Digital Horticulture: Adoption and Enhancement of Information Management in the Dutch Horticulture

C.N. Verdouw[*,1], R.M. Robbemond[1], P. Ravensbergen[2], A.J.M. Beulens[3] and J. Wolfert[1]

[1] LEI Wageningen UR, P.O. Box 29703, 2502 LS The Hague, Netherlands
[2] Commodity Board for Horticulture, Zoetermeer, The Netherlands
[3] Logistics, Decision and Information Sciences, Wageningen UR, The Netherlands
[*] cor.verdouw@wur.nl

Abstract

The study presented in this paper shows that the Dutch horticulture is active in the field of information management. Much progress is made, among others in the development and adoption of eBusiness standards. However, the development of information management in the sector is still fragmented and too slow. 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. As a result, the ambition of the sector to be leading in the field of information management in horticulture chains is hindered. To overcome this, the program Digital Horticulture was formulated to coordinate ICT initiatives within and between horticultural sub-sectors (various vegetables and ornamentals), in close cooperation with governments and research/education. The study has defined four key areas for future development: information standards, chain information management, enterprise information systems, Business-to-Government and ICT Knowledge and Competences. In these areas, the Digital Horticulture program will support the exchange of knowledge, development of shared visions, alignment of ICT projects, common representation in international standardisation bodies, and business-driven research.

Keywords: Innovation, Standardisation, Adoption, Horticulture

Introduction

The Dutch horticulture is traditionally a strong and innovative sector with a leading international competitive position and a great contribution to the national economy. It is internationally renowned as a strong cluster (Porter 1998). It's main product categories are fruit, vegetables, cut flowers, pot plants, bulbs and trees.

The Flowers & Food (F&F) co-innovation program aims to stimulate sustainable innovations that contribute to maintaining and expanding this position (F&F, 2007). One of its spearheads is the use of modern Information & Communication Technology (ICT) to enable a seamless connection of intelligent greenhouses with the marketplace.

This paper presents the results of a study, inducted by the F&F program, which aimed to assess existing ICT innovation projects in The Netherlands, to define the foremost remaining challenges, and to develop a co-innovation program to improve the adoption and enhancement of Information Management in the Dutch Horticulture.

Method

In Dutch horticulture, there are three active platforms that stimulate the adoption of enhancement of information management. These platforms are Frugicom (fruit and vegs, www.frugicom.nl), Florecom (cut flowers and pot plants, www.florecom.nl) and EDI-Bulb (flower bulbs, www.edibulb.nl). In these platforms, the horticultural business is leading and ICT companies are involved as solution providers. The total involved network covers nearly all companies active in the Dutch horticulture, including producer organizations and auctions, traders, logistics service providers and information technology vendors.

The research was carried out in close interaction with these platforms, the Commodity Board for Horticulture, and the Dutch Ministry of Economic Affairs, Agriculture and Innovation. A working group of representatives of these organizations was formed. This group intensively guided the research.

The research was organized in three steps: investigation, analysis and program development.

First, in total 19 projects were investigated based on desk research. The projects were identified and selected by the working group and investigated by using structured templates based on literature. The data gathering was done in 2009.

Second, the investigated projects were analyzed in-depth by identifying the addressed bottlenecks, main causes, chosen solution directions, intended business effects, progress, results and remaining challenges. Next, the project reports were abstracted to generic focus areas, which were categorized in five key themes.

Third, based on the analysis, a preliminary program definition was proposed. This definition has been discussed and refined in three workshops with key business representatives of the Dutch horticulture.

The remainder of this paper introduces the results following the research steps as described above, i.e. state of the art (investigation), future challenges (analysis) and a vision (program definition).

State of the art

The investigation shows that the Dutch horticulture is active in the field Information & Communication Technology. In total 19 projects were identified in 2009. Table 1 provides an overview of these projects.

Table 1 Classification of the projects

Nr.	Project name – brief summary	Inter enterprise	Intra enterprise	Process	Application	Data	Infrastructure	Operational	Tactical	Strategic
1	CLIENT – Exchange of import and export data	X		X	X	X	X	X		
2	Business Intelligence - in the horticultural supply chain			X	X	X		X	X	X
3	Codering Levend Groen –Uniform coding system for horticulture products	X				X		X		
4	De digitale slotplaat –Digital lock plate for trolleys	X					X	X	X	
5	KISS/it – Logistics Tracking & Tracing system	X			X	X	X	X		
6	Linneaus –revision of VBN product codes system	X				X		X		
7	Locatiecoderingen Sierteelt – introducing standard codes of delivery addresses in horticulture	X				X		X		
8	Plantform –integral management systems for pot plant growers		X	X	X				X	
9	RSLM – Registration system for logistic means	X			X	X	X	X		
10	Sierteelt Internationaal Digitaal – Applying, simplifying and ensuring international connection of XML in horticulture	X				X		X		
11	Van Plant tot Klant – Applying RFID in the horticulture trade chain	X				X	X	X		
12	Vers Schakel – Improving quality and availability of fresh vegetables	X					X	X		
13	Keteninformatiesysteem FresQ – professionalization of chain information management	X	X		X			X		
14	Foodcompass – early warning and response system for residue information	X				X		X		
15	Datatuin – standardizing data communication		X	X		X	X	X		
16	KwaliTenT: quality-driven tracking and tracing systems	X				X		X		
17	Horizontaal toezicht – optimizing fiscal processes	X			X	X		X		
18	SALDO – developing a governance for exchange of chain information	X			X	X		X		
19	LNV 100% digital – matching the digital services of the Dutch agriculture ministry with the horticulture chain	X			X			X		

In Table 1 the identified projects are classified according to their essential characteristics which are based on the information integration framework and the management type. The table shows that projects have been developed on all levels of information integration. However, there are some dominant emphases: i) most projects work on *inter-enterprise* integration, ii) the focus is on *data exchange,* iii) and most project have an operational perspective.

The emphasis on *inter-enterprise* integration shows that projects are strongly motivated by the trade/auction and retail. Another explanation is that this type of integration requires inter-enterprise coordination and consequently it increased the need for projects exceeding the level of individual companies. However, inter-enterprise integration heavily depends on reliable information on individual companies. The absence of good enterprise information systems is an ever more urgent bottleneck.

The emphasis on *data exchange*, in particular coding and electronic messages, can be explained from the relationships between different forms of integration. A technical infrastructure is a prerequisite for data exchange and forms the first level of integration. Data integration requires a technical infrastructure. The emergence of the internet has resulted in a worldwide basic infrastructure in general use. This shifts the accent to the second level of standardisation, namely agreements regarding data exchange. Huge steps have been and are being made to this end in horticulture. It is expected that in the near future the accent will continue to shift towards integrating application and coordinating processes.

The recent development of projects with a strong application integration component, such as KISSit, Plantform and KIS FresQ, heralds this trend.

The emphasis on the *operational level* can be partly explained by the demarcation of the inventory. Strategic programs, which are the parents of many of the identified projects, have a broader focus (like Flowers&Food 'winnen aan waarde', Plantform Agrologistiek/Florilog en Greenports). This makes sense, because ICT is not a goal in itself, but a means for business and chain optimisation in particular. However, a translation of these business strategies to a long term common ICT vision in horticulture is still lacking. There is also very little coordination between projects in the horticultural sector which are aimed at the same problems, and very little observation of the work of other sectors and other countries for learning purposes.

<u>Spearheads for future development</u>

This section establishes the spearheads for future development derived from the analysis of 19 Dutch projects (see Table 2). On the basis of the inventory, a number of key areas have been defined for future development. These key areas can be found on various levels, and are interconnected as illustrated in the figure below.
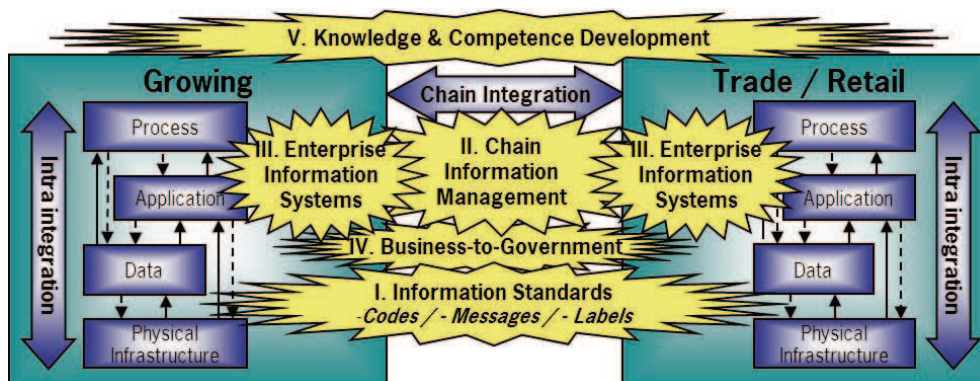
Figure 1. Main ICT themes

Information Standards

A rapid, error free and efficient information transfer is only possible when information systems in the chain 'speak the same language'. This can be realized by basing information standards on business processes. These standards are fixed agreements on the size, contents and meaning of the information (messages and coding) that is exchanged and the way on which these have to communicated technically (via internet of labels). The most important information standards are:

- 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 size 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.

This theme has been the main focus of the industry platforms Frugicom, Florecom and EDIbulb. As a result, much process has been made during the past decade. 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 must effort is made in creating awareness and improving the adoption of standards. For the future, this theme will remain very important. Important remaining challenges include:

- The generic eBusiness 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.

Chain Information Management

Rapid, error-free, efficient and safe information exchange between organizations in chains (breeders, growers, logistical service providers, auctions, packers, traders, retailers) is essential for good chain management. Chain information management addresses information problems on the level of the chain. A chain information manager contributes by facilitating the agreements between parties in the chain and by coordinating problems and guiding solutions, for example in the form of systems. Chain information systems digitally connect processes, businesses and chains. Examples of such systems are data hubs (like KISSit and GS1-DAS). Chain information systems can also connect applications to each also known as virtual platforms. Examples are the many digital marketplaces in the floriculture.

The emphasis in this theme is shifting from individual software interfaces and central data warehouses towards distributed software applications based on web services, without a central storage of data. These application should support a rapid, reliable, secure and flexible data communication. 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, Florecom Test Centre, Frug I Com Service Packs, and Florecom Software Development Kit).

Enterprise Information Systems

Information plays a key role in the management of business processes. To ensure the effectiveness and efficiency of business processes, information must be continuously captured, edited and communicated. Automating this process in business information systems realises speed, efficiency and reliability. Information systems support the processing of information at different levels ranging from (technical) operational to strategic:
- Mechanized cultivation and logistic systems like climatecomputers, potting robots, systems for order collections, path and time registration, precision agriculture applications, etc
- Business management systems: automating planning, security and administrative processing of sales, purchase, production, resource management, finance, etc. (for example in systems for Enterprise Resource Planning (ERP)).
- Management information systems (business intelligence applications).

Many horticultural companies strugle with their enterprise information systems. Important challenges include:

- The availability of solid and seamless integrated enterprise management systems, that are at the same time flexible and include dynamic planning.
- An important prerequisite of succesful implementation of an integral management system is a professional management of business processes. However, many horticultural companies heavily rely on improvisation. Consequently, well-structured process management and a good administrative organisation are important challenges.
- The development of standards to integrate technical greenhouse and logistics systems with management information systems.

Business-to-Government

Business to government covers the information exchange between commercial organisations and the government, and organizations that are prepared by commercial organisations for testing and inspections, mostly in context of legislation.

Companies in horticulture can gain many benefits if the integration with governments is improved. 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 a mismatch between the information need of the government and the already available information in horticulture and the mutual transparency is insufficient. The vision is present now both at the government and at companies, but the actual realisation is often only progressing with difficulty.

ICT Knowledge and Competence Development

Competence and knowledge development is the enrichment of knowledge and skills of entrepreneurs. This helps them make better corporate decisions aided by digital information systems.

This is identified as one of the most critical challenges. Companies lack the required knowledge, among others because information and communication technologies are perceived to be complex and development are going fast. Besides knowledge, many companies (in particular growers) are not convinced about the necessity to work actively on 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 providing companies knowledge among others about recent technologies and how to use ICT to improve business processes.

Table 1 ICT themes versus investigated projects		
ICT Theme	**Focus Areas**	**Investigated Projects**
I. Information Standards	Standardisation of product / article codes; logistic information codes, electronic messages, standards for auto-identification (including RFID)	Datatuin, Sierteelt Internationaal Digitaal / Florecom XML,Frugicom, Linneaus, Codering Levend Groen, Locatiecoderingen Sierteelt
II. Chain Information Management	Integration of enterprise systems among chain actors; logistic and quality Tracking & Tracing; Auto-identification in supply chain (including RFID); Chain Business Intelligence	KISSit, RSLM, Digitale Slotplaat, BI Sierteeltketen, Van plant tot klant, Versschakel, KIS FresQ, EWRS Food Compass, KwaliTenT
III. Enterprise Information Systems	Enterprise Resource Planning (ERP); Integration Enterprise and Nursery Information (ERP and mechanisation); Enterprise Business Intelligence	Plantform
IV. Business-to-Government	Information exchange among companies and governments	Client, Horizontaal Toezicht, SALDO, LNV 100% Digitaal
V. ICT knowledge and competence development (overarching challenge)		

Towards the Digital Horticulture program

The results of the inventory indicate that many activities have already been developed and are in progress in the field of information facilities in the horticultural sector. However, the conclusion drawn from the analysis is that there is not yet sufficient coherence in these activities and that a clear underlying long-term vision is lacking. Consequently, the development of information management in the sector is fragmented and too slow. On the other hand, it has also been established that although the various sectors certainly have their specific obstacles and questions, they also have much in common. Together, these findings demands a common coordinated approach over the course of a long-term programme set up according to a long-term vision.

The study has proposed a preliminary definition of such a programme, called Tuinbouw Digitaal (Dutch for Digital Horticulture). The main focus is to coordinate on ICT initiatives within and between horticultural sub-sectors (various vegetables and ornamentals), in close cooperation with governments and research/education. The goal, then, of this program is to improve and integrate digital information management in the Dutch horticulture cluster through an integrated approach by means of:

a. setting up an expertise centre where questions from the practical field regarding information facilities can be tackled quickly and efficiently;

b. setting up a platform where information can be collected regarding activities in the field of integrated digital information facilities in the horticulture cluster (from industry, research and government);

c. developing a broadly held long-term vision for integrated digital information facilities in the horticulture cluster, initiated by this platform;

d. giving shape to this vision by mutually working on connecting themes and correlating the pilots in the key areas to these themes;

e. embedding the results in a knowledge base in which the knowledge and experience gained is safeguarded for the long term;

f. allowing this knowledge and experience to flow over into both existing and new training and education.

Ultimately these goals must contribute to concrete effects in the horticulture cluster, such as: improved logistic services, lowered transaction costs, removal of trade restrictions, improved product quality and sustainable production processes. The suggested method of operating is characterised by a business-driven development in concrete pilots in the focus areas. This in combination with the development and implementation of a connecting vision and an architecture for sharing knowledge and for ensure coherence.

The preliminary program definition of Digital Horticulture has been discussed and refined in three workshops with key business representatives of the Dutch horticulture. The main results of this workshops are that the problem analysis is recognised unanimously. There is a very broad commitment for a coordinating program. Furthermore, the five themes as reported in previous section are clustered into four themes, i.e. e-Standards, e-Information-Integration, e-Business-to-Government and e-Competences, and further refined. Important points of discussion have been the extent to what the program should support the concrete software solutions and the organisation of Digital Horticulture. It is stressed that the development of commercial applications is not supported. Furthermore, it also made clear that Digital Horticulture is not intended to be a formal institution replacing existing organisations like the industry platforms Frugicom, Florecom and EDI-Bulb. Contrary, Digital Horticulture is a cooperation between these platforms, that supports the exchange of knowledge, development of shared visions, alignment of ICT projects, common representation in international standardisation bodies, joint initiation and guidance of research, et cetera (see figure 2). This cooperation is organised in an informal community, in which the core group is formed by the working group of Digital Horticulture. This working group is a continuation of the project group of the study reported in this paper, and includes representatives of the Commodity Board for Horticulture, the Dutch Ministry of Economic Affairs, Agriculture and Innovation and Wageningen UR.

Figure 2. The structure of Digital Horticulture

Conclusion

The Dutch horticulture sector has formulated the ambition to be leading in the field of information management in horticulture chains. The main conclusion of this paper is that, although the sector is already very active in information management, the developments are fragmented and too slow for achieving this ambition. To overcome this, a program was formulated in which the involved organisations have committed to come to a unified and joint approach: Digital Horticulture. The main focus is to coordinate on ICT initiatives within and between horticultural sub-sectors (various vegetables and ornamentals), in close cooperation with governments and research/education. This by supporting the exchange of knowledge, development of shared visions, alignment of ICT projects, common representation in international standardisation bodies, and business-driven research.

Acknowledgements

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