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DAVINC^{3}I: DEVELOPING INNOVATIVE LOGISTICS CONCEPTS FOR INTERNATIONAL FLORICULTURE TRADE NETWORKS

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Abstract

Today most flowers physically pass through the auction houses on their fixed routes from (inter)national growers to (inter)national customers. Physical presence is necessary to allow for physical inspection, quality control and break-bulk activities. Several developments, such as new markets in Eastern Europe and increased virtualization, stimulate the chain to become an efficient florticultural hub-network, in which cut flowers, plants and other products are delivered to customers taking different (direct) routes and using different logistics concepts. The Dutch sector aims to (continue to) be the (virtual) florticultural trading hub of Europe, and has therefore started a 4-year new Dinalog project called DAVINC^{3}I. The project's objective is to strengthen the international leading competitive position of the Dutch horticulture sector in a global, virtualized trade network by researching (1) the opportunities for new logistics coordination, consolidation and collaboration concepts in extended international tradeparc networks, and (2) the possibilities for making chain information directly and real-time available and usable to support decision making of all partners in the horticultural network. This paper presents the background and setup of the DAVINC^{3}I project. We characterise the sector and discuss the main sector developments in supply and demand. We identify main logistics bottlenecks and present opportunities for logistics performance improvement that will be further researched in the project.

Keywords: horticulture, distribution hub-networks, cold chain management, logistics concepts

Introduction

The floriculture sector in the Netherlands is of world-class quality, and serves as main trading hub for Europe. The sector as a whole has a huge impact on the Dutch economy, being the largest exporter of fresh-products in Europe, the top-3 largest exporter in the world with still significant opportunities for further growth. Despite the current leading position, the sector needs to look forward and innovate to stay in the lead. Today, most flowers physically pass through the auction houses on their fixed routes from (inter)national growers to (inter)national customers to allow for physical inspection,

quality control and break-bulk activities. However several developments, such as new markets in Eastern Europe and increased virtualization, stimulate the chain to become an efficient florticultural hub-network, in which cut flowers, plants and other products are delivered to customers taking different (direct) routes and using different logistics concepts. Cross-dock centers and hubs (tradeparcs) are being set-up in Europe (linking local with global flows) and the sector is searching for efficient coordination and control mechanisms for the complete logistics network to consolidate flows and fulfill market demands. However, this is not an easy task as the sector is characterized by a large number of independent SMEs (many growers, traders, and small LSPs) and a large cooperative auction each with their own objectives and views on roles and functions of parties in the supply chain network.

The Dutch sector wants to (continue to) be the (virtual) horticultural trading hub of Europe, and has therefore started a 4-year Dinalog project called DAVINC^{3}I (Van der Vorst et al., 2010). DAVINC^{3}I stands for Dutch Agricultural Virtualized International Network with Coordination, Consolidation, Collaboration and Information availability. The project started in 2011 and has as objective to strengthen the international leading competitive position of the Dutch horticulture sector in a global, virtualized trade network by researching (1) the opportunities for new logistics coordination, consolidation and collaboration concepts in extended international tradeparc networks, and (2) the possibilities for making chain information directly and real-time available and usable to support decision making of all partners in the horticultural network.

This paper presents the background and setup of the DAVINC^{3}I project. We characterise the sector and discuss the main sector developments in supply and demand. We identify main logistics bottlenecks and present opportunities for logistics performance improvement that will be further researched in the project.

Sector characteristics

Facts and figures

The horticulture sector in the Netherlands is concentrated in the so-called greenports. *Greenport(s) Holland* is a network, representing the Dutch cluster of businesses related to horticulture, including arboriculture and floriculture. The added value and employment of the whole agricultural sector in the greenports in the Netherlands is with 130.000 employees and 5.2 billion Euros roughly comparable to the mainport Rotterdam in the Netherlands, which is the largest port in Europe. There are 13,500 enterprises of primary production and 15,300 enterprises up and down the supply chain. In total, 290.000 jobs are directly related to fresh produce and 455.000 to the total horticultural cluster. In 2009 the local fresh production was worth € 7.7 billion; the export value amounted to € 14.5 billion. The sector has a yearly € 6.6 billion surplus on the Dutch Balance of Trade, representing 21% of the total surplus. The auction house FloraHolland alone had a turnover of € 3.9 billion in 2009.

For the agrologistics sector, road transport is the main transport mode. More than a quarter of all national road transport volume in the Netherlands in 2006 (28%) is related to agrologistics, while for the EU this is 19% in national transport volume. In international Dutch and EU transport the share of agrologistics is 25% or more – see Figure 1.

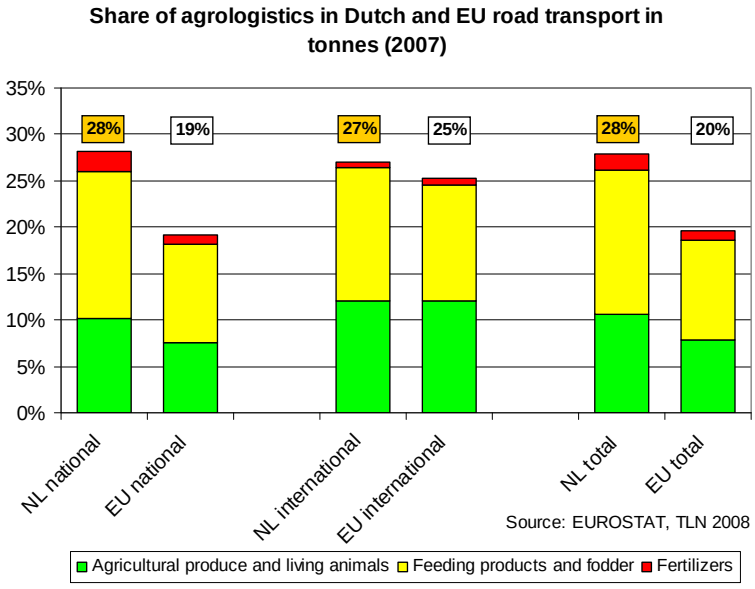

Figure 1. Importance of agrologistics

The supply chain network

The Netherlands is the heart of the international floriculture sector. It has an intricate and high-quality network of companies, ranging from breeders and growers to sales experts and export firms, representing every aspect of the business. The supply chain network consists of the following links: growers, auctions, traders, logistics service providers and outlets.

- FloraHolland flower *auction* has six auction centers for trading in cut flowers (about 70% of turnover) and ornamental plants (about 30%), a national intermediary organization (FloraHolland Connect) and an internationally active import department. Veiling Rhein-Maas (Herongen, Germany) is a joint venture between FloraHolland and Landgard. FloraHolland is a primary cooperative: the business is owned by its roughly 6,000 members, especially *growers* in the Netherlands, but also beyond.
- The *traders* can be split up in three groups: wholesalers, exporters and importers. Sometimes this overlaps, when a Dutch wholesaler also acts as exporter. There are about 1200 Dutch traders, dealing with many (inter)national customers. Most important import countries are Kenya, Ethiopia, Israel, Ecuador and Germany. Most important export countries are Germany, United Kingdom, France, Italy and Belgium.
- In many cases the transport between two chain stages is outsourced to a *logistics service provider*. In some cases the providers execute extra activities like quality control, handling and packaging.

- Different *sales channels* can be identified in the national and international market places. We can devide them into retail (supermarket, garden and construction centre, etc.) and detail (self-employed garden center, flower shop, street market, etc.).

The supply chain network design of ornamental plants and cut flowers is not the same. The most important difference between both chains is the fact that a flower after being cut can decrease 15% in value a day in case not delivered to the customer, whereas an ornamental plant is almost non-perishable (of course they do grow). So especially in flower chains speed is essential. A second difference is that consumers normally buy several cut flowers as a bouquet whereas potted plants are sold piece by piece. In the world of the ornamental plants the role of the garden centres and lumber yards is much stronger than in cut flower chains. This leads to direct deals between retailers and growers with a much higher volume.

Developments and research challenges

A number of specific developments and sector characteristics result in research challenges on the level of the design and management of logistics processes. Based upon desk research and stakeholder interviews we identified the following issues: (i) need for robust and flexible quality-driven logistics concepts, (ii) need for differentiated logistics concepts in demand-driven supply chains, (iii) need for transparency and an advanced information infrastructure, (iv) chance for innovative collaborative distribution strategies and (v) need for collaborative logistics.

Need for robust and flexible quality-driven logistics concepts

One of the main logistics challenges for the sector is to deal with strong dynamics and uncertainty in supply and demand, regarding fresh product quality as well as the available volume in time at a specific place. The sector is characterized by last-minute changes and rush-orders. Very specific is the difficulty to predict the exact quality of fresh produce before it has been harvested. The prediction of these quality changes is even more difficult during the trade, transport and storage processes (resulting in potentially large product losses if logistics is not organized adequately). At the same time there is a trade-off between expensive measures that can prolong the vase life of the flowers and the use of slower and cheaper transport modalities with often less carbon emmissions. Typically, next to biological variations, the quality of flowers and plants is determined by time and environmental conditions (such as temperature and humidity during transport). Environmental conditions may be influenced by, for example, the type of packaging, way of loading and the availability of temperature conditioned transportation means and warehouses. Customers demand guarantees on quality specifications leading to strict requirements on the logistics network concepts used in the sector. As a consequence, the required prediction and planning concept and accompanying logistics system need to be very flexible, enabling last minute changes and reallocations, but also to provide a robust planning (compared to the many rush orders and transports at the moment). More specific, it should allow for advanced logistics decision making taking real-time information on product quality behaviour

into account, resulting in the delivery of the right product to the right outlet in time; a concept called "Quality Controlled Logistics" by Van der Vorst et al. (2011).

Need for differentiated logistics concepts in demand-driven supply chains

The sector makes a difference between two types of marketing channels: "retail" (including supermarkets, garden centers and construction outlets) and "detail" (specialist shops). Retail industry has seen significant consolidation and concentration, which led to domination of the market by large retailers. Retail sells flowers and plants as by-product and aims for large volumes of specific products guaranteed via long-term (preferred supplier relationship) contracts and fixed prices. Specialist shops often gain their competitive advantage due to a deep product assortment (and hence small volumes per individual product) and a focus on high-quality products. They market value-added products via small-scale shops using day-to-day prices and volumes available. In both channels, the vase life is one of the most important product attributes (for flowers nowadays about 7 days). As a result, order lead times are continuously being reduced and there is a trend to smaller order batch sizes. Expectations are that in time retail and detail will find an equilibrium in which both have a market share of about 50% (VGB, 2010). Retail chains will be demand driven whereas detail chains might remain foremost supply driven (using the virtual auction clock). Obviously, there is a need for differentiated logistics concepts to fulfil the specific requirements of all market segments.

Need for transparency and an advanced information infrastructure

Last years a lot of work has been done to improve information standardisation and exchange in the supply chain. Although major steps have been taken, still improvements are needed. For example, many transport orders are communicated very late resulting in rush activities and reduced efficiency. Furthermore, there is a lack of transport status information, resulting in telephone calls to growers about the whereabouts of their product – something they have no insight in. And although growers invest heavily in production automation, investments in digitalisation and management decision support systems are less easily done. At the same time virtualization makes trading methods and price formation more and more admissible and transparent. E-trade and KOA ("Kopen Op Afstand", buying from a distance) are used by customers far away to buy directly at either producers or auctions, but have challenging implications for the (value-adding) activities of all stages between production and markets. In a demand-driven virtualized trade network, physical product flows are separated from information and commercial transaction flows. There is a need for transparency that provides information about partners, products, resources and logistics operations in order to effectively trade and operate. Clear definition of roles in the supply chain as well as more advanced information exchanges and collaboration concepts are needed to match supply with demand. It requires, for example, the formal description of a specific flower or plant and its dynamic features such as its "quality". To be able to support decision making and execution of tasks in the logistics network, there is a need for a new ICT infrastructure containing a knowledgebase *("Greenbase")* that can be used to

get the proper information system functionality available for configured processes and the right information at the right place at the right moment in the network (part of the features envisaged for Greenbase can also be found in the existing Portbase). A Greenbase includes the following capabilities: 1) a repository of the application services, 2) reference information architectures, 3) an internet platform, and 4) methods and tools for the configuration of run-time information systems. During the last decades, much progress has been made in ICT to provide these capabilities; however, these specific capabilities are not yet available or not applied in horticulture (Verdouw, 2010).

Chance for innovative collaborative distribution strategies

It is clear from the earlier text, that the horticultural sector is confronted with too many emergency orders and that ways have to be found to reduce this and enable more efficient and responsive logistics processes. In order to be responsive, a supply chain can make use of multiple delivery modes in which the slower and cheaper modes are employed for shipments under usual planning (push process) to enjoy the economies of scale and contribute to a cleaner way of transportatin by emiiting less carbon emissions (lean and green), while the faster and more expensive delivery modes are used for speedy and emergency replenishments by market demand (pull process) (Chan and Chan, 2010). Multi- (and synchro-) modal transport receives increased attention in this sector. Rail and sea transport using conditioned containers instead of speedy air transport has already proven to be a successful technology (Greenrail, 2010). This holds true especially for import flows as these containers usually contain large volumes of the same flower or plant type. In export flows multiple types of flowers or plants have to be distributed together, but they each respond differently to specific temperatures and humidity. Cymbidium, anthurium and other exotics require a warm environment, others such as roses and chrysanthemum need a cooler environment to preserve shelf lives. If these new conditioned technologies can be used to transport products over long distances, it could also provide us with opportunities to hold inventories at strategic locations within the network, i.e. at international distribution hubs. The above shows it is relevant to research the optimal temperature when facing different quality decay profiles for different products; as well as, given the demand for multiple products, which products could be combined in a common (flexible) container transported via rail, road, water or air.

Need for collaborative logistics

The floriculture sector is characterised by intensive cooperation between all actors in the network. However, from supply chain perspective still many logistics flows from source to sink are managed independently by chain actors, resulting in less efficient transport flows. This becomes more and more difficult due to increasing end-customer demands and a growing political pressure to reduce logistic movements. Flowers and plants are sourced internationally and might in the future, instead of being transported via the market place in the Netherlands, be directly distributed via a logistics hub network in Europe to regional customers. These customers require value-added products packed and delivered

within a complete assortment with specific logistics service constraints. More logistics collaboration between different actors in the chain, vertical as well as horizontal, may improve the efficiency of processes as harvesting and transport, and reduce product waste. Key issue is that in the new virtualised network, opportunities arise for different tradeparc network configurations as well as route and process (e.g. where to assemble and pack) configurations of supply chains through the network.

Research challenges

We conclude that these developments result in the following research challenges:

- Increased possibilities for demand driven logistics concepts, linking growers in different international sourcing areas directly to customers, thereby enabling new collaborative supply and logistics management concepts – while considering the continuous need for supply driven concepts (using the (virtual) auction clock);
- Coordinated logistics control concepts with emphasis on responsiveness and guaranteeing product availability and product quality to customers (including supply planning, capacity planning, transportation management and inventory management), i.e. focus on consolidation of product flows and improved matching of uncertain supply with variable demand, by using real time or the most actual product quality information in logistics decision making throughout the network (i.e. Quality Controlled Logistics) and taking into account sourcing preferences;
- Dynamic configurations of logistics routes in effective tradeparc networks from source to sinks (including the use of conditioned containers and multi-modalities), with redefined locations for specific processing activities, such as packing, combining, labelling, quality control, and sorting, taking into account product perishability, high demand and supply uncertainties and the logistics service requirements from the differentiated marketing channels;
- Dynamic configurations of information systems (and technical solutions such as a *Greenbase*), advanced information exchanges and transparency to facilitate virtual trade and advanced coordination and collaboration concepts.

DAVINC^{3}I project overview

These research challenges are central in the DAVINC^{3}I project, which states that virtual trade networks and logistics coordination are a means to stay or even become more competitive. That position is then to be guaranteed by designing a logistics hub-network for Dutch products and imported products on their way to the hinterland and by being a provider of ICT infrastructure and services that allow for coordination of product flows that are not physically routed through the Netherlands. More in particular, the objective is to research (1) the opportunities for new logistics coordination, consolidation and collaboration concepts in extended international virtual tradeparc networks, and (2) the possibilities for making chain information directly and real-time available and usable to support decision making of all partners in the horticultural network.

There are a great many actors involved in the project that have different views on the developments, have different stakes and different value propositions in current and changing scenarios. As a consequence, designing new viable scenarios is not a straightforward activity. One has to have a clear view on the infrastructural consequences of proposed scenarios. It is now often argued that improving competitiveness, economic growth and sustainability will heavily depend on being able to capture the coordination role for matching demand and supply using virtualized trading and logistics coordination systems. So, developing a clear understanding as to what the above may entail is a crucial part of scenarios. Finally, developments mentioned may have an institutional impact that again has to be taken into account when developing scenarios.

For DAVINC^{3}I to research these issues, we have defined *five work packages.* Figure 2 shows the various areas of the new coordination, consolidation and collaboration concept for the international horticultural trade network, and presents an overview of the work packages. All work packages have close interactions and depend on each other to realize the objective:

- *Workpackage 1* sets the scene and gives insight in the most relevant virtualisation scenarios defined for the different types of supply chains (e.g. retail vs. detail and flowers vs. plants). It describes the current situation and main international developments in virtual purchasing behavior, changes in market outlets and consumer requirements as well as in information systems and availability in the supply chain. It will set the road for more detailed analyses in WP 2, 3 and 4, and will result in potential pilot projects to be conducted in WP5.
- *Workpackage 2* studies the functional specifications for potential coordination, consolidation and collaboration concepts within these scenarios. Focus in this package will be on the design of value-added logistics services, comprising flexible and robust prediction, planning and control models and algorithms for inventory, packing and transportation management, considering the increased complexity, uncertainty and dynamics. Consecutively, two PhD's together focus on the following main research question: "Given a number of virtualization scenarios defined for the different types of supply chains in WP1, what are effective tradeparc network, route and process configurations, and responsive planning models and algorithms in allocating customer orders against supplier deliverables (including inventory management and transportation strategies in the logistics network) taking into account fresh product quality changes, uncertainties in supply and demand, available transport modalities/capacities as well as differentiated logistic service requirements?"
- *Workpackage 3* studies the opportunities for advanced information exchanges and architectures of knowledge bases to facilitate the advanced planning and control concepts developed in WP2. This knowledge base gives access to the basic ICT infrastructure functionality and can support value-added services by linking florticultural partners through web-based information architectures. Key research efforts involve identifying necessary *Greenbase* building blocks, defining information requirements to be included and the design and development of methods

and tools that will allow the agile development of specific information and decision support systems.

- *Workpackage 4* studies the implications of scenarios for the businesses involved and come up with business models that work for specific settings in open collaboration networks. Nice to have advanced tools and decision support models for planning and control, but if the actors in the chain are not keen on using them and are unwilling to collaborate, no gains are taken. This WP should therefore base its research on the findings and developments of WP1, 2 and 3.
- Finally, *workpackage 5* entails valorisation (including integration of findings and pilot studies) and knowledge dissemination, which is an activity that takes place as of day 1 until the end of the project. That is why it is an overarching package that embraces all other WPs, learning from project results as well as giving input to it (esp. via pilot studies and workshops).

The research is foremost done by two PhDs, and two Postdocs, in close cooperation with the business partners and researchers from WUR, VU and TU/e. A number of MSc students complement the researchers on specific research questions in collaboration with business partners.

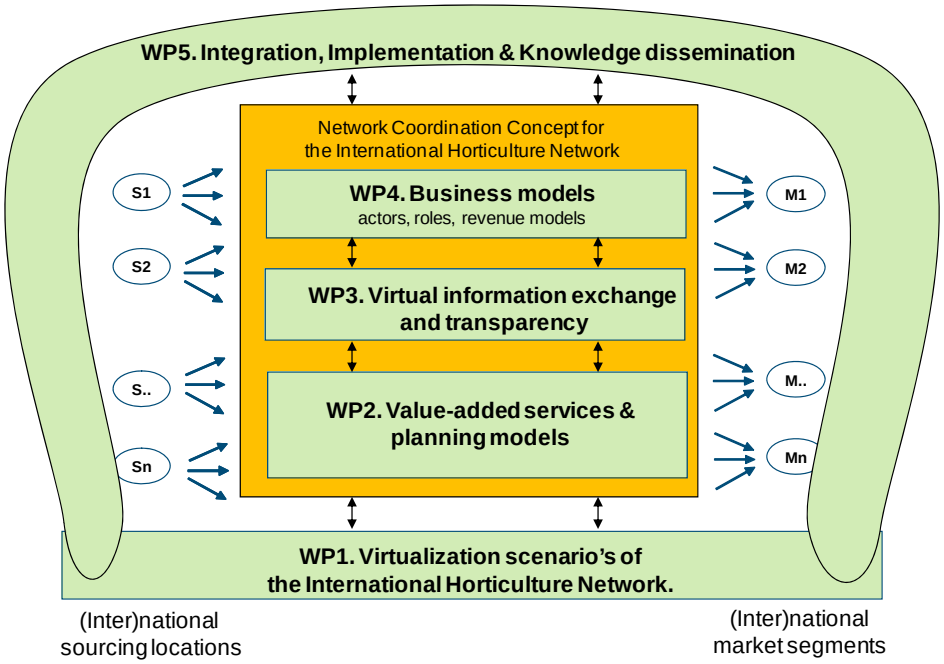

Figure 2. Overview of the work packages

To conclude

We have presented an overview the DAVINC^{3}I project. We have discussed the main sector developments and have identified the main opportunities for logistics performance improvement that will be further researched in the project. At the moment the focus is on the definition of relevant virtualisation scenarios. The coming year will focus on the other workpackages that aim for developing innovative logistics concept for international floriculture trade networks.

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