Practical management research in relation to information technology in glasshouse horticulture

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Abstract

During the past decade the Research Station for Floriculture and Glasshouse Vegetables (PBG) has been closely involved in the development of applications of automation in relation to the support of the management of the grower. This paper presents a review of the developments in the past and present.

A reference information model for glasshouse horticulture was drawn up, the aim of which was to stimulate the developments in the field of information technology. Business comparison plays an important role in present-day protected cropping, and the contribution of automation is of increasing interest. An advisory system for crop protection supports the grower in his day-to-day business, while systems for investment selection and management advice are meant as tools for the grower's consultant.

Key words : management, decision support systems

Introduction

The Research Station for Floriculture and Glasshouse Vegetables (locations in Aalsmeer and Naaldwijk) carries out applied research, which aims at boosting the efficiency of the production and the quality of the produce in the sectors floriculture and glasshouse vegetables within socially accepted boundaries, and which thus contributes to the continuity of these sectors.

The Department of Economics, Management, Labour and Technical Research contributes to the development of automation applications which concentrate on the support of the management of glasshouse enterprises. From this point of view three decision levels can be distinguished, ie, operational, tactical and strategic. These can be translated into the short-term (daily), medium-term (1-2 years) and long-term (5 years) decisions, respectively. This distinction can also be found in the applications of information technology.

In this paper a survey is given of the developments in information technology for the business management of the grower. Practical research itself does not develop commercial automation products, but provides stimuli to new developments, independently, but frequently also in co-operation with other organisations.

First, the development of the Information Model Glasshouse Horticulture, which took place between 1985 and 1990, is discussed. This formed part of the Informatics Stimulation Plan for Agriculture which was set up by the government. Subsequently, the developments of the business comparison activities among fellow growers and the accompanying automated data processing are described. The development of an advisory system which is to support the grower's daily decisions with respect to crop protection and after that briefly several investment selection models which can support advisory services and research in their recommendations to growers are presented. Subsequently, a management advisory system is introduced This system serves as a tool for advisory officers or consultants to determine the current and the desired management level of a grower. On the basis of the results the consultant can advise the grower specifically and efficiently on his management and the measures to be taken. Finally, the current developments in information technology for management support are described.

Information model glasshouse horticulture

In order to stimulate the use of information technology, the government set up the INformatics Stimulation Plan (INSP) in 1984. At the start of INSP-Agriculture the Ministry of Agriculture, Nature Management and Fisheries, in coöperation with private enterprises, opted for a specified stimulation of information technology in the agricultural sector. To this purpose, branch organisations have been set up to guide the developments in the field of information technology in agriculture. An important component in the implementation of INSP was the development of reference information models for the various sectors of agriculture. An information model consists of a systematic description of an agricultural enterprise from the point of view of information supply. This implies that the processes taking place in the enterprise are described together with the data used, index numbers and calculation rules. The most important aims of the information models were:

- uniformity of basic concepts, index numbers and calculation rules;
- to create a basis for the design of new systems and for integration of existing systems;
- to create a starting point for standardization of connections between system.

The following groups are considered to be potential users: farmers/growers, agricultural research, consultancy and education, supply firms, clients and service suppliers to primary agricultural enterprises.

During the years 1986-1989 the Information Model Glasshouse Horticulture was set up under supervision of the branch organisation ATC-SITU (SITU, 1987), and with considerable contributions from the research stations for protected cultivation. In the subsequent period parts of the information model were brought up-to-date.

In 1993 the Agricultural Economics Research Institute (LEI), together with the Agricultural Telematics Centre (ATC), carried out an investigation into the use of the information models set up (Beers et al., 1993). Two main groups of users could be distinguished: research, education and consultancy on the one hand, which predominantly use the process models, and the agro-software industry on the other hand, which mainly uses the data model. It became apparent that the information model was a source of ideas, but that the compatibility with systems used in practice was poor. A general recommendation from the researchers was to generate information models which are designed and made available for very concrete and specific activities. Rather than very voluminous products with a wide range of uses, the glasshouse industry profits more from limited products with great accessibility, tailored to a clearly defined form of use.

"Groeinet", a source of knowledge in horticulture

During the period 1982-1983 the Glasshouse Crops Research Station (PTG Naaldwijk), the Research Station for Floriculture (PBN Aalsmeer), both now merged into the Research Station for Floriculture and Glasshouse Vegetables, and the Federation of Dutch Horticultural Study Groups (NTS) took the initiative to uniformization of data recording and exchange in glasshouse horticulture. To this purpose a special set of registration forms was issued. These forms make it possible for growers to compare each other's data in their respective study groups. Internal differences may then lead to further discussion about possible causes and the best working methods.

In the same period several software suppliers were invited to develop software for automation of this data registration. This resulted in a number of registration kits, which are still in use.

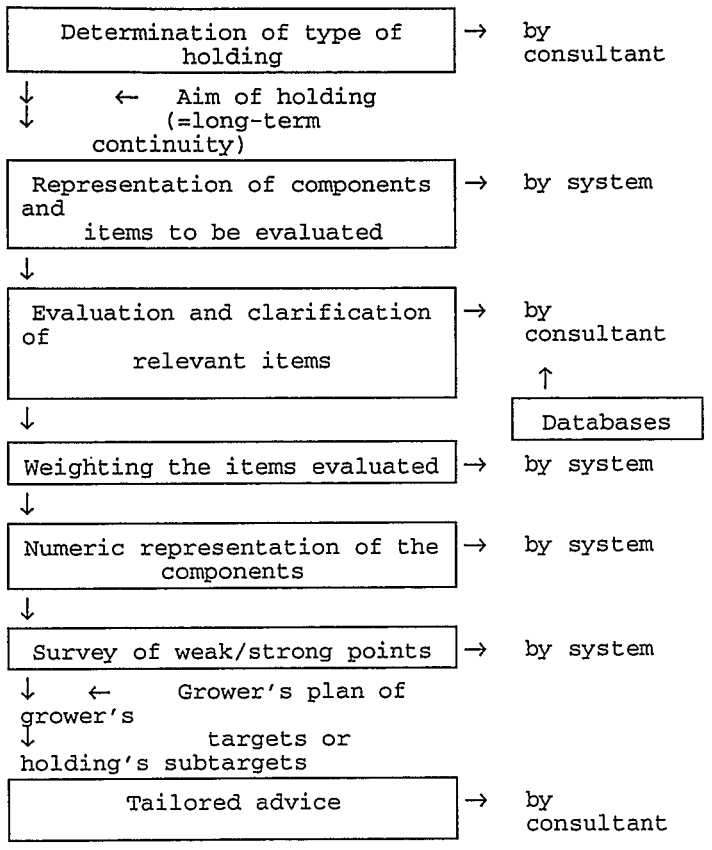
In the following period a number of vegetable auctions, in collaboration with the regional study groups, started to carry out the processing of yield and cultivation data themselves. By means of the auction computers, the yield data of participating growers were classified on basis of weekly surveys. Cultivation data were supplied by study groups and also classified in comparative surveys. In the ornamental sector processing the comparative figures was contracted out to data processing bureaus. The growers sent their data to these bureaus which entered them into their computer system and subsequently processed them to comparative surveys.

On the growers' request the Association of horticultural computer suppliers (DICOTU), developed a protocol which included the data exchange between auctions and registration computers and between the process computers in the horticultural enterprises and the registration computers.

Around 1990 the NTS took the first steps to set up a national centre for business comparison. This finally resulted in the introduction of "Groeinet" by the end of 1992. This centre processes and classifies the participants' data. The vegetable auctions send the yield data to the central computer of "Groeinet" daily, where they are processed into index numbers which are essential for the comparison groups. Other data, such as on climate, cultivation, labour or nutrition are entered by the grower by means of telecommunication. For those growers who do not own a pc, data-entering bureaus that are connected to "Groeinet" are available. These bureaus enter the data which are sent to them by mail.

Since 1984 PTG has used data recorded by the growers as a basis for research. That year saw the start of the annual publication of Quantitative Information for Glasshouse Horticulture. This publication contains estimates of yield, monetary yield and costs of about 300 crops. In 1988 the weekly publication of yield and financial results for the most important fruit vegetable crops was started. For this purpose "Groeilink", a communication programme with "Groeinet", was developed in 1992.

Figure 1 - Schematic representation of the model



Decision support system for crop protection

Introduction

The environmental issue makes particular demands on crop protection. Moreover, the consumer becomes increasingly quality-conscious. For these reasons growers have to meet increasingly high quality demands. For crop protection in the fruit vegetable crops biocontrol is used as much as possible. Although application is successfull on the whole, complicated assessment situations may occur occasionally.

An automated knowledge-intensive advisory system may offer support in daily decisions with respect to crop protection at business level in addition to the existing network of information sources. A prototype called CAPPA has been developed for the sweet pepper crop. The grower is the ultimate user of the system (Van der Maas, 1992).

Acquisition of knowledge

The expertise for the system is supplied by crop protection experts from research, advisory services and suppliers of biocontrol agents. This results in a wide public support. The knowledge has been translated into decision rules, which quantify qualitative information. For example, the incidence level of pests has been divided into incidence categories. It is, however, necessary to carry out observations according to a fixed method.

Results

CAPPA consists of the functions:

- registration (crop observations and measures taken);
- surveys;
- advisory service;
- reference information (agents, diseases, pests).

The system advises measures to be taken with respect to crop protection on the basis of recorded observations and measures taken. The registration data can be consulted in the form of surveys.

CAPPA was tested during the first 6 months of 1993 by 11 growers divided over 3 regions. The main aspects of the test were: operating the system, fitting the system in the management, determining the added value of the system.

All participants had a more positive opinion about the programme at the end than at the beginning of the testing stage, particularly with respect to registration. Incidence levels of pests were observed more consciously. The growers saw prospects for a system like CAPPA, provided it was part of a greater entity, e.g. a business registration kit.

Investment selection

During the past decade in horticultural research and consultancy various models with which the economic effects of different investment possibilities could be compared. The aim of these models was to improve the economic balancing of the different options. In parts of these models the Net Present Value was used as basis for comparison. An example of this is ISEM, a program with which the effects of the use of energy saving measured can be calculated, including the use of energy screens, flue gas condensers, double-glazed roof and walls and the choice of energy sources such as gas boiler, heat/power co-generation, heat pumps or heat from external sources. Another example is the CO_2 model, with which on the basis of crop growth simulation, the effects of various methods of CO_2 application and equipment can be calculated. A different kind of model is the Business Economic Advice, BEA. In this model, built in a spreadsheet, the effects of changes in organisation, cultivation plan or business equipment on the total costs, profits and financing are calculated. Basis for comparison in this model is the net business result and the profitability. The models described can support consultancy and research in their advisory services to the grower.

Figure 2 - Main functions, starting points and decision levels presented in a matrix

		Main functions			
		Commercial function	Production function	Personnel function	Financial/ Econ/Adm function
Starting points	Environment characteristics	X(1,0)			
		X(1,1)	X(1,2)	X(1,3)	X(1,4)
	Holding characteristics	X(2,0)			
		X(2,1)	X(2,2)	X(2,3)	X(2,4)
	Management characteristics	X(3,0)			
		X(3,1)	X(3,2)	X(3,3)	X(3,4)
Decision levels	Strategic	X(4,1)	X(4,2)	X(4,3)	X(4,4)
	Tactical	X(5,1)	X(5,2)	X(5,3)	X(5,4)
	Operational	X(6,1)	X(6,2)	X(6,3)	X(6,4)

Development of Management Advice Glasshouse Horticulture (MAG)

Introduction

The development of this programme has a long history. In 1979/1980 the Working Group Management Development investigated the management level in glasshouse horticulture. The results were published in 1982; the management level appeared to be inadequate. This research was followed up later by the Agricultural Economics Research Institute (LEI). After the concept of "fitting management level" was agreed upon in 1988, the automation has been worked out from 1989 onwards. A fitting management level is the desired management level of an individual grower against the background of his targets and specific business situation. A number of accountants' offices (GIBO-group), the OVTO (Organisation of Horticultural Consultants and Researchers), a computer centre and the PGB Naaldwijk jointly developed the automated MAG (ATC, 1993). Since 1993 the programme has been available for consultants in horticulture for applications in horticultural enterprises.

Set-up

In MAG, the activities carried out by a grower in his/her enterprise, are divided into four functions, i.e. the commercial, production, personal and financial/economic/administrative functions. In the various functions a distinction is made between starting points and decision levels. Starting points are characteristics of the environment, the enterprise and the management. These affect the way a grower takes decisions. Decision making is split up into strategic, tactical and operational decisions. In the system the higher level is always the framework for decisions at a lower level: in other words, it should be clear what the aim is in the longer term before decisions for e.g. the medium term can be taken.

Evaluation

In Figures 1 and 2 the contents are represented schematically. The MAG works with components. A component is a combination of a function with a certain starting point or decision level. Each component comprises a number of subjects, called items. An item is an aspect/piece of management important in the evaluation of the management. The evaluation of each item is carried out by means of one or more questions about that item. For example, how does a grower price his produce? Which information is collected for this purpose? Who is being consulted and which index numbers are used? The answers are compared with a normative scheme and are assessed according to a scale from 1-9.

The numeric evaluation of the items and components can be asked for via a programme on a computer screen or printed on paper. On the basis of this evaluation the consultant can determine in great detail what the strong and weak points of the management are. With this he can advise the grower very specifically and efficiently on his management and propose a line of approach for that particular glasshouse enterprise.

Current developments

From a business management point of view the present developments in information technology constitute a supporting function for the following areas: total quality control; chain control; recording and transfer of knowledge and business development. The following developments can be distinguished:

In both glasshouse vegetables and floriculture projects are under way with the aim to characterize the distinctive features of an environmentally conscious cultivation method and an environmentally friendly product. Participants in these projects have to record data on their business management. The recording of the data, the data processing and the control will increasingly take place along an automated way. "Groeinet" (see above) will become the appropriate medium for this.

Apart from attention for the environment, there is an increasing interest in integrated quality control (= product quality control + environmental control + labour control). This will imply a greater information flow (two-way traffic) through the various links in the chain.

Expectations are that the research station will shortly begin with the development of an automated knowledge base in the areas of product quality, environment and labour, with the aim to set up quality control systems in horticultural enterprises. In this way index numbers will become available for growers, consultants, researchers and others, and which can be used as reference material for horticultural enterprises.

Subsequent development of an advisory system for crop protection, following the prototype CAPPA, has been taken over by a software supplier in the glasshouse industry, together with a supplier of biocontrol agents. The new system centres around the registration component linked to the advice module and the possibility of communicating the data to third parties. The advice component has been enlarged to comprise the most important fruit vegetable crops (tomato, sweet pepper, cucumber). The system was developed and tested in 1994, and will be marketed as a commercial product in the near future.

In agricultural education information technology applications are increasingly made use of. Parts of the developments described are used as training material, eg the information model, the investment selection models, and the decision support system for crop protection.

It can be concluded, that nowadays automation has a distinct function in supporting the grower's management. In the future the function of applications of automation will increase.

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