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Port community systems interoperability with the data pipeline, a case study in the port of Rotterdam

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Preface

This thesis presents the results of my master thesis project of the Executive Master in Customs and Supply Chain Compliance at Rotterdam School of Management, Erasmus University.

With this research I finalize this parttime programme which lasted about 2,5 years.

I would like to thank all the people that contributed to this thesis, especially Prof. dr. Yao-Hua Tan who proposed the subject of this thesis to me. His trust and support really helped me to finalize this thesis. Another special thanks goes out to Dr. Boriana Rukanova, who helped me a lot by keeping the focus in the research, structuring the work and never stood back to provide me feedback on the progress of my work.

Also , I would like to thank the people I interviewed. Their names are anonamized but their information was very helpfull. Next to the interviews I regularly discussed the findings with my direct colleagues at APM Terminals . So my thanks goes out to mr. Rik Geurtsen, former senior manager of operations at APMT MVII and mr. Leo de Werker, customs compliance coordinator at APMT MVII.

Finally, my thanks goes out to my wife Marloes, for finding the patience for me to spend basically all of my free time on this project. And my son Brent for his love, which motivated me to go on.

Stefan Verhagen

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Executive summary

This research focusses on the exchange of information at APM Terminals Maasvlakte II in Rotterdam. APMT MVII is one of the most advanced container terminals in the world.
A container terminal has lots of exchanges of information with other actors in the supply chains, for instance with ocean carriers, customs , truckers, forwarders and so on.
In Rotterdam the Port community system , Portbase, has an important role in providing the platform for this information exchange.

Portbase has a very strong presence in the port of Rotterdam and is of vital importance for APMT MVII. For a terminal operator timely and accurate information is of great importance to be able to make the berth, yard and vessel planning.
What Port community systems can't provide is the international dimension of connecting all the actors in the global supply chain. Port community systems offer a platform for information exchange in one port or one country.
The data pipeline concept does provide this dimension. So the objective of this research is to investigate if Portbase can be linked to the international data pipeline and what advantages this can bring / what problems it can solve that can't be solved by the Port community system.
Maersk Line is implementing a real-life version of the data pipeline in a pilot fase right they under the name 'Global trade digitization'.

The main research question is:
Can Portbase be seen as an example of a landing place for a data pipeline and how can Portbase be connected to a data pipeline such as the global trade digitization?

To be able to answer the main question three subquestions were formulated:

- What is the difference between a data pipeline and a Port community system?
- Identify bottle neck processes at APMT MVII that delay the container handling process and could be solved by collecting more accurate and/or timely data via a data pipeline solution?
- What are the advantages for the community if Portbase is connected to a data pipeline such as the global trade digitization?

First an analysis was done on the academic literature on Port community systems and on data pipelines. From this review a research gap was identified. No literature has been performed before on how a port community system can act as a national landing place for data pipelines.

The chosen methodology for this research is design science. Design science is a sequence of expert activities that produces an innovative product/ artifact by addressing the research through the artifact's building and the artifact evaluation. (March & Smith, 1995)

The developed artifact is how a Port Community system can be used as a landing place for an international data pipeline, like the GTD. The design results in a number of scenarios and these scenarios are evaluated with experts from APM terminals and an expert of Portbase.

For the problem analysis a long list of problems was identified based on interviews and workshops. These problems were prioritized and a short list of problems was selected. Problem driven scenarios were developed and for each individual problem was discussed whether the problem could be solved by Portbase, by a data pipeline or a combination. Then technology driven scenarios were discussed to look which problems could be solved by which solution.

In the next fase the research questions were answered analytically and scenarios and the analytical findings and were validated with experts.

The key conclusions from the research are:

- a Port Community system, in particular Portbase, provides an important addition for data pipelines because they can be used for their experience with access and identity management in local ports or airports

- a Port Community system does not provide the possibility to exchange source documents like, e.g. E-invoices or packing lists. The data pipeline can do this, so the data pipeline can enrich a PCS. This enrichment of PCSs by GTD is possible, because PCSs can only exchange data/documents at national country level, whereas data pipelines, like the GTD, can exchange data/documents at global level and across countries. In addition, PCS typically do not have access to commercial data/documents such as invoices, packinglists, etc.

- Port community systems can't be completely replaced by data pipelines because of the local complexity in every port or airport.

- The IPCSA has the ambition to connect the PCSs in Europe to each other. However, by using a data pipeline, like the GTD , more benefits can be achieved. The benefits are access to source data/documents and updates from events all the way through the supply chain. For instance delays because of unplanned transshipment can be obtained from the GTD, not from other PCSs.

- The global trade digitization or another platform or platforms is a way how the different PCSs in the world or globally can be integrated.

The contribution to research is that this research expands the research on data pipeline by further examining and explaining the role that Port community systems can play as a landing place for a data pipeline and how the combination of the data pipeline and PCS allow to better address inefficiencies at import compared to solutions based on the PCS or data pipeline alone.

The contribution for practice of this thesis is that it can be used by decision makers to investigate what possible advantages the GTD can bring to existing situation. The global GTD team can use the scenarios to see what possible implementation strategies they can use. And they can use the findings from this research to see what the implementation problems would be when installing the GTD without using Portbase as a landing place.

Limitations for this research are:

1) the research was performed in the port of Rotterdam only. Although other modern ports most likely have comparable situations as the port of Rotterdam different findings could be obtained from performing the research in these ports.
2) Rotterdam is one of the most advanced ports in the world. They are the biggest container port in Europe. it would be very interesting to investigate how the data pipeline could be applied in ports without a Port community system , like several African ports.
3) The research has been performed using a prototype of the data pipeline, in particular the GTD. The findings for this reason could not be tested with real life data.

Recommendations for further research are:

- Repeat the research in a couple of years again. This will be interesting because there can be observed if the problems that were intended to be solved by initiatives like the Container vrijgave bericht and the Inspection portal are really solved or that maybe the data pipeline could still provide the solution
- Once the Global trade digitization start pilots in Rotterdam perform an analysis of the pilot results of this research. It can be proved if the assumptions made were correct
- Perform the research in other ports. In other ports the developments of PCSs might not be as advanced as in Rotterdam. or there might not even be a PCS in every port.
- The list of bottle neck processes can be used to further investigate the possible application of the Gtd. Apps or displays could be developed to help address the other identified painpoint processes.

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Chapter 1: Introduction

1.1 Research background:

Rotterdam is one of the biggest ports in the world. In 2015 Maasvlakte II was taken into operation, expanding the container handling capacity to make Rotterdam fit for future growth.
The handling of containers for trucks on Maasvlakte 2 is done completely automated. The handling of sea vessels is done by semi-automated gantry cranes. These cranes are remotely operated by people working from the terminals office looking at big screens and operating a joystick. Containers are internally transported from the quayside to the stack by automated guided vehicles.
The terminals are setup to load and unload the biggest container vessels that are operational at this moment and even next generation containers vessels can be handled. To picture this, the biggest containers vessel can now carry 18.000 TEU (twenty foot equivalent units). Next generation ships are expected in the future with a capacity of 20.000+ TEU.

The exchanges of all messages are done electronically, mostly via EDI. APMT MVII has a department in place called Data/ EDI.[1]
Standard messages are exchanged with the terminals clients, the carriers like Maersk and MSC. Examples of these messages are for instance load lists, unloading lists, and commercial releases.

A container terminal has to deal with several other parties in the supply chain, like: government, (e.g. Customs, health authorities) trucking companies, barge companies, forwarders.
The new terminals at the 2nd Maasvlakte have decided that all message exchanges with these parties takes place via the local Port Community system called Portbase.

When a container is shipped the carrier has to submit an ENS[2] declaration to customs 24 hours before loading of the container on the vessel in the port of origin. This ENS declaration, must be submitted to the customs authority in the first port of entry in the EU[3]. In Rotterdam, the situation with the ENS is that most carierrs submit the ENS with software providers like Descartes, Dakosy or they have developed their own application to submit the ENS. Approximately 20% of the carriers use Portbase to submit their ENS.
Customs in the first port of entry then makes a risk analyses on the ENS declaration and a load or no load confirmation is send to the carrier and/or the submitter of the ENS. The risk assessment is also performed here for the containers that are unloaded in other ports in the EU. The customs authority in the first port of entry communicates the selections via the common risk management system to the customs authority at the port of destination. Here the local customs administration uses these selections and combines these with their national risk assessment.

Under the new legislation multiple parties can submit the ENS, so not only the carrier can do this, but also the freight forwarder or another party can submit it or parts of it.
72 hours before arrival of the vessel in the port of destination the carrier has to submit a temporary storage declaration. In Rotterdam a 100 % of the carriers use Portbase to submit the TSD to Dutch customs.

[1] EDI stands for Electronic Data Interchange
[2] Entry summary declaration
[3] Not many carriers use Rotterdam as their first port of call in the EU

Customs makes a national risk analyses on this declaration, taking into account the findings on the initial risk assessment made in the first call of entry and specifically looks for safety & security aspects. Both declarations, the ENS and the TSD are checked via a system of Dutch customs called 'Prisma'.
The selections made by customs are then communicated to the terminal and to the carrier via Portbase. If the terminal and the carrier are AEO[4] certified the inspection selections are send before arrival of the vessel at the port.
Portbase sends a message to the terminal that automatically triggers a customs block on the container. This can be a scan inspection block, a physical inspection block, and so on.
Every container terminal has a blocking matrix in place in their terminal operating system which is approved and changed in cooperation with customs in the port of Rotterdam.

After the containers have been placed under temporary storage a customs approved status or use has to be chosen. These declarations typically are done by the cargo owner or his representative the freight forwarder.
All customs documents are to be submitted to the terminal via the PCS and no longer are paper documents accepted at the terminals gate, except for some hard copy documents that are not electronically available yet.[5] This fits perfectly into the automated concept of the container terminal. There are other documents that are not available in electronic form yet. Examples of these documents are veterinary or phytosanitary documents. Also most of the certificates of origin are not electronically used yet. These documents however, are not needed on the container terminal. The documents are to be kept in the archives of the declarant. Typically the declarant in Rotterdam would be a forwarder or a customs broker.

The port community system is, amongst others, used by forwarders and shippers to enter their import and export customs documents to the terminal. Terminal operators only receive the MRN[6] numbers. The message exchange between customs and the container terminal happens completely paperless via Portbase. This is different in case of border inspection agencies like the NVWA.[7] who still use paper documents.
A challenge that the terminals are facing is that after May 1st 2016 the holder of a temporary storage facility is responsible for the contents of the container. But in practice the terminals only get a MRN number and they have no information on what's declared on the documents. Terminals don't have access to view in the IT systems of the customs authorities and are not able to check if the customs documents are complete and correct. Except if they would start asking hardcopies of the documentation but this would not be an ideal situation since approximately 12 mln TEU pass the port of Rotterdam every year. For this reason, and for several others, customs is developing the container release notification. The container release notification will be a confirmation from customs that the TSD declaration of a container is fully cleared and that all inspections of customs are performed. The customs authorities will place the message on a platform where it can be downloaded by the container terminal operators.

[4] AEO stands for Authorized Economic Operator, This is a license that can be obtained from customs in which a company is a trusted partner for the authorities and in return gets certain trade facilitation benefits
[5] An example are documents used by the US army or ATA carnets (ATA stands for Admission temporary)
[6] MRN number means movement reference number. This is the number that is used to identify a customs document in the customs systems.
[7] Nederlandse voedsel en waren autoriteit. (Dutch food and health authority)

Other users of the Port community system are the transport companies also known as hauliers. They plan their containers via the services, road planning, rail planning or barge planning.
By doing so the transport operator sends their load list to the terminal via Portbase. A load list is a list of containers to be loaded on the barge or train. In case of transport by truck no loadinglist is used because trucks don't carry more then max. three containers in one trip. The messages are then received and compared to the information in the terminal operating system. The service then shows to the transport operator the status of the container. In particular the following details are checked: container presence, commercial release, customs block and document block. A customs block is an indication that a container is not released yet by customs, for example because it has to be scanned by the Xray scan. A document block is a block that indicates that the container has not been placed under a customs procedure yet. These data are checked for import containers, for export containers the details are different, but comparable to the previous.
If one of the details is not in good order the transport operator can contact their principal and ask them to arrange it. Typically the principal of a transport operator is the freight forwarder or the importer. They assign a transport company to pick up their container and deliver it to their warehouses or their customers warehouses. So in case one or more blocks are still on the container an action has to be performed by the principal.
In that case either a commercial release is arranged via the carrier, a customs document is send or a new pick-up date is advised.
An observation that can be made here is that the interactions between the terminal and the transport operators is done via Portbase but the interactions between them and their principals still happens in old fashioned ways like e-mail, telephone, etc.

The terminal makes a planning on the vessels that are discharged and loaded. The sooner the terminal has its information the better it is for planning purposes. The strategy is chosen that information allways comes ahead of the containers. Containers that are transported via barge or rail are stacked immediately in specific sub stacks.
If no information is available in advance containers have to be relocated to these stacks.
Research has indicated that approximately 30-40% of the moves at the terminal are internal moves (van Baalen, Zuidwijk & van Nunen, 2009).

For other parties in the supply chain it is also an advantage to get more reliable information. The better the information the smaller the chance of waiting times, dead freight etc.
In other words, information is of crucial importance for APMT MVII.

The academic supervisors for this research thesis are prof. dr. Yao Hua Tan and dr. Boriana Rukanova. As Internal supervisor Rik Geurtsen, sr. manager of operations of APM Terminals Maasvlakte II, has supported this thesis. In May 2017 mr. Geurtsen left APM Terminals and the position of internal supervisor switched then to Erik van de Kamp MSc. Business development manager of APM Terminals Maasvlakte II B.V. and Leo de Werker, customs compliance coordinator.
Also, as external supervisor / advisor mr. Marty van Pelt acted from May the first.

1.2: Scope of the assignment:

This research focusses on the exchange of information at APMT MVII in Rotterdam. APM Terminals has an extensive network all over the world but no single information architecture is found in the APMT organization.
Every port has its own characteristics, e.g. is it a private port or government run port and if is there a Port community system and how is the involvement of government authorities in the port? The focus is on information exchanges with other actors in the supply chain. The exchange of information of the internal IT systems is out of scope in this research.

Also, this research focusses on the import of containers. For export containers there are a lot of similarities but also differences cound be found.

1.3: Focus of data collection:

As indicated in the previous subsection this research focusses on APMT MVII. Several departments are involved in the information exchange. For the interviews employees from several departments have been involved. Not every department of the company was taken in the scope but the research involved the information exchange with operational actors in the supply chain. I.e. Carriers, customs, barge companies, trucking companies and freight forwarders. Departments involved in the interactions with these actors are: data/edi department, berth planning, short term planning, vessel planning, etc. Also some cross validations were held with experts from other container terminals in the port of Rotterdam.
For the list of interviews please consult appendix 2.

Chapter 2: Problem definition

2.1 Research goal:

As can be concluded from the research background Portbase is of strategic importance for the port of Rotterdam community. To make sure Rotterdam is ready for the future it's important to know if Portbase is agile enough to change its infrastructure and services for future developments.
At this moment the global trade digitization pipeline is being built by IBM together with Maersk line. It is uclear at the moment which problems the GTD can solve that are not already solved by Portbase. Portbase seems to be the data pipeline solution for Rotterdam already because it connects all the actors in the port community with each other and distributes the information to the actors that need it. The potential added value of the GTD is that when data is needed from parties from the other side of the ocean or from the exporter for instance, the GTD could provide it , because it has a direct link to them. Portbase can only exchange data between supply chain actors in the Netherlands and does not reach over the ocean. Hence, Portbase can be considered as a kind of national landing place of the data pipeline, for instance the GTD.
The research objective is to investigate how Portbase can be linked to the international data pipeline and what advantages this can bring / what problems it can solve that can't be solved by the Port community system.

2.2 Research questions:

The main research question is: *Can Portbase be seen as an example of a landing place for a data pipeline and how can Portbase be connected to a data pipeline such as the global trade digitization?*

2.3 Research sub-questions:

The main research question can't be answered immediately because it contains unknown elements in it. In order to answer the main question several sub-questions are formulated.

The sub -questions in this research are:

- What is the difference between a data pipeline and a Port community system?
- Identify bottle neck processes at APMT MVII that delay the container handling process and could be solved by collecting more accurate and/or timely data via a data pipeline solution?
- What are the advantages for the community if Portbase is connected to a data pipeline such as the global trade digitization?

2.4 Structure of the thesis:

The remainder of this thesis is structured as follows:

Chapter 3: Review of research literature: To be able to answer the first research question an analysis of relevant literature has been done. Academic papers have been used to learn more about Port community systems and data pipelines. For an overview of the findings on literature about Port community systems the reader is referred to Appendix 1.The literature review is used to answer subquestion 1.

Chapter 4: Research methods: In this chapter the research methods are described in more detail. The research can be typologized as 'design science'. In this type of research the objective is to produce a viable artifact in the form of a construct, a model, a method or an instantation (Hevner et. al. 2004). In the other subsections of this chapter the way data is collected is explained and an explanation on the selected problems and the process of the selection is given.

Chapter 5: Case decription: In this chapter the detailed case description is written leading to the explanation of the AS-IS situation. From the case description the main problems are identified. Via empirical validation the problems were validated. This has lead to more specific focus on specific issues. These issues were analysed to the extent that Portbase already solves these issues.
The outcome of the analysis is used to answer subquestion 2. Then the current developments of Portbase and the GTD are handled. Information for this was received from several sources like interviews, documents, presentations etc. In the next part of this chapter the TO-BE situation is described including possible solutions for the three main problems. These solutions were validated with experts of APMT MV2 and an expert of Portbase and the analysis of this ends the chapter and answers subquestion 3.

Chapter 6: Conclusions and recommendations: In this chapter the research question and the subresearch questions are answered. Then it highlights the main findings of the research and gives recommendations for further research. It also explains the limitations of the research.
In the following subsection is explained how the results of this thesis contribute to the further development of the main research publications that were used as a basis for this research.

Then the next subsection explains how the main findings findings of this research can be used by the problem owning organisation, APM Terminals Maasvlakte 2 and by other interested stakeholders.

Chapter 7: List of references: The list sums up all the used sources: Academic papers, working documents, internet sources.

Chapter 8: Appendices, here the appendices can be found.

Chapter 3: Literature review

This research focusses on the data exchange in the port of Rotterdam community via the Port community system called Portbase.
Before the research has started an analysis of academic papers has been performed. The first paragraph will describe the most important literature about research that has been performed about Port community systems. Throughout the years a lot of academic research was done on this subject. In the second paragraph the relevant literature about data pipelines will be discussed. Not so much research has been performed about the data pipeline.
The papers that are written on this subject are mostly explorative in nature.
Paragraph 3.3 wil give a summary of the research literature and identifies the research gap.

3.1: Port community systems:

The International Port Community Systems Association (IPCSA) defines a Port Community system as: a neutral and open electronic platform enabling intelligent and secure exchange of information between public and private stakeholders in order to improve the competitive position of the sea and air ports' communities. A Port Community system optimises, manages and automates port and logistics processes through a single submission of data and connecting transport and logistics chains (IPCSA, 2011).

The IPCSA was founded in 2011 originally as the European Port Community Systems Association by six founding members, all European Port Community Systems. The six founding members were: Soget, Le Havre, France; MCP, Felixstowe, Uk; Portic, Barcelona, Spain; Portbase, Rotterdam and Amsterdam, Netherlands; DBH, Bremen Germany and Dakosy, Hamburg, Germany. Today members all over the world have joined the IPCSA from the following regions: Europe and North America, Asia Pacific, Latin America and Carribean, West Asia, Africa and Associate members. [8]

The mission of the IPCSA is: Influence public policy at the international level, principally by lobbying, in order to promote the adoption of e-logistics as the key element in the development of international maritime, shipping and logistics sectors (http://ipcsa.international/about/mission).

Throughout the years a lot of research has been performed about PCSs. The next section will give an overview of the studied academic papers used for this research. For every paper a short explanation was given why the paper was selected for this research.

[8] For a full list of members please consult http://ipcsa.international

Dimitrios and Athanasios (2013) examined the user requirements, functionalitites and ways to overcome complications in the implementation of Port Community systems. They used the case study of the Adriatic Port Community implementation. In their conclusions they state that the ship, cargo and passenger service processes in many ports remain predominantly paper-based, despite the development in information and communication technologies. In Rotterdam, however, the PCS has been implemented several years ago and the PCS is already in an advanced stage. Portbase is now the PCS for the ports of Rotterdam and Amsterdam and has the ambition to become the national PCS of the Netherlands in the future (www.portbase.com/about-us).

Other interesting findings from their work are that in many ports the lack of integration of IT systems has been reported as a common problem. For instance the transmission of the bay plan prior to the actual ship arrival at port is not always utilized by Terminal Operators leading to suboptimal planning of the relevant operations. A bay plan is a document listing the container numbers and position in the various ships cells. This information (if properly used) allows for the planning of port's seaside and yard side handling processes and for the estimation of the necessary resources (quay cranes and quay to storage area transfer equipment) They also found in their research that the integration of the Customs processes in a PCS is the most difficult step in implementing a PCS. This is because Customs involve paper work in a heterogeneus operating environment. A database including documents and the corresponding clearances (issued by the Customs agency and relating to the shipments crossing the port area) seems adequate to solve the problem and could also be used to control traffic at the gates, they state.

This paper was selected because of the functionalities of the PCS. In the case description the functionalties will be relevant to determine if a PCS can solve the identified problems.

Aydogdu and Aksoy (2015) performed a study on the quantitative benefits of PCSs. They state that most literature regarding PCS is either a case study or qualitative in nature. Hence their research aims to develop a simulation model to capture the differences between conventional port logistics business and a simulation model where a hypothetical PCS is in place in Turkish ports. Their main contribution is to propose a new methodology to determine the qualitative benefits of a PCS. How did they do this: All procedures from arrival to departure of any ship in a Turkish port are descriptively analysed. Then the steps that could be eliminated after implementing a PCS are designated. Then they used two simulation models for the conventional method of port logistics business and one with a PCS and simulated them separately using ARENA simulation software. They found out that an estimated amount of 29,5 million TL can be saved per year in Turkey through a PCS. This is approximantely 16.8 million USD. The development and implementation costs for PCS are difficult to estimate but for descision makers this amount can be used for investment evaluation. This is relevant for this research as the qualitative benefits can be offset to the possible integration with the data pipeline.
The researchers further state that the financial benefits of PCS are not limited to these savings. They also refer to research of Keceli (2011). In that research other indirect economic benefits are named:

- decreased costs of information access.
- decreased communication costs for shipping companies
- extra income for government
- correct taxation
- prevention of smuggling
- prevention of illegal income(i.e. bribery)
- decreasing foreign dependancy on port and logistics software

Next to these economic benefits , PCSs provide general benefits:

- increased competetiveness
- increased information quality
- increased operational performance
- safe paperless document exchange procedures

Van Oosterhout, Veenstra, Meijer, Popal and van den Berg (2006) performed a case study in the Port of Rotterdam. They focus on how supply chain visibility platforms can be used to enhance supply chain security. In their conclusion they state that the information needs to get the information elements for supply chain visibility you have to get data from four different systems.

1. Community systems: these are closed community systems like INTTRA[9] and open community systems. Examples of these systems are Portbase and Portkey. The difference is that the closed systems are aimed for a specific user group and open systems are used by companies an the regulatory authorities to exchange information and are neutral in nature.
2. Authority systems: These systems contain information that is shared between regulatory authorities and are not available to companies. Also authority systems can exchange information with companies but if they do this is often on bilateral basis. Typically information found in authority systems is: scanning information / contents of the container
3. Container integrity systems: Examples of these systems are : Commerceguard and Savi networks. These systems supply information about the integrity of the container during transport.
4. Business systems: examples are Terminal operating systems, shipping line systems. These are the systems of individual companies.

They propose three different scenarios towards the development of a wider supply chain visibility platform for the port of Rotterdam. To build these scenarios the PCS must be linked to different Container Integrity Systems and the authority systems and share data. This article is relevant because the results indicate that the PCS in Rotterdam does not give a sufficient supply chain visibility. This term means that containers can be monitored through the whole supply chain. At the moment security risks are found in nodes or activities in the supply chain where vulnerability for disruption is relatively high and security controls are relatively low. To get full visibilty several messages are missing in Portbase like: Information during the transshipment of container in different ports, the information from the point of stuffing of the container and information on stops during in-land transport.

Bisogno, Nota, Saccomanno and Tommasetti (2014) investigated inter-organizational routines characterizing PCSs providing a model of an integrated information system, able to take into account the entire information requirements of all the actors in the supply chain.

They performed a case study approach in the port of Salerno (South Italy). In their findings they highlite the importance of going beyond a myopic vision based on the adoption of the viewpoint of each actor, without taking into account the relationship between them. The architecture of their model does not aim to replace the information systems of each actor, the model works towards the replacement of the old inter-organizational routines based on tediuous tasks with new routines.

[9] INTTRA is a global booking system to book containers with carriers.

This in order to improve their knowledge of the logistic processes as well as to facilitate the exchange of documents and information. This article can be relevant to get insights into how old routines can be replaced by new ones. Old routines are for instance re-typing of data by several actors in the supply chain. With the implementation of a PCS re-typing of data can be prevented. Data that is entered once can be used by others and the PCS is the central platform that distributes it. Other examples of old routines that can be replaced are paper documents that are substituted by electronic communications.

Another interesting finding is that according to Bisogno et al. the basis idea of the PCS concept is the need to standardize messages that actors have to exchange with each other. They state that the first generations of PCS pursued this objective through a central information platform based on bilateral applications. The second generation PCss are based on more flexible platform modular middleware.

Baron and Mathieu (2013) wrote a conceptual paper to discuss the evolution of local PCSs towards a vast network of interlinked locations in Europe.
They make a comparison to the payment system industry to discuss the potential outcomes and shapes of a European PCS.
Their research provides insights taken from the payment industry into the market organization, the types of rules, the architecture and the constraints remaining in the process of building a European market for maritime information. Findings from the payment system experience are, amonst others: that all systems in the world provide compensation for the network used by another. Something to be kept in mind when the various PCSs in the world link to each other. Also, the size of the network matters as it protects operators from the substitutions effect. We can also learn how cooperations between competitors may be organised: the inititial innovation is licensed, then associations appear to deal with interdependencies, then operators become public owned.
The implications for PCS operators are for instance that in the IPCSA interchange fees could be decided on. This way any European customer could access any service provider across Europe through the intermediary of any PCS operator.
European customs authorities would get access to the full amount of data available in the different PCS and use it for risk assesment purposes.

In their findings they state that a centralized European Customs' system may appear when linking the various PCSs. Another finding is that full interoperability would ease transactions for large European players and promote greater competition among PCS operators.
The limitation in their research is that more research must be performed why PCS customers or ports would find it usefull to have the systems interoperate.
For this research the findings are relevant since they state that full interoperability would ease transactions for players.
Maybe the concept of the data pipeline could help to connect the different PCSs.

Lambrou, Rodseth, Foster and Fjortoft (2012) propose service-oriented computing and model-driven development techniques as a robust Port Information Systems(PORTIS) modelling and development approach. In their opinion software evolution is a critical challenge towards emergent PORTIS development. The reason for this evolution is that stakeholders have changing requirements over time.
Service-oriented computing (SOC) demands an interdisciplinary approach towards the analysis,design and engineering of core business processes and the life cycle of developing software as services.
SOC and Service oriented architectures (SOA) is a new paradigm that focuses on e-services as encapsulated software functionalities with standardized interface to be composed and orchestrated in order to provice applications, namely PORTIS applications, offering services such as ship formalities reporting e-services (Lambrou and Foster 2010).

PORTIS have to take into consideration the requirements of several stakeholders and that is why SOC and SOA approach is very applicable to it.

Model-driven development (MDD) entails the consideration of a multitude of concepts within SOA and SOC. Examples are models and methods across a service development life cycle and the tools to construct software systems in a systematic and efficient manner (Papozoglou and Heuvel 2006).

The proposed approach has been tested in a martitime single-window case. They have written a taxonomy of Port information systems and their use.

In this taxonomy they categorize PortIS systems in the following manner:

1. Authority of operation: A2b or B2B Where A2b systems are used for the authorities enforcement of regulations, taxations and tariffs. B2B systems are intended to support the commercial operations in ports.
2. Operational domain: trade or nautical: For nautical operations , the amount of information is generally much lower. Also shipping is much more standardized than trade. Trade support functions are much more extenseive as they cover a larger part of the complete set of buy-ship-pay processes.
3. Geographic scope: To classify the geographic scope of PORTIS they propose the following classification:
    - Terminal PortIS: only used in a part of the port, E.g. a TOS
    - Port: component is used only in one port, E.g. a PCS in a single port
    - Regional: PortIS is common to a group of port, E.g. the MCP PCS
    - National: PortIS is used in all or most of the ports in a nation, E.g. Portbase
    - International: PortIS is used in a group of nations: E.g. data pipeline

Their contribution is the proposed PORT IS logical reference model and a service-oriented and model-driven development methodological framework and technical platform solution. By this reference model and methodological framework the challenge of satisfying the changing requiremens of Port IS stakeholders over time and achieving next generation performance levels can be met.
In the current research the use of Portbase is investigated and this article is relevant because it proposes how next generation performance levels can be achieved. These performance levels are also needed for APM Terminals in Rotterdam.

Another interesting observation from their paper is the explanation on the single window. They define this as: '' a facility that allows parties involved in trade and transport to lodge standarized information and documents with a single entry point to fullfill all import, export, and transit-related regulatory requirements'
They then make a distinction between maritime single window and trade single window. The first one is a single window for the clearance of ships to enter or leave a states port or ports, including general safety and and security related properties of the cargo they carry. The second one is an authority operated single window that caters for document flows related to import, export or transit clearance of cargo.

Heilig and Voss (2016) present a classification and a comprehensive survey of information systems and related information technologies applied in ports.
In the section on vessel traffic services they state: Delays and over-punctual vessel arrivals as well as weather conditions, equipment breakdowns, and a change of vessel priorities, for example, cause changes to the berthing planning. According to them this is caused by a lack of real-time coordination and adaptable planning. In practice nowadays a carrier makes an appointment for a certain timeslot to berth the vessel. However due to all kind of circumstances the vessels can be delayed. If the terminals would get more real time information they can improve the terminal planning activities. When the ETA is refined the planning of the terminals resources can be optimized. Adabtable planning means that the terminal is more flexible in making the berthing planning so they can adapt to these changing circumstances.
The term vessel traffic services can be explained as: an information system that includes functionality to collect, analyze and disseminate information, in particular to navigate vessels in busy, confined waterways and port areas.

The writers also added a section on Terminal operating systems. (TOS) They first explain that a container terminal manages the flow of goods and materials between the waterside and the hinterland of a port. A container terminal consists of three main operations areas: ship operation areas, yard operation area and truck and train operation area.
A TOS is the central system that manages the terminal operations, facilities and equipment.
For instance on the waterside the TOS manages the berth allocation. Where does a ship berth and when? Stowage plannning. Where do I load the container in the vessel, taking account of the destination of the container and crane split. How many cranes do I operate on each vessel?
In the yard area, where the decoupling takes place between waterside and hinterland operations, storage planning and stacking decisions are important for the performance of a container terminal. These stacking decisions are also important for the truck and train operation area. Containers must be stacked taking into account the modality of inland transport.

An interesting observation is that common TOS support EDI standards, such as Un/EDIFACT. In most ports a link to the PCS is established to enable the interchange of certain information over a shared platform.They further write that an analysis of existing TOS has shown that many TOS lack of integration with external parties, system integration , management decision support and information services for customers. This could be an important observation for the integration with a datapipeline like the GTD.

In the same subsection they write someting about NAVIS SPARCS N4, which is the TOS used by APM Terminals in Rotterdam. The system currently is the global market leader and provides extensive means to customize the TOS according to individual requirements of terminals operators.[10]

Carlan, Sys and Vanelslander (2016) focused on the costs and benefits of PCS. They conducted an in-dept literature review where they have found a research gap on this subject.
In their findinds they state that most studies have used a descriptive approach. Another interesting observation they made is that very few studies used quantitative data to assess the features implemented by PCS. They support in this regards the findings of Aydogdu and Aksoy (2015).
Below table is taken from their research and gives a clear overview of their findings on PCS literature.

[10] For instance if a terminal is manual operated or automated

Tabel 1 Approaches used with respect to PCS developments. (Carlan, Sys and Vanelslander 2016)

Approaches	Time block	Number of references	References referring to PCS benefits	References referring to PCS costs
Descriptive approach	1994-2015	19	16	4
Conducting interviews and expert meetings	2005-2011	7	7	2
Development of indictors for measuring PCS efficiency	2012-2014	2	2	1
Quantitative approach	2011-2015	3	3	0

The main scholarly finding of their research is that the functionalites and the design of each PCS are the main elements that determine the range of costs and benefits incurred by port operators.
They categorize the benefits of PCS in two categories:

1. Benefits brought by digitalization of administrative procedures
2. Benefits to the PCS users of being part of a community.

In another section they write on the PCS design and functionalities. Interesting fact here is that they state that PCS are individual platforms that incorporate different functionilities of one specific port. These functionalities are supported by applications of different modules that deal with more specific tasks. The stakeholders in the Port community can either use the entire range of functionalities or only a part of them. The functionalities a PCS offers are continously under developement.
A PCS typically covers the following areas:

- Logistics
- Customs clearance
- Navigation
- Dangerous goods declaration

To give an explanation on this: pre notification of delivery /collection to a container terminal is done through a logistics function. Customs declarations can be submitted through the customs clearance modules. Navigation modules are used for smooth and safe traffic and optimum planning during arrival and departure. Finally the dangerous goods declaration function helps in electronic communication to meet the obligations in regards to dangerous goods.

van Baalen et al., (2009) wrote a monograph on por inter-organizational information systems. They state that in container transport EDI was adopted between the shipping lines and the terminal operators. Then the need came for a central messaging infrastructure where EDI messages could be routed to different parties and which supported the translation from one format into another. The reason was that the different formats used and the fragmented hinterland led to this need and finally in the birth of PCSs in the 1980s.

Later in the problem sections some typical data issues for container terminals are dealt with. Specifically: Container reshuffling and uncertainty of container release times and disruptions intermodal transport. Re-shuffling of containers can be explained as follows. Containers in a container yard are stacked on top of each other.

To be able to retrieve containers below other containers , they need to be re-shuffled. Uncertainty of container release times can be explained in the following way: to pick up a container from a container terminal the container needs to be released by the terminal, the shipping line and customs. This is not always clear for the actor that wants to pick up their container. Disruption intermodal transport means: Intermodal transport means transport using more than one transport means, like vessel, train or truck. Intermodal transport can be disrupted because of all kinds of reasons like: problems in the administrative process, execution that differs from the original logistics plan etc. These issues are later in this thesis investigated in more depth and have lead to the identification of the 5 main problems in chapter 5.

As can be seen from the previous section 9 papers on Port community systems have been analysed for this research. Appendix 1 gives an overview of the title and author of the paper and their main findings.

3.2 The data pipeline:

The data pipeline is an innovative concept from the Cassandra research project. The global data pipeline is an enabling infrastructure to achieve connectivity to accurate source data. (Zomer, Tan and Hofman, 2014).
A data pipeline is built by inter-connecting the different IT- systems of all parties in the supply chain. The Cassandra research project was finalized in 2014. http://www.cassandra-project.eu/. This project is now followed up by CORE. (Consistently optimized, resilience and real –time optimization) Core will further validate the use of the data pipeline in several living lab methodologies.
http://www.coreproject.eu/

Relevant literature:
As indicated in the introduction not so much research has been performed into the data pipeline. The two selected articles are exploratorive in nature.

Hesketh (2010) writes that international supply chains have become more and more complex to the point that clear visibility is masked to those who need to know what is going on. International conventions like COSGA. [11] Drive the way goods are described by the consignor on transport documents and the way carriers can reduce their liability.
In other words, the carriers do not want to know the precise goods description because it will increase their liability, as a consequence of which the ocean freight rates will increase.

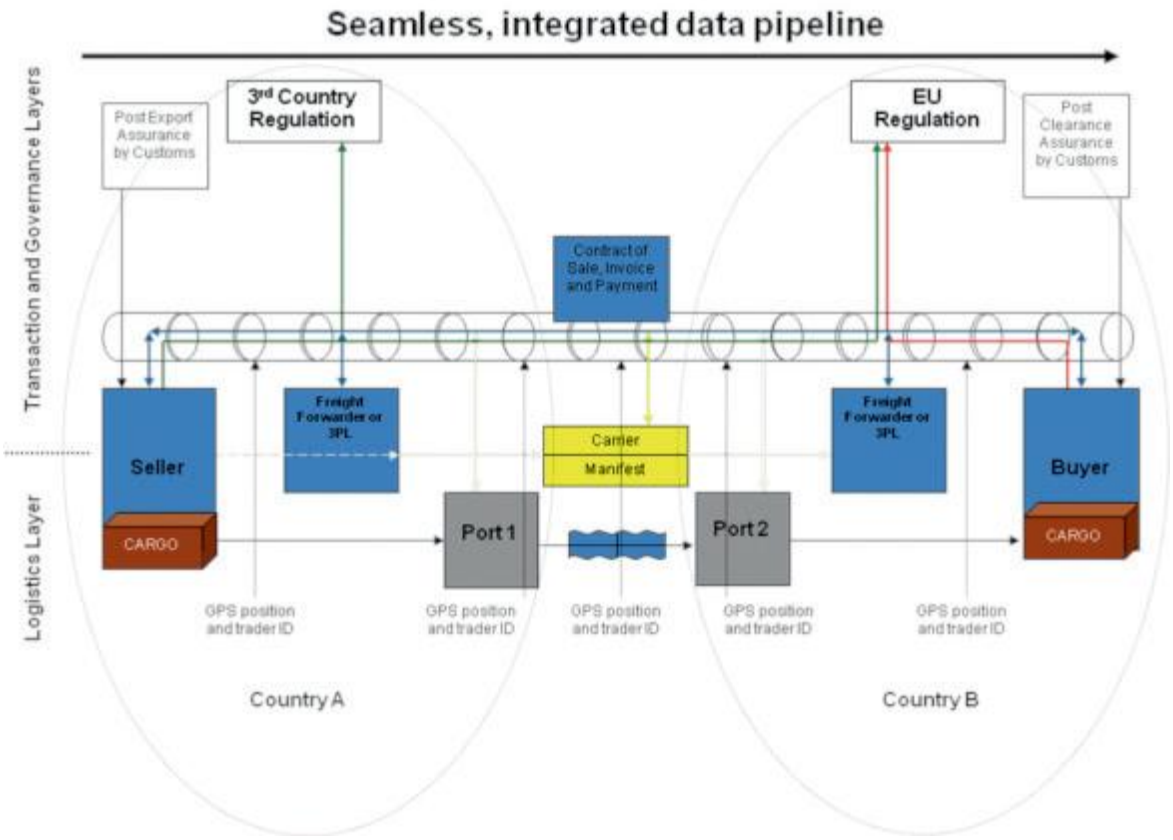
He further writes that, based on commercial data, Customs will use automated targeting tools to identify shipments that are high-risk as early as possible in the supply chain, at or before the port of departure.
By using data pipelines, the shift from limiting carrier liability and an outdated paper trail, will move to supply chain visibility and predicatability.

The current legislation has the problem that the data required by customs for the risk analysis is received from the carrier and not from the actual consignor. Instead customs, in case of doubt, will ask for more information from the carrier or from the consignee who never saw the goods before. The actual consignor, who knows what is packed in the container is out of the jurisdiction of the local customs authorities.

[11] Carriage of Goods by Sea

Hesketh calls for national legislation with enforceable jurisdiction but within a multilateral international legal framework.
The data pipeline is intended for customs for getting business data from the source (e.g. packing list, purchase order, pro-forma invoice etc.)to cross-validate customs declarations. In this way customs can collect data inter-continentally from countries of origin.
Here we also see main difference with PCS that only exchange data within one single country.

In his recommendations he asks for the construction of a web-based, seamless, electronic data 'pipeline' linking the seller /consignor and the buyer/consignee and the interested economic operators in between.



Figuur 1 The data pipeline concept (David Hesketh 2010)

For this research the question is what the added value for this 'datapipeline' could be for terminal operators.
The conjecture is that the data pipeline can have added value for container terminals in two ways:

1. By providing access to relevant data from other origin countries
2. By providing a platform for data exchange between two or more PCS from different countries

The port community system plays an important role in the port of Rotterdam. In a way PCSs can already be see as a local data pipeline, if we look at the definition from Cassandra: *A data pipeline is built by inter-connecting the different IT- systems of all parties in the supply chain.* However, the main difference is that the data pipeline works between different countries, whereas PCSs provide data sharing only in one country.

The objective of a PCS: A PCS is mainly built to optimize the flows of information. (Van Oosterhout et al, 2007) The preliminary conclusion can be drawn that both the PCS and the datapipeline are systems used to connect different IT-systems of different actors in the supply chain and have the objective to optimize information flows.

Klievink, van Stijn, Hesketh, Aldewereld, Overbeek, Heijmann and Tan (2012) have written an exploratorive paper on the data pipeline concept.
The concept of the data pipeline is based on the use of SOA[12] to enable access to the existing information systems that are used and operated by the various parties in global supply chains.
The main benefit of the data pipeline is increased visibility.
Further they write that the data pipeline enables the principles of piggybacking and system-based approach. Piggybacking means that company business data are re-used for government control purposes like customs or phytosanitary border inspection.
System-based control is the approach of customs control focussing on assessing the IT systems and operations of a company that they use to control their own business processes, instead of assessing each individual shipment transactions of the company. For both business and customs this will improve efficiency as customs needs less resources to inspect every single container and for business the advantage is that containers do not have to be stopped at the border making the supply chain more reliable and faster.
The concept of systems-based control is based on the SAFE Framework of standards of the World Customs Organization.[13] This approach is used in the concept of trusted trader certificates, better known as Authorized Economic Operator. (AEO).
An AEO is a trusted trader that has proved to customs that their processes are under control and that they are reliable. In exchange for this the AEO can get certain benefits. I.e. less checks from customs , decreased guarantees, precedence at customs controls.

3.3: Summary and conclusions on the literature:

Quite some extensive research has been performed on Port community systems. The main subjects on this research are how to implement a PCS, what the costs and benefits are and how the PCSs can connect to each other. We can see from the literature that the core strenghts of PCSs are : the introduction of paperless procedures due to digitalization of administrative procedures and the benefits for the users being part of a community. I.e. because of the PCS the local port community is better organized and the operational effectiveness is improved. (this is also improved by the re-use of data.) We see that a trend in PCS is the internationalization of PCSs. A good example is the forming of the IPCSA that has the objective to improve the cooperation between the different PCSs of the world. However,the international component is still in its starting face. The PCSs are not interoperable with each other yet. The main themes from the literature of the data pipeline is that the data pipeline can provide access to source data. It has no constraints to the geographical position the PCS has. The data pipeline can connect every actor in the whole supply chain from end to end. What the literature on data pipelines did not describe was how to deal with the local complexities in every different port.

The research gap is that both Port community systems and Data pipeline have got strengths but also limitations. No research has been performed so far that investigated what the potential benefits could be to link the two systems together. In other words no research has been done to investigate if a PCS can be seen a a national landingplace for a data pipeline.

[12] Service-oriented architectures
[13] http://www.wcoomd.org/-/media/wco/public/global/pdf/topics/facilitation/instruments-and-tools/tools/safe-package/safe2015_e_final.pdf?la=en

Chapter 4: Research methods

4.1 Research methodology

This chapter wil describe the research methods and methodology. In order to be able to answer the research question we need to identify what the problems are in the current situation and to what extent they can be solved by a PCS, to what extent by a data pipeline, like the GTD, and to what extent by a combination of the two. By examining this we would be able to answer the research question. Can Port community systems be seen as a landing place for a data pipeline and are there any benefits of doing this for solving current problems and inefficienies. In performing this research the focus is on terminal operators.

The folllowing steps were taken to perform this research:

1. We identified a long list of problems (based on interviews and workshops)
2. We prioritized and selected a short list of problems (also by performing further interviews.
3. Problem driven scenarios were developed. (i.e. discussed for each individual problem whether it could be solved by Portbase, a data pipeline , or a combination.
4. As a next step technology driven scenarios were discussed to look which combination of problems can be solved by the PCS, by a data pipeline or by a comination
5. Based on step 4 my own analytical observations were made regarding the research question
6. The findings from this analytical observation were validated with experts to see whether the analytical findings are confrimed by experts.
7. Finally the research question is answered.
8. To do this research design science was used.

The remainder of this section explains how the design science was used.
As mentioned above the chosen methodology is design science.
Design science has its roots in engineering and the sciences of the artificial (Simon, 1996).
As a basis for the setup of this research extensive use was made of the paper of Professor Hevner: ‘Design science in information systems research’ (Hevner, March, Park and Ram, 2004).

The paper gives an explanation of the foundations of Information systems (IS) research. They state that two paradigms characterize the IS discipline: Behavioral science and design science.
Where the first one seeks to develop and verify theories that explain or predict human or organizational behavior, the second one seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts.
IT artifacts are broadly defined as costructs, models, methods and instantiations.

The choice for design science was made because this type of research has the goal to solve important unsolved problems in unique or innovative ways or solved problems in more effective or efficient ways.
One could say that the problem definition of this research has a problem that is partially solved and partially unsolved. For container terminals PCSs solve the problems of data exchange in the local port community to a certain extent. However not every problem is solved by Portbase for APMT MVII. Some problems could be solved better or possibly in a better way. This research looks into the challenges that terminals deal with and gives an advice how these challenges could be addressed. Either in a more effective way, by changing the programming of Portbase or maybe in another way, by connecting Portbase to an international data pipeline.

The conclusion is that design science can be used here for the solved problem of the port community systems in a way that it can be used to investigate how the problem can be addressed in a more effective or efficient way. On the other hand it could be used to solve the problem of the implementation of the international data pipeline concept in a unique or innovative way.
In the article of Hevner is said that IT artifacts in design-science are rarely full-grow information systems that are used in practice.
That is also not the goal of this thesis. The goal of this thesis is to design an artifact how a Port Community system can be used as a landing place for an international data pipeline, like the GTD. The design results in a number of scenarios and these scenarios are evaluated with experts from APM terminals and an expert of Portbase.

The below figure shows the conceptual frame work created by Hevner et al. (2004) for design science research.
An explanation for the framework: The environment is the starting point for the research. It defines the contect of the organization and its people, organizations and technology. These elements determine the business needs perceived by the researcher. To meet these business needs artifacts are first built and then evaluated. On the other side there is the knowledge base. From the knowlegde base the foundations and methodologies for the research can be used to shape the search for the artifacts to meet the business

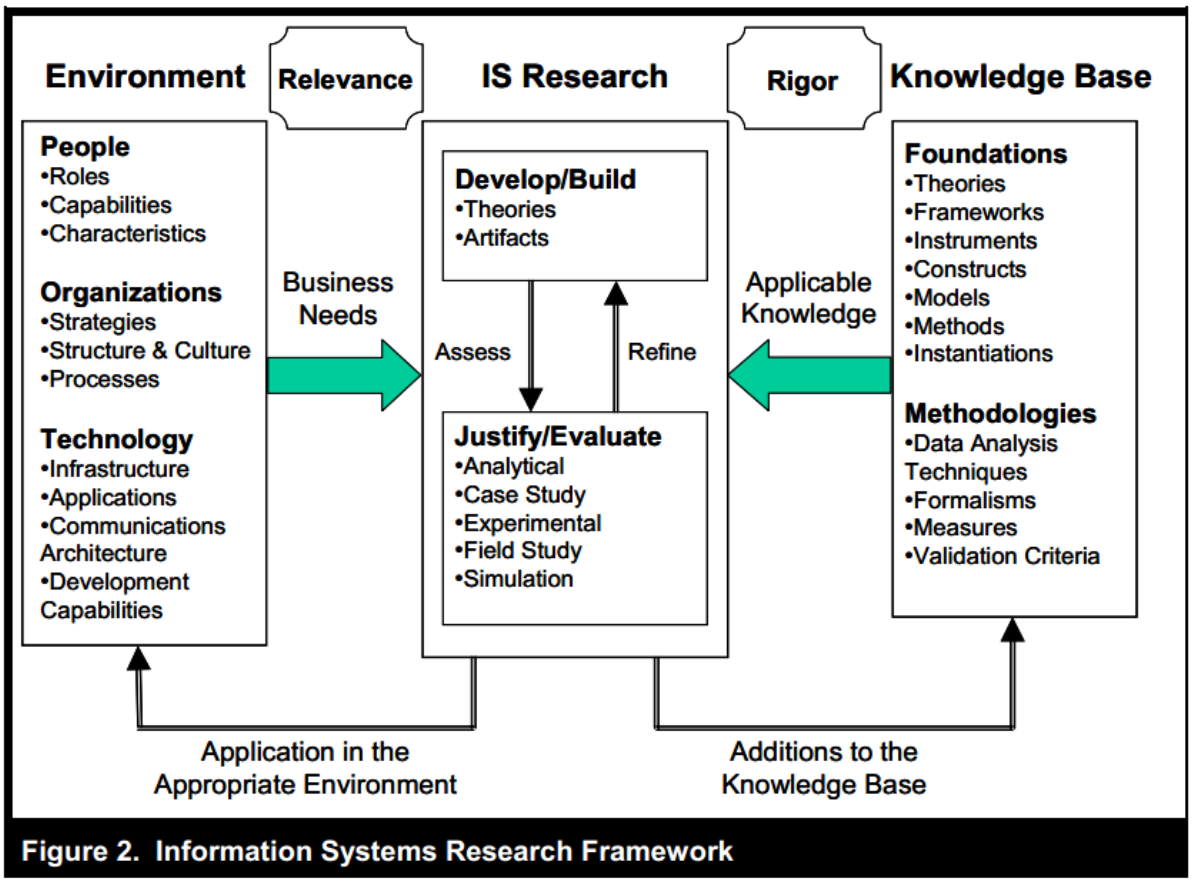


Figure 2. Information Systems Research Framework

Figuur 2 Information systems research framework (Hevner et al. 2004)

The paper of Hevner et al. gives guidelies for Design Science in information research.
Below table gives an overview of these guidelines:

Tabel 2 Design-Science research guidelines (Hevner et. al. 2004)

Guideline 1: Design as an Artifact	Design –science research ust provide a viable artifact in the form of a construct, a model, a method, or an instantation.
Guideline 2: Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design Evaluation	The utililty, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4 : Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.
Guideline 5: Research Rigor	Desing-Science research relies upon the application of rigorous methods in both the construction and evaluationof the design artifact.
Guideline 6: Design as a search Process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of Research	Design-science research must be presented effectively both to technology-orietented as well as managemet-oriented audiences.

In this research these guidelines are used for the research design.
The following section will give a brief overview on how these guidelines are used in the research.

Guideline 1 Design as an artifact: The specific artifact in this research is a high level functional specification how the global data pipeline can be connected to a local PCS. In the literature review section the conclusion is drawn that no research has been performed on this specific topic before. Please note that artifacts constructed in design-science research are rarely full-grown information systems that are used in practice (Hevner ET. Al, 2004). The research will give scenarios how the data pipeline can be implemented and the validation of the scenarios with experts.

Guideline 2 Problem relevance: The problem in the research is very relevant to business.
The PCS is of strategic importance for APM Terminals and the port of Rotterdam. (The reader is refered to the section on the case description)
Also the data pipeline is a relevant subject. Maersk line and IBM have developed a Beta version of a working data pipeline. (https://www-03.ibm.com/press/us/en/pressrelease/51712.wss)
The global trade digitization is a real life implementation of the data pipeline described in the literature in chapter 3.
Although PCSs are important for container terminals they can solve only some challenges terminals are facing. Other challenges can't be solved by PCSs. The relevance of this research is that the design artifact will help identify possibilities to improve the current practices.

Guideline 3 Design Evaluation: For the evaluation of the designed artifact, using Portbase as a landing place for the data pipeline, a case study was used.
Case study research emphasizes the rich, real-world context in which the phenomena occur (Eisenhardt and Graebner, 2007).
Specifically for the evaluation of the artifact the case of the Port of Rotterdam and in particular APM Terminals Rotterdam was used.
The evaluation of the artifact was done by performing expert interviews and empirical validation was done in a workshop. [14]

Guideline 4 Research contributions: Please see the part on contribution for research later in this thesis. (subsection 6.4 and 6.5, contributions for research and contributions for practice.)

Guideline 5 Research Rigor: This research has been designed starting with a study of relevant academic literature. A lot of research has been done on Port community systems. The most relevant papers have been addressed and are summarized in a table in this thesis. On data pipelines not so much research has been performed yet, most of the research is explorative.
After the analysis of the literature the research gap is identified. The global trade digitization project of Maersk and IBM is an example of an implementation of the data pipeline concept. Hence, the case study that is performed investigates the potential and further detailing of the data pipeline.
The contibution for research rigor is that is extends the research on data pipeline by zooming in on the aspect how the data pipeline can act as complementary to PCS and the PCS could be seen as a national landing place for data pipeline.
Also it extends the existing literature on PCS by linking it to the data pipeline research.

Guideline 6 Design as a Search Process: Problem solving can be viewed as utilizing available means to reach desired ends while satisfying laws existing in the environment (Simon, 1996).
In this research one of the laws existing in the problem environment is that Port community systems exist all over the world. That is why the research tries to find an aswer to the question how a PCS can connect to the data pipeline.
Simply ignoring the fact that PCSs exist does not help in the world wide implementation of the data pipeline concept.

Guideline 7 Communication of research: The research must be presented to both technology-orientied as to management-oriented audiences. Whilst the development of the GTD has been started mainly by IT-architacts, later in the project more users groups have been involved in the project. Clearly the technical audiences are very good at looking into the technical detailing these are however not the users of the system.
In the communication of the research this thesis can be used to inform the reader and/or decision makers about the developed artifact. The buidling of scenarios for the potential use of Portbase being used as a national landing place for the GTD.

[14] See section on the setup of the research.

4.2 Research design and data collection:

This research has been structured in the following manner:
First a literature research has been performed on PCSs and on the data pipeline concept. Then, after the literature study was finished, the case analysis was made. For the case analysis several sources have been used. Examples of these sources are internet sources, working documents, informal converations and interviews.
All this data has been used to identify the main problems. Then the main problems were discussed with several people in interviews to check their relevance in the empirical part.
A list of interviewed persons can be found in appendix 2 of this thesis.

The interview protocol that was used: The interviews were performed in a semi structured manner. In some interviews only a topic list was used, in others some basic questions were posed in advance to give structure to the interview. Interviews can be unstructured, focused with more structure or highly structured resembling a questionnaire (Voss, Tsikriktsis and Frohlich, 2002).
For every interview notes were made and these notes were send to the interviewee for approval.

On 24 and 25 April 2017 the author has participated in a two day meeting and workshop about the pilot implementation of the global trade digitization.
In their article 'Case research in operations management '(Voss et al., 2002) the authors state that evidence can also be gathered by direct observation of meetings, processes, etc.

During the workshop the subject was introduced to all participants in an intro on the global trade digitization. After the introduction the processes in the supply chain were mapped and painpoints in the processes were identified. Finally these painpoints were used in a discussion how the GTD can help solve these problems.

The workshop was attended by people from several different organizations to get a good idea on the different perspectives.
For privacy reasons the names of the attendees are not displayed here but the workshop was attended by:

- Business development manager, APMTMVII
- Account manager landside, APMTMVII
- Customs affairs coordinator, APMTMVII
- Product manager GTD, Maersk Line
- Venture Partner, Maersk Line
- Consultant GTD, Maersk Management consulting
- Senior enterprise architect, Maersk Line
- Head of marine operations NEU (Northern Europe), Maersk line
- Strategy and innovation consultant, Portbase
- Policy advisor, Fenex /TLN
- Managing director, Ritra freight forwarding
- Director, GIST container transport
- Professor of information technology, TU Delft
- Researcher Core EU project, TU Delft
- EDP Auditor, Dutch customs
- Head of trade relations, Dutch customs

From the GTD workshops held on 24 and 25 April 2017, different painpoints were identified again. In appendix 3 a longlist of the identified painpoints can be found from all different sourcs.

This research focusses on the problems of a container terminal operator, specifically APM Terminals. Hence the choice made for paintpoints to be addressed are the main painpoints as experienced by APMT.

From the initial research the preliminary conclusion can be drawn that APM Terminals, and other terminal operators, are depending on information from other parties in the supply chain.
For some of the identified problems there are already initiatives taken to solve them.

Several other problems are found in the list of painpoints that have a relationship with data sharing. However these problems are more important to other supply chain actors than for container terminals.
At the start of the terminal a memorandum of understanding was made between Fenex en APM terminals MVII.
This memorandum states the definitions and procedures that are used by APMT and has created a shared understanding of each others needs and wishes.
Basically two problems can be derived from this memorandum and these problems are still not solved today. They are also found in the list of identified painpoints from the GTD workshops.

Finally from the long list of painpoints three problems were selected in a shortlist.
The explanation for the choice of the specific problems can be found in the case description.
The three main problems were used to built the scenarios for the TO-BE situation. In total 8 scenarios were built and these were evaluated with experts from APM Terminals and from Portbase.
The evaluation of these scenarios can be found in chapter 5.

Chapter 5: Case description

5.1 Introduction:

This chapter describes the case used for the research and analyses the problems identified and the possible solutions to the problems.
Paragraph 5.2 will describe the stakeholders in the port and zoom in further to the stakeholders involved in the thesis, then it will explain the AS-IS situation with a high-level model of the current process. Next it will explain the main identified problems and explain which problems were selected for the solutions in the TO-BE situation. Paragraph 5.3 will give a brief overview of the developments that are going on at Portbase and the development of the GTD[15] built by Maersk and IBM.
In paragraph 5.4 the different problem driven scenarios for the TO-BE situation are explained in the fist subsection and in the second subsection the IT solution driven scenarios are handled. In the final subsection the evaluation of the artifact is handled and this closes chapter 5.

[15] GTD stands for Global Trade Digitization.

5.2 AS-IS Situation

5.2.1 Background Rotterdam – Le Havre range:

Rotterdam is the biggest port in Europe. It handled 12,385 mln. TEU of containers in 2016. (12,235 mln. TEU in 2015) (see port statistics at www.portofrotterdam.com)
In the Rotterdam – Le havre range Rotterdam is followed by Antwerp (9,654 mln. TEU in 2015), Hamburg (8,821 mln. TEU in 2015) and Bremerhaven (5,547 mln. TEU in 2015).
In the Rotterdam – Le Havre range the competition is fierce, Antwerp is growing more rapidly than Rotterdam. Even though Rotterdam invested heavily in the port in the last few years. As a result of these investments APM Terminals Maasvlakte II B.V. and Rotterdam World Gateway B.V. started their operations in 2015.
Every port in Europe tries to become the first port of call into Europe for the global carriers.

The scope for this thesis is the situation in Rotterdam, the other ports are out of scope for this research.

5.2.2 AS-IS Processes:

Below BPMN model depicts the current situation.This is a high level overview of the processes and the main stakeholders that are involved in the problem definition. More detailed explanation on the problems will be given in the specific problem descriptions in later sections in this chapter.

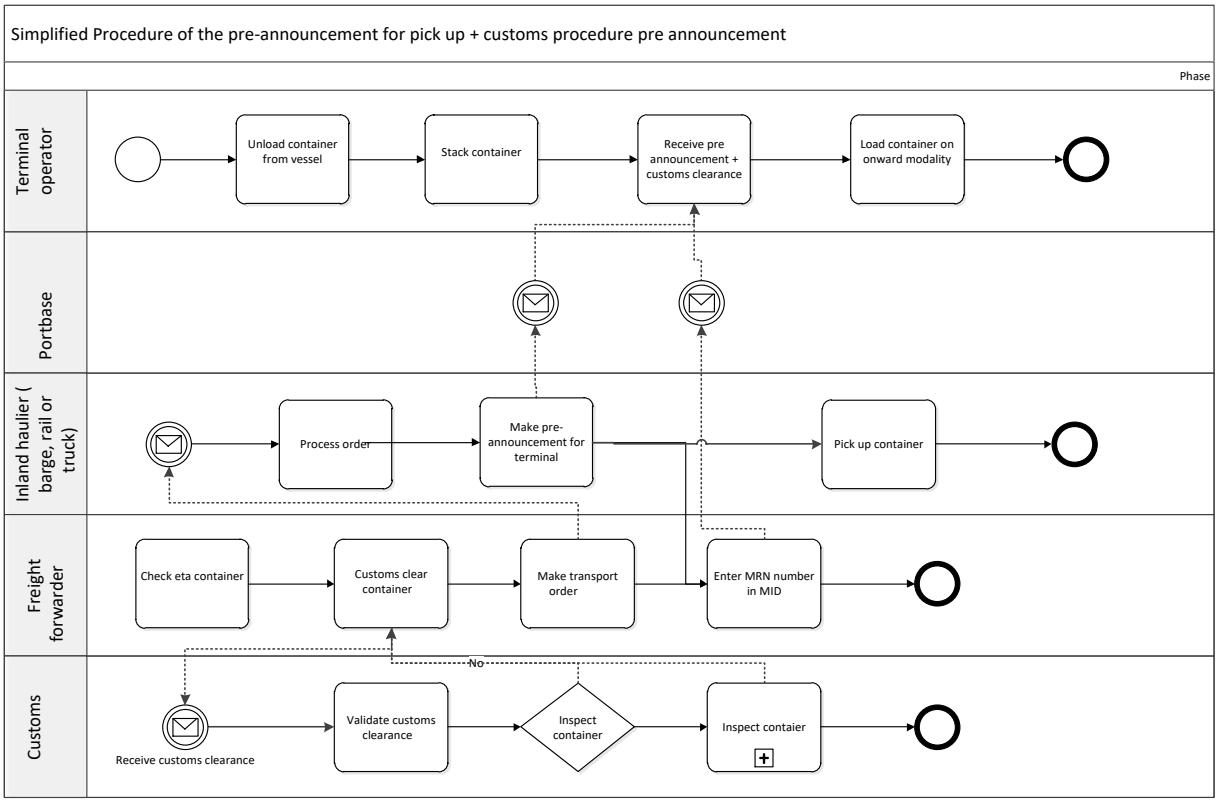
In the figure the following stakeholders are mentioned: Terminal operator, Portbase, Inland haulier, freight forwarder and customs. Also the carrier plays a role in the problems but for simplicity reasons they were not taken up into the model here.
The next section will explain the stakeholders in more detail.

Explanation of the figure:
On the highest level the operational processes of the container terminal take place.
The basis steps are : unloading the container from the vessel, place the container in the stack, receive pre-announcement and customs clearance and load container on onward modality.

As you can see in the picture the pre announcement is the first interaction with the hinterland parties.
First the freight forwarder checks the ETA of the container and when the container is available he will send the customs clearance to the customs authorities. The customs authorities will check the customs clearance and validate the contents. In the next fase they decide whether or not to physically check the container. If they decide to perform a physcial inspection on the container another sub process starts. If they release the container the confirmation is send back to the freight forwarder with the MRN number of the declaration.

The freight forwarder can then proceed with the process of the container delivery. They will send a transport order to the haulier and enter the MRN number in the service ‘MID’ from Portbase who will send the message to the terminal operator.

The haulier receives the transport order from the freight forwarder and makes the pre-announcement, via Portbase, to collect the container. After the pre announcement is confirmed the haulier will plan the actual transport and transport is executed.



Figuur 3 The process of pre-announcing a container for import and the customs clearance procedure. Made by the author

5.2.3 The situation in Rotterdam, stake holders:

5.2.3.1 Port authorities:

Being the largest (container) port in Europe makes Rotterdam a very important asset for the Dutch economy. The port authority manages the safe and smooth handling of all shipping in the port, on their website their mission is displayed:

Mission: The Port of Rotterdam Authority creates economic and social value by working with customers and stakeholders to achieve sustainable growth in the world-class port.

The port authority has two stakeholders: The municipality of Rotterdam and the Dutch state.
The container terminals operating in Rotterdam are not the owner of the ground and the quays. These assets are owned by the Port authority and rented out to the terminal operators who get a concession to use the terminals for a determined time.

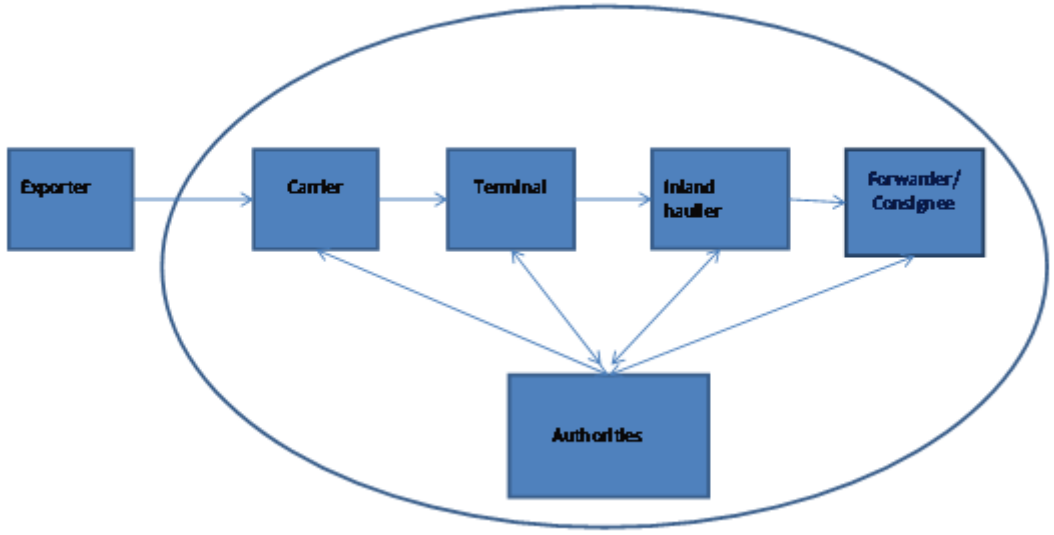
The port authorities take a special position in the port and for this thesis they are out of scope for the remainder of the problem analysis. The key stakeholders that are used for the analysis are listed and discussed in the section below.

5.2.3.2. Key stakeholders directly involved in the supply chain:

Below figure shows the stakeholders that are in scope for this thesis. The most important stakeholders are:

- the carriers
- terminals
- freight forwarders
- the authorities.
- Inland hauliers

The following section will give more detailed information on these specific stakeholders and also the Port community systems and inland hauliers will be introduced.



Figuur 4 overview of the key supply chain actors. Made by the author.

Container terminal operators:

In the below section a summary of the 5 most important deepsea terminals is given in the area of the 1st. and 2nd. Maasvlakte. The city terminals are out of scope (Uniport, RST/Steinweg, Barge Center Waalhaven)

APM Terminals:
Is a leading global port and cargo inland services provider with a presence in 69 countries providing the world's most geographically balanced global terminal network with 73 ports, nine new ports under construction and ten facilities in expansion mode – along with an inland services network spanning 140 locations (www.apmterminals.com).
APM Terminals has 22000 employees worldwide and their global head office is based in The Hague, the Netherlands. The company is a part of the transport and logistics division of the A.P. Moeller Maersk Group A/S from Copenhagen Denmark. Other renowned companies in this group are Maersk Line, the biggest container carrier in the world and Damco, one of the world's leading third party logistics providers.

In Rotterdam APM Terminals operates two facilities: APM Terminals Rotterdam B.V. (APMTR) and APM Terminals Maasvlakte II B.V. (APMTMVII). APMTR started their operations in the year 2000, under the name Maersk Delta Terminal. It won the award for the most productive terminal in Europe four times in a row. The terminal is operated by using straddle carriers to load and unload trucks and mts. (multi trailer systems.) Straddle carriers are vehicles that lift a container from above and drive over the container. This is different from a fork lift truck that lifts the container from the ground. A straddle carrier operated terminal can reach improved Quantry crane productivity. (Vis & De Koster, 2002)

APM Terminals Maasvlakte II B.V. started their operations in April 2015. It is one of the most advanced container terminals in the world and the flagship terminal of APM Terminals worldwide. The terminal has 0% Co2 emission and is almost completely operated automated by using automated stacking cranes and AGVs (automated guided vehicles) AGVs are robotic vehicles which travel along a predefined path. The road system consists of eletric wires in the ground, or a grid of transponders, that control accurately the position of the AGV. (Vis & De Koster, 2002) Automated stacking cranes are fully automated cranes that get the containers from the stack and load them on the next vehicle.[16]

APMTMVII has a capacity of 2, 7 mln. TEU and can grow untill a capacity of 4, 5 mln. TEU.

APM Terminals is one of the interviewees in this research. Several expert interviews are held with managers and specialists at APM Terminals. The author of this thesis also worked fulltime for the company until 31-05-2017 and a lot of information is used from his empirical observations.

Europe Container Terminals:
Is the largest container terminal operator in Rotterdam and in Europe (www.ect.nl).
ECT is part of Hutchinson Port Holdings (HPH) Group, one of the largest port operators in the world. ECT celebrated its 50 years anniversary in 2016. It operates two container facilities in Rotterdam: ECT Delta Terminal B.V. and Euromax Terminal B.V. In 2016 ECT sold a 35% interest of the shares of Euromax Terminal B.V. to COSCO Ports (Rotterdam). This creates a strategic alliance with China Cosco Shipping Corporation limited.
In 2015 ECT handled 7, 5 mln. TEU In the port of Rotterdam. [17]

Rotterdam World Gateway:
Started its operation in September 2015 and is one of the most advanced container terminals in the world (www.rwg.nl). Just like APMTMVII is has zero emissions of CO2 and the operation is performed mostly automated.

RWG has a capacity of 2, 35 mln. TEU in the first fase and can grow further and expand its capacity until around 4 mln. TEU.
The company is a global consortium that consists of 4 global carriers (APL, HMM, MOL, CMA-CGM) and terminal operator DP world.[18]

[16] This can be either an AGV or a chassis of a truck
[17] Total handling of containers in the port of Rotterdam in 2015 was 12,235 mln. TEU. This makes the market share of ECT around 62%.
[18] In 2015 CMA CGM bought APL and with this acquisition they immediately have become the largest shareholder of RWG.
http://www.nieuwsbladtransport.nl/Nieuws/Article/ArticleID/47602/ArticleName/CMACGMkooptNOLvoor24miljard

The Dutch customs administration:

Dutch customs is ranked 2nd place on the Logistics Performance Index of the World Bank.[19]
This means Dutch customs is one of the most advanced and most efficient customs administrations in the world.

Dutch customs is a part of the Dutch Tax Administration.[20]
Their task is to check the import, export and throughput of goods (www.douane.nl). Customs makes sure that the Dutch excise and European import duties are collected. Next to this task Dutch customs also checks if the goods conform to the demands of safety/security, health, economy and environment.

The customs administration has over 4500 employees. It has several covenants with other inspection agencies like, the food and health authorities (NVWA), Police, Ministry of economics (for sanction laws and regulations), etc.

Ocean carriers:

For a port like Rotterdam the global carriers are very important stakeholders. The carrier is the party that actually ships the containers.
In Rotterdam the carriers are united in the VRC. (The association of ships agents)
This association has over 70 members (www.shipsagents.nl).
Currently there is a lot of consolidation going on in the container market. Global carriers are cooperating in shipping alliances to better make use of their resources and to become cost leaders in their trades. In 2017 three mayor shipping conferences will start their operations: 2M, The Ocean Alliance and THE Alliance.[21] Because of the developments there is still a lot of uncertainty which ports of call the alliances will use and which terminals they will use.

Freight forwarders:

Another important group of stakeholders are the freight forwarders. This group organizes transports and value added logistical services for their principals, typically owners of the goods such as importers or exporters. Value added tasks of forwarders are storage, packing or unpacking, insurance, and value added services, tracking and tracing, and very important, to perform customs formalities. In the Netherlands the freight forwarders are united in the Fenex (www.fenex.nl).
Freight forwarders can be divided into several groups: Ocean freight forwarders, Airfreight forwarders, customs brokers. Fenex is part of TLN [22] and has 400 members from top global forwarders to local customs brokerage agencies.

[19] http://www.nederlandlogistiek.com/praktijk/douane-nederland-tweede-op-wereldranglijst
[20] ‘ De Belastingdienst’ in Dutch.
[21] 2M consists of Maersk Like and MSC
The Ocean Alliance consists of: CMA/CGM, OOCL, China Cosco Shipping and OOCL
THE Alliance consists of: Hapag-Loyd, MOL, Kline, Nyk and Yang Ming
[22] TLN, Transport en Logistiek Nederland.

Inland carriers/hauliers, logistics service providers:

The final group of stakeholder taken into consideration are the inland carriers. After or before containers are loaded on an ocean vessel there is pre carriage arranged to bring the container from the shipper/consignor to the place of departure, or after sea carriage to the importer, buyer.
In the Netherlands there are several modes of hinterland transport that can be used. Via road, rail or barge.
Rotterdam has a very good network of connections for all these three modalities.
Of great importance is the correct flow of information of the arrival, departure and availability of containers to this group.

5.2.3.3 The Port Community system of Rotterdam: Portbase

Via Portbase's port-transcending Port Community System, companies can benefit from a multitude of intelligent services for simple and efficient information exchange, both between companies and between the public and private sector. This enables all the participants to optimize their logistics processes, thereby improving their own competitive position and that of the port. Portbase belongs to and serves the port community and is a non-profit organization (www.portbase.com).

Portbase has two shareholders: The port of Rotterdam authority and the port of Amsterdam authority.
It has an advisory board in which several stakeholders take position.

Portbase has over 3200 customers in all the sectors of the ports like: agents, barge operators, shipbrokers, customs, forwarders, terminals. [23]
For every customer different service packages have been and are being developed.
We can see here that a Port community system, like Portbase has a lot of know how from the local complexity in a port.

5.2.4 Problems in the supply chain:

The primary goal of this research is to investigate how supply chains can be more efficient, from the terminals persepctive, by connecting Portbase to the data pipeline.
For container terminals there are four main problems identified that are data related and that have an influence on the process efficiency and a fifth problem is identified, which is related to the carrier and the authorities having an effect on the supply chain.

The key problems that were identified based on the analysis are:

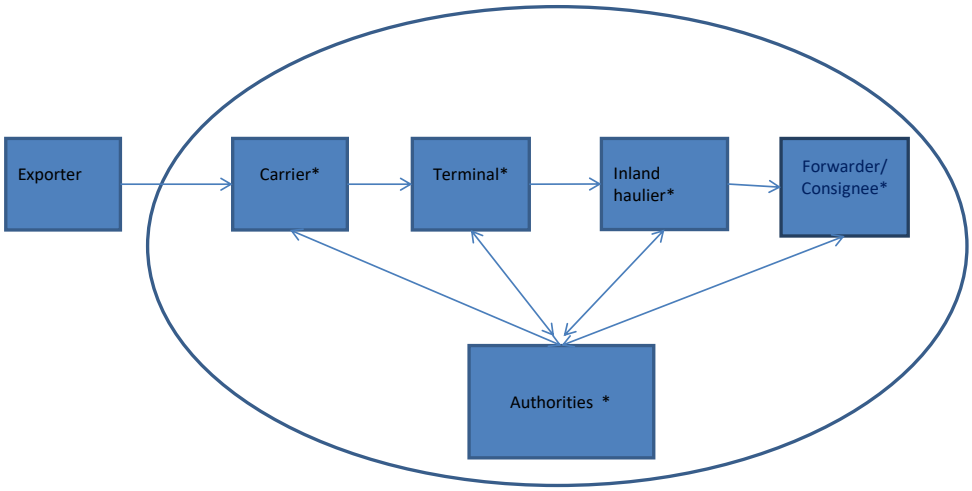
1. Correctness of ETA/ETD
2. Time and modality of pick up/delivery
3. Customs and other inspection agencies
4. Internal moves
5. Problems related to the quality of the ENS/TSD

[23] For a complete overview of customers: www.portbase.com.

In the methods section the process of how these problems were identified and selected is addressed.

The below figure maps how these problems are related and how they affect the key stakeholders analyzed in this thesis, as introduced in section 5.2.3.2.

Below figure shows the relationship between these elements



Figuur 5 problems in the supply chain mapped to the actors. made by the author.

Legenda:

The * with the number means that the stakeholder is the holder of the problem.
The other actors are affected by the problem but are not specifically the problem holder.
In reality every problem can affect every stakeholder. Problems in one area have Consequences further down the chain.

The picture shows the local situation in Rotterdam, the Netherlands. Before arrival in the Netherlands a whole process has taken place on the other side of the ocean. In principle the situation is in mirror of the situation here. The exporter or consignor is the start, followed by the freight forwarder (which can be the same forwarder as on this side of the ocean). The freight forwarder arranges several things, like organizing transport, issuing export documents and booking the ocean freight. After loading the container, the box is delivered to a container terminal with the intention to be loaded on a vessel.

5.2.4.1 Problem 1: ETA/ETD

This research focusses on the import flows of containers. For container terminal operators the ETA (expected time of arrival) and the ETD (expected time of departure) of the container are very important as they are the starting point for their planning activities.
At APMT MVII ten or more calls a week on average are handled and the main interest for a carrier is to have the vessel as short as possible in the port. The port fees in a port like Rotterdam are extremely high.
Also, the sooner a vessel can start sail again, the shorter the transittime of containers.

In practice predicting the correct ETA is very difficult due to several kinds of reasons. For instance, ships can be delayed because of weather conditions, strikes, port congestion etc. Next to the prediction of the ETA also the accurate and timely update of the ETA when delays occur during the vessel journey is a problem.
A terminal operator prepares the planning ahead and the exact time of arrival is amongst others important for the proper planning of staff, for determining the moment of cargo cut-off and for starting the preparations for the vessels operations. Cargo cut-off is the moment from which the terminal operator finalizes the loading list of the vessel. For instance , if 12 hours before arrival of the vessel the container is not arrived in the yard yet, it will be cancelled from the loadlist.
Basically for every stakeholder in the port the ETA is important. Freight forwarders need to know when to customs clear their cargo, customs needs to know when they can start to inspect the cargo, inland hauliers need the information so they can send their transport modality for pick up of the containers and cariers need to know when to release the containers.
Freight forwarders and customs brokers handle the customs clearance of containers. Legally they are not allowed to do so if the containers are not present on the terminal. The reason for this is straightforward. The customs authority needs to be able to inspect the containers after they have been selected for inspection.
What happens in practice is that the terminal operator sends gate-in and gate-out [24]messages to Portbase. These messages are then displayed in the services of Portbase so interested actors can see when a container is actually present. The actors that need the information are indeed Customs, inland hauliers and freight forwarders.
The gate in message is also used by the carrier or shipsagent. This actor will send a release message to the terminal if the client has performed his commercial obligations. The obligations mostly are e.g. payment of the ocean freight, payment of the terminal handling charges and hand over of the original bill of lading.
There are a lot of interdependencies in these processes. If the freight forwarder does not know in time that the container is available in the container yard he will not start with the customs clearance yet. But the customs clearance is needed by the terminal operator and the carrier to prove to customs that the container can leave. At the same time the inland haulier needs the customs clearance confirmation to be able to pre-announce the pick-up of the container at the terminal.

[24] gate In and gate out messages are known as CODECO messages in EDIFACT

Interesting fact for the TO-BE situation is to investigate if the GTD can help improving the quality of the ETA of the vessels.

The current process at APMT in Rotterdam, and this is also validated with experts from other terminals, is:
Before arrival the carier makes his appointment for the call at the port with the berth planning department. Here the provisional ETA is send to the terminal who arranges the berthing place including the position of the ship at the berth. (boldernumbers) and if the ship has to lay at the Quay larboard or starboard side.
Due to several kinds of circumstances the exact ATA is constantly changing. Finally the ETA is communicated over the telephone to the berthplanner who enters the ETA manually in the terminal operating system.

The role of Portbase for notifying the ETA isn't very big for container terminals. Of course the ETA is entered in the PCS, however this isn' t used by the terminal operators.
This is a very important observation about the actual use of data exchange of Portbase.
The reason that container terminal operators don't use this information is because the ETA of the vessel is published in a service that is called 'Ladinginformatie 2.0' This service is not available for terminals. Besides this, the terminal has intense contacts with the ships agents about the actual arrival of the vessel. Actually the terminal is the first one to know the exact moment the ship has arrived.

Other parties in the port/ supply chain are aware that the ETA is flexible due to changes so for the more exact ETA they check the container terminals website and/or contact the carrier or shipsagent by telephone. The ETA can change due to all kinds of circumstances, like bad weather , delays with pilotage, delays at other ports, etc.

Below is an example taken from APMT's website:
https://termview.apmterminals.com/TERMView/Default.aspx?terminal=MVII

Ships On Berth

Vessel	Inbound Voyage	Outbound Voyage	Actual Time of Arrival	Estimated Time of Departure	First Available Date	CargoCutoff	ReeferCutoff	Start Receive Date
Mayview Maersk	706E	706E	2/23/2017 1:50 AM	2/26/2017 5:05 PM*		02-22-2017 06:00	02-22-2017 06:00	02-14-2017 00:01
Maersk Niagara	1702	1702	2/25/2017 12:48 AM	2/25/2017 3:05 PM*		02-23-2017 13:00	02-23-2017 13:00	02-15-2017 00:01
Maersk Nienburg	1702	1702	2/11/2017 1:17 PM	2/11/2017 10:00 PM*		02-10-2017 07:00	02-10-2017 07:00	02-01-2017 00:01
Ltr Hirschhorn	1611205	1611205	2/25/2017 11:47 AM	2/25/2017 1:25 PM*				

Figuur 6 Overview of ETA and ATA of vessel at APMT MVII

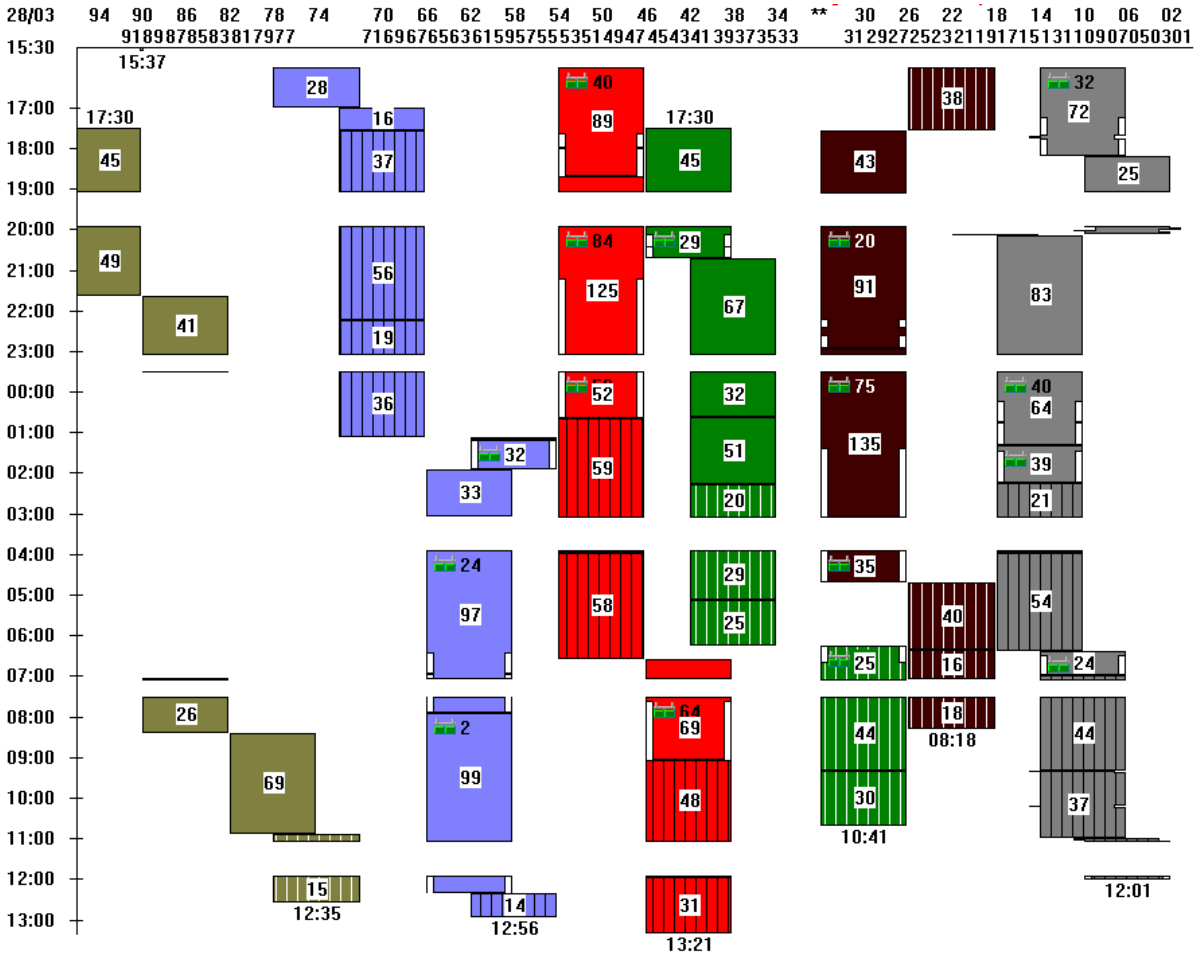
Before arrival of the vessel the freight forwarder will monitor when their container is available at the terminals yard.
Freight forwarders get a notice of arrival fom the carrier that states the expected time of the vessels arrival and the terminal that will unload the container.
Unfortunately the information from the carrier is not very accurate. (This is confirmed by a freight forwarder at the GTD workshop at 24 and 25 April 2017).

So what most forwarders do is that they check either the terminals website or Portbases service cargo information to get the correct ETA. Empirically validated from an interview is that the quality of the ETA published by Portbase is of adequate quality. [25] Every 8 hours an update from Dirkzwager is received and processed in the PCS.

But even if the ETA of the vessel is correct the time of unloading of the container is still uncertain at that point. In this time of ever growing vessel sizes it takes terminals on average between 24 and 48 hours to handle an ULCV[26]. Meaning that after arrival of the vessel in the worst case scenario the haulier has to wait for 48 hours before the container is available. And then even customs inspections are not taken into account.

The terminal operator does actually have a planning on the unloading time of the container.
From the stowage plan and the bayplan (see figure 12 below) terminals can estimate the expected time of unloading of the container. With the average numbers of the terminals productivity they can calculate how many moves must be done before that specific container is unloaded. This obviously is not extremely accurate, however with a safety margin it can be estimated roughly when a container is available. In manual controlled container terminals the vessel planner can use an Excel tool to calculate the expected time of arrival if he has the stowage plan. For APMTMV2 the TOS calculates the expected time of unloading automatically.

[25] Portbase gets regular updates on the vessels ETA from Royal Dirkzwager. For more information on Dirkzwager see: http://www.dirkzwager.com/
[26] Ultra large container vessel



Figuur 7 Bayplan

In pilots at APMT they have measured that with a margin of two hours the estimated unloading time can be calculated with a percentage of nearly 100.

As described above the expected time of unloading is not communicated via Portbase to the freight forwarder. Currently a pilot is done at APMT MV2 to communicate the time to the haulier. However, the haulier is not in the lead to determine the time that the container must be delivered.

5.2.4.2 Problem 2: Time and modality of pick up / delivery

The second problem relates to the actual pick up (again focus on the import side) of the containers. APMT has three possible inland modalities: Truck, train, barge.[27]
In the terminal concept of APMT MVII there are specific substacks allocated for truck, barge and rail. The reason APMT MVII has these substacks for different modalities is because it improves the hinterland pick up optimization.
In the current situation inland carriers pre – announce their visits through Portbase. Within this system they book timeslots within which they can arrive at the terminal.

The most reliable means of transport is by truck. However this isn't the cleanest way of transport.

[27] At Maasvlakte 2 an agreement has been made between the port authorities about the modal split. By 2033: 65 % of all containers delivered to or picked up from the area must be transported by barge or rail. https://www.maasvlakte2.com/nl/index/show/id/495/masterplan-over-achterlandvervoer

The least reliable is barge, in the port of Rotterdam a lot of 'ghost ' annoucements of barges are made. These announcements are appointments made by barging companies but they don't show up at these appointed times. Sometimes the barge company already expects that they can't meet their appointment times but they make the planning for in case another terminal cancels their appointment.
Barge is very much subject to congestion at other deepsea terminals and inland terminals. Besides this barges can be delayed because of the tides in the rivers. Advantages of barges are that they can take a lot of containers at once, making it one of the cheapest means of transport and it is also one of the most safest means of transport.

The third inland modality is rail transport. Also for rail, several delays may occur.For instance a container may not be loaded on the train because it simply did dot arrive in time at the terminal (van Baalen et al. ,2009).

For a container terminal it is very important to know well in advance the correct means of transport and the time of pick up. The services of Portbase work quite well for barge, rail and road planning. However they depend on different kinds of other information like the ETA. If the ETA is incorrect at the moment of planning, or if it changes during execution, the next stages in the supply chain are affected. The ETA in Portbase is not used by the terminals , as said above. For the actual pick up of the containers for hinterland transport the ETA of the container is more important then the ETA of the vessel. Even if the vessel has arrived it does not automatically mean that the container is available, it can still take 2 days before the terminal has finished the operations on the vessel. Another delaying aspect is the administrative process. Before a container can be loaded on the next modality the container needs to be released by the terminal operator, the carrier and by customs (van Baalen et al. ,2009). If one of these parties didn' t release the container the operational execution is disturbed. The terminal operator will only release the container after receipt of the terminal handling fees, the carrier after payment of the ocean freight (if the shipment term is freight collect.) and customs will release only after the risk analysis has been made and inspections are done. Futher elaboration on the customs release will be made later in this Paragraph.

The role of Portbase: To plan the pick up of containers the transport companies use the services of Portbase.

Truck planning: In this service truckers pre-announce their containers and ask for a specific lock time. During these lock times the terminal guarantees the trucker can access to the terminal and guarantees that the container is made available. [28]
The trucker has to fill in several fields in the webscreen of the PCS and this will exchange information wih the terminal via XML[29]/EDI messages. APMT will advise a TAR number to the trucker when making an appointment. (Truck arrival registration)
Specifically the following data elements are checked in the terminal operating systems:
AW = Container presence
CV = commercial release
DB = customs block
DD = customs document
Only when ALL these elements are okay the driver is granted access to the terminal.

Barge planning and rail planning: these services don' t specificaly work with lock times like truckplanning does. The reason for this is obvious, these modalities carry several containers in one call. Instead a timeframe for the handling of the complete transport means is agreed upon.

[28] Guaranteed times excluding problems due to IT systems, bad weather conditions, etc.
[29] XML means Extensible markup language

First the planner makes an appointment via the PCS when the barge or train will arrive. This timeframe is communicated with the terminal and if available it will be confirmed. The barge and rail services , like road planning, also check on the data elements as indicated above. Again the PCS communicates directly with the terminal operating system via XML/EDI messages.

For terminal operators the pre announcement of Portbase is very important. The information is used for the planning of the terminal , specifically the yard planning is affected. Containers that are pre announced for barge for instance can be planned for the barge stack so the system automatically stacks the containers in the right position.

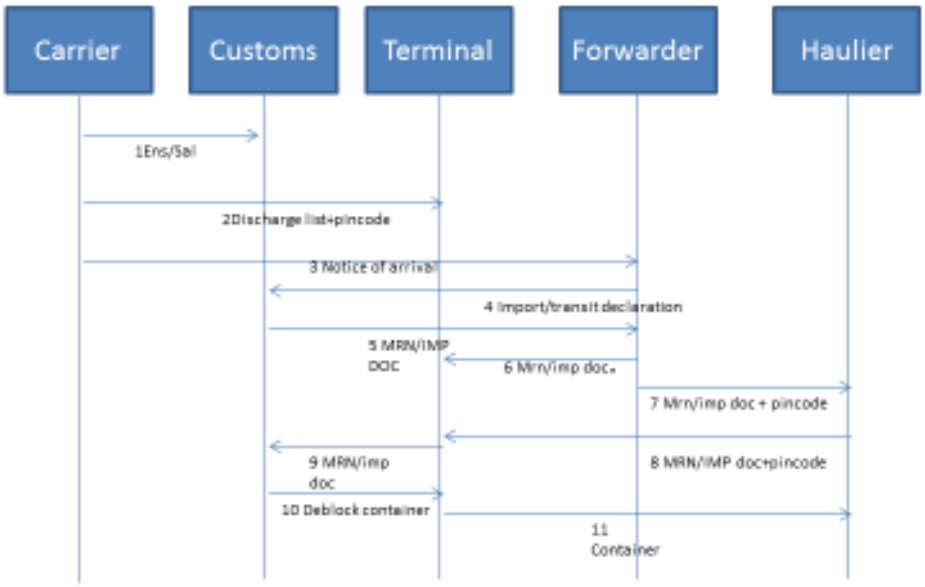
In practice the terminal receives the onward modality from the carrier based on historical data. This data is used if no pre announcement is made yet, if a pre announcement is received this will be of higher value then the data from the carrier.

How does it work now?

- The shipping line submits the entry summary declaration to customs and they make a risk analysis on the goods together with the information from the ENS
- The shipping line then sends a notice of arrival to the consignee or forwarder
- The consignee will submit the customs clearance or other procedure to customs and will get an MRN number if the goods are released
- The importer or forwarder will submit the original Bill of lading and pay for the THC[30] charges
- They will then receive the PINCODE and sametime they send a release [31]to the terminal
- The freight forwarder sends the MRN number to the terminal via Portbase
- The freight forwarder then gives a transport order to a haulier (barge, rail, truck)
- The haulier pre announces to the terminal the date and time of the onward modality
- The terminal sends a confirmation and the haulier can pick the container up on the planned time

[30] THC Terminal Handling charges
[31] This message can be referred to as the COREOR message from figure 5

Below figure depicts this process.



Figuur 8 The import process at a container terminal. Made by the author.

The freight forwarder and/or importer decides on the onward modality to be used.
They already long before arrival of the vessel know that the container will be picked up by barge, rail or truck.
However, the forwarder does not have the option to inform the terminal about the onward modality in the so called 'Copino 13' message. It's the inland haulier that sends this information via Portbase to the terminals.
In principle it could be possible for the freight fowarder to inform the terminal via telephone or e-mail. This would however increase the costs for the terminal and for the freight forwarder and is not an option.

In the GTD workshop a freight forwarder that attended stated that already from the moment they book the container with the carier they know what the onward modality will be. Off course this can change during the journey because of unforeseen events but that is mostly only in exceptional cases. As said events that take place during the execution of the transport in the supply chain can have an impact on the chosen modality. For example a delayed vessel can be the cause to switch to truck. Or another well known example is low water in the rivers causing barge not to be able to sail to their destinations.
Up to date this problem of getting the containers ETA still exists in the supply chain in the port of Rotterdam.

5.2.4.3 Problem 3: Customs and other inspection agencies

The third problem is the delays caused by customs and other inspection agencies. Dutch customs task is to check the import, export and throughput of goods.
For this task customs has several means to assist. For every vessel a risk analysis is made. The outcome of this risk analysis is the input for the specific containers that are selected for inspection. At APMT MVII an X-ray scan is placed in the yard. [32] As soon as the selections are decided by customs they are send to the carrier and also to the terminal operator through Portbase. Customs sends an EDI message to Portbase that translates the message in an e-mail for the carrier and an XML message for the terminal that triggers an inspection block in the TOS.
Next to X-ray scanning customs also can decide to do physical inspections of the container. These inspections are not done on the terminal but at the DCL (customs inspection warehouse).
The DCL will be replaced by the end of 2017 by the RIT (Rijks inspectie terminal). The RIT will be used by the different inspection authorities to handle their inspections in one place in a more coordinated manner. The other inspection agencies, besides customs, that will use the RIT are: ILT (inspection environment and transport) and NVWA.
In this way coordinated border management (CBM) can be reached. CBM can be defined as: a coordinated approach by border control agencies, both domestic and international, in the context of seeking greater efficiencies over managing trade and travel flows, while maintaining a balance with compliance requirements (Aniszewski, 2009).

From an operational perspective X-ray scanning of containers is a more efficient way of inspection then physical inspection.
There are two main reasons for this:
1) the X-ray scan can take place on the terminal itself so the container does not physically have to leave the container terminal.
2) The supply of the containers to the X-ray scan is under control of the terminal. For physical inspections the containers need to be left behind at the DCL and here the planning is made by another party when the actual inspection will be performed.

The mean time for X-ray scanning on a container terminal with their own scanning facility is a couple of hours after unloading. In contrary the physical inspection of containers can take 1 or 2 days after the container has been delivered to the DCL.

A third way of inspecting containers can be to use sniffer dogs. Not only customs have responsibilities on import of goods, other inspection agencies also have specific laws and regulations to adhere to. (for instance the food and health authority)
The messaging of these controls are done in two ways:
If the inspection is performed by the customs authorities under assignment of another government agency the inspection is send to the terminal via Portbase. However, if the inspection is not performed by customs the inspections are make known to the terminal via other conventional ways, mostly via E-mails.

The inspection of containers is a delaying factor for terminal operators. Only after the inspection is done and approved the inland carrier can start planning the pick up. Often because of an inspection by customs the onward modality has to be changed. The reason for this is that it can take a barge up to three or four working days to reach an inland place where a truck only needs several hours.

[32] Currently the X-ray scanning facility on the 1 St. Maasvlakte is being built. Here the containers from ECT Delta Terminal and APM Terminals Rotterdam can be scanned by the end of august 2017. All five deep sea terminals will have their own X-ray scanning facility after this is realized.

If a container inspection takes three days the agreed time of delivery can' t be met anymore by barge and the forwarder has no other way then to use a truck. As a result of this the terminal has to make extra internal moves to bring the container to the correct stack location.[33]

Hence for terminal operators, but also for other parties in the supply chain, it is important to know which container needs to be inspected and when an inspection is finalized. Unfortunately the time required for a customs inspection can't be predicted very well. This is dependent on the profile that was hit in the risk analysis, and resulting in the check that must be performed.

The interference of the authorities in the logistics process is very important for this thesis. The thesis is written to conclude the executive master in customs and supply chain compliance and hence the customs formalities take a central role in the complete research.
In the next section the general process of the inspections of customs will be explained, the role of Portbase in this, the historical developments and the way Portbase, customs and the businesses cooperated to improve the situation.

Historical developments of the interactions between the businesses, customs and portbase.

In the old days manual documents were submitted at the customs offices by the ships agent. These documents were named the ' generale verklaring' for the ship itself and the ' D11' (Douane 11) for the cargo on board of the vessel.[34]
Customs officers would check the documents manually and select containers for inspection.

In the year 2009 Portbase was founded as a merger between Portinfolink and Portnet. The Port community system improved the situation considerably.

The process of releasing a container with the use of Portbase works as follows:
(based on Klievink, Aldewereld, Knol, Tan, 2014 small adjustments are made by the author)

1. Carrier sends ENS declaration to customs in European union, directly or via Portbase, 48 hours before loading the container in the port of origin.[35]
2. Carrier sends TSD declaration to customs, via Portbase, 72 hours before arrival of the vessel in the port of discharge.[36]
3. Customs sends NLBB16 (EDI message) to Portbase to confirm receipt of the TSD declaration (this message contains the initial movement reference number (MRN); this message is also used to inform the declarant of funtional errors in the declaration.) Portbase translates the message to an e-mail message for the carrier.
4. Customs performs the risk analysis and targets containers for inspection.
5. Customs sends NLBB15 message, via Portbase, to the carrier and to the terminal to indicate that a container is targeted.
6. After inspection, a NLBB24 message is send, via Portbase, to the carrier and the terminal, to indicate that the container is released for on-carriage transportation.

In the research performed by Dinalog in cooperation with Delft University of Technology under the name ' Extended Single Window' (Klievink et al.,2014) amongst others the role of Portbase was investigated in the import process.[37]

[33] More on this subject can be found at problem area 4: Internal moves.
[34] For transshipment containers a D51 declaration was required.
[35] Ens means Entry summary declaration
[36] TSD means temporary storage declaration, this is used to put the goods in temporary storage until a customs destination or use is chosen.

Interestingly one of the identified problems was that small design choices can have an enormous effect on the lead times.
In the import case the TSD was send to customs via Portbase, Customs would send an EDI message back to Portbase that was translated to an E-mail message and send to the carrier. The carrier subsequently informed the terminal about the selections.
Here the design choises like having unmanned terminals in the weekend or terminals not being able to receive EDI messages could delay the containers during the weekends.
For this reason the release messages and inspection messages from customs are now also send to the terminal via Portbase.

In the case of Maersk line the handling of e-mails was outsourced to a service center in India.
India, being in a different time zone would send the information about targetted containers at incovenient times to the terminals causing delays.
Another problem was that if the TSD[38] was submitted Friday afternoon at 16:30 the message to block certain containers would arrive too late at the terminal and because of this all containers would be blocked the whole weekend.
Another situation that was not mentioned in the research report but that was advised in an interview by Maersk line was that containers missing their message to be inspected could be taken from the terminal during the weekend and this caused severe consequences for the declarant. (The carrier)
What happened was that containers that were selected for customs inspection were picked up by the consignee before the e-mail message was processed. As a result of this customs was not able to perform the inspections as the containers would already have left in the hinterland. This, by law, is a criminal offence for which the carrier is liable.

Portbase, customs and the businesses have cooperated intensively to find solutions for the problems mentioned above.

Nowadays messages about containers to be expected which customs decides on to be inspected are send to Portbase by customs and Portbase sends an XML message to the terminals. This message automatically triggers a customs block in the Terminals operating systems making the previous problems someting of the past. This can also be seen by the inland carrier when pre announcing a pick up in Portbase.

Current situation and identified problems.

This paragraph describes the current situation and the developments going on. Specifically there will be zoomed in to the container release notification and a new service built by Portbase called inspection portal.

Container release notification:

The current process still mainly functions as described in the section above taken from the ESW project. Under the UCC several changes are about to happen in the coming years.
One of these changes is that terminal operators wil have additional responsibilities over the containers they handle. [39] From the 1st. of may 2016 they are responsible for the contents of the container.

[37] The import process was investigated looking at a case study at Frugi Venta.
[38] In the time of the ESW research the TSD was called the SAL(Summiere aangifte van lossen goederen)
[39] The Unamar arrest is taken up in to the legislation.

At the moment there are two separate declarations required to import containers into Europe. The ENS/TSD declaration and the placing of goods under a customs procedure or use.
The ENS/TSD has to be made using the customs system called 'Douane Manifest' (DMF). In DMF the summary information of the container is advised to customs and this information is used for their risk assesment processes. The placing under a customs procedure takes place in either the system Aangifte Systeem (AGS), New computerized transit systems(NCTS) or another type of declaration is made, like entry in the declarants records or a manual procedure i.e. an ATA carnet is used. In the systems for a customs procedure in general more specific data is entered by the declarant. As specific data can be seen the value of the goods, the H.S. code[40] and the incoterms.
These systems aren't communicating with each other in realtime. In practice it happens that freight forwarders and customs brokers submit their customs declarations to customs already before the goods are actually unloaded in the port. This situation is not legal but for several years this was common practice.
While placing goods under a customs procedure or use the declarant has to mention the bill of lading number in the AGS or NCTS declaration system . By having the bill of lading number the customs systems can recognize that the goods have been placed under a customs procedure and the manifest of the TSD can be cleared in DMF.
However, this does not happen in real time. After the goods have been placed under the customs procedure, the declarant immediately gets his release from customs. Then in the night after the acceptance and release of the customs clearance the customs systems match the information with the information received from the carrier in DMF. This is done in a system called the matchbox.
If a mismatch happens this does not cause a block on the container. Customs follows up the non cleared manifests with the carrier retrospectively. The container by that time might already have left to the hinterland.
This situation caused a lot of mismatches at customs and a breach of legal obligations to only declare goods that are present and available for physical inspection.

For terminal operators the situation got worse after the UCC came into force. Since a terminal operator has now under UCC a legal responsibility for the goods under temporary storage, customs will address the terminals for mismatches in the documents. If a Bill of lading in DMF stays (partially) ucleared customs will send a notice of assesment for the import duties and taxes to the terminal operator because he is responsible for the contents of the container. In the old situation the carrier would receive the assesment and would have to pay for the missed duties and taxes.
This brings terminals in a difficult position for several reasons.

1. The terminals contractual party is the carrier and not the actual shippper.
2. The terminal operator does not have any information about the contents of the containers.

   Ad1. The carriers contracting parties are the shippers and the terminals. The shipper has a contractual relation with the carier under the Bill of lading conditions. Because of this the carrier has a stronger legal position than the terminal operator has.
   Ad2. Terminal operators do not have information on the contents of the containers unless it is needed because of legislation or other special purposes.[41] The reason that terminals are not having this information is two fold. First for security reasons, the more people knowing whats in a container the bigger the risk of theft and second TOS systems are not equipped to process the containers contents.

[40] H.s. code means Harmonized system code.
[41] Terminals must have information about dangerous goods based on IMO legislation. Special purpose goods can be reefer containers so the operator knows when a reefer container must be plugged in to an electric plug to keep the temperature at the correct settings.

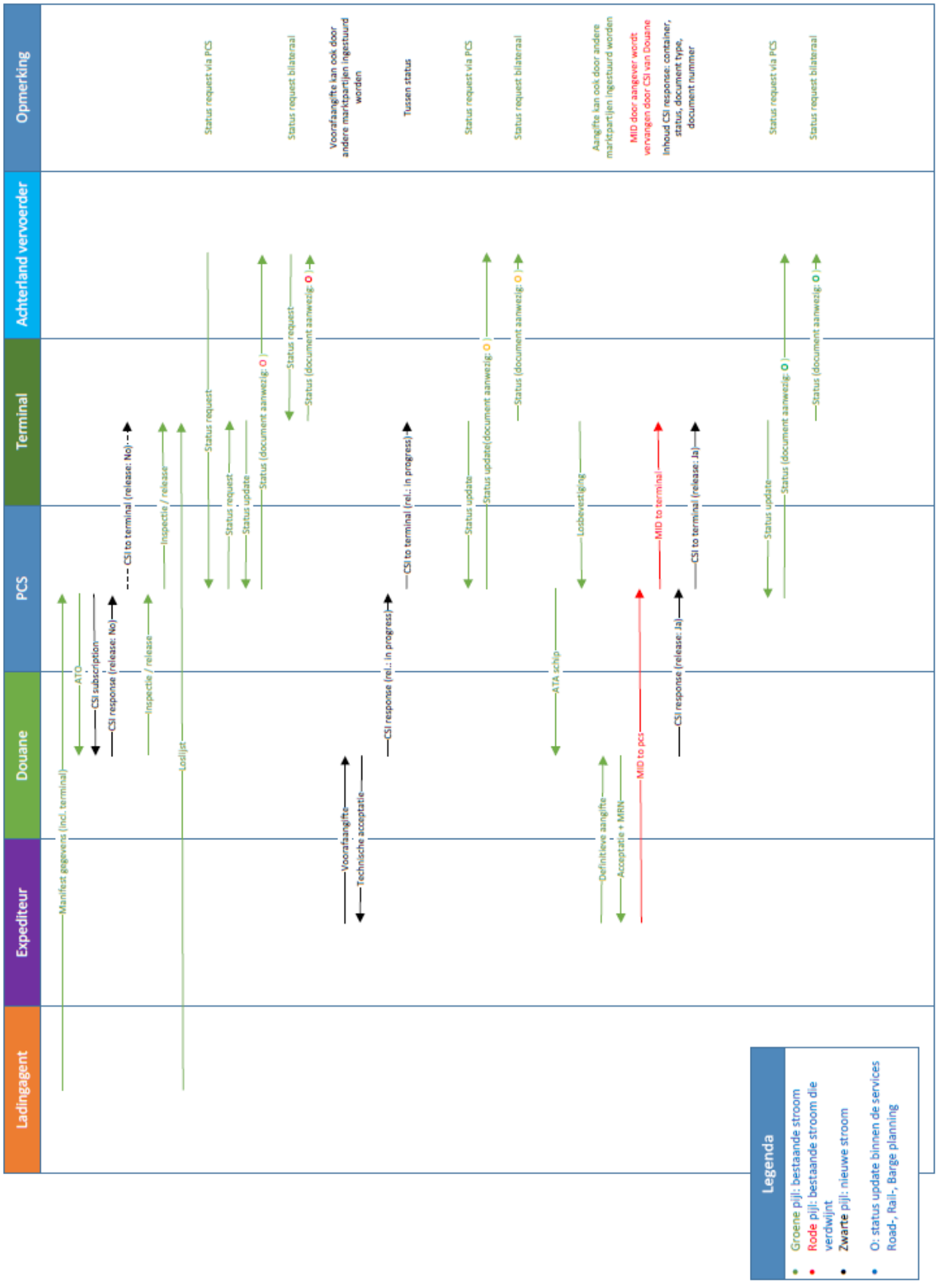
To solve these problems the container release notification (CVB)is developed. The expectation is that customs will implement CVB[42] by the end of 2017, beginning of 2018. The implementation of the message has two components:

1. The fundament. After implementation of the fundament goods can no longer be placed under a customs procedure before the goods TSD has been submitted by the carrier and the vessel has been arrived in the port. Also a customs declaration can no longer be accepted if the data in it can't be matched with the TSD. This means that the systems of customs in real time check if the declared customs document contains the correct referral to the ENS/TSD declaration and if a match can be made between the data of the documents for a customs procedure and the declared data in DMF. If the data does not match the customs declaration will be rejected.
2. The CSI Container status information. After implemetation of this system a message will be send to inform the declarant that a container is released and that the TSD has been cleared. This information can be important for the declarant, the carrier and for the terminal. For the declarant this is important as they will be informed that the container is released for import, that there are no more inspections to be performed and they can use this to pre- announce the container for pick-up from the terminal. For the carrier the release notification means their entry summary declaration is cleared and for the terminal this is the confirmation that the temporary storage declaration is cleared and that they can release the container for pick up to a haulier.

The Container release notification has advantages for several parties but also disadvantages. What is an advantage is that the mismatch problem will be solved and this brings the terminal operators and customs in a better position.
However the main disadvantage is that if a declaration for a customs procedure is not yet accepted the planning at the terminal on hinterland transport can start only from the moment that the declaration is accepted. As indicated in previous paragraphs one of the fields that is checked in the truck, rail and barge planning of Portbase is the presence of a customs document at a terminal. Without this a haulier can't make an appointment to pick up the container. In combination with the poor information about the ETA this can cause severe delays in the supply chains.
We can see here that the problems with the seaside ETA and the hinterland planning problems come together. The hauliers, whether barge , rail or truck have a need for exact information on the unloading time of the container. They already have this in the current situation to know the exact availability of the container. However in the situation when the Container release notification is implemented this becomes even more important. The reason for that is that when the customs broker wants to customs clear the container they need the prezice ATA of the vessel.When they submit the customs document before the ATA the documents will be refused by the customs systems. Without the container release message from customs the inland haulier will not be able to pre-announce containers at the terminal.

At the moment customs is talking intensively with the terminals and Portbase to find solutions for this. One possbile solution could be that a declarant makes a pre clearance procedure where customs advises wheather they want to inspect the container at arrival. (pre-notification) At the moment of arrival the declarant only has to send the final clearance to customs and receive the release.
The possibility could be explored if the data pipeline can be used for this data exchange.

[42] More information on CVB: https://douane-inzicht.nl/article/305638761



Figuur 9 The container release notification (made by Portbase)

Inspection portal:

The inspection portal is being built by Portbase. After deployment the technical maintenance will also be managed by Portbase.
Inspection portal will be used by customs, other government agencies, carriers and terminal operators. Each of these parties has access to their specific required data im the portal.

In the current situation customs informs the container terminals and carriers about automatically selected containers via an EDI message. This EDI message is send to Portbase and here it is converted into an XML file for terminal operators and in to an e-mail for carriers. The service for this is called Customs scan process.
Via customs scan process the automatically selected containers are send to the responsible parties. Next to automatically selected containers customs also selects containers manually through the scan application. The scan application is part of the IT infrastructure of terminal operator ECT and managed by Portbase. Selections made in the scan application are then send to the carrier via e-mail. These manual selections for customs controls are not send via Portbase. So after an inspection is decided on by customs the carrier is informed via E-amil from customs and they carrier subsequently informs the terminal via E-mail. This is one of the main reasons why the inspection portal is being developed.

In the new service inspection portal the selections made by customs and other inspection agencies are send to the container terminals via EDI.
This prevents mistakes made by missed e-mails, resulting in missed inspections.
Inspection portal will have a a dashboard where inspections can be followed. Here the carrier can draw statistics on the processes to measure the average time an inspection has taken.
This will help to measure the defined KPI's that are agreed upon in the SLA made between the customs authorities and businesses in regards to the scanning proces.

Obviously the inspection portal has many advantages for several parties in the supply chain.
In these modern times it should not be needed to block containers with an e-mail messsage.

A problem that still is not solved is how to get all inspections in the inspection portal. Not every government inspection agency is involved in the building of the new service. It would be helpful if, for example, the NVWA would start integrating their procedures in this portal.

Finally on customs and other inspection agencies the point must be made here that customs makes the risk analysis on the ENS and TSD data obtained from the carrier. This leads to a lot of false positives.[43] Customs has KPI's in place that measure the amount of inspections made and the hit rate on these inspections. Obviously the number of inspections is not the primary goal but the % of succesfull inspections are.

5.2.4.4 Problem 4: internal moves

The fourth problem related to data are the internal moves that have to be made at a terminal. After containers are unloaded from a vessel they are put in a container stack. Full containers are stacked maximum as high as three containers on top of each other. If the pick up of a container is executed this can cause a lot of container reshuffling. APMT MVII has one specific barge stack and one specific rail stack. The other stacking locations are designated for truck.

[43] False positives are customs inspections on container where nothing suspicious is found in the container

If a container that was indicated to be destined for barge, for some reason, now is picked up by truck, a lot of internal moves have to be made. This can delay the operation significantly. On average this can take up to three hours for a container to be re-reouted to the correct stack and a manual operation from a PCO is needed.[44] If the number of containers in the yard increases, the internal reshuffles increase also. In other words, the higher the yard density, the slower the operational performance.

The reshuffling of containers is managed by sophisticated stacking algorithms in the Software of the TOS of the terminal. A main element in these algorithms is the estimation of the residence time of a container, i.e. the time until the container is transported further (van Baalen et al. ,2009).

For APMT it is very important to have the details of the inland modalities as soon as possible. This way the terminal operating system and the algorhithms can stack the containers in a more efficient way.

The problem of the internal moves is related to the other problems explained in the previous paragraphs, the ETA and the pick up time determine the residence time and these both elements are also influenced by the inspections of the authorities, especially customs.

Via expert interviews more clarity on the process of internal moves was received. The following section explains how the container terminal knows what the next modality is and what the role of Portbase is.

The onward modality is at first communicated by the carrier in their unloading list. This message is called COPRAR DISCHARGE. This message is communicated to the terminal via EDI and not through Portbase. This could typically be an example of a message exchange that the data pipeline could be used for.
In the unloading list the onward modality is indicated only when known by the carrier. This is done based on historical data.
Another example for the data pipeline can be identified here. The onward modality could be communicated to the carrier via the data pipeline and the carrier can then use this information to give a more accurate unloading list to the terminal.

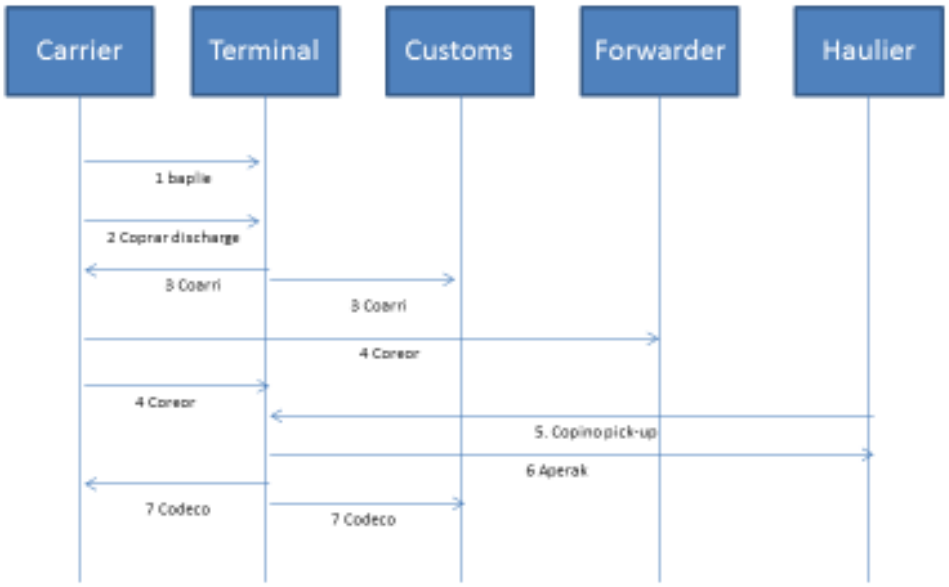
Next to the data provided by the carrier, the customers that are pulling their containers from the terminal, provide information via the services road, barge and railplanning of Portbase.
This data is more accurate then the data provided by the carrier so it has a higher hierarchical value in the systems at APMT. In practice, the transport company makes an appointment via Portbase, either by webscreens, or with an interface connection to their own systems. PCS then sends a COPINO 13 message (a pre announcement) to TOS and TOS replies with an APERAK (confirmation) message to PCS.
A specific note here is that this is the situation in the Netherlands. In other countries the Port community systems might not be as advanced as Portbase is. In these situations the data pipeline can be used to manage the pre-announcement process or the process of the unloading list between the carrier and the terminal.

Working with locktimes and with fixed windows for the barges and trains has the adantage for a container terminal that it helps to predict the dwell time of the containers and to allocate containers to a correct containerstack. Currently, only the terminals on Maasvlakte 2 make use of lock times. The 'old'terminals don't make use of it.

[44] PCO Process controller operations.

The inspection authorities also influence the internal moves. Customs sends their pre-notifications for inspections to the container terminal operator via Portbase.
Portbase translates the message from customs into an XML-EDI message and then sends it to TOS. The message structure that is used is recognized by TOS and triggers a specific blocking rule. With this the systems knows what kind of inspection has to be performed and the algorhitm plans that the containers are automatically stacked in the correct location.
The X-ray scanning of containers at APM Terminals MVII is done completely automated. After a block is received from customs, the TOS plans that the container is loaded on an AGV and is driven through the X-ray scan on an AGV. This is an internal terminal move and costs on average several (1-3 hours) After customs has studied the images and has no findings the release is send to TOS again via Portbase using EDI. Please note that APMT MVII is the first full-automated container terminal in the world. In the majority of other container terminals in the world the scan process is not automated and the physical location of the X-ray scan is most often not in the area of unloading. For these reasons there are a lot of delays for the internal moves.

Below figure depicts how the information flows at container terminals work:



Figuur 10 Overview of the EDI messages at a container terminal. Made by the author.

From this picture the following message types can be identified: [45]

[45] Only the import flow is explained

Tabel 3 Overview of the EDI messages used at a container terminal. made by the author

Message type	Explanation
1)Baplie	Stowage plan of the vessel send by the carrier to the terminal
2)Coprar Discharge	Unloading list of the vessel send by the carrier to the terminal
3)Coari	Confirmation that a container is unloaded send by the terminal to the carrier
4)Coreor	Commercial release message send by the carrier to the terminal
5)Copino Pickup	Pre-announcement for pick up send by the haulier to the terminal
6)Aperak	Confirmation send by the terminal to the haulier
7)Codeco	Gate-out message send by the terminal to the carrier

As can be concluded from the previous sections Portbase has a central role in the exchange of information in the Port of Rotterdam. Given the complexity of the identified problems there is still enough room for improvement. Sometimes the information can be more accurate or timely.
There is a need to investigate whether data from earlier in the supply chain, for instance data from the GTD, in combination with data from Portbase, can help to better adress the problem areas from the cases.

If the information from earlier in the chain can help this will also have effects further down in the chain.
Better and more timely information about correct ETA's and customs inspections can improve the predictability about a containers availability. This will significantly improve the customers satisfaction. A better ETA of the container is a great advantage for the planning on a terminal and this advantage indirectly also affects the final customer. The customer has more reliable information about when the goods are present and can be in the shelves. Also the delivery of goods can be done against lower costs.
Here a separation must be made between the ETA of the vessels arrival and the ETA of the unloading of the container. There can be quite a difference between these two because a broken data link can exist between the vessel and the container. To explain this in more detail: On the tradedocuments is written that the container was booked in the port of origin on vessel X. But last minute the container is rolled over to another vessel Y. In that case the data link is broken and in the port of arrival is unknown that the container of vessel X was loaded on vessel Y.
Another example of this is that it occurs often that a container has first been loaded on a feeder vessel to a transshipment point, like Singapore , where the container is then loaded on the main vessel. In many cases the bill of lading will indicate the feeder's name.

The freight forwarder perspective.

An introduction on freight forwarders was made in paragraph 5.1. Here we zoom in further in how the data pipe line can be of use for the freight forwarders.
Freight forwarders oversee the whole supply chain.[46] When a freight forwarder is contracted by the importer to ship a product they will first contact their local office or agent in the country of origin. This relationship depends on the incoterm derived from the contract of sale.

[46] Depending on the incoterm that is used by the buyer and the seller. In case of ex works the forwarder of the buyer will arrange the whole logistical process from the point of pick up to the point of delivery. (end to end)

The next lines are the case when the shipment term is EXW or FOB , but in case of DAP or DDP the exporter arranges the transport. This local agent will arrange the domestic transport to the port of departure, customs clearance for export, shipping documents and delivery of the container to the terminal. After the container has been loaded on the ocean vessel the carrier takes over the responsibility for the container and will inform the terminal at the port of destination as well as the forwarder about the ETA of the vessel in the port.

On arrival of the container the forwarder at destination will arrange the pick up from the terminal, make the customs clearance at import, arrange the release with the carrier.[47] And finally deliver the cargo.
For the freight forwarder the ETA is of great importance. With the ETA they can plan the pick up and contact the final buyer on the date and time for the delivery of the goods.
The forwarder makes use of Portbase to arrange several processes. The customs clearance number is submitted to the container terminal via a service called MID.[48] The pick up is planned by the freight forwarder and then the haulier, under order of the freight forwarder, uses the road, rail or barge planning of Portbase. In these planning services a number of mandatory fields is filled out and send to the terminal by the haulier. If everything is in order the terminal sends back a confirmation to the haulier via Portbase.
In ' Ladinginformatie 2.0' the forwarder can check the arrival of the container, the contents of the container and wetter the container is going to be inspected by the authorities.
As we have seen from earlier sections Portbase has a central role in the local exchange of data in the port of Rotterdam. In other ports the situation is most likely comparable. Antwerp has APCS and Hamburg has Dakosy. Here the remark must be made that this research focussed on the situation in the port of Rotterdam. A validation was not made with the ports of Antwerp or Hamburg what exactly the Port community systems can do there.

All these Port community systems don' t interact with each other. Data on the international flow of goods is obtained from the carriers.
The fact that the PCss don't exchange information is a significant problem. The datapipeline would be able to support this; to exchange the data between the PCSs of a carrier that sails the ports of the Hamburg - Le Havre range, like Maersk. A known problem is that the ENS is submitted, as described in the introduction, in the first EU port of call. From there the ENS data can't be shared with the subsequent ports, allthough this was the original plan of the European commission when the ENS was implemented.

The reason freight forwarders are mentioned in this subsection is that they have a huge impact on the internal moves a terminal has to make. The freight forwarders decide on the use of the onward modality. They are the principal of the inland hauliers. This means that the hauliers, the inland transport providers, are the customer of the freight forwarder. The haulier plans the pick up of the container after the unloading of the container is done. In case the onward modality changes the container has to be re-shuffled through the stacks (in particular when the modality changes) Examples of causes for modality changes are: a ship is delayed this means the ETA is later and the delivery date stays the same. A container that was firstly planned for a barge now has to be transported by truck. Another example is a container that was planned for a barge but missed the barge because the customs release was missing. Now, to still make the intended delivery date the modality is changed to truck.

[47] A release from the carrier will be handed over after the hand over of the original Bill of lading and payment of the Terminal handling charges to the shipsagent.
[48] MID means Melding import documentatie

5.2.4.5 Problem 5: the quality of the ENS and TSD

For a freight forwarder the shipping documents are very important. Unlike a container terminal that has no interests in the contents of the containers, forwarders do have this interest.[49] For the customs clearance the goods description must be as precize as possible to determine the correct classification of the goods. Typically freight forwarders act as customs brokers for their customers. The classification in combination with the correct customs value and the origin determine the amount of import duties to be paid.
Next to the use of documents for customs purposes, the original documents are needed to arrange the release of the container at the terminal. Portbase doesn't distribute any trade documents. These are mainly send by express courier. Important documents that can't be distrubuted by Portbase are: booking confirmations, container release, certificates of origin, health certificates or dangerous goods declarations.
If the documents are missing the entire shipment will be delayed. It would be a good opportunity if the data pipeline could be used to obtain these missing documents.
Also for the customs authorities trade documents can be important. The quality of data in the ENS declaration and the TSD isn't always of good quality (Hesketh, 2010). In his papers he explains why. The ENS is submitted by the carrier, not by the actor that packed the box. Also, if the cargo is booked via a freight forwarder the name of the consignor and consignee on the bill of lading shows the name of the agent and not the actual seller/buyers names. For this reason Hesketh , together with Heijmann introduced the concept of the data pipeline, making it possible to retrieve data from the actual person that packed the box. This problem can't be solved by a PCS, since the PCSs only are working on a national platform.
In a lot of shipments the actual shipper and consignees are not shown on the bills of lading.
From an interview information was obtained that sometimes the bill of lading mentions in the field ' consignee ' *To order* '. This makes the risk assessment for customs nearly impossible because for a proper risk analysis the name of the actual seller and buyer are needed.
This is crucial because the Prisma Software of customs looks at the AEO status of the actual consignor and consignee. if the system can't identify if the consignor or consignee is AEO certified the AEO facilitation of fewer government controls is lost.

Because of the poor quality of the ENS and TSD customs selects a lot of containers that afterwards have no suspicious cargo in them. (False positives) So low quality data of the ENS and TSD does indeed have a negative effect on the terminals operation because there are too many false positives. By using the data pipeline better sources for data can be used for the ENS and TSD , so these declarations become more accurate resulting in fewer false positives.

In practice customs will in a lot of cases contact the carrier for additional information like the Invoice, packing list, etc. The causes delays in the operational processes of the supply chains.

A current trend is the supply chains is the exponential growth of E-commerce.
In E-commerce a buyer who is mainly a consumer buys goods in another country, via a marketplace on the internet, and the good is then shipped by an intermediary to the buyer. If these goods are shipped in ocean containers this means that hundreds or even thousands of shipments can be in a container.
The bill of lading does not mention the name of the individual buyers so these containers are likely to be selected for customs inspections.
The growth in these types of containers can have an impact on the number of containers that are selected by customs and this can influence the logistical process on container terminals.

[49] Only for special cargo terminals are interested about the contents, examples are dangerous cargo, refrigeratred cargo or out of gauge cargo.

5.2.4.6 Summary of the problems from the case description and selection of problems to be addresses in the TO-BE situation :

In the previous paragraph we have identified the main data related problems in the local supply chain.
In this section the 5 main problems were:

1. Correctness of ETA / ETD
2. Time and modality of pick up/ delivery
3. Customs and other inspection agencies
4. Internal moves
5. Problem related to the quality of the ENS/TSD

In the further elaboration of these problems the role of the PCS was explained. Looking at the overall conclusion these problems are very interrelated in some way: The correctness of the ETA and the moment of pick up or delivery are directly influencing each other. If the ETA is incorrect this has consequences further down the chain. Trucking companies make a planning on the wrong date, freight forwarders don't have the correct date for making the customs clearance, etc.

Problem one and two are also influenced by the inspections performed by customs and other government agencies. We have seen that in the past these inspections could delay the supply chain not only because of their reason of existence , which is primarily customs compliance , but also because of design choices like unmanned terminals during the weekends and terminals not being able to receive EDI messages.

All these problems are having an effect on the internal moves a terminal has to make. By having the correct ETA, time and modality of pick up container terminals can make a better planning and more efficient stacking can be done. Customs inspections have to be known by the terminal operator as early as possible to prevent extra moves.

We have also seen that several solutions have been implemented or are being implemented to improve these problems. Examples are the inspection portal that is currently under development by Portbase in cooperation with government agencies and supply chain partners and the container release notification.
These solutions clearly are designed to address the problems with the customs and inspection agencies. From interviews with experts the conclusion can be drawn that customs inspection in the current state do not have a big influence on the terminals processes. Selections are decided on by customs before arrival of the containers and the terminals can keep the selection into acccount when making the planning. However for the correct ETA and the subsequent problems (i.e. onward modality) there is no solution onhand from Portbase in the short term.

For the fifth problem, quality of the ENS /TSD, the conclusion can be drawn that Portbase doesn't handle any shipping documents. Portbase merely handles information in the form of messages between the members of the port community. So if a document is needed by a freight forwarder or by customs they can't get this document from the community platform. The documents have to be send by e-mail, post, courier etc.
Another aspect of the document problem is that another group of stakeholder that needs these documents are customs and other governent inspection agencies.
Because of the poor data of the ENS and the TSD, customs needs to have more information than the carrier can provide. This information would in the best case be obtained from data from the source, like the packing list from the shipper. However, customs doesn't have access to this source data.

The actual shipper isn ‘t in the jurisdiction of the customs authorities and customs can only adress the local consignee or forwarder. The developments of E-commerce can even make the situation with the data quality worse as the e-commerce shipments do not show the actual shipper in the ENS.

The conclusion from the case description is that there are three main problems that can’t be solved by the PCS.
If we look into the initial 5 problems the preliminary conclusion is: Problem 1 , problem 2 and problem 5 are not solved today. In regards to problem 1, a further refinement must be made. From empirical validation the problem turns out not to be the ETA of the vessel but more specifically the ETA of the container is an important problem. The empirical validation came from two interviews. One with mr Rik Geurtsen from APMT about the vessels ETA and one from mr Marty van Pelt stating that the actual problem from freight forwarders is the ETA of the container and not of the vessel.
If a solution could be found for problem 1,2 and 5 this would improve the situation in Rotterdam. Problem 3 is already solved for the biggest part and some extra developments (container release notificication and inspection portal) will improve the situation even better.
By solving problem 1,2,3 and 5 problem 4 will automatically be solved or at least improved as well.

Therefore the selection of problems for the TO-BE situation is:

1. Correctness of ETA , in particular the ETA of the Container
2. Timeliness and correctness of the onward modality pick-up of container
5. Quality of the ENS/TSD caused by the lack of documents.

5.3 New developments at Portbase and the GTD implementation of Maersk

5.3.1. Developments at Portbase:

In paragraph 5.2.3.3. an introduction on Portbase was given. Here the governance structure and the mission was given, below section zooms in more into the current architecture and developments.

5.3.1.1 Role as a national hub connecting thousands of users nationally:

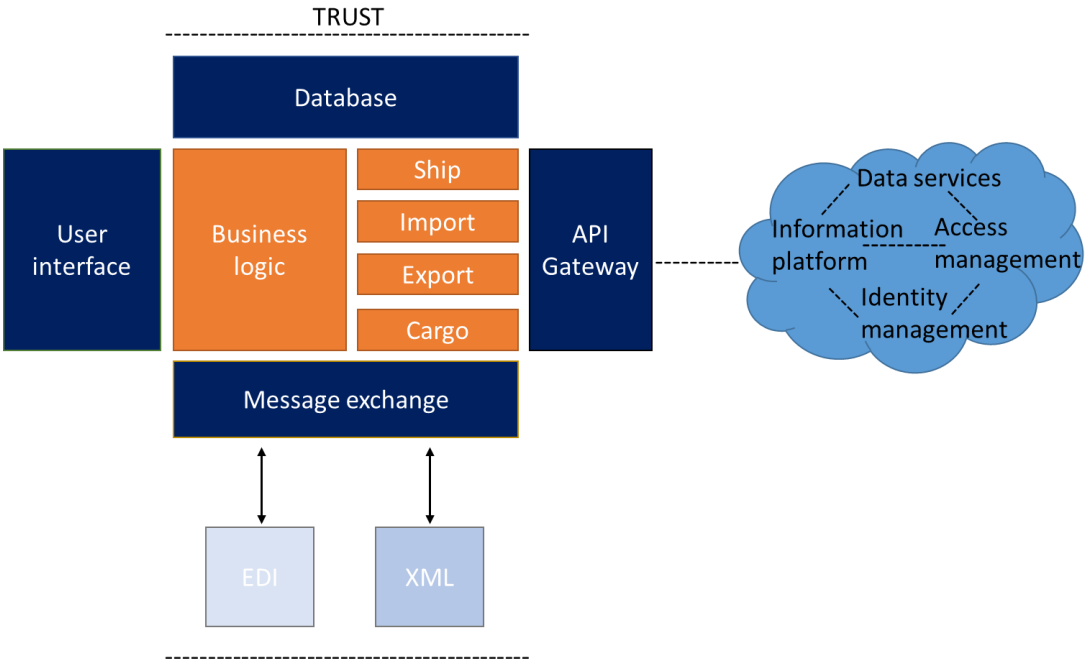
Portbase constantly tries to improve the PCS by cooperating with the community.
Currently their services that mostly relate to the (container)terminals are: Barge planning (45 operators), Rail Planning (17 operators), Road Planning (1288 operators), MID (615 importers, forwarders and hauliers) and MED (2599 exporters and forwarders)
MED is used by exporters, freight forwarders and customs brokers to send export clearance documents to the terminals.

5.3.1.2 Portbase and the international dimension:

In the strategy for the following years Portbase wants to be the national port community system for the Netherlands and be connected to the other PCSs in Europe. The mission is that Portbase together with the community will become the Smart ports of Europe.
Portbase will connect with other PCSs with the goal to exchange information with each other, however, the aim is not to exchange source documents with each other.

In the IPCSA Portbase is investigating with other PCSs in Europe how Port Community systems can connect to each other. If all PCSs are interconnected more additional value can be added to the Port communities of Europe. Information from other ports can be used by Portbase to help the port of Rotterdam.

Below picture gives an overview of the new architecture of Portbase.



Figuur 11 Portbase architecture. Adjusted from Portbase

The largest part of message exchanges at Portbase is done via EDI or XML interface. Also the possibility to enter data manually is possible via the user interface.
On top of the internal database the application services are built. Companies only have to submit data once and Portbase can re-use the data for different purposes.

5.3.1.3 Advanced identity and access management in place:

Portbase also acts as an identifying party. The determine the access and identity management for the port community actors. It is an important observation that the image shows trust on top of their services. This underlines that Portbase masters the local complexities in the Port of Rotterdam. Portbase is also developing an API gateway to make further use of information possible.

5.3.2 GTD implementation of Maersk:

In the literature review section there was mentioned that several research projects were done to improve the visibility in international supply chains. The most important ones were Cassandra and Core. From these projects the data pipeline innovation for global supply chains was invented.

Currently Maersk line, together with IBM, are developing the ‘ Global trade digitization solution[50] ‘ built on block chain technology.[51]

[50] Previously the name was ‘ Shipping information pipeline or SIP ‘
[51] http://www-03.ibm.com/press/us/en/pressrelease/51712.wss

The solution is intended to connect the different IT systems of the different actors in the supply chain. Like the internet, that was also built as a system of systems, the datapipeline can connnect local systems to each other and connect a global network of systems.
Maersk and IBM want to cooperate with a network of shippers, freight forwarders, ocean carriers, ports and customs authorities. The more actors that connect with the GTD the better the visibility on international supply chains. Through the events that are published by the different actors can be seen how the containers are flowing through the transport chains. For instance, the shipper sends a notification when the container is loaded, the terminals sends a gate- in message after receival of the container in the yard, and a gate out message when the container is loaded on the outgoing vessel, etc.

Maersk line investigated that a shipment of flowers from Kenia to the Netherlands require more than 200 interactions and communications passing through 30 people and organizations. If something unexpected happens, e.g. an original document is missing at the right time and location, in these interactions this can have an enormeous impact further down the chain. The world trade organization estimated that, by reducing barriers in the international supply chain, the global GDP could improve by 5% and the total international trade volume by 15%.[52] [53]

From the Cassandra project the following business benefits were identied: [54]

- Overall increased supply chain visibility
- Improved data accuracy, predictability and efficiency of supply chains
- Reductions in administrative burdens

And for government inspections the benefits are:

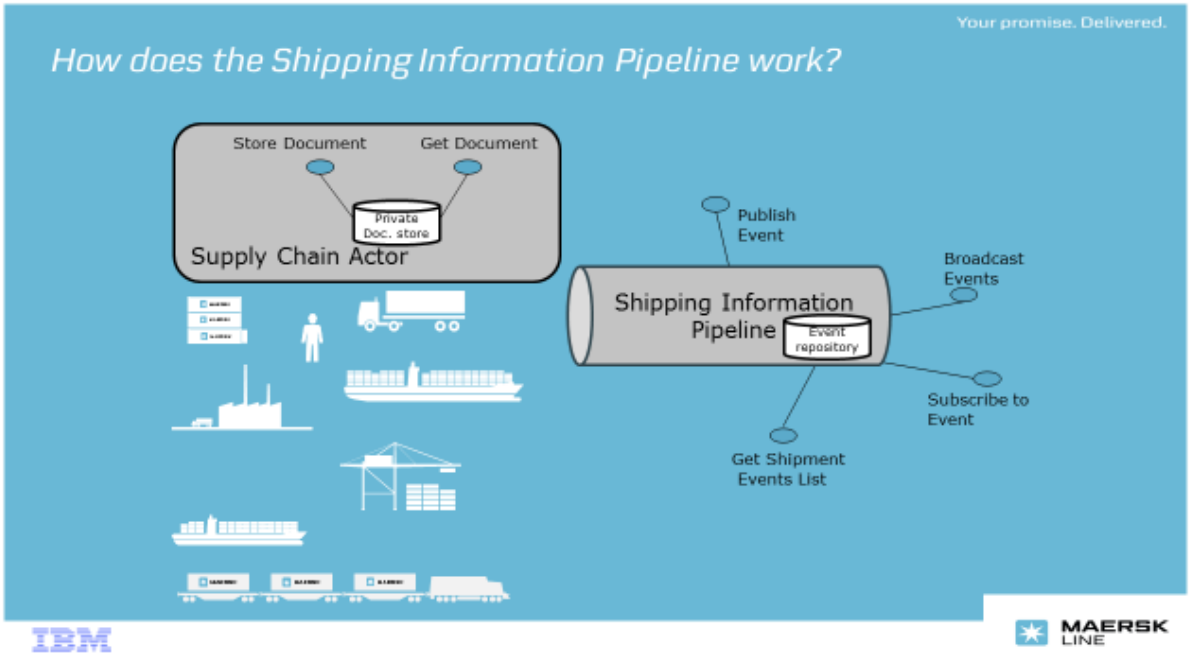
- Increased cargo compliance
- Fewer invenstions in logistics
- More risk-assessed inspections

The GTD solution enables the real time exchange of original supply chain events and documents through a digital infrastructure, or data pipeline, that connects the participants in a supply chain ecosystem (http://www-03.ibm.com/press/us/en/pressrelease/51712.wss).
Below figure explains how the shipping information architecture is set up.

[52] https://www.youtube.com/watch?v=dcddYatMCGQ&feature=youtu.be

[53] http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&cote=ECO/WKP(2005)19

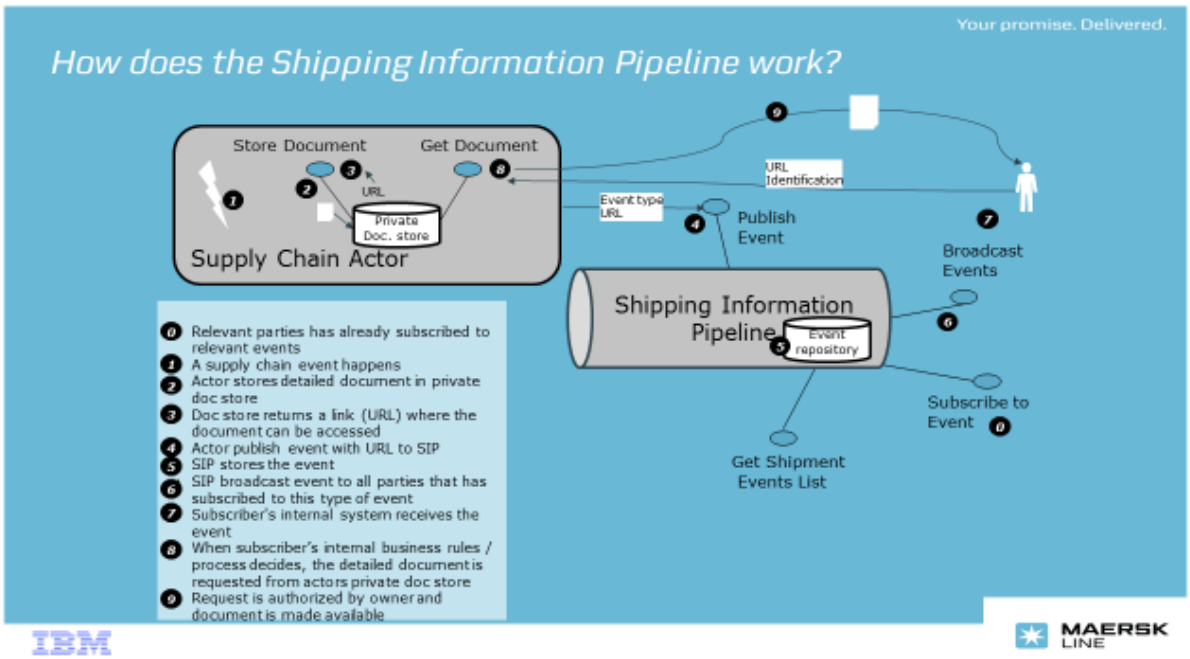
[54] https://www.youtube.com/watch?v=jqdGvjzUVNA&



Figuur 12 The shipping information pipeline. (made by Maersk)

As can be seen in the picture the functionality is mainly a ‘ thin data pipeline’ It can be used to exchange trade data /documents and meta data about these data/ documents in different It platfoms.

‘ Thin data pipeline’ means that the actual documents are not stored in the repository of the GTD. It only stores information about when events have happened and the URL where the documents/ data can be obtained. The actor that publishes the events/ data determines who can receive the published data. For security of the information about the data block chain technology is used.



Figuur 13 The 10 steps in the GTD. Made by Maersk.

In this figure the collection of messages /documents works via an external weblink. This could also be done via Portbase. So Portbase and GTD can complement each other in this perspective.

The figure shows what happens in 10 steps:
Step 0: Subscipe to events: the relevant parties can subscibe to events that are important for them. For instance, customs can subscribe to the event when the ENS has been submitted by the carriers.
Step 1: A supply chain event happens: for instance gate- in at a container terminal or container is loaded and sealed on the container completion point.
Step 2: The actor stores the detailed document in his own document store: for instance the shipper stores the packinglist in its own ERP system.
Step 3: The URL for the specific document is returned by the doc store.
Step 4: The URL for the specific document is published in the GTD.
Step 5: The event is then stored in the GTD repository.
Step 6: The GTD will broadcast the event to the relevant actors that have subscribed to this type of event. For instance the freight forwarder might have subscribed to the gate- in messages for their specific bills of ladings/bookings.
Step 7: After this the internal systems receives the event: for instance container 1234567 has arrived at APM Terminals Rotterdam.
Step 8: The systems of the subscriber for example the customs office at import can then request the detailed document, based on its own business rules, from the private actor.
Step 9: The request is validated by the owner of the data and the URL can be published when the validation is right. For instance the packing list can be published to the importer or to the customs authorities.

The key strenghts of the data pipeline are:
1. the international dimension
2. The possibility to enable access to commercial documents

The GTD has a global ambition, as can be read from the last subsections. It would allow for a global coverage but due to the local variations in countries and ports it may be challenging to capture and deal with this local complexity as part of the global GTD and next to this the identity and access management of all the different users would also pose a challenge.

5.4 Scenarios for the To-Be situation:

In this part different scenarios will be made for the three selected problems .
These scenarios show possible solutions for the problems. The scenarios tackle each problem individually and identify how Portbase, the datapipeline, or a combination can be used to address each of the identified problems individually. This would be used a a basis to derive the technology driven scenarios (in section 5.4.2.), where we look in a more holistic view from a technology perspective and we discuss how a specific technical solution (i.e. Portbase, the GTD or a combination) can solve a range of the identified problems.
Based on the technoloogy driven scenarios we are able to clearly articulate what issues can be solved by the PCS, by the data pipeline alone, and by a combination of both, and by doing this we are able to examine whether the PCS can serve as a national landing place for the data pipeline and whether or not this helps to solve the existing problems and efficiencies.

Subsection 5.4.1. handles the problem driven scenarios. Subsection 5.4.2 looks into the IT-solution driven scenarios.

Finally in subsection 5.4.3 the evaluation of the scenarios is handled.

5.4.1 Problem driven scenarios:

The table below summarizes the problems and the possible solution scenarios.
These are the problem-driven scenarios , to identify per problem what possible technical solutions are available.

Tabel 4 The problems and the possible scenarios

Problems	Scenarios
Problem 1: unloading time of the container	**Scenario1a:** Connect the freight forwarder and terminals to GTD
	Scenario 1b: Use Portbase to inform the freight forwarder on the unloading time
	Scenario 1c: Connect Portbase to the GTD and let the forwarder pull data from it
Problem 2: onward modality	**Scenario 2a:** Connect freight forwarder and terminals to GTD
	Scenario 2b: Use Portbase to inform the terminal on the onward modality
	Scenario 2c: Connect the freight forwarder to the GTD, so the freight forwarder can update the Copino 13 into GTD
Problem 5: Bad quality of ENS/TSD	**Scenario 5a:** Connect customs to the GTD to pull additional info when required
	Scenario 5b: Connect Portbase to the GTD to exchange information

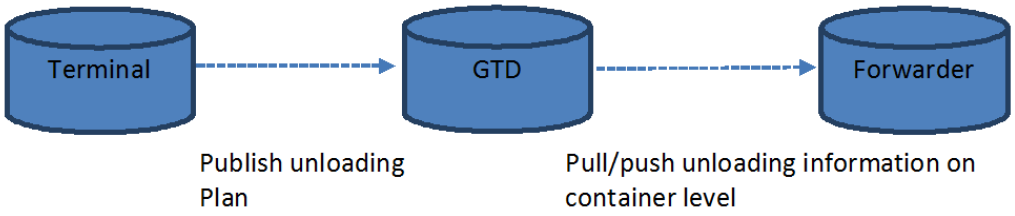
Connect the freight forwarder to the GTD , so the freight forwarder can update the Copino 13 into GTD

5.4.1.1 Problem 1. Proposed solutions to the problem of the unloading time of the container

Scenario 1a: Connect the freight forwarder and the Terminal operators to the GTD and don't make use of Portbase

In the current situation the freight forwarder does not have access to the unloading time of the container.
APMT MVII does actually communicate the time of unloading to the haulier in the services truck, barge and railplanning. (See scenario 2) The way this is communicated is via the APERAK message the hauliers gets when they pre announce the container. What happens in practice is that the APERAK is send to PCS and PCS publishes it in the user interface.

In the proposed solution the terminal operator publishes the unloading plan in the GTD and the freight forwarder takes a subscribtion on the event.
Once the time of unloading is known they can pull this information from the GTD, or even better, once unloading time is known by the terminal, an event notification is send immediately to the FF via GTD.



Figuur 14: Connect the freight forwarder and the terminals to the GTD. Made by the author.

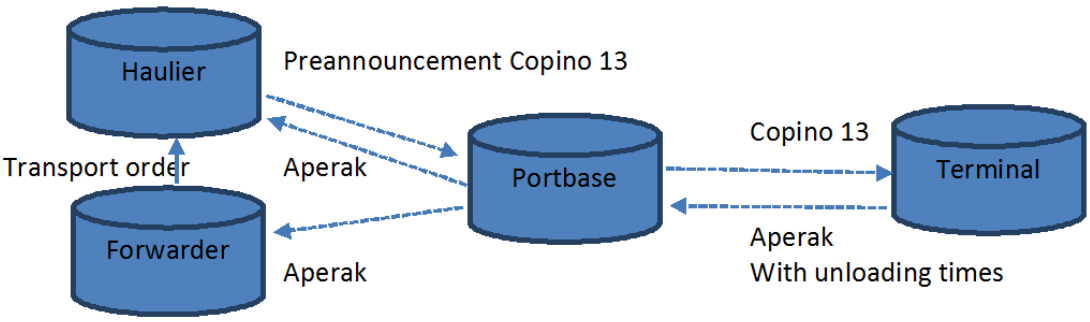
Same as in the previous subsection the advantage is that this solution does not require changes in the code at Portbase. However the disadvantage is that new interfaces would have to be developed between the forwarders systems and the GTD. This does not seem like a problem for bigger freight forwarders[55], but for the smaller ones, the SME's it can be too expensive to change the IT systems. Therefore event notification for the GTD can also be provided via a mobile app to the haulier. Next to this even the truck driver can access the data in real time via his smart phone.
And even if the bigger freight forwarders would make an investment to interface with the GTD, investing in an interface for each ports PCS is in total much more expensive than a single interface with the GTD.
There can also be thought about informing the freight forwarder about the unloading times via tradiotional telephone or e-mail. This would only be too expensive for both sides and would not create an ideal situation.

Scenario 1b: Adapt the service Ladinginformatie (cargo information) of Portbase to have the forwarders receive the unloading times.

In this scenario some changes would be made in the services of Portbase. From an interview with a business manager from Portbase the information was received that the best possible service for this is the service cargo information.
Right now, as we have seen in earlier subsections the ETA of the vessel is communicated in this service. Freight forwarders further use this service for other purposes, like checking if the container is selected by customs, checking whats declared in the TSD and for some carriers the first day of demurrage can be consulted. However using this service does not solve the key issue that ETA info is often not accurate and out-dated. Accurate ETA requires that it is updated at every event during the vessel journey (transhipment port, bad weather etc.) that can cause a delay. The GTD has an international component that a PCS does not provide. With the GTD these events are all made visible in real time, and for this reason can provide real time updates of ETA to make it more accurate when the vessel is approaching Rotterdam; i.e. the last three days before actual vessel arrival. From an interview the information was received that now Ladinginformatie also gets real time updates from Royal Dirkzwager but these updates are given from the moment the vessel can be seen on the radar, not for instance three days in advance.

Since the terminal already communicates the ETA to the hauliers in the APERAK message, the same message could also be used for cargo information.

[55] Eg the TOP 3: Kuehne & Nagel, DHL global forwarding and DB Schenker.



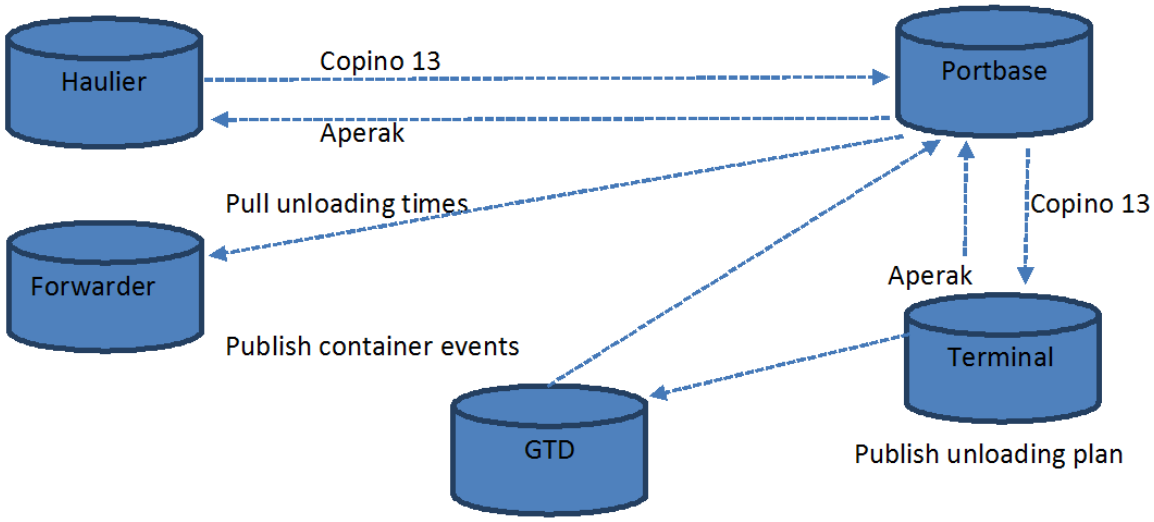
Figuur 15: Use Portbase service Cargo information to inform the forwarder aboout the unloading time. Made by the author.

In terms of ease of implementation this solution seems to be the best one. We have seen in subsection 5.6.1 that there are already interfaces built between the freight forwarders and Portbase, between the hauliers and Portbase and the terminals and Portbase.
The only extra change to be made here is that a message that is already published to a certain user group (hauliers) can be shared with another one (freight forwarders).

The disadvantage in this solution is that there is no connection with the GTD here. Other painpoints were identified (Appendix 3) which might not be able to be solved by Portbase. This research focusses mainly on the problems experienced by terminal operators. Further research could take a more detailed look on the other problems /painpoints identified and investigate if the GTD can solve these.

Scenario 1c: Connect the services of Portbase to the GTD and let Portbase update the data from the terminals, in particular the unloading times in the GTD.

In this scenario the proposed solution is that a freight forwarder can subscribe to the events of containers via Portbase. The terminal operator publishes the unloading plan into the GTD and with a link to Portbase the forwarder gets a message with the expected time of unloading. This gives the freight forwarder a jump start when planning the delivery. Instead of being reactive they can be more proactive in making their process of planning.
Just as in the other solution the terminal only needs to publish the event in the GTD and not to all the individual freight forwarders.
The terminals already have an EDI connection with Portbase and the forwarders can access data from Portbase already in the current situation either via EDI, via the user interface or via webservices.



Figuur 16: Portbase connecting the Port community to the GTD. Made by the author.

Another solution could be that every terminal operator develops its own solution but this would complicate the matter even more. On their public websites terminal operators could publish their expected unloading times. This means that supply chain actors get data from even more different sources.

The advantage of this solution is that it only takes a minor change in the systems of Portbase to publish the uloading times for the freight forwarder. And another advantage is that it does not bypass the PCS like in solution 1.

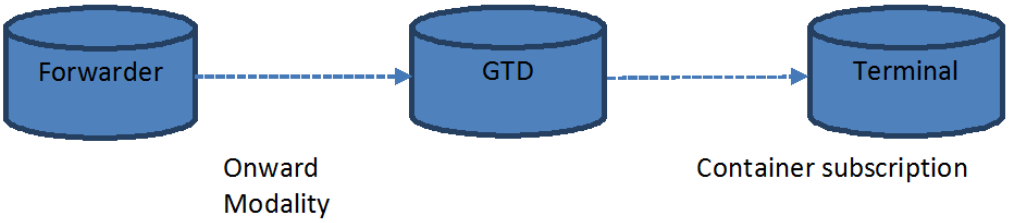
The disadvantage is that the added value compared to scenario 2 is hard to find. If Porbase can already publish the unloading times without using data from the GTD, whats the extra use of the solution then?
On the other hand an advantage of this solution is that a connection betwee the terminal and the GTD will be made so that important events that are published by the terminal could be shared with other interested parties in the supply chain.

5.4.1.2 Problem 2. Proposed solutions to the onward modality problem

This subsection will describe proposed solutions to solve the problem for the terminal operators timely need of the onward modality.

Scenario 2a: Connect the freight forwarder and the Terminal operators to the GTD and don't make use of Portbase

In this scenario the GTD is connected to the systems of the terminal operators and of the freight forwarders.
The Freight forwarder, once the information is known, sends a message to the GTD with the intented onward modality.
The terminal operator has a subscribtion on the container and pulls the information from the GTD and uses this to make the planning and stack the container.

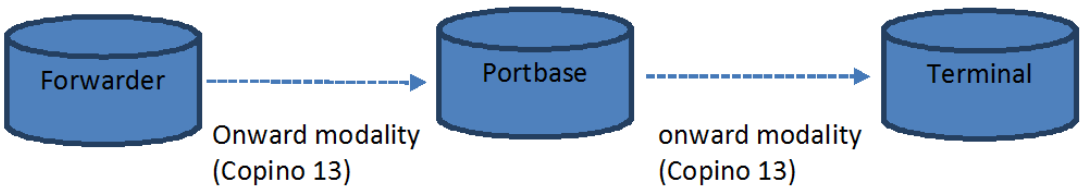


Figuur 17: Connect the freight forwarder and the terminals to the GTD. Made by the author.

The advantage of such a solution is that is does not need any changes in the current processes at Portbase. The services can stay the way they are and not the whole market needs to be involved in the change.
The disadvantage is that all the freight forwarders would need to built an interface between their software and the GTD. Smaller freight forwarders specifically wil not be able to invest in interfaces and would need a user interface to enter the data manually in the GTD. The GTD has smart phone apps making it possible to enter data manually. For instance the mobile app for trucking companies, with which container status info can be entered by the truck driver. The situation is comparable with Portbase. Smaller forwarders can use the Graphic user interface (GUI) where larger ones can develop their own interfaces to communicate with the PCS.
Next to this the terminals also need an interface with the GTD. In Rotterdam there are only five large container terminals so this seems acceptable.

Scenario 2b: Make use of Portbase and develop a new service to inform the terminal about the next modality

In this scenario the GTD is not connected to Portbase and neither to the individual systems of supply chain actors. The GTD will in this case not be used to solve the onward modality problem but the PCS is.
To solve the problem for terminals to get the onward modality from the freight forwarder a new service can be developed. [56]In the current state only the hauliers can send the onward modality to the terminals with the so called Copino 13 message. By making a change in the PCS freight forwarders will also be able to do this.



Figuur 18: Figure 18: Make use of Portbase to let the freight forwarder communicate the onward modality with the terminals. Made by the author.

[56] Currently terminals get the onward modality from the carier in the discharge list and from the haulier in the pre annoucement.

The advantage of this solution is that it is the easiest way to solve the problem. The terminals already have connections via EDI with Portbase and so so the freight forwarders. (And smaller freight forwarders can use the GUI of Portase.)
From an interview with Portbase we learnt that APMT does not have a specific interface with Portbase. APMT makes uses of the standard developed services of the PCS and communicates via EDI with PCS.
The costs to connect to a service of Portbase are to be divided into two categories:

1. The development costs of the service as a whole
2. The initial connection fees.

Ad1 The development costs of the services are paid by Portbase. For every new service and every change in an existing service Portbase makes a business case. In the business case the development costs are calculated. The investments are earned back via subscribtion fees and a fee for each transaction. This also works the same with GTD, for every message a transaction fee is calculated and invoiced to the user.
Ad2. These are costs made to set up the connection. In particular to fill In the MIG[57], test the messages, etc. This works the same with the GTD.

This has been checked with an expert of APMT and is confirmed. For every new EDI connection to be made some initial costs are made for the setup. This is also required when a new clients needs to be connected and is built up of the hours needed by the EDI expert of APMT'S It department.

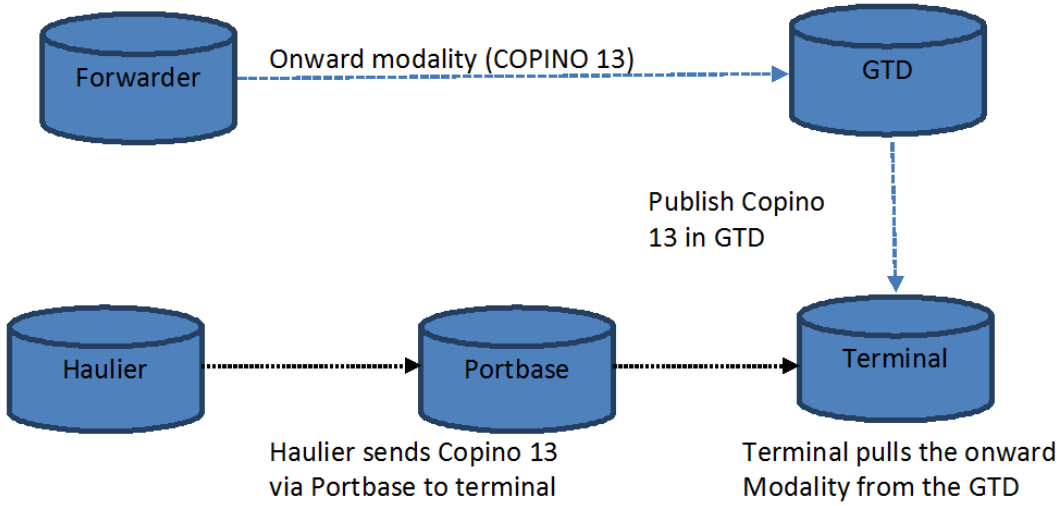
From a cost perspective this solution is probably the best one. Portbase would have to investigate and calculate the amount of work to be able to change the code of the service and make the solution possible.
The expectation is that is would merely increase the costs compared to the current situation.

The disadvantages of this solution are 1) that it does not solve the other problems that the GTD can solve. To implement the GTD successfully in Rotterdam some way of connection to the supply chain actors IT systems would be needed. 2) the freight forwarder needs a new interface for every port, because the PCSs are not interoperable with each other. GTD is a global system, so the freight forwarders only need to make the interface costs once and can re-use it for every port they need.

Scenario 2c: Connect the freight forwarder to the GTD , so the freight forwarder can update the Copino 13 into the GTD.

The proposed solution is to let the freight forwarder update the onward modality into GTD.
GTD then sends this information to the terminal so the terminal can use it for planning purposes.
In this solution the current systems of pre-announcing a container can be kept as is.
The terminal just needs to take a subscribtion on the events of the specific containers. (Which they already need anyway)

[57] Message implementation guide



Figuur 19: Freight forwarder sending the COPINO 13 message via GTD to the terminal. Made by the author.

From the introduction on the GTD, Henrik Jensen of Maerk line said that the GTD is not going to develop the services. It only provides the infrastructure that several actors can connect to.
It wil also be a thin data pipeline. This means that there will be no storage of documents or information in the pipeline. Only the URL weblink will be published and the event can be seen at the publisher.

As indicated before Portbase has about 4500 customers. If all these customers would have to connect to the GTD that would mean a vast amount of communication must be done to connect these customers. Besides this, Portbase now also acts as a platform for identity and access management. This can be an advantage for GTD, because GTD then does not have to make this again for the 4500 Portbase customers.

In this solution only the terminals and freight forwarders would have to connect to the GTD and not all the different Portbase customers.
Since the GTD is an international infrastructure it is advisable to have the Port communities all over the world play a role in the GTD on a local level.
PCSs have already a lot of know how on a local level and have the support and trust of their port communites. Trust is always an important motive for new initiatives like these to succeed.

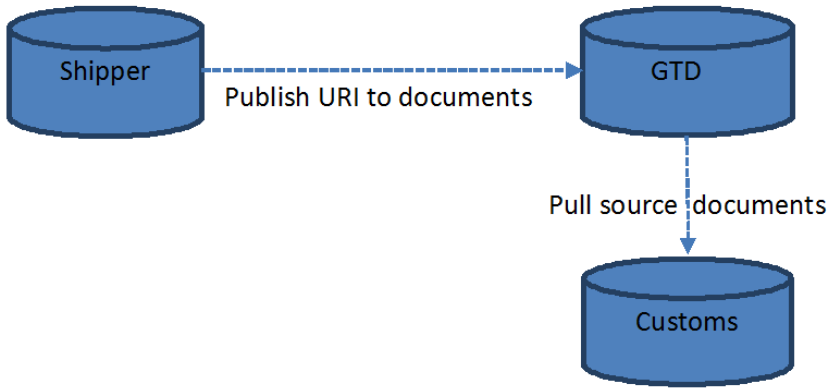
The advantage of this soluton is that the Freight forwarder can send the event to the GTD. It does not require changes in the programming of Portbase.
For the connection of the GTD with the Terminals IT systems new interfaces might have to be developed.
This depends on the technology that will be used by the GTD.

The disadvantage of this solution is that it is unsure what the costs are to connect the terminals and freight forwarders to the GTD. That is depending on the used technology and the types of messages to be exchanged. It is assumed that the costs to connect to GTD are the same as the connection costs with Portbase.

5.4.1.3 Problem 5. Proposed solutions for the bad quality of the ENS and TSD resulting in delays and false positives.

In this subsection scenarios for the problem of the quality of the ENS and TSD will be described.
The case in practice in Rotterdam is that these declarations are submitted to customs via Portbase. Portbase transforms the data in a format that can be read by customs and forwards the information to Dutch customs.
On the basis of this information customs performs the risk analysis.

Scenario 5a: Connect customs to the GTD to be able to pull better information from it to perform their risk analysis.



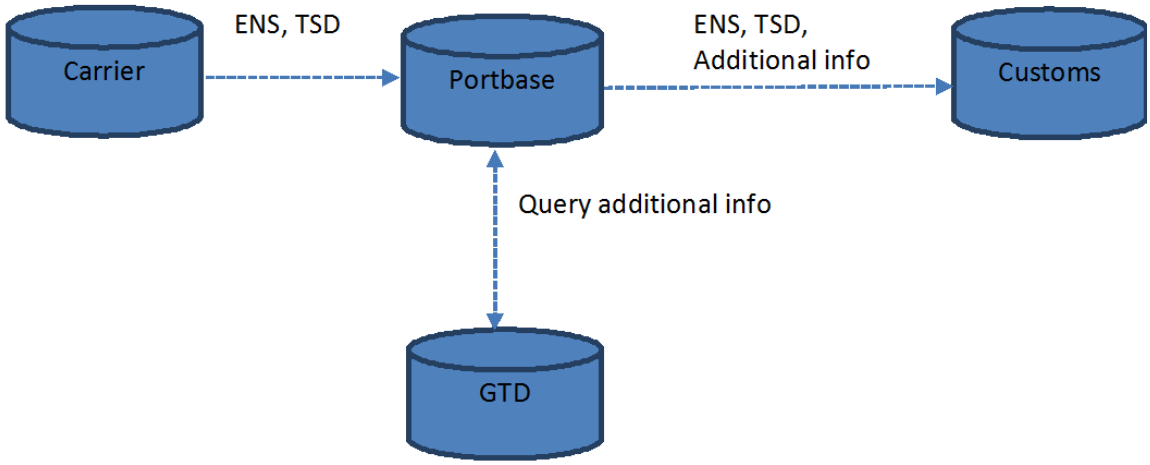
Figuur 20: Proposed solution to get source data from the GTD. Made by the author.

In this scenario customs will be able to subscribe to events pusblished in the GTD to be able to get data from the original source when required.

Via a dashboard customs can look into the shipment documents.
The main advantage for this solution is that is simple. Other supply chain actors don't have to change their IT systems to be able to make these documents available to customs. On the condition that every actor is connected to the GTD an uploads the source documents in it.
Extra phonecalls or e-mails will no longer be necessary. When the risk tool ' Prisma' encounters the problem of an unknown shipper or consignee the customs officer get informed about this and can decide to check the details of the shipment In the GTD.

The disadvantage of this solution is that it requires customs to look into two different it systems.
It could be made easier if the customs officer could obtain the information directly from Portbase.
That is the basis of the second scenario.

Scenario 5b: Connect Portbase to the GTD to exchange information with each other.



Figuur 21: Proposed solution to get source data from the GTD through Portbase. Made by the author.

In the above mentioned situation customs does not need a separate link with the GTD. They can automatically pull information from the GTD and publish this for customs.
The other way around Portbase can broadcast the events in their system to the GTD. So if the carrier has submitted the entry summary declaration this event can be published in the event ledger of the GTD and interested (and authorized) parties can access this information.

Portbase stays the local solution for the data exchange in the supply chains, carriers can still submit their TSD declarations via Portbase to customs. Actually Dutch customs is already builing the so-called 'customs dashboard' (this information was received from in interview with a project manager from customs) which works as an interface for GTD and possible other data pipelines. With this dashboard customs can pull the additional documents like pro-forma invoice, container packing list etc. from the source parties at the country of origin. So for this, from Dutch customs perspective, no intervention from Portbase is required. It would require an extra implementation costs if they would have to built an extra interface with Portbase to collect these additional documents.

5.4.2 IT Solution-driven scenarios

In the previous sections the possible problem driven scenarios were described. From these scenarios the below table can be drawn. It answers the question which problem can be solved by which system.

The technology driven scenarios allow to look in a holistic view at a whole range of problems and see which of these could be solved by PCS only, GTD only, or a combination. This is usefull from an investment point of view. As parties are confronted with problems and the question is whether they need to invest in PCS only, in GTD only or combined solution to address these problems.
Further the technology driven scenarios offer overview of what is possible based on each scenario and pros and cons for the different alternatives are discussed.

These arguments are made analytically. In the next section, the scenarios and argumentations are validated by experts.

Tabel 5: Which problem can be solved by which system.

IT-Technology	Problem	Scenario
Portbase only (first technology solution)	1	Scenario 1b: Use Portbase to inform the freight forwarder on the unloading time
	2	Scenario 2b: Use Portbase to inform the terminal on the onward modality
GTD only (second technology solution)	1	Scenario 1a: Connect the freight forwarder and terminals to GTD
	2	Scenario 2a: Connect freight forwarder and terminals to GTD
	5	Scenario 5a: Connect customs to the GTD to pull additional info when required
Combination (third technology solution)	1	Scenario 1c: Connect Portbase to the GTD and let the forwarder pull data from it
	2	Scenario 2c: Connect the freight forwarder to the GTD, so the freight forwarder can update the Copinon 13 into GTD
	5	Scenario 5b: Connect Portbase to the GTD to exchange information

As can be seen from table 5 several technological solutions are possible.

Portbase only scenario

1. Solution 1 is that Portbase is expanded and improved to further addres the situation in the port.
   Portbase can solve the first two problems without drastically having to change its infrastructure.
   The additional information can be obtained from existing services or from services that are already in the planning.
   By using Portbase no new interfaces are needed as every actor in the port of Rotterdam is already connected in some way to the system.
   The fundamental problem that Portbase can't solve is that PCSs are not able to collect additional documents such as pro-forma invoice, container packing lists etc. from the country of origin to cross-validate the accuracy of the ENS and TSD. This can only be done by a global data pipeline such as GTD.

GTD only scenario

2. Solution 2 is that the GTD is introduced without any link to Portbase. The GTD can connect every actor with each other and could solve all three problems. The onward modality could be uploaded in the GTD and be pulled by the terminals. The moment of unloading of the container the same, only then pulled by the freight forwarder. The ENS/TSD problem could be solved by having customs pull information from the GTD for risk assessment purposes.
   The downside of this solution is that every actor would have to connect with the GTD. This will give an issue with thousands of users that have to connect and the costs involved to this. Besides this there are costs involved relasted to accumulating and capturing local knowledge for the specific country or port. Finally there is the issue how to arange the identity and access management for all the users.
   The situation in Rotterdam is comparable to the situation in Antwerp , Hamburg, and basically every modern port in the world.

If the GTD would really want to become a system of systems the easiest way would be to have the data pipeline connect to the local PCSs.

Combined Portbase /GTD scenario

3. Solution 3 is that the GTD connects to Portbase and to the container terminals. For the two first problems this would probably not be the easiest solution. Most likely it would be better that the first two problems are solved by the PCS. However, the third problem can't be solved by Portbase. So if we look into problem three there are two scenarios thinkable. Both are possible by the easiest one would be to connect the GTD to Portbase. Customs already has a link with Portbase. If Portbase can pull additional information from the GTD , Dutch customs does not need any extra link with the GTD.
   This solution can solve the three problems combined an take in account the fact that Portbase is already heavily in use in Rotterdam.
   Besides the argument can be made here that if problem 1,2,3 and 5 are solved the problem with the internal moves (problem 4) will also be addressed.

Based on the previous subsections we can formulate the following observations:

- If the Portbase only solution is chosen just two of the three problems can be solved. A Port community system has the limitation that it is based on a local Port community in one country. (see the literature section) There is *no international component* which provides the possibility to obtain source documents from the country of origin.
In most European ports, PCSs emerge from local communities. (Baron and Mathieu, 2013).
One could argue why the problem with the bad quality of the ENS/ TSD is important for container terminals operators. From interviews information was received that the scan inspection processes at container terminals in Rotterdam already works quite well. However by getting better ENS quality the false positives inspections will decrease and this has a positive influence on the whole community.

Arguing further to the missing international component the question is how successfull the integration of the PCSs would be. From an interview the information was obtained that the IPCSA does indeed talk with the different PCSs about interoperability between PCSs.
Baron and Mathieu (2013) have written that when connecting variuous PCS, many actors fear the arrival of new competitors.

The second technical solution could be to use the GTD only. GTD has the ability to solve all three problems individually. GTD has the *international component* and can store and distribute *documents from the source*. The problem with the GTD only scenario is that the implementation will be very complex for a number of reasons, i.e.

- lack of local knowledge; if they have to capture this local knowlegde for every port globally that would lead to a lot of costs and complexity
- Lack of installed base of users in specific countries, (GTD would need to built interfaces to thousands of users in different countries) PCSs already have this installed base
- Identity and access management. Operating on a global level GTD does not have a national trusted network of users. PCS do have such a trusted network and have already arranged the identity and access management

PCSs as they have emerged from local port communities have a *lot of knowledge and experience on a local level.* They have emerged because of fragmented markets , because building an inter-organizational information systems requires working with all port users and because such a project requires working with all port users. (Baron and Mathieu, 2013)

In other words PCSs have a lot of know how and experience on the local /national level.
Their added value for the GTD is that if the GTD would have to gain this local knowledge it would take them years to obtain this.

Another argument is that Portbase has many, many users in place. They have an identity and access management policy in place to allow the users to access the PCS services. (subsection 5.3.1)
If the GTD would have to identify all these users it would add to the complexity.

The third solution is to combine the two systems. We argue that this is the best solution to succeed. This is based on the following: The combined solution can solve all the identified problems.
On the one hand the strengths of Portbase can be used. So that is 1) the knowledge and experience on the local level and 2) the identity and access management can be used to have the community access the services of the PCS and of GDT. 3) already existing connections to thousands of users who are already connected to the PCS.

On the other hand the GTD complements the services of Portbase because of the following strengths:
1) The GTD has the international component. The system is developed to exchange information on a global level , not only in one port community / country.
And even if the Port Community systems would become interoperable this could also lead to resistance. We have seen this in the article from Baron and Mathieu (2013). PCSs fear for new competitors threatening their existence. If the GTD would be used to connect the different PCSs together every PCS can keep its own local presence.
Portbase has the aim, together with the community, to become the Smart ports of Europe. (section 5.3.1.2) However to be able to get full visibility, all Port communities in the world should be able to capture and share relevant events and make available information about commercial documents.

2) the second strength that the GTD adds to Portbase is that it can make available and exchange information about commercial documents from the country of origin. (see figure 13)
Portbase does not provide this, but , for a smooth process at import, customs do require these documents to cross-validate the declarations.

Concluding the argumentation above we analytically argue that although the GTD seems to be able to solve the problems without Portbase, due to the implementation issues PCS can play a very important role to act as a landing place for the data pipeline because of:
1. the local knowlegde they capture
2. The installed base of thousands of users who already are connected
3. The identity and access management that is arranged as part of the operating practices in place to work in a trusted community.
Therefore we advocate that for a succesfull GTD implementation in the port of Rotterdam, Portbase can be used as a national landing place so these three challenges can be met.

The next section these findings and the scenarios are further validated with experts

5.4.3 Evaluation of the artifacts by experts:

In this section first the problem-based scenarios are evaluated with experts, i.e. how PCS, GTD or a combination can solve an individual problem and what experts think about these scenarios.

Second, the evaluation is made on the technology-based scenarios to show a holistic view, i.e. to what extent PCS, GTD or a combination can solve a whole range of problems.

As a result we validated with experts the conclusions that were analytically derived regarding the role that the PCS can play as a landing place for the data pipeline (section 5.4.2) and the final conclusions for the research problem are derived for the research question.

Tabel 6: Problem-based view

Problems	Scenarios	Evaluation
Problem 1: unloading time of the container	**Scenario1a:** Connect the freight forwarder and terminals to GTD	Apmt: This scenario is not likely because of the integration level of Portbase. Portbase: This scenario does not have the preference from Portbase perspective
	Scenario 1b: Use Portbase to inform the freight forwarder on the unloading time	Apmt: We already do this in a pilot for the haulier. If the freight forwarder needs this information Portbase needs to adapt their services. Portbase: We have the information and can make it available to every actor that needs it.
	Scenario 1c: Connect Portbase to the GTD and let the forwarder pull data from it	Apmt: We think Portbase should be connected to the GTD because of their local integration. Portbase: This is very well possible. Portbase is an integrator and can connect to any platform.
Problem 2: onward modality	**Scenario 2a:** Connect freight forwarder and terminals to GTD	Apmt: Again this scenario is not likely because of Portbase. Portbase: Same as scenario 1a
	Scenario 2b: Use Portbase to inform the terminal on the onward modality	Apmt: We support this scenario. From the initial moment the terminal opened we have asked the FF to advise us the onward modality. Portbase: Please take into account that this scenario works well for Merchant haulage,but not for carrier haulage.
	Scenario 2c: Connect the freight forwarder to the GTD, so the freight forwarder can update the Copino 13 into GTD	Apmt: We think this scenario is the best. Since APMT will most likely integrate with the gtd and the integration with Portbase is already made it will help integrating all systems. Portbase: Depending on the technique of GTD we agree on this scenario.
Problem 5: Bad quality of ENS/TSD	**Scenario 5a:** Connect customs to the GTD to pull additional info when required	Apmt: The problem with the bad quality of the ENS/TSD is not of interest for us. Portbase: This scenario looks strange to us. Every shipsagent submits their

		TSD via Portbase so this would require customs to view in a different platform.
	Scenario 5b: Connect Portbase to the GTD to exchange information	Apmt: The problem with the bad quality of the ENS/TSD is not of interest for us. Portbase: Indeed Portbase was nog designed to distribute source documents so the GTD could be of extra benefit for us.

The table below shows the evaluation with the experts of the technology based scenarios.

Tabel 7: IT-solution based view

IT-Technology	Problem	Scenario	Evalutation
Portbase only (first technology solution)	1	Scenario 1b: Use Portbase to inform the freight forwarder on the unloading time	Apmt: This is fine for us, if we get the onward modality in return. Portbase: This is possible. We are now developing the service track and trace which would be fit for this purpose.
	2	Scenario 2b: Use Portbase to inform the terminal on the onward modality	Apmt: This would really help improve the yard planning. Portbase: Same feedback as on scenario 1b.
GTD only (second technology solution)	1	Scenario 1a: Connect the freight forwarder and terminals to GTD	Apmt: We think that this is not likely to happen. Portbase has the trust of the market. Portbase: This would mean every ff and terminal would need to connect to a different platform where Portbase was the basis.
	2	Scenario 2a: Connect freight forwarder and terminals to GTD	Apmt: We think that this is not likely to happen. Portbase: see scenario 1a.
	5	Scenario 5a: Connect customs to the GTD to pull additional info when required	Apmt: this is not of importance to terminals. Portbase: we would recommend to integrate with Portbase here.
Combination (third technology solution)	1	Scenario 1c: Connect Portbase to the GTD and let the forwarder pull data from it	Apmt: This is a good scenario , we expect this to happen in the near future. Portbase: We can integrate with any platform. We have a lot of experience as integrator.

	2	Scenario 2c: Connect the freight forwarder to the GTD, so the freight forwarder can update the Copino 13 into GTD	Apmt: This would mean that we do not need to integrate with additional systems. Portbase: This is possible , however it seems more easy to use a new service of Portbase for this purpose.
	5	Scenario 5b: Connect Portbase to the GTD to exchange information	Apmt: this is not of importance to terminals. Portbase: Technically it is possible to publish the URI via Portbase. Integration depends on the technique used by GTD team.

Reflection on the evaluation: Details about the evaluation can be found in the above tables 6 and 7. We will not repeat this but interesting observations from the evaluation of the problem driven scenarios are:

The scenarios were agreed on by the respondents. As could be expected both APM Terminals and Portbase did not prefer a solution where GDT would be implemented separately from Portbase.
In regards to the updating of the services to solve problem one and two, Portbase confirmed that some services are already in revision. An example is the ETA of the container. Portbase basically responded that they have the information available and are able to distribute it with everone who needs it.
For the other problems they responded that there are several services that can be used to inform the terminal about the onward modality. The response from the writer was that if there are several services to do this, then how come that the problem is still unsolved.
Portbase took notice of this argument and said that a new to be developed service 'track and trace' could provide the solution.

The problem with the quality of the ENS/TSD was questioned by APM Terminals respondents. Both APM Terminals respondents felt that the problem with the bad quality is not the problem of the terminal operators.

The reaction of Portbase was that it would be very strange if the GTD would be directly accessed by the customs authorities to obtain additional documents.
100 % of the shipsagents submit their TSD via Portbase to customs. This would mean that customs would need an additional platform to obtain the souce documents.

Some important observations from the technical solutions are:

Portbase only solution: Both the experts from APM Terminals and Portbase agreed that Portbase could solve problem one and two.
It seems like the easiest way to solve these specific problems.

GTD only solution: It was agreed that the GTD has the ability to solve all three selected problems. However, this solution does not seem feasible.
Portbase has the trust of the market and all the local players know them.

The expert of Portbase noticed that every actor would have to make use of two different platforms, Portbase and GTD.
This confirms the analysis made in subsection 5.4.2.

The combination solution:
Both APM Terminals and Portbase agree that this solution is possible. From APM Terminals perspective the solution is feasible because it would mean they do not need to integrate with every individual forwarder. This was also one of the intitial objectives of the Portbase Port community system. To connect every actor via one single point of contact.

Portbase said that they can integrate with every system they need to. Portbase has a lot of experience with integrating systems. Either via EDI, XML or via an API gateway.
Not only are they able to connect to the GTD but also to other data pipeline solutions.
An interesting observation is that Portbase confirmed that technically they are able to publish the URI to a document. But this is not the original aim of Portbase as one of their objectives is to digitize documents were possible.

The conclusion from the expert validation is that the findings regarding the role of Portbase as a landing place for the GTD that was derived analytically is confirmed by the evaluation of the experts. Two of the three problems can be solved by the Portbase solution alone. Problem three can only be solved by either the GTD alone or the combination. The solution of the GTD alone is however not likely to happen so using Portbase as a landing place for the data pipeline is confirmed.

Chapter 6: Conclusions and recommendations

6.1 Introduction:

This is the concluding chapter, which provides conclusions and recommendations for this thesis. The first subsection will formulate answers to the main research question and the research subquestions.
After this section the main findings are explained and the conclusions are given. Then the next section explains the limitations of the research and gives recommendations for further research. The next subsection explains how the main findings of this research contribute/ expand to the main research publications that were used as a basis for this research and in the final subsection an explanation will be given how the findings can be used by the problem owning organization and other stakeholders.

6.2 Conclusions:

The research objective was to investigate how Portbase can be linked to the international data pipeline and what advantages this can bring / what problems it can solve that can't be solved by the Port community system.

Based on the research objective the research question was formulated:
The main research question is:

Can Portbase be seen as an example of a landing place for a data pipeline and how can Portbase be connected to a data pipeline such as the global trade digitization?

In order to be able to answer the first research question three research sub questions were formulated. Below section formulates the answers to these research questions based on the research.

Subquestion 1: What is the difference between a data pipeline and a Port community system?

To be able to answer this research question we formulated the definition of a Port Community System and of a data pipeline.

The definition of a Port Community System according to the IPCSA is: a neutral and open electronic platform enabling intelligent and secure exchange of information between public and private stakeholders in order to improve the competitive position of the sea and air ports' communities.

The definition of a data pipeline according to Overbeek et al., 2011) is: the data pipeline is a concept based on the use of service-oriented architectures to enable access to the existing information systems that are used and operated by the various parties in global supply chain.

Further Zomer et al."(2014) define the data pipeline as: The global data pipeline is an enabling infrastructure to achieve connectivity to accurate source data.

We can see from these definitions that there are similarities and differences between both concepts. Both concepts enable the exchange of information between supply chain actors. However the Port Community systems have a focus on the ports in a specific country in contrary to the data pipeline that has a focus on the global supply chains.
If we look at the other definition the data pipeline enables to obtain source data. In particular this concerns commercial documents, like pro-forma invoices, packing lists etc. wich are important to be used by customs to cross- validate TSD declarations. A port community system does not provide this. The reason is that a Port community system does not exchange commercial documents.

Another fundamental difference between PCS and GTD is that a PCS can only exchange data at national level within one country, or sometimes even only within one port. The data pipeline can collect data/documents such as for example pro-forma invoice, packing list from parties at the country of origin. These documents can then be used to cross-validate the ENS, TSD or import declaration for improved risk-assesment by customs at import in the country of destination of the goods. A PCS typically does not exchange data that originates from outside their own county, so typically no documents from the country of originnabout the goods imported into the Netherlands.

Based on the findings from the research the limitations of Portbase are:

- Portbase can't provide the international dimension to exchange information/ data. Portbase serves primarily the port community of Rotterdam and Amsterdam. That means that events en-route from other ports can't be published in the system. For instance the information from the port of loading or from transhipment ports. And also no information such as pro-forma invoice / container paking list about the Consignment Completion Point (CCP) of stuffing and sealing the container in ht ecountry of origin. In hesketh (2009,2010) it was extensively argued that these key source data documents from the CCP origin are essential for customs in the country of destination of the goods to cross-validate inaccurate import declarations for these containers/goods. At the moment Portbase is talking with the IPCSA to investigate how the Port Community systems of Europe can become interoperable. Portbase indicates that if the PCSS are interoperable they can use information from other ports to enrich the data in Portbase. Unfortunately Portbase only talks about interoperability with the ports community systems of Europe. To get the full visibility Portbase should also become interoperable with ports from outside Europe, like eg. Shanghai. Besides this the succes of the interoperability can be quiestionned. Port community systems mostly have emerged as proprietary systems. From research from Baron and Mathieu (2013) there was a finding that most PCS operators fear the interoperability because when PCSs are connecting to each other they fear for the arrival of new competitors. PCS operators have managed this by developing separate and independant platforms.
- The second limitation is that Portbase does not provide access to and exchange information about commercial documents available from the country of origin. Customs requires these documents as they contain information that customs can use for cross-validation of the ENS/TSD declarations. For an efficient customs process at import it is essential that customs can access the additional document when required.

Further from the research the strong points of Portbase were identified, these are:

- Portbase has a lot of know how and expertise of the complex information exchange on the local level. Even though the main legislation and regulations that memberstates in the EU have to comply with are the same, the way the implementation is done is implemented different in every country. An example of this is that in Belgium the complete port had one temporary storage license where the administration was managed by the customs authorities. Where in the Netherlands every terminal has its own Temporary storage facility license and the terminal manages the administration. (this was before the UCC came into force) Another example is the audit file. Terminal operators in the Netherlands have to supply an audit file to customs where all the container movements are registered from their TOS. German terminal operators don't have this. The services of Portbase are the result of years of cooperation between all the different actors in the port community. There are local arrangements of the planning of the onward modalities. Portbase is able to capture the national specifics.
- The second important strength of Portbase is that is has thousands of users in place, hence a large installed base.
- Portbase has an identity and access management in place to allow the community members to access the services of the PCS>

Subquestion 2: Identify bottle neck processes at APMT MVII that delay the container handling process and could be solved by collecting more accurate and/or timely data via a data pipeline solution?

From the research several bottle neck processes are identified for APMT MVII. In the workshop on the GTD several bottle necks were identified, a list of these issues was composed and added to this thesis in Annex 3. Also bottle necks that are having consequences for other actors were identified in this workshop.
Next to the workshop bottle neck processes were identied from other sources. These sources are from interviews , from empirical observations and from documents.

To identify the main processes to delay the container handling process further interviews were held and this resulted in the identification of three processes that could be solved by collecting more accurate and/or timely data via a data pipeline:
1. the unloading time of the container.
2. to obtain the onward modality of a container for better yard planning
3. bad quality of the ENS/TSD resulting in false positive inspection of containers.

The problems were used for the formulation of the TO-BE scenarios and the evaluation of the TO-BE scenarios confirmed that the combination of both the PCS with a data pipeline solution could solve these bottle necks were the individual systems could only solve part(s) of them.

These scenarios are: (divided by the three problems they can solve)

Problem 1: unloading time of the container

Scenario 1a: Connect the freight forwarder and the Terminal operators to the GTD and don't make use of Portbase: This scenario means that the FF and terminals connect to the GTD. The terminal publishes the expected time of unloading of the container in the GTD based on the bayplan and the FF can pull this information directly from the GTD.

Scenario 1b: Adapt the service Ladinginformatie (cargo information) of Portbase to have the forwarders receive the unloading times: This scenario means that the service ladinginformatie from Portbase is updated. FF can at this moment see in this service when a vessel has arrived and when a container effectively is unloaded. But with some adaption in the services it could also display the expected time of unloading for the FF.

Problem 2: onward modality

Scenario 2a: Connect the freight forwarder and the Terminal operators to the GTD and don't make use of Portbase: This scenario is the same as scenario 1a. Both the freight forwarders and the terminals connect to the GTD. The freight forwarder, in return for the Unloading time of the container publishes the onward modality as soon as they know it in the GTD. Terminal operators can then pull the onward modality from GTD for Yard planning purposes.

Scenario 2b: Make use of Portbase and develop a new service to inform the terminal about the next modality: This scenario makes no use of the GTD. A new service is developed by Portbase where the next modality can be communicated to the terminal. No new connections, identity and access managment etc has to be done in this scenario. However Portbase would have to develop a new service which probably only the terminals would use.

Problem 5: Bad quality of ENS/TSD

Scenario 5a: Connect customs to the GTD to be able to pull better information from it to perform their risk analysis. In this scenario customs connects with an interface to the GTD. If an actor published a commercial document in the GTD , the customs authorities can download it. This way customs does not have to individually approach every different actor for the commercial documents to cross validate the ENS / TSD/ Import declarations.

Scenario 5b: Connect Portbase to the GTD to exchange information. In this scenario Portbase connects to the GTD. Customs receives the ENS/TSD via Portbase and can also get access to the additional information via Portbase. Information was received from Dutch customs that they have actually developed a dashboard to obtain the source documents directly from the GTD. However we argue that this is a task that could also be done by a Portbase community system. Possibly in another port.

Subquestion 3: What are the advantages for the community if Portbase is connected to a data pipeline such as the global trade digitization?

The advantage for the community is that the connection between a data pipeline and Portbase can solve problems that can't be solved by Portbase alone. If we look back in the literature from Hesketh (2009,2010) he stated that the problem of not knowing who packed the box causes the bad quality of the ENS. Port community systems alone are not able to solve this problem.
Data pipelines, like the GTD, have the additional value compared to PCSs that they can provide access to source data.
This way customs has direct access to data from the souce, in other words, from who 'packed the box'.
Basically the GTD has the technical ability to solve all the different problems, but, because of the local complexity in each port, the chances of success are much bigger when making use of the local expertise and know how of Portbase.

PCS has the advantage that they already provide a complete identity and access management system for data pipelines. For Portbase this consists of a system for their 4500 customers. And in other ports PCS have systems that also have thousands of companies in their country. Data pipelines can greatly benefit from re-using the existing identity- and access management systems from the national PCS, and it saves them enormeus efforts and costs to dvelop these systems themselves for all the hundreds of large international ports world-wide they are connected with.

The GTD can be seen as an example of a data pipeline because the solution is intended to connect the different IT systems of the different actors in the supply chain. The GTD solution enables the real time exchange of original supply chain events and documents through a digital infrastructure, or data pipeline, that connects the participants in a supply chain ecosystem. The GTD is a thin data pipeline, whicch means that the actual documents are not stored in the repository of the GTD. It only stores information about when events have happened and the URL where the documents/ data can be obtained.

The answers of the research subquestions and further information from the research results in the following conclusions:

- a part of the messages that are important for international supply chains are already arranged by Port Community systems

- a Port Community system, in particular Portbase provides an important addition for data pipelines because they can be used for their experience with access and identity management in local ports or airports

- a Port Community system does not provide the possibility to gain access to source documents like, e.g. E-invoices or packing lists. The data pipeline can do this, so the data pipeline can enrich a PCS. This enrichment of PCSs by GTD is possible, because PCSs can only exchange data/documents at national country level, whereas data pipelines, like the GTD, can facilitate access to data/documents at global level and across countries. In addition, PCS typically do not have access to commercial data/documents such as invoices, packinglists, etc.

- Port community systems can't be completely replaced by data pipelines because of the local complexity in every port or airport.

- The IPCSA has the ambition to connect the PCSs in Europe to each other. However, by using a data pipeline, like the GTD , more benefits can be achieved. The benefits are access to source data/documents and updates from events all the way through the supply chain. For instance delays because of unplanned transshipment can be obtained from the GTD, not from other PCSs.

- The global trade digitization or another platform or platforms is a way how the different PCSs in the world or globally can be integrated.

Based on these conclusions and the answers to the research subquestions the answer to the main question can be formulated:

Can Portbase be seen as an example of a landing place for a data pipeline and how can Portbase be connected to a data pipeline such as the global trade digitization?

The answer is yes, Portbase can be seen as a local landing place for the global trade digitization. Based on the case the main reasons for this are: 1) Portbase captures the complexity of the national context. and 2) Portbase has an identity and access management in place to link thousands of users from the local community. 3) Portbase can provide access to the local community of thousands of users.

The overall conclusion is that the research objective has been reached. There are problems identified that can't be solved by Portbase alone and the combination of Portbase, acting as a local landingplace for the GTD, can solve these problems.

6.3 Limitations and recommendations for further research:

Limitatations:

Every research has its limitations. Limitations have several causes like , lack of time, lack of resources,etc.
For this research the main limitations are:

1) the research was performed in the port of Rotterdam only. Although other modern ports most likely have comparable situations as the port of Rotterdam different findings could be obtained from performing the research in these ports.
2) Rotterdam is one of the most advanced ports in the world. They are the biggest container port in Europe. it would be very interesting to investigate how the data pipeline could be applied in ports without a Port community system , like several African ports.
3) The research has been performed using a prototype in the initial pilot fase of a data pipeline, in particular the Global trade digitization of Maersk. The findings for this reason could not be tested with real life data.

Recommendations for further research:

Based on the limitations of the research the following recommendations for further research can be made:

- Repeat the research in a couple of years again. This will be interesting because there can be observed if the problems that were intended to be solved by initiatives like the Container vrijgave bericht and the Inspection portal are really solved or that maybe the data pipeline could still provide the solution
- Once the Global trade digitization start real-life piloting in Rotterdam perform an analysis of the pilot results of this research. It can be proved if the assumptions made were correct
- Perform the research in other ports. In other ports the developments of PCSs might not be as advanced as in Rotterdam. or there might not even be a PCS in every port.
- The list of bottle neck processes can be used to further investigate the possible application of the Gtd. Apps or displays could be developed to help address the other identified painpoint processes.

6.4 Contribution for research:

For this research two kinds of academic literature topics were studied: 1 the literature on Port Community systems. 2 literature on data pipelines.

Port Community Systems have been the subject of lots of academic research for years. A selection of the enormeous amount of research was made for this thesis. The research topics included: Requirements, functionalities and implementation complications, quantitative benefits of PCSs, supply chain security, cost benefit frameworks for PCSs, PCS design and PCS interoperability.

Data pipelines have not been the subject of many researchers yet. There are a couple of academic papers published and also some conference papers were published by Stijn et. al., Klievink et. al. etc. These papers are explorative and do not explain the role of PCS, such as Portbase as national landing place for a data pipeline, like the GTD.

This research contributes to the literature of both the topic of Port Community systems as well as data pipelines. It contributes how the PCS can be used as a national landing place for international data pipelines, like the GTD.
By taking into account the existence of PCSs on a local level, and using these PCSs as a national landing place, the data pipeline can enrich the PCSs functionalities by providing access to source data and/ or documents. On the other hand the data pipeline concept is extended by using the PCS as a national landing place and this extends the literature written on the data pipeline concept, like Hesketh, Stijn et. al, Klievink et al.

Portbase can be seen as a suitable landing place for the data pipeline because they capture the complexity of the national context, and because of their identity and access management they have in place to link the thousands of users in the port community.

The data pipeline has the technical ability to solve the problems alone but they would face the following issues:
a) the GTD would have to deal with the local context / complexity itself. This would add a lot of complexity and costs, and also maintenance issues.
b) In every country it will need to deal with the identity and access management for thousands of users. When GTD would connect with a PCS , the latter one can cover the local identity and access management.

PCS have the limitation that (a) it cannot support the international dimenstion (i.e. capture data from other countries earlier in the chain, e.g. the country of origin), and (b) it does ot exchange information about commercial documents from the country of origin.

The data pipeline, like the GTD can solve the above mentioned issues, because:
- it would allow to connect internationally and collect information from the country of origin and along the route, which is an addition to what PCS can cover. it could also allow fro inter-linking various PCS as providing the infrastructure to interconnect.
- It can enable access to commercial documents from the source. (something that PCS do not offer)

As a result the scientific contribution is that this research expands the research on data pipeline by further examining and explaining the role that Port community systems can play as a landing place for a data pipeline and how the combination of the data pipeline and PCS allow to better address inefficiencies at import compared to solutions based on the PCS or data pipeline alone.

6.5 Contribution for practice:

The contribution for practice of this thesis is that it can be used by decision makers to investigate what possible advantages the GTD can bring to existing situation. A this moment an actual real life instantation of the GTD is going to be tested in Rotterdam.

The global GTD team can use the scenarios to see what possible implementation strategies they can use. And they can use the findings from this research to see what the implementation problems would be when installing the GTD without using Portbase as a landing place.

Also the list of painpoints can be used to investigate the further possible solutions the GTD can bring to other parties in the supply chain (e.g. freight forwarders, shippers) , besides the container terminal operators.

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Appendices

Appendix one
An overview on the academic papers that were analyzed with subject 'Port Community Systems'

Title	Authors	Main findings/ points	Approach
Dimitrios and Athanasios	Port Community Systems: Requirements, functionalities and implementation complications	- Non-uniformity of documents used - Manual submission of many documents/ Lack of integration of IT systems - Lack of integration of customs - Extraction of usable information from systems databases - Difficulties in automatinf several port functions Port Community Systems will be transformed to advanced PCS both locally and internationally exchanging information among the interconnected ports.	Case study
Aydogdu and Aksoy	A study on quantitative benefits of port community systems	The study provides more substantial information about the benefits of a PCS. This can be used for investment evaluation for descision makers. Other findings: PCS increase: competitiveness, increased information quality, increased operational performance and safe paperless exchange procedures for port authorities	Developing a simulation model/ quantitative analysis
Van Oosterhout, Veenstra, Meijer, Popal and van den Berg	Visibility platforms for enhancing Supply Chain Security: a case Study in the Port of Rotterdam	Security gaps are found in the following nodes/activities in the supply chain: - Point of stuffing and stripping	Case study

		- Transshipment processes - Stops during in-land transport Visibility platforms can improve Supply chain Security.	
Bisogno, Nota, Saccomanno and Tommasetti	Improving the efficiency of Port Community Systems through integrated information flows of logistic processes	- An in-depth understanding of port logistic processes - Taking into account the viewpoint of each stakeholder Can improve the efficiency of a PCS	Case study
Baron and Mathieu	PCS interoperability in Europe: a Market for PCS operators?	PCS play a growing part in their home market and in Europe. The papers gives insight in building an European market for maritime information on the following aspects: market organization, types of rules, the architecture of the system and remaining constraints.	Conceptual paper
Lambrou, Rodseth, Foster and Fjortoft	Service-oriented computing and model-driven development as enablers of port information systems: an integrated view	A proposed PORTIS logical reference model and a SOA and model driven framework are developed for stakeholders and decision makers. For effective implementation to be kept in account are: Allignment of strategic and organizational capabilities,supporting envisaged policies and business relationships of a multitude of supply chain stakeholders	Case study

Heilig and Voss	Information systems in seaports: a categorization and overview	-berth planning at terminals are influenced by delayed vessel arrivals due to several reasons -improved vessel scheduling and terminal planning can be achieved by more accurate information on vessel movements and sea traffic - Many TOS lack of integration with external parties, syste integration management decision support and information services for customers.	Survey
Carlan, Sys and Vanelslander	How port community systems can contribute to port competitiveness: Developing a cost-benefit framework	Benefits of PCS are categorized in two categories: -benefits brought by the digitalization of administrative procedures -benefits to the PCS users of being part of a community Category one can be further divded in: 1 economic benefits 2 increased quality of information 3 increased performance Category two: 1 increased efficiency 2 increased connectivity	Case study

Appendix 2

list of interviews:

Date of interview	Organisation	Position
05-02-2017	Maersk Line	Cargo execution manager
15-02-2017	Maersk Line	Senior project manager
17-02-2017	APM Terminals	Planning manager operations
29-03-2017	Fenex	Teamcoordinator forwarding And logistics
30-03-2017	APM Terminals	Sr Manager operations
30-03-2017	APM Terminals	Coordinator ETT department
30-03-2017	APM Terminals	Business operations analyst
07-04-2017	APM Terminals	Business Development manager
07-04-2017	APM Terminals	Customs specialist/Foreman Gate department
12-04-2017	Douane Nederland	Client manager/ Projectmanager
25-04-2017	APM Terminals	Berth planner
20-05-2017	APM Terminals	Customs compliance coordinator
25-05-2017	APM Terminals	Business development manager
19-06-2017	Portbase	Innovation consultant

Appendix 3

List of painpoints:

Category 1, from my own document and problem definition so far:

- Terminal operators are responsible for the contents of the container but from a security point of view are not interested what is in there
- 30/40 % of the moves are internal moves due to having the onward modality after unloading
- Correctness of ETA of the vessels arrival
- Moment of pick up and modality
- Government inspections
- Trade documents not timely available

Category 2, from the interviews:

- Eta is communicated via telephone to the berth planning and manually updated in TOS
- For veterinary containers that are transshipped Maersk needs to hand over the veterinary document if the containers did not leave the EU within one week
- For dangerous cargo Maersk hands over the documents to the authorities, but it would be better if they could be pulled from the data pipeline
- Eta predictor is now made available via Portbase but this does not function very well
- Forwarders can't pre announce a container via Copino 13 (portbase is piloting on this)
- For a carrier the tracking& tracing of containers is a very complicated process. Sometimes the gate in of the terminal is received before the confirmation of the empty depot, this disturbs the tracking systems
- Forwarder need the expected time of unloading of the containers. These are not communicated to the freight forwarders.
- Customs has not enough data / or data of not enough quality to make a correct risk analysis. Data from the pipeline could improve this process, it would help if customs would look into the next customs systems if a customs clearance is already done
- Customs can't find additional information on other systems as they do not have the proper search criteria (MRN number)
- Containers that are planned for the ETT barge are regularly cancelled because of scan inspections
- If containers are not present yet Portbase standard gives the status document missing and blocked by customs
- Terminal operators can see in their system if a container has an inspection block but the hauliers can't

Category 3, from the Workshops on the GTD:

- Terminal get bad forecasting of expected barge and rail volumes (onward modality)
- Forwarders get too late information of damaged containers. Terminal have this information available through OCR images. (gate out process)
- In case of transshipment in a different port, the consignee is informed too late, this can cause delays of up to several days to weeks. (sea transport)
- Timeliness of onward modality for landside pick up of containers (onward modality)
- Demurrage/detention management (gate out)
- 1 st. day of demurrage detention (gate out)
- Change of modality , communication (transport , barge/truck/rail
- Disconnected from systems/ data (hinterland terminal)
- Arrival time of barge (hinterland terminal)
- Traffic jam / low water (last mile delivery)
- Arrival of trucks (returning empty container)
- Availability of equipment (returning empty container)
- ETA at stuffing location (stuff process)
- Cargo opening, cargo closing, prenotification (plan container delivery)
- Availability of space and confirmation (booking process)
- Vessel ETD and ATD (loading at terminal process)
- Splitting or rolling of bookings (load process)
- Inspection at export to be done by the customs authorities (export process)
- Import document not ok by terminal is communicated to the haulier not the freight forwarder
- Forwarder are unable to check the exact moment of unloading of containers