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# PATCH WORKED DIGITAL INFRASTRUCTURES IN THE MARITIME INDUSTRY

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## ABSTRACT

Transportation of horticultural products from Africa to Europe entails numerous challenges. This study of a large European importer of perishable goods in The Netherlands presents complexities of the physical flows of the goods along with information flows related to the goods. Throughout the journey of horticultural products public and private stakeholders in different countries contribute to the production and exchange of data, information, and heavy load. Based on data from a longitudinal research project focusing on global supply-chains the paper aims at providing a mapping of the numerous actors which contribute to the journey of the goods as well as the production of information travelling with the goods. The objective of the mapping is to illustrate the complexity of the infrastructure including the potentially overlapping and competing digital infrastructures of private and public actors. The mapping serves as a tool for highlighting aspects which challenge the forming of governance structures for information infrastructures in international trade where transparency of processes are crucial for a successful outcome of the transactions. The study suggests that at present international transporting of horticultural products from the grower to the consumer is dependent of a patch worked digital infrastructure.

## INFRASTRUCTURES IN THE MARITIME INDUSTRY

Sea-transport is the primary mode of transportation of goods in the world. But until recently it was not the primary means for transportation of horticultural products such as flowers and fruit from Africa to Europe. The major reason being that sea transportation often takes time beyond the durability of the perishable products. Furthermore, it can be subject to a number of delays caused by forces beyond human control, for example weather. Given the geographical position of commercial ports container transport at sea is closely connected to the hinterland chains before and after the shipment of the goods (van der Horst and van der Lugt, 2011). Coordination of the different modes of transportation is prudent to avoid delays which are often leading to cascading effects in supply-chains because there are only limited windows of interaction between different players in the chain (Wang and Meng, 2012). Similar to other industries information systems are seen as a remedy for reducing some of the delays and in general streamlining the processes in the maritime industry. The literature on supply-chain management reflects this eminently. The supply chains can be studied from a market or an infrastructural perspective (van der Horst and van der Lugt, 2011). In this context focus is on the latter and the market perspective of supply chain is not addressed further. The infrastructural perspective on the other hand provides a good platform for identifying the features of the maritime industry.

Specifically the information infrastructure literature provides a suitable lens of interpreting the flow of goods and data in the international trade domain. International trade is characterized by being a highly regulated domain (Rukanova et al., 2009) which requires a high level of documentation throughout the process which leads to a parallel flow of goods and information (Henningsson and Henriksen, 2011). Whereas private sector mainly focus on the physical flow, the public sector has more interest in the documentation following the goods, e.g. tax, customs and security. Such an information infrastructure user base is heterogeneous and pursues different goals (Constantinides and Barrett, 2015), but they do none the less share an interest in improving the efficiency throughout the chain (van der Horst and van der Lugt, 2011).

## THE PATCH WORK OF INTERNATIONAL TRADE

Sea freight is still fairly new in the horticultural sector and at present there are only a few examples of utilization of the trade lane from Kenya to The Netherlands for this type of products. This section provides the empirical mapping of the processes and stakeholders involved from a grower picks a perishable product and until it arrives at the wholesale auction in The Netherlands.<sup>1</sup> The mapping is based on insights from a longitudinal research project which aims at:

- Decrease dependencies on paper documentation.
- Improve visibility to supervisory bodies.
- Increase responsiveness in the event of interruptions in the supply chain by improving visibility.
- Share Supply Chain status events proactive and throughout the entire chain.
- Enable more focus on irregularities in the supply chain and its administrative process to increase reliability.
- Re-use digital information in data entry-related tasks to improve data quality and increase efficiency.

In the sea freight trade lane, the Dutch importer of the horticultural products acts as a third-part logistics operator, offering full services to growers from container loading until delivery at the auction of the perishable goods. Services such as shipment and customs clearance are outsourced to various other parties. This requires high level of control over the supply chain and it is therefore crucial to know where a shipment is, who holds responsibility for the goods and how to anticipate to irregularities such as delays or faulty documentation.<sup>2</sup> In recognition of the increased use of the sea freight trade-lane there is a high interest in establishing a more robust information infrastructure.

The reported study of horticultural sea freight is based on data from a pilot from a living lab environment. Three shipments departing from Mombasa (Kenya) on December 16<sup>th</sup> 2015, January 13<sup>th</sup> and March 17<sup>th</sup> 2016 provide the empirical foundation for the mapping.

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<sup>1</sup> One of the central informants in this study has asked for anonymity and it is therefore not possible to reveal type of product or the name of the auction where the products are shipped to.

<sup>2</sup> In an earlier stage of the project a smart Container Security Device (CSD) for sealing the container and monitoring temperatures inside of the container was developed. The CSD provides remote read-outs of the status of container security devices. This feature is utilized in the present project where focus is further on visualizing of the read-outs from the CSD on Dashboards to public and private stakeholders.

**Table 1: Overview of the Kenya ocean freight trade lane activities and data generated in the process**

Location / type /	Location / Country	Private data	Public data	Activity
Grower / Farm	Kenya	X		Settling commercial deal. The grower harvest the goods packs them in boxes for transportation. Invoice is issued.
Consolidation Centre	Nairobi, Kenya	X X	X	The consolidation centre receives the goods. All boxes are scanned with an x-ray scanner, boxes are weighed and the temperatures are measured. Bill of lading is generated. Temperature loggers placed strategically to monitor the temperature during the shipment. A phytosanitary inspection takes place at the centre, when approved, a phytosanitary certificate is provided.
Port of departure	Mombasa, Kenya	X	X	Near the port of departure the container is stacked at the freight forwarders premises. The freight forwarder delivers the container to the terminal for loading on the vessel. Customs control and export declarations.
Cargo ship	International sea	X		Visualization of shipment information in a Business Dashboard, including acquired shipment status information.
Port of arrival	Antwerp, Belgium	X X	X	The shipping route by Maersk entails transshipment in the port of Salalah, Oman. First port of entry in the EU customs territory is Algeciras, Spain. The port of arrival is Antwerp, Belgium. At the port of arrival the container is handed to the freight forwarder who will take care of transportation to its final destination.
Dutch border	Netherlands		X X X	Phytosanitary certificate to Dutch Customs is handed over. Risk assessment Shipment information and invoice is handed over to Dutch Customs.
Consignee warehouse	Auction, Netherlands	X		At the premises of auction the container is unloaded. The quality is checked and temperature measurements are registered. The temperature loggers are collected for analysis. Finally, the goods are prepared for sale to the end customer.

Each X in the table illustrates how data is generated (and collected/utilized) by private and public stakeholders throughout the shipment. The table serves as an illustration of the fragmented flow of information in the process. It is beyond the scope of this paper to elaborate on where data collected in the process is stored and processed inside the respective organizations which collected it. But clearly this is where the serious patch working starts.

Data from the first two pilot shipments resulted in valuable insights as both shipments experienced unexpected and undesirable events. In the first shipment, the ship was delayed and the container was selected for a container scan. In the second pilot shipment, the ship arrived earlier but a transport document for transferring the right to do the phytosanitary inspection in The Netherlands was missing. Furthermore, the reliability of the service was partly affected by border-related complexities due to the fact that the trade lane route implies involvement of border control agencies from several countries. For instance because the container arrives in Belgium, and is then transported by truck to the Netherlands. This lack of transparency hinders agencies such as the Dutch Customs Administration in conducting a risk assessment during the import process. The pilot shipments were therefore very insightful in identifying explicit infrastructure inefficiencies in the import process.

## CONCLUDING REMARKS

Two decades ago Hanseth and Monteiro (1997) provided insights to the developing of information infrastructure standards in the national healthcare in Norway. Hanseth and Monteiro pointed to the fact that standards though central to information infrastructures are challenging to establish. About 20 years later Constantinides and Barrett (2014) did a similar exercise for the Greek healthcare concluding that a bottom-up approach appear to be the most appropriate..

The mapping of the journey of horticultural products from Africa to Europe illustrates the complexity of the physical infrastructure which private players excel in optimizing (see for example Lambert and Cooper, 2000) along with the digital infrastructure. However, the study also indicates that standards will be difficult to reach as long as so many players are involved in the processes, players which individually are highly dependent on data for their operations which are processed in their own information systems. Given that international trade involves the international community it might also be a challenge to reach an agreement for a bottom-up solution to the problem.

The mapping raises a number of questions which we plan to explore further. The first one is: What are the incentives for the individual stakeholder in the logistics chain to contribute to the building of an information infrastructure?

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