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# Towards a Smarter Greenport: Public-Private Partnership to Boost Digital Standardisation and Innovation in the Dutch Horticulture

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## ABSTRACT

The horticulture and propagation materials sector has been designated as one of the so-called top sectors in which the Netherlands excels globally and that are a government priority. The top sector approach for further innovation is based on public-private partnerships (PPPs) in which businesses, knowledge institutes and the (national) government are working closely together towards a common vision and action plans (the 'golden triangle'). This paper introduces the Digital Greenport Holland (Dutch: Tuinbouw Digitaal) and its research and innovation programme 'a Smarter Greenport'. Digital Greenport Holland is the PPP of the horticultural top sector that focuses on digital information management. The business involvement consists of the collaboration between three active industry associations for chain information, i.e. Frug I Com (fruit and vegetables), Floricode (flowers and plants) and EDIbulb (flower bulbs). The activities focus on four main themes: E-standards, E-information-integration, E-business-to-government and E-competence. The programme 'a Smarter Greenport' has currently conducted eight projects on these themes.

*Keywords: Public-private partnership; Collaborative innovation; Information standards; Interoperability; ICT adoption; Horticulture*

## 1 Problem context

The Dutch horticulture is an innovative sector with a leading international competitive position and a great contribution to the national economy (CBI, 2008b, a, c). It is internationally renowned as a strong cluster (Porter, 1998). It's main product categories are fruit, vegetables, cut flowers, pot plants, flower bulbs and trees. The sector is concentrated in so-called Greenports, i.e. geographic and knowledge-intensive concentrations of related companies and institutes in a particular market with a strong global position (Breukers, 2008). Greenport Holland is a network of these clusters in the Dutch horticulture , representing over 29.000 companies, a production value of €7.9 billion, an export value of €15,6 billion an employment of about 400.000 employees (GreenportHolland, 2014).

Despite the current strong position, the sector currently faces major challenges due to the increasing international competition, the economic crisis, food incidents such as the EHEC crisis and fast advances in (information) technology, among others. These developments urge the sector to look forward and innovate to stay in the lead. In nowadays dynamic and international business environment, digital

information management is an important factor to achieve this challenge. Information plays a crucial role in the efficiency of, and ability to effectively organise, the Dutch horticultural supply chains. This holds for the production, handling, trade and transportation of horticultural products: good information is the lubricant of the horticultural supply chains. For this reason, the Dutch horticulture sector has formulated the ambition to be leading in the field of digital information management in horticulture chains. In order to achieve this, several critical conditions must be met coherently:

1. Knowledge and expertise must be available to businesses in order to be able to apply information management within their organisations and supply chain.
2. Agreements must be present on which national and international information standards will be used by the businesses in the chains, and between businesses and the government.
3. The technical means must be present with which information can be used and shared quickly, unambiguously and accurately. This concerns both 'soft' technology (e.g. software and information systems) as well as 'hard' technology (e.g. scanners and RFID chips in packaging and transport units).

The horticulture industry has been active in this area for several years already. Large steps have been made. Greenhouses have developed towards high-tech factories that are highly automated. The sector is also very active in eBusiness and in the standardisation of information exchange. However, the development of information management in the sector is still too fragmented and it is not progressing quickly enough. Furthermore, it is found that most projects work on inter-enterprise integration, the focus is on data exchange and most projects have an operational perspective (Verloop et al., 2010; Verdouw et al., 2011b). As a result, the ambition of the sector to be leading in the field of information management in horticulture chains is hindered. In order to strengthen the international position of the Dutch horticulture, it is necessary that the current developments are accelerated and bundled. It is for this reason that the Digital Greenport Holland (Dutch: Tuinbouw Digitaal) has been started. The next sections will introduce: 1) the objectives and organisation, ii) focus areas and challenges, and iii) the research and innovation programme of this Public-Private Partnership.

## 2 Digital Greenport Holland

Digital Greenport Holland is the Public Private Partnership (PPP) of Greenport Holland that focuses on digital information management and standardisation in the Dutch horticultural cluster. It has the ambition to be globally leading in the area of information management in horticultural supply chains.

The Digital Greenport Holland is part of the so-called top sector Horticulture and Propagation Materials Sector. The Dutch government has decided to strengthen nine of these crucial sectors in the Dutch economy, which implies that targeted investments in these sectors are made alongside business and scientific institutions (Verhagen, 2011; Wiel and Kroon, 2014). To do so, in each of these sectors, businesses, knowledge institutes and the (national) government are working closely together towards a common vision and action plans. The government does not make its own proposals for the sectors, but invites businesses and scientists to define multi-annual agreements (i.e. innovation contracts) in which research and education is being attuned to the needs of the companies. This approach of intensive co-operation between the business community, knowledge institutes and government approach is characterized by the metaphor of a 'Golden Triangle'

The 'Golden Triangle' of the Digital Greenport Holland (see Figure 1) is a community which heart is formed by the collaboration between three active industry associations for chain information in the Dutch horticulture: Frug I Com (fruit and vegetables), Floricode (flowers and plants) and EDIbulb (flower bulbs). Within the Digital Greenport Holland these associations are working together with the Dutch Ministry of Economic Affairs, Wageningen UR and TNO to:

- Connect available knowledge and running projects in the different horticultural subsectors;
- To accelerate the use of information standards at companies within the sectors;
- To disseminate knowledge to all stakeholders, i.e. horticulture companies, trading companies, service providers, and knowledge and educational centres, etc.;
- To manage a common research and innovation programme on digital information management in horticulture.


**Figure 1.** The 'Golden Triangle' of the Digital Greenport Holland

The member organisations of the Digital Greenport Holland cover nearly all companies active in the Dutch horticulture, including producer organisations and auctions, traders and logistics service providers (see Table 1). In these platforms, the horticultural business is leading and ICT companies are involved as solution providers.

**Table 1.**
Industry involvement in the Digital Greenport Holland

| *Association* | *Industry Involvement* |
|---|---|
| ***Frug I Com (fruit & vegetables)*** | - Direct members (companies)represent over 70% market share in the Dutch fruit & vegetables industry (including companies like The Greenery, Fruitmasters, FresQ, Haluco, ZON Fruits & Vegetables amongst others).<br>- Dutch Produce Association (DPA): Dutch sector association for marketing organisations of fruit, vegetables and mushrooms, 14 Producers Organisations are the members of DPA;<br>- Frugiventa: Dutch Fruit and Vegetables Trade Association with 420 members;<br>- CBL, Dutch Retail and Food Service Association with 27 members, including for example Albert Heijn, Metro NL and Deli XL;<br>- LTO: Dutch Federation of Agriculture and Horticulture, an entrepreneurial and employers' organisation, representing almost 50,000 agricultural entrepreneurs;<br>- Commodity Board for Horticulture;<br>- GS1 The Netherlands. |
| ***Floricode (flowers and plants)*** | - FloraHolland, the biggest flower auction in the world, growers cooperative with about 6,000 members;<br>- VGB, Association of Wholesale Trade in Horticultural Products : about 270 flowers and plants traders are member;<br>- HBAG, Trades Council agricultural wholesale trade: over 2.300 wholesalers are members, of which 725 companies export;<br>- Commodity Board for Horticulture<br>- Plantform (producers association with over 70 members)<br>- GS1 The Netherlands. |
| ***EDIbulb (flower bulbs)*** | - Anthos: the Royal Trade Association for Nursery Stock and Flower Bulbs)<br>- B4, association of mediators in bulbs, tubers and perennials with around 1.500 members<br>- KAVB, Royal General Bulb Growers' Association |

## 3 Focus areas of the Digital Greenport Holland

The activities of Digital Greenport Holland focus on four main themes (see Figure 2): information standards (E-standards), information integration within and between businesses in chains and networks (E-information-integration), information exchange between companies and governments (E-business-to-government) and increasing awareness, knowledge and skills on digital information management (E-competence).

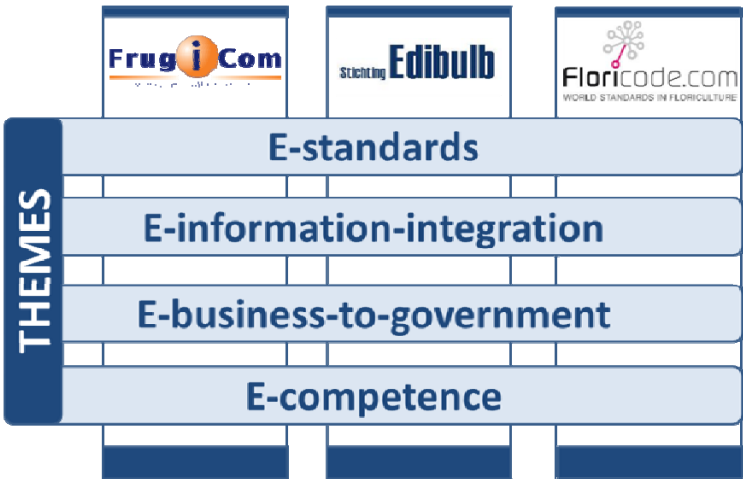


**Figure 2.** Focus areas of the Digital Greenport Holland

Below, the focus areas of the Digital Greenport Holland and its main challenges are introduced, based on Verloop et al. (2010), Verdouw et al. (2011b) and Verdouw et al. (2013).

### 3.1 E-standards

A rapid, error-free, efficient and secure exchange of information between organizations in supply chains (breeders, growers, logistical service providers, auctions, packers, traders, retailers) is essential for effective chain management (Lee and Whang, 2000; Bechini et al., 2008). An important prerequisite is that information systems in the chain 'speak the same language'. The business process-based information standards of the Digital Greenport Holland ensure this interoperability. They are composed of international agreements on the format, content and meaning of the information to be shared (i.e. messages, codes) as well as on the method by which they are to be communicated technically. The most important information standards include (Wolfert et al., 2010):

- *Standard messages*: agreements on the functionality and structure of electronic messages, for example: which information should be contained in an order?
- *Standards codes*: digital number plates of e.g. products, load carriers, crates and locations. These codes are used as information keys in applications through the entire chain, like scanning barcodes, reading RFID tags and tracking and tracing;
- *Standard labels*: agreements about the format of barcodes, RFID chips, etc. so that they can be read consistently;
- *Data communication standards*: technical agreements about how information (via the internet) should be exchanged between parties in the chain.

The theme E-standards has been the main focus of the industry associations Frug I Com, Floricode and EDIbulb. As a result, much progress has been made during the past decade (Verdouw et al., 2011b). In particular, horticultural coding and message standards have been developed, the generic standards (like orders, invoices, despatch advices, etc.) are mostly aligned with available international standards (via cooperation with GS1) and much effort is made in creating awareness and improving the adoption of standards. For the future, this theme will remain very important. Important challenges include (Verdouw et al., 2011b):

- The generic e-Business standards are fairly well integrated with international standards, in particular because of cooperation with GS1. However, the international embedding of horticulture-specific standards is an important future challenge.
- The adoption of standards is still too low. The challenge is to increase the usage of standards by the horticultural business and ICT vendors.
- There are several national standards for coding horticultural products (in particular floriculture). Reasons are that there are very many species and the required level of detail differs for different purposes of usage. The challenge is to harmonise the different standards and to integrate them with relevant international standards.

### 3.2 E-information-integration

This theme is concerned with the exchange of information within and between businesses in chains and networks (i.e. breeders, growers, logistic service providers, auctions, packagers, handlers and retailers). It includes integration of i) enterprise information systems, 2) supply chain information systems and 3) market information systems.

*Enterprise Information Systems* support the processing of information at different levels ranging from operational to strategic, including mechanized cultivation and logistic systems, enterprise management systems and business intelligence applications (Laudon and Laudon, 2002). In the horticultural industry impressive achievements have been made concerning the mechanisation of production, harvesting, sorting, packaging and warehouse management. However, many companies in the sector, in particular growers, struggle with their enterprise management systems (Verloop et al., 2009; Robbemond and Verdouw, 2012). They are often characterised by island automation, which results in insufficient management information and a lot of manual data entering with a high risk for errors. Furthermore, the integration of technical greenhouse and logistics systems with enterprise management systems is an important challenge in particular due to a lack of standards.

*Supply Chain Information Systems* are software systems that support the rapid, error-free, efficient and safe information exchange between supply chain participants, including systems for Tracking & Tracing and Supply Chain Planning (Gunasekaran and Ngai, 2004; Verdouw et al., 2011a). The adoption of these systems advances only with difficulty in the Dutch horticulture (Verdouw et al., 2011b; Verdouw et al., 2013). Important limiting factors are a lack of intra-enterprise interoperability and organisational factors such as unclear business models, a lack of trust in the privacy of data and the big number of SMEs that miss the competences and mass needed for the implementation. In response to these difficulties, the emphasis in floriculture is shifting from individual software interfaces and central systems towards software platforms based on Service Oriented Architecture (SOA) that support the exchange of information and the configuration of customised solutions (Verdouw et al., 2011b). Using such application requires big changes of business processes and supply chain cooperation. Furthermore, the technology is complex. In particular SME miss the competences and mass needed for the implementation. Related to this issue, the added value often is not clear enough. Important challenges are to increase the knowledge and awareness and to support innovative pilots and to establish a common infrastructure, including supporting services and tools (like Fresh Digi Check, Floricode Test Centre, Frug I Com Service Packs, and Floricode Software Development Kit).

*Market information systems* support the processing of transactions via a market mechanism (Timmers, 1998; Stockdale and Standing, 2002). They include functionality to provide information about available products, to compare products on buying criteria, to agree on price, and to process the transaction administratively (including payment). Market information systems can be subdivided into Business to Business (B2B) and Business to Consumer (B2C) systems. The usage of B2B market information systems in the Dutch horticulture has expanded a lot in the previous years (Verdouw et al., 2011b). Important developments include the emergence of web shops and on-line trade platforms and the digitalisation of the auctioning process in the floriculture. In B2C the dominance of non-perishables in web trade is currently being changed. Retailers and specialised internet traders are trying to achieve competitive advantage with the delivery of high-quality fresh products. To do so, new solutions for fulfilment and last-mile deliveries are introduced (for example: Amazon Fresh). This is expected to have a big impact on the horticultural sector. Moreover, the communication with consumers about horticultural products via smartphone apps and social media is advancing fast. Important challenges include the organisation of the underlying data and how to effectively influence consumer behaviour with these new technologies.

### 3.3 E-business-to-government

This theme concerns the exchange of information between business, government and via the organisations appointed by the industry to perform certification and inspection, often within the context of legislation and regulation. Companies in horticulture can gain many benefits if the integration with governments is improved (Yildiz, 2007). Administrative burdens could be lowered and the speed of tests and inspections could be improved significantly. A crucial challenge to achieve this that governments and certification and inspection bodies better connect to information systems and standards as apparent in the horticultural business. There still is a mismatch between the information need of the government and the already available information in horticulture and the mutual transparency is insufficient (Verloop et

al., 2010; Verdouw et al., 2011b). The vision is present, both at the government and at companies, but the actual realisation is often only progressing with difficulty.

### 3.4 E-competence

This theme concerns stimulating the development of knowledge and skills of entrepreneurs and their staff so that they may make better use of digital information systems in their daily tasks, as well as to help them to be able to make both tactical and strategic decisions through the use of these information systems. Many companies in particular SMEs still lack sufficient knowledge, among others because information and communication technologies are perceived to be complex and development is going fast (Verloop et al., 2010; Verdouw et al., 2011b). Besides the knowledge gap, too many entrepreneurs are not yet convinced about the necessity to work actively on and invest in the improvement of their information management. Therefore, an important challenge is to create a sense of urgency. This can be done by developing incentives by chain partners to stimulation the usage of standards, tailored communication, and educational activities. The next challenge is assisting companies in developing knowledge and skills on digital information management.

## 4 Research and innovation programme 'A Smarter Greenport'

The Digital Greenport Holland has started the research and innovation programme 'A SMARTER Greenport' to work on the challenges as described in the previous section. This programme aims to enhance innovations of digital information management in the Dutch horticulture by the development, application and valorisation of innovative information and communication technologies. The Dutch horticulture industry is committed to strengthen the existing cooperation with R & D institutes through this programme.

The programme is organised in the form of a Public-Private Partnership (PPP) as described previously in this paper. Companies, knowledge institutes and the national government closely collaborate and continuously interact to develop a common vision and action plans. At this, the horticultural industry is leading in defining the innovation needs and research priorities. The operational activities are managed by a programme team with representatives of the horticultural industry (i.e. Frug I Com, Floricode, EDIbulb), the knowledge institutes (Wageningen UR) and the government (Ministry of Economic Affairs). The programme teams reports to an Executive Board, which reflects a broad commitment in the Dutch horticulture. Furthermore, a lot of attention is paid to the (informal) community of the Digital Greenport Holland by organising network and dissemination meetings and communication via an internet portal and social media.

The programme 'a Smarter Greenport' has currently conducted eight projects on the focus areas of the Digital Greenport Holland (see Table 2). Each project is guided by a specific advisory board of directly involved stakeholders, in particular horticultural companies.

**Table 2.**
Research projects of 'A Smarter Greenport'

| Project | | Objective | Theme |
|---|---|---|---|
| ***1*** | Community of Practice | To set up and develop a physical community (networking meetings and conferences) and a digital community (web portal and social media). | Overall |
| ***2*** | Quality of Standards Dutch Horticulture | To assess and improve the quality of information standards in the Dutch horticulture concerning the implementation, the content (in particular semantics), standardisation process and organisation. | E-standards |
| ***3*** | Standardisation from Nursery to Supply Chain | To develop guidelines for the integration of nursery systems with administrative systems for enterprise management and exchange of cultivation and product information within horticultural supply chains, including the use of existing international standards and protocols such as ISA-95, ISA-88, B2MML and BatchML. | E-information-integration |
| ***4*** | Consumer Interaction | To analyse of the opportunities of smartphone apps to interact with consumers about horticultural products. More specifically, the aim is to improve the *Veggipedia app*, available in the Android and Apple store since December 2013. This app provides information for consumers about storage, purchase and processing of 230 vegetable and fruit products. Furthermore, the app contains 600 recipes and a bar code scanner to assess the origin of the product (name of grower and trader). | E-information-integration |
| ***5*** | Quality-based Tracking & Tracing | To develop and demonstrate an innovative system for real-time management of product quality in horticultural supply chains. This system combines several new technologies, regarding tracking and tracing (e.g. RFID), quality monitoring (e.g. wireless sensor networks) and internet (e.g. cloud computing and web services). | E-information-integration |
| ***6*** | Big Data in the Dutch Horticulture | To analyze the opportunities of big data in horticulture, comprising structured data (including linked open data) and unstructured data (including social media), and to demonstrate this in pilot projects. | E-business-to-government |
| ***7*** | Hort-I-management Scan | To stimulate awareness and support competence development on information management in horticulture, by providing interactive tools (e.g. self-assessment and gaming) on the web portal of the digital community. These tools will help entrepreneurs to enhance their information management. | E-competence |
| ***8*** | Knowledge Portal Digital Greenport Holland | To develop a knowledge tool in the web portal of Digital Greenport Holland that supports personalized and self-learning internet searches. The tool contains a knowledge based model with keywords per theme to find and evaluate all available news items. Subsequently, only a selection of most relevant items will be published on the web portal. | E-competence |

## 5 Conclusions

This paper has introduced the Digital Greenport Holland (Dutch: Tuinbouw Digitaal) and its research and innovation programme ‘a Smarter Greenport’. Digital Greenport Holland is the Public Private Partnership (PPP) of Greenport Holland that focuses on digital information management and standardisation in the Dutch horticultural cluster. It has the ambition to be globally leading in the area of information management in horticultural supply chains.

The Digital Greenport Holland is part of the so-called top sector Horticulture and Propagation Materials. The Dutch government has decided to strengthen nine of these crucial sectors in the Dutch economy, which implies that targeted investments in these sectors are made alongside business and scientific institutions. The top sector approach is based on public-private partnerships (PPPs) in which businesses, knowledge institutes and the (national) government are working closely together towards a common vision and action plans (characterised by the metaphor of the 'Golden Triangle').

The ‘Golden Triangle’ of the Digital Greenport Holland is a community which heart is formed by the collaboration between three active industry associations for chain information in the Dutch horticulture: Frug I Com (fruit and vegetables), Floricode (flowers and plants) and EDIbulb (flower bulbs).

The activities of Digital Greenport Holland focus on four main themes (see Figure 2): information standards (E-standards), information integration within and between businesses in chains and networks (E-information-integration), information exchange between companies and governments (E-business-to-government) and increasing awareness, knowledge and skills on digital information management (E-competence). The Digital Greenport Holland has started the research and innovation programme 'A SMARTER Greenport' to work on important challenges within these four focus areas. This programme aims to enhance innovations of digital information management in the Dutch horticulture by the development, application and valorisation of innovative information and communication technologies. At this, the horticultural industry is leading in defining the innovation needs and research priorities. The programme has currently conducted eight projects, entitled: Community of Practice, Quality of Standards

Dutch Horticulture, Standardisation from Nursery to Supply Chain, Consumer Interaction, Quality-based Tracking & Tracing, Big Data in the Dutch Horticulture, Hort-I-management Scan and Knowledge Portal Digital Greenport Holland.

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