 21 (repeat of Figure 4 on page 15), there is a difference between the document lead time and the dwell time. This difference is the time that elapses between the document receipt and the moment that the container leaves the terminal (exit). For purpose of convenience this period is defined as DT-DLT.

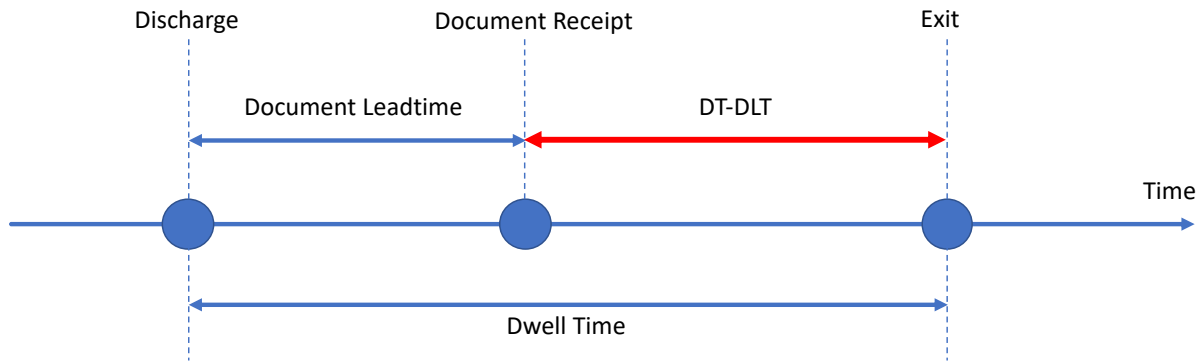


Figure 21; Definition of document lead time and dwell time

The relation between the document lead time and DT-DLT is illustrated in Figure 22. This graph shows the mean DT-DLT for the (binned) Document lead time. As can be seen in the graph, there is not a strong relation between the document lead time and the mean DT-DLT that would indicate inverse proportionality. Variation in the documentation lead time does not have great impact on the mean DT-DLT.

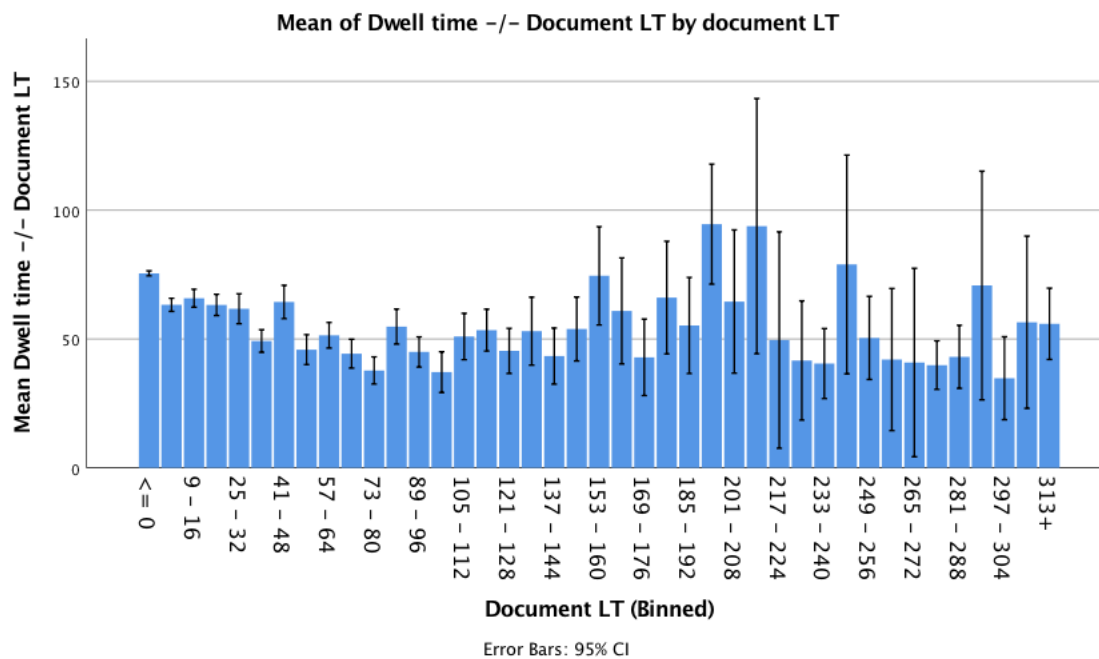


Figure 22; Relation between Document lead time and DT-DLT

The question to answer is: is there evidence of a linear relationship between the variables document lead-time and DT-DLT at the 0,001 level of significance? A statistical inference test is performed to answer this question.

The ‘strength’ of the relation between document lead time and dwell time in the population N is expressed with Pearson’s correlation coefficient ρ . The strength of the correlation coefficient in sample n is expressed with r. The probability for a type 1 error, a false claim that there is an association between the variables when there is none, is expressed by α . The hypothesis for testing are defined as stated below:

$H_0: \rho = 0$ (no correlation)

$H_a: \rho \neq 0$ (correlation exists)

$n = 21.758, \alpha = 0,001$

The test is performed by first calculating Pearson’s correlation coefficient for sample n and then to test if the probability of a type 1 error is below 0,001. The calculation of correlation coefficient r was calculated with SPSS.

X = Document Lead time (hours)

Y = DT-DLT (hours)

$$r = \frac{\sum XY - n\bar{X}\bar{Y}}{\sqrt{\sum X^2 - n\bar{X}^2} \sqrt{\sum Y^2 - n\bar{Y}^2}}$$

The correlation coefficient r for sample n is -0,112, indicating that there is not a strong correlation between the variables of the cases (containers) within the sample. With a test statistic it is calculated if H_0 should be accepted or rejected at the significance level α of 0,001.

$$t = \frac{r}{\sqrt{\frac{1-r^2}{n-2}}} = \frac{-0,112}{\sqrt{\frac{1-0,0125}{21758-2}}} = -16,6241$$

The calculated value for t is smaller than the critical value (-3,291), which leads to the conclusion that the null hypothesis is to be rejected and consequently that there is evidence of a (weak) negative linear relationship ρ between the Document Lead time and DT-DLT in population N at the level of 0,1 % of significance. Although the association between the

document lead time and DT-DLT is statistically significant (due to the large sample size), it has little effect on the total dwell time as can also be witnessed in Figure 22. Although the relation between the document lead time and DT-DLT is statistically significant, it is of low relevance because the strength of the relation (expressed by the correlation coefficient) is low. When looking at the Figure 22 one could also argue that that the relation is not linear at all.

The time period that the container is stored at the terminal after the terminal operator received the notification that the goods are assigned to a subsequent customs procedure is not strongly affected by the document lead time. In other words: containers with long document lead times on average are not collected substantially quicker after the terminal operator received confirmation that these containers were assigned to subsequent customs procedures. The inverse statement also holds. Containers with relatively short document lead times on average are not collected substantially slower after the terminal operator received confirmation that these containers were assigned to subsequent customs procedures. Where the Dwell time is the sum of the document lead time and DT-DLT, the DT-DLT on average is more or less constant. This is illustrated by Figure 23. The total height of each bar shows the mean dwell time in hours and the colours depict the share of document lead time and DT-DLT. This also helps to understand the correlation between document lead time and dwell time and the outcome of the linear regression analysis of section 7.3.

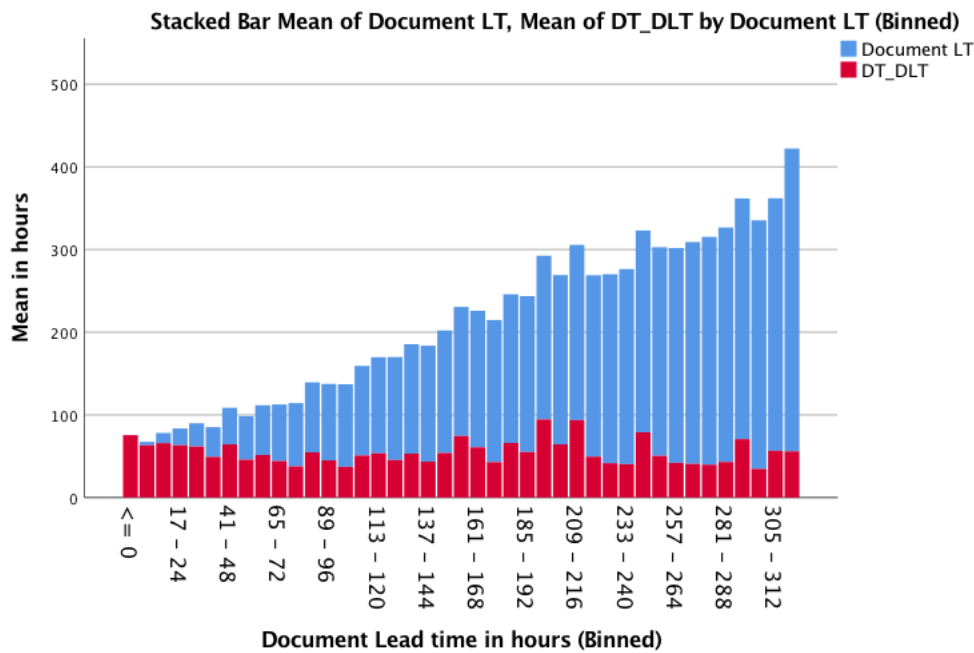


Figure 23; Mean document lead time and DT-DLT

The data set also includes the modality by which each individual container leaves the terminal. Table 10 includes information on the modal split for the containers in the data set. For each modality (Barge, Rail, Truck) the mean DT-DLT is included in the table. The average time required for pick up of the container after the cargo interest has confirmed that the container is assigned to a subsequent customs procedure is 69 hours. Containers that are transported by truck are collected from the terminal on average 59 hours after document receipt whereas containers that are transported by barge on average are collected 88 hours after document receipt. The different modalities selected by the cargo interests (or parties acting on their behalf) have greater impact on the DT-DLT than the document lead time. This may be partially explained by the difference in cut-off times for the container release for different modalities as explained in section 5.4.

		DT-DLT		
		Count	Column N %	Mean (hours)
Modality	Barge	6865	31,6%	88
	Rail	1770	8,1%	74
	Truck	13123	60,3%	59
	Total	21758	100,0%	69

Table 10; Average DT-DLT per modality

8 Conclusions

This concluding chapter strings together the research findings offered in the preceding chapters to answer the research questions that were at the basis of his research project. In addition, it will expound on the relevance, validity and limitations of the research findings. Before coming to the conclusions, the research questions will be briefly revisited.

In chapter 2 the research topic for this thesis was introduced. The overarching objective of this research project is to research the effect of customs formalities on the lead time of hinterland transport. This study is not about the disruptions caused by customs controls but about the effect caused by customs formalities.

The research questions that are at the heart of this study were formulated as follows:

- Is there evidence that customs formalities can be associated with the lead time of hinterland transport?
- To what extent do customs formalities increase the lead time of hinterland transport (Days, hours) ?
- Is there a causal effect of customs formalities on hinterland transport lead time?

Because customs formalities do not influence the speed of hinterland transportation itself, this research project focused on the process of transshipment in the port of Rotterdam. While the dependent construct of this study was narrowed to the “dwell time” of containers at the port terminal, it is still justifiable to make statements on the hinterland transport as a whole (as explained in chapter 3). Based on the gained understanding of the legal, commercial and operational backgrounds of the release procedure at the terminal, the construct “document lead time” was introduced. This construct served as a measurable parameter for customs formalities in this study. Subsequently the effect of “document lead time” on “dwell time” was studied to explain the relation between customs formalities and the lead time of hinterland transport.

8.1 Findings and conclusions

Through statistical analysis it was observed that containers with longer document lead times dwell longer at the port terminal. Simple linear regression was used to describe this relation and predicts that on average every “extra” hour for the document lead time adds 0,93 hour of dwell time.

It was also observed that there is no strong association between document lead time and the time that elapses after the terminal operator is notified that the cargo is assigned to a subsequent customs procedure until the moment that the container is collected from the terminal (DT-DLT). Increase in document lead time cannot be associated with similar reduction of DT-DLT. On average, a container dwells 69 hours at the terminal after the terminal operator receives confirmation that the goods are assigned to a subsequent customs procedure.

Although this type of research cannot produce indisputable evidence for causation, the findings are in line with the qualitative analysis reported in chapter 5. Terminal operators will not release containers before they have received confirmation that the goods are assigned to a customs procedure and hinterland transport operators in general will not add containers to loading lists when the container has not been released by the terminal operator. Only after the release of the container by the terminal operator the hinterland transportation is included in the planning of the transport operator. Port terminal procedures dictate that loading lists must be submitted to the terminal 12 hours before ETA of barge or train and one hour before pick up with a truck. This also partially explains the variation between modalities. Hinterland transport operators use extra time to avoid unused transport capacity due to cancellations by the port terminal operator (as explained in section 5.4). The uncertainty for the hinterland transport operator that the container will be released before the cut-off time leads to longer lead times.

From the above it follows that the time used for customs formalities is an important factor of influence on the variation in the lead time of hinterland transport. Since customs declarations that are compliant with the applicable legal requirements are to be accepted by the customs administration immediately, this means that the document lead time is driven by the actions of parties in the hinterland. The underlying cause is the time used by parties in the hinterland to lodge the customs declaration and for notification of the terminal operator that the goods are assigned to a subsequent customs procedure. Cargo interests, directly or

indirectly through parties acting on their behalf, influence the time that containers dwell in the port terminal and consequently the hinterland transport lead time as a whole.

The findings above support and build on the conclusion of Ypsilantis (2016, p. 42) that parties in the hinterland have considerable influence on dwell time of containers at a port terminal. Dwell time is not only controlled by terminal operations, but is influenced by factors out of control of the port terminal operators. Where Ypsilantis identifies that variation in dwell time can be related to actions controlled by parties in the hinterland, this thesis identifies handling of customs formalities as one of these actions.

8.2 Relevance

The findings reported above underpin the importance of integration of customs formalities in supply chain operations. When the dwell time for hinterland transport of inbound containers are being lengthened by customs formalities, this has detrimental effect on merchants trading the goods and logistics service providers, in particular the port terminal operators. On a macro economical scale these delays can be identified as a non-tariff barrier to trade.

Section 4.1 shows that there is great attention of academics for the optimization of port terminal operations and hinterland transport. The link with customs formalities received less attention and is mostly limited to more general statements. Section 4.2 shows that research in the domain of trade facilitation is mostly of macro-economic nature. Consequently, this research in the domain of trade facilitation does not provide great detail on the actual barriers it tries to overcome.

Against the background of the academic literature in the supply chain and trade facilitation domain, the outcome of this study provides better insight in the relation between supply chain operations and customs formalities. It supports the notion that exogenous factors influence port terminal operations as suggested by Ypsilantis (2016). Furthermore, it provides a more detailed bottom-up view on a non-tariff barrier to trade as called for by Granger (2014).

The outcome of this study should also raise awareness under practitioners that the handling of customs procedures directly affects their supply chain operations. Focus on the document lead time for their inbound containers could reduce the time required for hinterland transport and increase the reliability of the planned lead times. Hinterland transport planning

and handling of customs declarations are mutually dependent and therefore require to be coordinated, especially when these activities are outsourced to different subcontractors.

8.3 Limitations and recommendations for further study

The findings of this study are based on operational data of container terminal operator RWG. The data quality was of good standard and the dataset included 21.758 instances that could be used for analysis. The dataset included all containers arriving with container vessels with a destination in the hinterland in September 2017. As already indicated in chapter 6, one could argue that the selection method for the sample reduces the external validity of the research results. It is unlikely that the selection criteria “container terminal” and “September 2017” have influence on the document lead time for individual containers from a large group of cargo interests and as a matter of principle all individual containers from different cargo interests had an equal chance to be selected. The results are limited to inbound containers with a destination in the hinterland. Another aspect to bear in mind is that RWG is one of the newest terminals in the Rotterdam port and uses the most advanced technology. Information exchange with parties in the hinterland is “routed” via the Rotterdam port community system Portbase. Although this will have limited effect on the findings of this research, it could be that specific terminal procedures such as the cut off time for the release of the container create differences between terminals. Other aspects, such as great congestion at terminals could reduce the dependency of the dwell time on the speed at which customs formalities are completed.

This study focused on the relation between customs formalities and hinterland transport and described the relation between these two phenomena. A recommendation for further study is to conduct a case study research to compare containers with long and short document lead times to identify the factors that support or hinder expeditious handling of customs declarations by cargo interests or parties acting on their behalf. The outcome could support practitioners to improve business procedures and processes.

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Appendix A; Example data format for analysis

	 PassageKey	 ZIBI	 LUAF	 Modality	 MDBI	 MUDA	 DocumentReceipt	 DocumentType
1	85849	6-Sep-2017 20:47:18	11-Sep-2017 13:12:27 B		.	7-Sep-2017 16:09:19	7-Sep-2017 16:09:19	MRN
2	90148	19-Sep-2017 21:34:51	20-Sep-2017 12:15:52 T		.	20-Sep-2017 11:06:32	20-Sep-2017 11:06:32	IM4
3	90322	9-Sep-2017 15:16:02	11-Sep-2017 08:25:00 T		9-Sep-2017 15:16:02	.	9-Sep-2017 15:16:02	MRN
4	93137	22-Sep-2017 22:29:07	26-Sep-2017 07:56:41 T		22-Sep-2017 22:29:07	.	22-Sep-2017 22:29:07	IM4
5	93849	12-Sep-2017 16:07:53	15-Sep-2017 01:26:23 R		.	13-Sep-2017 09:30:47	13-Sep-2017 09:30:47	DEN
6	101763	22-Sep-2017 14:46:26	27-Sep-2017 16:10:14 T		22-Sep-2017 14:46:26	.	22-Sep-2017 14:46:26	DEN
7	101859	22-Sep-2017 09:19:26	25-Sep-2017 12:19:32 T		22-Sep-2017 09:19:26	.	22-Sep-2017 09:19:26	MRN
8	103213	27-Sep-2017 07:55:38	27-Sep-2017 17:03:55 T		27-Sep-2017 07:55:38	.	27-Sep-2017 07:55:38	IM4
9	104771	18-Sep-2017 18:36:07	20-Sep-2017 17:16:42 B		18-Sep-2017 18:36:07	.	18-Sep-2017 18:36:07	IM4
10	106402	20-Sep-2017 04:27:28	21-Sep-2017 07:00:57 T		20-Sep-2017 04:27:28	.	20-Sep-2017 04:27:28	IM4
11	107585	14-Sep-2017 21:11:44	20-Sep-2017 09:01:38 B		.	18-Sep-2017 08:56:55	18-Sep-2017 08:56:55	MRN
12	110382	19-Sep-2017 14:26:17	20-Sep-2017 23:01:35 B		19-Sep-2017 14:26:18	.	19-Sep-2017 14:26:18	DEN
13	110434	1-Sep-2017 16:24:47	6-Sep-2017 04:49:05 T		1-Sep-2017 16:24:47	.	1-Sep-2017 16:24:47	IM4
14	110931	12-Sep-2017 18:06:00	17-Sep-2017 15:38:03 B		12-Sep-2017 18:06:00	.	12-Sep-2017 18:06:00	DEN
15	111389	16-Sep-2017 04:35:39	20-Sep-2017 08:20:57 T		.	18-Sep-2017 09:04:55	18-Sep-2017 09:04:55	MRN
16	112868	29-Sep-2017 09:45:09	29-Sep-2017 19:46:59 B		29-Sep-2017 09:45:09	.	29-Sep-2017 09:45:09	IM4
17	113007	20-Sep-2017 07:22:06	21-Sep-2017 15:43:57 T		20-Sep-2017 07:22:06	.	20-Sep-2017 07:22:06	MRN
18	113650	20-Sep-2017 04:28:48	24-Sep-2017 00:25:25 B		20-Sep-2017 04:28:49	.	20-Sep-2017 04:28:49	MRN
19	116867	6-Sep-2017 12:20:53	10-Sep-2017 06:51:20 B		6-Sep-2017 12:20:53	.	6-Sep-2017 12:20:53	IM4
20	119132	24-Sep-2017 15:04:43	25-Sep-2017 18:40:05 T		24-Sep-2017 15:04:43	.	24-Sep-2017 15:04:43	IM4

Appendix B; Terminal procedure RWG for pick up

Truck

RWG works with a so-called Truck Appointment System that consists of time slots of 2 hours. During the week, a grace period of 30 minutes is added after the time slot. Time slots must also be booked during the evening and at night, between 20.00 and 06.00. However, it is possible to enter the terminal throughout this entire period of time. The same applies for the weekend period from Fridays 20.00 until Mondays 06.00.

Keep in mind that your appointment will be cancelled one hour before the start of the booked time slot if the pre-announcement is not (entirely) correct. It is possible to book a time slot within a slot up to one hour and 45 minutes (105 minutes) into that particular slot. To be able to do this, though, all pre-announcement conditions have to be met within 15 minutes after you have booked the time slot. The truck visit needs to be pre-announced through the Port Community System of Portbase. Click [here](#) for more information about the pre-announcement.

Click [here](#) for the real-time occupancy of the time slots.

Barge

Pre-announcement for barge visits has to be done through Portbase. The pre-announcement has to be done at least 48 hours before ETA. Click [here](#) for more information about the pre-announcement. The designated window for the barge will be sent to you latest 24 hours before ETA. The load list and discharge list must be sent to RWG at least 12 hours before ETA. For barge, a cut off of 2 hours before ETA applies.

Rail

Pre-announcement for train visits has to be done by means of the railway timetable. The pre-announcement has to be done at least 48 hours before ETA. The load list and discharge list can be accessed through Portbase. The designated window for the train will be sent to you latest 24 hours before ETA. The load list and discharge list must be sent to RWG at least 12 hours before ETA. For rail, a cut off of 2 hours before ETA applies.

Appendix C; Pre-notification via Portbase

