Digitalization: A Supply Chain Revolution?

Albert W. Veenstra

Professor, Scientific Director
Dinalog, Dutch Institute for Advanced Logistics

Albert Veenstra is scientific director of the TKI Dinalog – Dutch Institute for Advanced Logistics of the Dutch Topsector Logistics and professor of International Trade Facilitation and Logistics at the Eindhoven University of Technology (School of Industrial Engineering and Innovation Sciences). His main responsibility is in the execution and maintenance of the innovation agenda for the logistics industry in the Netherlands.

Supply chain management has seen its share of revolutions. They seem to come with the field. Banker (2015)[1] provides a whole list, from the launch of the concept supply chain as an extension of logistics, via optimization, operational excellence through lean and six sigma, via the extension of S&OP[2] to IBP[3], to demand driven supply chains, closed loop supply chains and sustainable supply chains to control towers. The latter includes big data analytics, transparency and connectedness and real time control.

Many of these revolutions lean on the further development of information technology as a major enabler. Core systems, now part of German IT giant SAP[4], distinguishes between digitization, digitalization and digital transformation. Digitization is simply the process of making information available in digital form. Digitalization is the use of digital information to support decision making. Digital transformation is the development of business applications to integrate digitized data and digitalized applications. Perhaps these are the real revolutions in supply chain management.

In this article, I will provide an overview of developments in the area of digital transformation in the logistics industry in the Netherlands. I will draw from a portfolio of projects and initiatives that is part of the Dutch government policy to promote, among others, the logistics industry as a core industry in the Netherlands[5]. In 2011, an innovation agenda for the Dutch logistics industry was developed, that has set goals and priorities until 2020. Many results can be identified that might also offer some insight for logistics industries in other countries around the world.

In the remainder of this article, I will first explain briefly the agenda for digital transformation for the logistics industry. In subsequent sections, I will concentrate on three of the most revolutionary initiatives of the last few years in the Netherlands.

1. Agenda for Logistics Innovation

The Topsector policy in the Netherlands was initiated by the Dutch Ministry of Economic Affairs in 2011/2012. The goal was to promote research and innovation in nine major economic sectors, such as energy, water, horti- and agriculture, health and logistics. Part of the policy is the development of special purpose institutional vehicles to develop the research and innovation program in detail, and to allocate and monitor the spending of innovation funding. These vehicles are called Topconsortia for Knowledge and Innovation (TKI). The existing Dutch Institute for Advanced Logistics (Dinalog) in Breda, the Netherlands, became the TKI for Logistics. Major participants in this

[1] https://www.forbes.com/sites/stevebanker/2015/08/12/the-next-revolution-is-supply-chain-management/#62f1208c5fc9

[2] Sales and Operations Planning

[3] Integrated Business Planning

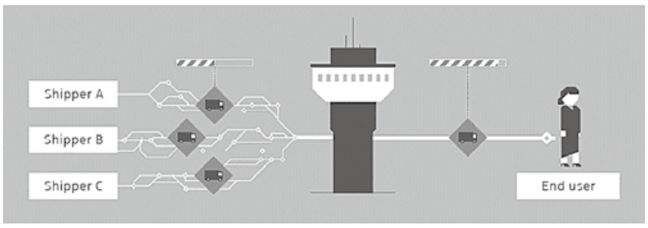
[4] https://www.forbes.com/sites/stevebanker/2015/08/12/the-next-revolution-is-supply-chain-management/#62f1208c5fc9

[5] www.topsectoren.nl

TKI are the Dutch Science Foundation (NWO) and the Netherlands Institute for Applied Research (TNO). The TKIs receive special innovation funding from the Dutch Ministry of Economic Affairs.

The first agenda in 2012 contained five research lines that were associated with the strengths of Dutch logistics services: cross chain collaboration, service logistics, supply chain finance, trade compliance and border management and synchromodality[6]. In a later stage, a research roadmap for smart ICT was added to this list (Fig.3). In 2015, additional funding from the Dutch Ministry of Infrastructure and Environment was obtained to strengthen the impact of this innovation agenda for the period up to and including 2020.

1, The roadmap for cross chain collaboration research concentrates on the development of control towers to manage and optimize supply chains (Fig.1), as well as bundling of supply chains; hence the term cross chain collaboration. Major research issues, apart from the technicalities of solving ever-complex planning problems, are the understanding of building trust in collaboration, as well as the required IT-solutions to make control towers work in practice.



Source: Dinalog, 2016
Figure 1 Control Tower to manage and optimize supply chains

2, Service logistics focuses on the maintenance and upkeep of capital goods. The manufacturing industry in the Netherlands is strongly geared towards the manufacturing of capital goods, and this research roadmap supports the development of servitization[7] as a major revolution. The main way to achieve effective servitization is to develop control towers, and therefore the underlying research requirements are similar to the cross chain collaboration roadmap.

3, Supply chain finance looks at the further integration of financial tools and solutions into the supply chain. This has benefits for supply chain partners, such as faster payments of receivables, and it also creates new ways of lending, financing, offering guarantees and managing risks. The ultimate goal of this roadmap is the development of a so-called supply chain finance house, which refers to a mature financial control function within the supply chain.

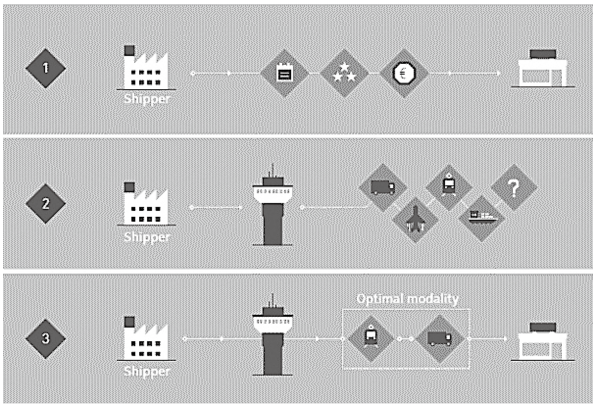
4, The Netherlands is a trading nation, and therefore it is common sense that trade compliance and border management is part of the innovation agenda for the logistics industry. The core of this agenda is to further develop compliance and control solutions for companies active in international trade. This agenda also has a strong educational dimension which has given rise to the support for a new bachelor and a new master program for customs and supply chain compliance.

5, The Netherlands is blessed by an advantageous geography for multimodal transport: road, rail and waterway. The roadmap synchromodality supports the development from unimodal to true and synchronized multimodal transport to and from the European hinterland. This is partly a planning problem, and as a result, many new planning solutions have been developed. It also requires control towers, and as such, the success of this roadmap also depends on a digital transformation (Fig.2).

It is clear from this brief overview of the original five roadmaps that IT is a crucial facilitator for their development. The Topsector Logistics had recognized this from the start, and also started a program to support digital transformation in the Dutch logistics industry in 2013

[6] Synchromodality aims to further develop modern multimodal transport, in which the planning and allocation of capacity is fully synchronized to satisfy overall demand for transport services.

[7] Servitization is the development from a product based business model towards a service based business model. In some industries this development has already taken hold (leasing copying machines, for instance, and paying by the sheet), but in many other industries, this is a fairly novel idea.



Source: Dinalog, 2016

Figure 2 Synchromodality based on intelligent software and combining goods flows

with a strong focus on direct implementation of practical solutions. This initiative has culminated in new solutions for specific white spots in the logistics IT landscape. The most important of these solutions will be discussed in detail below.

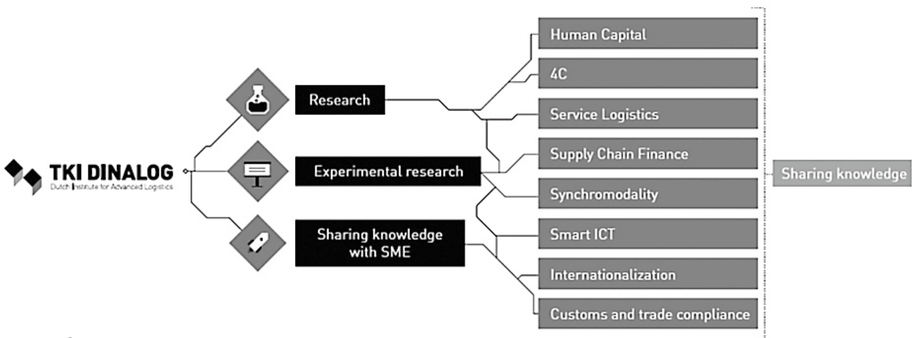
At the same time, however, it was recognized that we also need research to advance the use of modern tools and techniques in logistics. Important new research areas such as artificial intelligence, big data analytics, blockchain were not mentioned at all in the original agenda of 2011/2012, but showed, at first glance, great promise for applications in logistics. As a result, the sixth roadmap of Smart ICT was introduced to enable research into these fields.

The characterization of the type of research is an important part of the Dutch innovation policy. This is driven by European Union rules on state aid, and the exception that has been created for research and exploration. We distinguish between fundamental research (by academic institutions), applied research (mainly carried out by national research institutes) and experimental development. The latter requires a relatively small involvement of knowledge institutes. These three research types match the well-known technology readiness levels scale, and differ in terms of the amount of government funding that can be allocated to projects. For the three types, these are 85%, 50% and 25% respectively for fundamental, applied and experimental projects.

The Dutch TKI for logistics spends 95% of its annually available funding of about €10 mln on fundamental and applied research (Fig.3), in more or less equal parts. Another institution in the Topsector Logistics has a similar amount of funding, that is spent mostly on market research, pilots and implementation support programs.

2. Experiences with Digital Transformation in Logistics

In the remainder, I will discuss some of the flagship initiatives in the Dutch logistics industry, that were funded via the Topsector Logistics. The first of these, iShare, is related to the IT-implementation agenda and supports the sharing of data in logistics chains. Secondly, I will discuss several projects that centered around the use of external data in internal operational systems to improve performance. Thirdly, I will discuss a program that started as a supply chain innovation, and is now scaling up as a result of the development of a control tower. To close this paper, I will briefly introduce some further applications of information technology, in service logistics, customs supervision and multimodal transport.



Source: Dinalog, 2017

Figure 3 TKI Dinalog activities and roadmaps

2.1 iShare

Over the last two decades or so, the logistics industry in the Netherlands has seen a multitude of initiatives and projects to enhance the use of digital information, the sharing of data between chain partners, and the enrichment of data with smart algorithms. A lot of these initiatives have led to proof of concepts that do not, however, lead to wide adoption and implementation.

One of the reasons why this is the case, is that the actual sharing of data is not as simple as connecting and sending data back and forth. Partners have to know each other, the connection is usually a dedicated EDI-link[8], and not all relevant information is available in digital form. Nowadays, the standardized EDI cannot facilitate the flexibility and continuous change that has become the norm in transport and logistics. Moreover this type of information exchange cannot deal with external data that might contribute to performance enhancements, such as weather, traffic and infrastructure data.

To create a more flexible environment, where data can be more easily exchanged with partners and other, unknown parties, a new set of agreements and guidelines were developed that cover access to data, and partner identification, authentication and authorization. The main idea is that partners no longer transfer data to each other, but that they allow others to access data within the partner's IT environment. For this purpose, proper identification is required, to know who a party is, and what data she needs for what purpose. Authentication is the formal process of verifying the information of the data requesting party. Authorization is then the process of giving permission to access data, which might imply access to IT systems, data bases, servers or (part of) a cloud.

iShare[9] is the system of agreements towards a single understanding of how identification, authentication and authorization should be implemented in any IT system in logistics, in order to facilitate the seamless interaction between partners that want to share their data.

The current status of this program is that the full set of agreements have been delivered, that the institutional framework has been put in place, and that use cases have been developed to show the potential. In addition, several IT suppliers have adopted the iShare approach in their products, which will result in adoption throughout the logistics industry, especially for small and medium sized enterprises.

2.2 Using External Data

Much improvement in logistics performance can be achieved if certain public or semi-public data sources would be used in logistics planning. Traffic data is a well-known example that is now widely available through household applications like Google Maps. Relatively reliable estimates of driving time are now available for everyone. Similar requirements are held by professional road transportation, shipping, barge transportation on inland waterways, and rail transport.

Several projects in the Topsector Logistics portfolio tried to remedy this gap by developing the data sources, and linking these data sources into company planning tools. A good example is the work around barge transport in the Netherlands. The Netherlands lies in a delta of rivers, and barge transport is therefore heavily used. Strangely enough, however, the performance of barge transport (on time arrival, reliability of transit times, minimization of idle times at bridges and locks) has never received much attention. This is no longer acceptable for large shippers of especially containers, that can easily switch between different modes of transport.

First of all, information on barge locations, speed and direction is available, but not widely shared. Still many barge operators live on their vessel, which means it is their livelihood, but also their home. Sharing location and speed data is therefore protected by privacy laws in the Netherlands and Europe. Some hinterland terminals,

[8] EDI stands for Electronic Data Interchange, which as a technology, stems from the 1980s and was designed for digital bulk transfer of data. Standard data formats have been developed by the UN. In logistics, the EDIFACT (EDI for Administration, Commerce and Transport) standard is the main standard.

[9] https://www.ishareworks.org/en/ishare

however, work with a dedicated group of barge operators, that have agreed to share this data to optimize the planning of the hinterland terminals.

Secondly, the barge operators can benefit substantially from better infrastructure information on maintenance schedules and opening times of bridges and locks, and potential congestion at some of the bridges and locks. To avoid queuing, they might slow down, and substantially save on fuel. They also might selectively speed up to meet a closing deadline for a lock and realize their expected arrival time at a terminal. Similar information requirements exist for truck operators and hinterland terminals. Terminals, for instance, might publish data on queues, availability of containers, arrival or departure of vessels, and so on. This type of data can improve the planning of hinterland transport operators substantially.

Much of the time in projects is devoted to making data available from private or public sources. Data on infrastructure, for instance, is notoriously poorly published. There is a wide range of different formats in which data on road, bridges, locks, maintenance schedules, water heights and so on, is published: word documents and pdfs can be found, but some sources also make application programming interfaces (APIs) available. Digital maps of the waterway system, published by the government also might require some adjustment to make them useful for plotting and visualizing certain data. Many private – business – systems in logistics were never designed to share data with third parties. In many cases, internet access portals, and APIs had to be purpose built to enable the basic sharing of data.

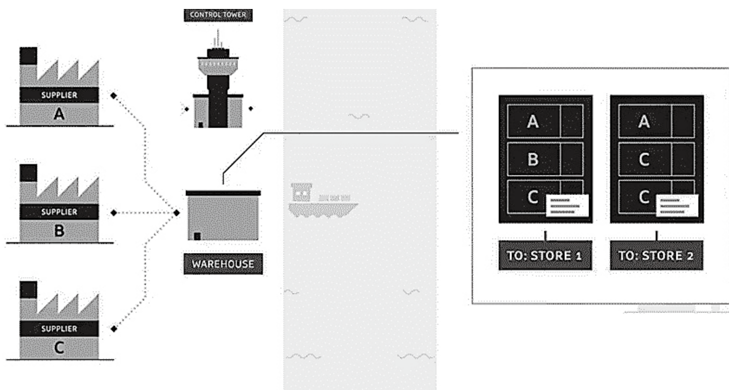
While all the work to actually be able to share data is often tedious, there is a pay-off. For simple applications to share data between a hinterland container terminal and its truck operators, additional revenue for the truckers of 50-75 euro were recorded, as well as a 32% CO_2 reduction overall. This additional revenue enabled the trucking companies to invest in the mobile devices required for the data exchange, with a payback period as short as 10 to 15 working days. Sharing data between a hinterland terminal and barge operators resulted in an improved load factor of 25%, and cost reduction of about 40 euro per container.

2.3 Bundling at Source

The project “bundling at source location” was a supply chain innovation initiative that aimed to avoid fragmented and erratic delivery of goods to fashion shops in city centers. The solution that was developed in this project was to bundle shipments at shop level much earlier in the supply chain (at the “source”) (Fig.4). A second project dove deeper in fashion supply chains and looked into ordering and production planning behavior in these chains. The focus of this further study was the harmonization of delivery times of fashion in shops, which also requires contractual adjustments at the beginning of the chain[10].

To implement these supply chain innovations, many IT-innovations were also necessary: electronic notifications

[10] See for a more detailed discussion: Te Lindert (2013) Control towers are emerging everywhere. Supply Chain Management 3(3), 16-25.



Source: MODINT, animation, 2017

Figure 4 Control Tower Bundling at source location of delivery, for instance. The main contribution was, however, the development of a control tower that could facilitate the integration of data required for the advanced planning for the bundling of goods at the manufacturing source, across many different manufacturing companies (Fig.4). This control tower solution is currently being rolled out in other European countries. This broad roll-out now makes it possible to support centralized European distribution solutions that until now had eluded the fashion industry.

2.4 Other Initiatives: Real Time Data

One of the main developments that is going to impact logistics is the development of real-time data applications. Such applications are particularly relevant in the field of service logistics. This is the logistics for the maintenance, management and repair activities for capital goods, such as advanced medical equipment, chip making machines, dredging vessels, fighter planes and modern wind mills. These are all advanced machines that generate a lot of data as part of their normal operation. That data can be used to make sure that breakdowns of these machines are anticipated and avoided, or at least that their duration is minimized. For advanced, expensive, machines, a reduction of hours or even minutes in down time represents a substantial value.

Part of this research is in the development of new sensors and data formats for these sensors. Another part of the research is in developing predictive models to estimate the expected time until a breakdown. Finally, the research is revealing that companies struggle with the integration of advanced operations of machines and the planning of logistics. Some companies are able to very accurately predict breakdown, but are then unable to determine how and when logistics intervention is required to avoid the breakdown. The latter is a behavioral problem that is related to the internal communication between different departments of a company. Currently there is little understanding about this type of behavioral problems.

A different, but related application area is the maintenance management of offshore windmill parks. The Netherlands is increasingly relying on renewable energy and windmills are an important part of that. These parks are, however, offshore. Maintenance efforts, therefore, need to be carefully planned, and activities need to be consolidated to reduce the costs of sailing back and forth to the wind mill parks. Advanced predictive maintenance models play a crucial role in this. In fact, the research seems to show that logistics planning for maintenance might play an important role in the business case for offshore wind parks.

3. Concluding Remarks

Logistics is an indispensable activity for the international position of the Netherlands. Therefore, we push innovation in this industry. A large part of our innovation agenda is related to information technology. In this overview, I have highlighted a few revolutionary developments. First of all, we strive for actual implementation of IT innovations by especially small and medium sized enterprises. iShare is an important facilitator for this. Secondly, control towers in various sizes and shapes drive many supply chain and logistics innovations. I have pointed out a promising application in the fashion industry. Finally, in the Netherlands, we expect much from advanced, real-time, data applications in logistics. The research addresses technical challenges in big data handling and predictive model development, but also socio-economic and behavioral challenges in order to actually apply new solutions in business practice. We are witnessing an exciting time in logistics worldwide and in the Netherlands. We hope our research and application development will reshape logistics and global supply chains and contribute to a better, cleaner and more prosperous world.

General Resources

www.dinalog.nl;
website of the Dutch Institute for Advanced Logistics

www.topsectorlogistiek.nl;
website of the Dutch Topsector Logistics

www.hollandlogisticslibrary.com;
website that showcases Dutch logistics for a foreign audience