USE OF INFORMATION, PRODUCT INNOVATION AND FINANCIAL PERFORMANCE ON BELGIAN GLASSHOUSE HOLDINGS

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ABSTRACT

In order to meet the changing needs and preferences of consumers it will be important for Belgian glasshouse growers to change from a production-driven to a customer-driven strategy. More than ever, use of information and product innovation become critical factors in the changing competitive environment. The aim of the research is to analyse the relationship between business and managerial characteristics, use of information sources, product innovation and financial performance of the firm. The results indicate that the average Belgian glasshouse grower makes low use of external information sources for production decisions. However an important variation in information use can be observed among the growers. The results reveal that vegetable producers make more use of external information than producers of ornamental plants, which can be related to their co-operational organisation. Although the predictors of information use can vary substantially across information sources, the results reveal that, independent of sector differences, the value attached to 'creativity and innovation' is an important determinant of information use. A significant positive relationship was found between the use of information and product innovation. The results indicate that product innovation and financial performance are associated, however this association was only statistically significant for the growers of ornamental plants.

INTRODUCTION

For many decades Belgian glasshouse growers have been able to compete on national and international markets by supplying products of good, standardized quality at low cost. However since the beginning of the nineties, the growing production in the southern regions, the changing consumer preferences and the countervailing power of retailers resulted in an important change of the competitive environment. In order to meet the changing needs and preferences of consumers it will be important for Belgian glasshouse growers to change from a production-driven to a customer-driven strategy, with special attention to product innovation, product quality and environmental sound production (Van Lierde et al., 1998, 1999 ; Saverwyns et al., 2000 a, b; Ministerie van Middenstand en Landbouw, 2000). For the growers, it implies a huge turnabout in their thinking about production. The goal is no longer to bring to the market a quality product meeting standard specifications, but rather to tune into hugely differentiated needs emerging at the market (Steenkamp, 1996). In previous research the adoption of environmental sound and high quality production strategies by Belgian glasshouse growers was analysed (Taragola & Van Lierde, 2000; Taragola, Van Huylenbroeck & Van Lierde, 2000 a, b).

The aim of the current research is to analyse the influence of personal characteristics of the firm manager and characteristics of the firm on the use of information for production decisions. Also relationships among the use of information, product innovation and financial performance will be investigated.

DETERMINANTS OF THE USE OF INFORMATION FOR PRODUCTION DECISIONS

The importance of search behaviour as a step in the decision making process was first described by Cyert and March (1963). They argued that information is not given but has to be obtained; that alternatives are searched for and discovered sequentially. In the search process, the internal and external environments are scanned for information that can be formulated into relevant alternatives. A variety of factors are expected to influence the use of information. According to network theory, networks consist of organized systems of relationships, and hence a network is generally defined as a specific type of relation linking a defined set of persons, objects or events (Szarka, 1990; Donckels & Lambrecht, 1997).

In this paper, we concentrate on the possible influence of firm manager and firm related characteristics on the use of network information. Personal characteristics of the firm manager are included because research suggests that the firm managers,

embedded in their businesses and in the external environment, are the actual composers of the network elements (Donckels R. & Lambrechts J., 1995). Birley (1985) stresses the fact that every set of relationships is unique and is determined by the person creating the network. Several researchers have attempted to uncover relationships between managerial and farm characteristics and use of information (e.g. Driver and Onwona, 1986; Ford and Babb, 1989; Schnitkey et al., 1992; Ortmann et al., 1993; Gloy et al., 2000).

Table 1 shows the hypothesized relationships between the characteristics and the use of information. Age and education are thought to influence the use of information. These factors are related to a decision maker's ability to create value from the information gathered from different sources.

Table 1. - Hypothesized relationships of the influence of firm manager and firm related characteristics on the use of external information sources for production decisions at Belgian glasshouse holdings

	PERSONAL INFORMATION SOURCES	WRITTEN AND OTHER MASS MEDIA INFORMATION SOURCES
PERSONAL CHARACTERISTICS		
- AGE	+	-
- SUCCESSOR	+	+
- EDUCATION LEVEL	+	+
- PERSONAL OBJECTIVES		
expressive objectives	+	+
intrinsic objectives	-	-
FIRM CHARACTERISTICS		
- ECONOMIC DIMENSION	+	+
- FIRM TYPE		
type vegetables	+	+
- BUSINESS OBJECTIVES		
creativity and innovation	+	+
growth	+	+
stabilisation	-	-

Schnitkey et al. (1992) argue that age is related to farming experience and that farmers with more experience should have less demand for external information. However, according to Ford and Babb (1989) more experienced farmers relied more on the extension service than younger farmers for information about cropping decisions. Kool, Meulenberg and Broens (1997) found that input suppliers were more likely to have established relationships with older producers. Consequently, one can hypothesize

that age will have a positive influence on the use of interpersonal information sources and a negative influence on the use of written and other mass media information.

According to Gasson and Errington (1993) the presence or absence of a successor may have more influence upon decision making than the farmer's age. One can expect that firm managers with a successor will make more use of external information.

With respect to education, higher levels of education are expected to be positively related to the use of information received from all information sources. Higher levels of education should be consistent with increased ability to process information and should also influence the usefulness of information received from the sources that deliver the most sophisticated information.

According to research in the field of 'objectives, behaviour and decision making', personal objectives can be important in explaining behaviour of the firm manager. Expressive objectives consist of ambition, achievement, self development,... and are expected to be positively related to the use of external information.

Based on sociological literature (e.g. Gasson & Errington, 1993), one can assume that firm managers who attach a great importance to the 'lifestyle' or intrinsic aspects such as independence, working with plants, ... will think in a traditional way and do not welcome new ideas and external information.

A reason why firm size might be related to the use of information is that large firms should be able to derive a greater benefit from the costs of information acquisition. Most of the researchers found that farm size was positively related to attitudes toward and the use of information sources for production decisions (e.g. Ford and Babb, 1989; Schnitkey et al., 1992; Ortman et al. ,1993).

One can expect that differences in the use of external information will exist among the growers of glasshouse vegetables and the growers of ornamental plants. According to Vijverberg (1996) the structure of commercialisation has a great influence on the exchange of knowledge among the producers. The sector of glasshouse vegetables is characterized by a co-operative commercialisation structure (auctions), with a great number of producers per product (homogeneous production), stimulating an open structure of knowledge exchange. The sector of ornamental plants on the other hand is characterized by individual commercialisation and a small number of producers per product (heterogeneous production), resulting in a closed structure of knowledge exchange. However, one must remark that recently important changes are taking place in the commercialisation structure of glasshouse vegetables.

According to the innovation diffusion theory (Rogers, 1995) earlier adopters of innovations have greater exposure to interpersonal communication channels and mass media communication channels than later adopters. Earlier adopters seek

information about innovations more actively than later adopters. So growers who attach a high importance to the objective 'creativity and innovation' are expected to use more information.

According to network research in small and medium sized enterprises the business objective 'growth' will have a positive influence on the use of information, whereas 'stabilisation' will have a negative influence (Donckels, 1992; Donckels & Lambrecht, 1995, 1997).

CONSEQUENCES OF THE USE OF INFORMATION SOURCES FOR PRODUCTION DECISIONS

Based on the theory of diffusion of innovations (Rogers, 1995) one can hypothesize that mass media channels are relatively more important than interpersonal channels for earlier adopter than for later adopters of product innovations. Earlier adopters possess a more venturesome orientation, and the mass media stimulus is enough to move them over the mental threshold to adoption. But the less change oriented later adopters require a stronger and more immediate influence, like that from interpersonal networks.

According to the innovation diffusion theory socio-economic status and innovativeness go hand in hand. The hypothesis can be stated that earlier adopters of product innovations do have a higher income than later adopters. The question arises if innovators innovate because they have a higher income, or do they have a higher income because they innovate ? However the answer to this cause-and-effect question can not be answered solely on the basis of cross-sectional data.

DATA COLLECTION

The data of the research are obtained from a representative sample of 148 glasshouse holdings belonging to the FADN (Farm Accountancy Data Network) of the Centre of Agricultural Economics (C.L.E.) for at least five years. The sample consists of 89 holdings specialised in production of ornamental plants and 59 specialised vegetable producers. An advantage of this approach is the availability of indicators on financial performance over a longer time period, of indicators on firm structure and of information on biographical characteristics of the farm manager (Taragola., 1999). Data on objectives and several management items were obtained from personal interviews performed during the first half of 1999 using a pre-tested questionnaire.

The respondents were asked to rate on a five-point Likert-type scale how often they make use of several personal and written information sources for production decisions. Nine of the sources (partner, family members, fiscal accountant, accountant of the C.L.E., consultants, colleagues glasshouse growers, auction, traders, suppliers of plants) can be characterized as personal sources. Six of the sources (own farm accountancy data, data of consultants, average accounting data of the C.L.E., publications of research institutes, horticultural magazines, demonstrations in experimental stations) can be characterized as written or media sources.

In addition to the personal interviews at the glasshouse holdings, a workshop was organised with the accountants of the C.L.E.. During this workshop the glasshouse holdings were classified according to their degree of product innovation during last five years. Group 1 ('innovators' and 'early adopters') consisted of 8 growers of glasshouse vegetables and 17 growers of ornamental plants. Group 2 ('majority') was composed of 30 growers of glasshouse vegetables and 34 growers of ornamental plants. Group 3 ('laggards') consisted of 21 growers of glasshouse vegetables and 38 growers of ornamental plants.

RESULTS

Use of information sources

Table 2 shows the distribution of the ratings, the mean and the standard deviation for each source of information. The results indicate that the average Belgian glasshouse grower makes low use of external information sources for production decisions.

The most important sources of information are the partner (4,40), own farm accountancy data (3,55), suppliers of plants (2,85), average accounting data of the C.L.E. (2,64), consultants (2,59), horticultural magazines (2,52) and data of consultants (2,51). An average score of less that 2,5 was obtained for the family members (2,42), demonstrations in experimental stations (2,26), publications of research institutes (2,24), traders (2,12), colleagues glasshouse growers (2,07), auction (1,80), the accountant of the C.L.E. (1,45) and the fiscal accountant (1,12). The standard deviations indicate that an important variation in information use can be observed among the growers.

Table 2. - Use of information sources for production decisions at Belgian glasshouse
holdings (percent of respondents - mean - standard deviation)(n = 148)

	1 Never	2 Seldom	3 Regular	4 Often	5 Always	Mean	Stand. dev.
INTERPERSONAL INFORMATION SOURCES							
- Partner (n = 140)	16,7 %	2,2 %	6,5 %	4,3 %	70,3 %	4,40	1,31
- Family members	54,7 %	6,1 %	7,4 %	6,1 %	25,7 %	2,42	1,74
- Fiscal accountant	92,6 %	4,7 %	1,4 %	0,7 %	0,7 %	1,12	0,51
- Accountant C.L.E.	79,1 %	6,1 %	8,8 %	2,7 %	3,4 %	1,45	1,00
- Consultants	39,9 %	12,2 %	17,6 %	10,1 %	20,3 %	2,59	1,57
- Colleagues glasshouse growers	45,9 %	18,9 %	20,3 %	11,5 %	3,4 %	2,07	1,20
- Auction	61,5 %	16,2 %	8,1 %	9,5 %	4,7 %	1,80	1,21
- Traders	52,7 %	11,5 %	15,5 %	11,5 %	8,8 %	2,12	1,39
- Suppliers plants and seeds	29,7 %	14,2 %	18,9 %	16,2 %	20,9 %	2,85	1,52
WRITTEN AND OTHER MASS MEDIA INFORMATION SOURCES							
- Own farm accountancy data	24,3 %	4,7 %	9,5 %	14,2 %	47,3 %	3,55	1,66
- Data of consultants	43,2 %	10,8 %	14,9 %	14,2 %	16,9 %	2,51	1,56
- Average accounting data C.L.E.	31,1 %	20,9 %	18,9 %	10,8 %	18,2 %	2,64	1,48
- Publications research institutes	44,6 %	19,6 %	14,9 %	9,5 %	11,5 %	2,24	1,40
-Data in horticultural magazines	34,5 %	18,9 %	18,9 %	15,5 %	12,2 %	2,52	1,41
-Demonstrations experimental stations	41,9 %	21,6 %	16,2 %	9,5 %	10,8 %	2,26	1,37

Determinants of the use of information sources

In tables 3 and 4 the influence of firm manager and firm related characteristics on the use of several information sources for production decisions is presented. Although the analysis was performed for all information sources, only four personal sources and four sources of written or mass media information are presented in the tables. The relationship between producers' ratings of the use of information and the factors that influence this rating were examined with logistic regression models, allowing to test the 'ex ante' hypotheses as formulated in table 1. The results were presented corresponding to the natural logarithm of the cumulative odds that a producer rated the use of an information source as regular to always as opposed to never or seldom.

The chi-square statistics for the likelihood ratio tests of the joint significance of the parameters are highly significant in all models except the model of horticultural magazines (p = 0,09) and the model of publications of research institutes (p = 0,26).

47,9 percent of the respondents makes regular to always use of consultants for production decisions. The probability to make use of consultants decreases significantly for growers older than 50 years without a successor and increases significantly for vegetable producers and creative and innovative growers. The percentage of growers that makes regular to always use of information from colleagues

amounts to 35,2 percent. The probability decreases significantly when the grower is older that 50 years old (independent from the availability or not of a successor) and when intrinsic objectives are important. On the other hand the probability increases significantly for the variables 'vegetable growers', 'creativity and innovation', 'expressive objectives' and economic dimension 3 (65.000 - 100.000 S.G.M. '80' Euro).

22,3 percent respectively 35,8 percent of the growers makes regular to always use of information from the auction or traders. Especially sector membership is a significant determinant since auctions are still more important in the sector of glasshouse vegetables. Also the objective 'stabilisation' is found to have a negative effect on the use of information from the auction.

The percentage of growers that makes regular to always use of information from demonstrations in experimental stations amounts to 36,5 percent and is significantly influenced by the importance attached to 'creativity and innovation'.

47,9 percent of the respondents makes regular to always use of the average accounting data of the C.L.E. for production decisions. The results indicate that again 'creativity and innovation' has a positive influence; however the importance attached to 'expressive objectives' has a significant negative influence for this source of information.

An interesting finding is that the importance attached to 'creativity and innovation' is highly significant in almost every model. Also, as indicated by Vijverberg (1996), sector membership seems to have an important influence on the structure of knowledge exchange. The open knowledge structure in the sector of glasshouse vegetables is confirmed by the data. Another finding is that the availability of a successor is important for the use of information for production decisions.

Table 3. - Influence of firm manager and firm related characteristics on the use of interpersonal information sources for production decisions at Belgian glasshouse holdings

Variable	CONSULTANTS			COLL. GLASSH. GROWERS			AUCTION			TRADERS		
	Estimate (st. err.)	Probability (p)	Exp (β)	Estimate (st.err.)	Probability (p)	Exp (β)	Estimate (st. err.)	Probability (p)	Exp (β)	Estimate (st. err.)	Probability (p)	Exp (β)
Intercept	-0,17 (0,97)	0,86		-1,98 (1,04)	0,06		-0,42 (0,98)	0,67		-0,30 (0,87)	0,73	
PERSONAL CHARACTERISTICS												
- AGE (dummy)												
age 2 (36-50)	-0,19 (074)	0,80	0,83	0,90 (0,78)	0,25	2,46	-1,07 (0,77)	0,16	0,34	-0,37 (0,64)	0,56	0,69
age 3 (>= 50 without successor)	-2,36 (0,63)	**0,00**	0,09	-1,56 (0,59)	**0,01**	0,21	-0,46 (0,60)	0,44	0,63	0,10 (0,50)	0,84	1,11
age 4 (>= 50 with successor)	-1,20 (0,87)	0,17	0,30	-3,02 (1,27)	**0,02**	0,05	-1,30 (1,06)	0,22	0,27	0,75 (0,81)	0,36	2,11
- EDUCATION LEVEL (dummy)												
education 2	-0,42 (0,55)	0,44	0,66	-0,34 (0,57)	0,55	0,71	-0,93(0,61)	0,13	0,39	0,59 (0,53)	0,27	1,80
education 3	-1,49 (0,77)	**0,05**	0,23	-0,37 (0,71)	0,60	0,69	-0,63 (0,72)	0,38	0,53	0,91 (0,66)	0,17	2,49
- PERSONAL OBJECTIVES (factor scores)												
expressive objectives	-0,08 (0,22)	0,71	0,92	0,50 (0,25)	**0,04**	1,65	0,03 (0,25)	0,92	1,03	0,18 (0,22)	0,41	1,20
intrinsic objectives	-0,27 (0,24)	0,25	0,76	-0,60 (0,26)	**0,02**	0,55	0,38 (0,27)	0,16	1,47	-0,07 (0,22)	0,75	0,93
FIRM CHARACTERISTICS												
- ECONOMIC DIMENSION (S.G.M. '80' EURO)												
economic dim. 2 (42.500-65.000)	0,85 (0,60)	0,16	2,33	0,28 (0,60)	0,64	1,32	-0,58 (0,68)	0,39	0,56	-0,30 (0,58)	0,60	0,74
economic dim. 3 (65.000-100.000)	0,79 (0,59)	0,18	2,21	1,23 (0,60)	**0,04**	3,42	0,95 (0,60)	0,11	2,58	0,55 (0,59)	0,35	1,73
economic dim. 4 (>= 100.000)	0,47 (0,68)	0,49	1,59	0,01 (0,67)	0,99	1,01	-0,06 (0,68)	0,93	0,94	0,28 (0,64)	0,66	1,33
- FIRM TYPE (dummy)												
type vegetables	2,52 (0,52)	**0,00**	12,46	1,80 (0,50)	**0,00**	6,08	1,23 (0,49)	**0,01**	3,42	-2,23 (0,51)	**0,00**	0,11
- BUSINESS OBJECTIVES (factor scores)												
creativity and innovation	0,65 (0,26)	**0,01**	1,91	0,97 (0,29)	**0,00**	2,64	0,12 (0,25)	0,63	1,13	0,36 (0,24)	0,14	1,44
growth	0,43 (0,26)	0,09	1,54	-0,15 (0,26)	0,57	0,86	0,23 (0,25)	0,36	1,26	0,14 (0,24)	0,57	1,15
stabilisation	0,13 (0,25)	0,61	1,14	-0,00 (0,24)	0,99	1,00	-0,58 (0,27)	**0,03**	0,56	0,11 (0,21)	0,62	1,11
	-2LogLL = 136,93 ; χ^2 = 65,23 ; p = **0,00**			- 2LogLL = 133,96 ; χ^2 = 53,70 ; p = **0,00**			- 2LogLL = 126,79 ; χ^2 = 26,77 ; p = **0,02**			-2LogLL = 152,04 ; χ^2 = 39,26 ; p = **0,00**		
	Member pred. rate = 72,9 % Non memb. pred. rate = 75,0 % Overall pred. rate = 74,0 %			Member pred. rate = 60,0 % Non memb. pred. rate = 86,5 % Overall pred. rate = 77,4 %			Member pred. rate = 31,3 % Non memb. pred. rate = 96,5 % Overall pred. rate = 82,2 %			Member pred. rate = 52,8 % Non memb. pred. rate =79,6 % Overall pred. rate = 69,9 %		

Table 4. - Influence of firm manager and firm related characteristics on the use of written and other mass media information sources for production decisions at Belgian glasshouse holdings

Variable	DEMONSTRATIONS EXPERIMENTAL STATIONS			HORTICULTURAL MAGAZINES			PUBLICATIONS RESEARCH INSTITUTES			AVERAGE ACCOUNTING DATA C.L.E.		
	Estimate (st. err.)	Probability (p)	Exp (β)	Estimate (st. err.)	Probability (p)	Exp (β)	Estimate (st. err.)	Probability (p)	Exp (β)	Estimate (st. err.)	Probability (p)	Exp (β)
Intercept	-1,17 (0,91)	0,20		-1,28 (0,83)	0,12		0,57 (0,82)	0,49		-1,39 (0,90)	0,12	
PERSONAL CHARACTERISTICS												
- AGE (dummy)												
age 2 (36-50)	-0,17 (0,69)	0,80	0,84	0,69 (0,64)	0,28	2,00	0,14 (0,63)	0,83	1,15	1,26 (0,71)	0,08	0,65
age 3 (>= 50 without successor)	0,60 (0,49)	0,22	1,83	-0,04 (0,45)	**0,04**	0,96	-0,47 (0,47)	0,32	0,63	0,09 (0,47)	0,84	0,84
age 4 (>= 50 with successor)	-1,28 (0,89)	0,15	0,28	-1,03 (0,79)	-1,03	0,36	-1,55 (0,93)	0,09	0,21	-0,21 (0,76)	0,78	0,84
- EDUCATION LEVEL (dummy)												
education 2	-0,56 (0,50)	0,27	0,57	0,15 (0,46)	0,75	1,16	-0,06 (0,48)	0,91	0,95	-0,42 (0,48)	0,39	3,98
education 3	-0,63 (0,63)	0,32	0,53	0,04 (0,59)	0,95	1,04	-0,01 (0,59)	0,99	0,99	-0,25 (0,62)	0,69	1,23
- PERSONAL OBJECTIVES (factor scores)												
expressive objectives	0,05 (0,22)	0,81	1,05	0,22 (0,19)	0,26	1,25	0,15 (0,20)	0,44	1,16	-0,54 (0,22)	**0,01**	1,20
intrinsic objectives	0,02 (0,22)	0,91	1,02	-0,03 (0,20)	0,88	0,97	-0,12 (0,21)	0,56	0,88	0,04 (0,22)	0,85	1,90
FIRM CHARACTERISTICS												
- ECONOMIC DIMENSION (S.G.M. '80' EURO)												
economic dim. 2 (42.500-65.000)	0,69 (0,59)	0,24	2,00	0,69 (0,50)	0,17	2,00	0,15 (0,50)	0,77	1,16	0,91 (0,52)	0,08	1,71
economic dim. 3 (65.000-100.000)	1,10 (0,58)	0,06	3,00	0,71 (0,51)	0,16	2,03	0,15 (0,51)	0,77	1,16	0,28 (0,52)	0,60	1,71
economic dim. 4 (>= 100.000)	0,26 (0,63)	0,67	1,30	0,22 (0,56)	0,69	1,25	-0,82 (0,59)	0,16	0,44	-0,33 (0,58)	0,57	1,78
- FIRM TYPE (dummy)												
type vegetables	0,77 (0,42)	0,07	2,17	0,27 (0,39)	0,49	1,31	0,68 (0,40)	0,09	1,97	0,46 (0,41)	0,26	7,15
- BUSINESS OBJECTIVES (factor scores)												
creativity and innovation	0,86 (0,27)	**0,00**	2,36	0,65 (0,22)	**0,00**	0,00	0,52 (0,23)	**0,02**	1,68	0,85 (0,26)	**0,00**	1,74
growth	0,38 (0,23)	0,10	1,46	0,14 (0,21)	0,51	0,51	0,08 (0,22)	0,73	1,08	0,39 (0,22)	0,08	0,84
stabilisation	-0,03 (0,22)	0,89	0,97	-0,01 (0,19)	0,94	0,94	-0,01 (0,20)	0,96	0,99	-0,24 (0,21)	0,25	0,76
	-2LogLL = 156,11 ; χ² =34,04 ; p = **0,00**			-2LogLL = 180,53 ; χ² = 21,19 ; p = 0,09			-2LogLL = 174,34 ; χ² = 16,96 ; p = 0,26			-2LogLL = 169,35 ; χ² = 32,94 ; p = **0,00**		
	Member pred. rate = 40,4 % Non memb. pred. rate = 85,1 % Overall pred. rate = 69,2 %			Member pred. rate = 66,2 % Non memb. pred. rate = 70,5 % Overall pred. rate = 68,5 %			Member pred. rate = 34,0 % Non memb. pred. rate = 83,9 % Overall pred. rate = 65,8 %			Member pred. rate = 74,7 % Non memb. pred. rate = 64,0 % Overall pred. rate = 69,2 %		

Use of information sources and product innovation

The influence of the use of the different information sources on membership of the 'product innovation groups', as determined during the workshop, is analysed by means of 'multiple group' discriminant analysis. The results for the vegetable growers are presented in table 5. The probability of the univariate F ratios indicates that when the predictors are considered individually, colleagues growers (p = 0,00), own accounting data (p = 0,01), average accounting data C.L.E. (p = 0,04) and consultants (p = 0,04) significantly contribute to the differentiation between the groups. Also data of consultants (p = 0,06) and horticultural magazines (p = 0,06) seem to contribute to the differentiation between the groups. Two discriminant functions are estimated. The eigenvalue associated with the first function is 0,71, and this function accounts for 76,8 percent of the explained variance. The second function has an eigenvalue of 0,21 and accounts for 23,2 percent of the explained variance. The value of Wilks's λ is 0,48 with 24 degrees of freedom, which is significant (p = 0,045). Thus, the two functions together significantly discriminate among the three groups. The interpretation of the results is aided by an examination of the standardized discriminant function coefficients and the structure matrix of pooled within-groups correlations between the discriminating variables and the canonical discriminant functions. Variables with correlation coefficients which are larger for function 1 than for function 2 are shown with asterisks, and vice versa.

The correlation coefficients indicate large coefficients for colleagues glasshouse growers (0,58), own farm accountancy data (0,53), consultants (0,41), average accounting data of the C.L.E. (0,38), publications of research institutes (0,38), horticultural magazines (0,30), demonstrations in experimental stations (0,29) and the accountant of the C.L.E. (0,25) on function 1; whereas function 2 has relatively larger coefficients for traders (-0,49), colleagues glasshouse growers (-0,29) and average accounting data of the C.L.E. (0,27). Function 1 tends to separate the groups 1 and 2 (highest value) from group 3 (lowest value). Function 2 separates group 2 (highest value) from group 1 (lowest value).

The results reveal that membership of the groups 1 and 2 is positively associated with use of information of colleagues glasshouse growers, own farm accountancy data, consultants, average accounting data of the C.L.E., publications of research institutes, horticultural magazines, demonstrations of experimental stations and accountants of the C.L.E.. Membership of group 1 is positively associated with use of information from traders and colleagues glasshouse growers. The classification results indicate that 76,3 percent of the cases are correctly classified. One can conclude that personal as well as mass communication information sources are significantly less

important for the 'laggards'. However a significant higher use of information from traders and colleagues glasshouse growers was observed in group 1. The importance of the use of information from traders in the sector of the glasshouse vegetables can be explained by the emergence of new commercialisation channels. This finding is in accordance with the findings of Diederen et al. (2000), who found that product innovations often go hand in hand with organisational innovations.

Table 5. - Use of external information sources by vegetable growers according to 'product innovation group' membership (three group discriminant analysis)

	Univariate F-ratio		Standardized canonical discriminant function coefficients		Structure matrix correlation coefficients	
	F-ratio	Probability	Function 1	Function 2	Function 1	Function 2
INTERPERSONAL INFORMATION SOURCES						
- accountant C.L.E.	1,48	0,24	0,22	0,31	0,25*	0,18
- consultants	3,44	**0,04**	0,46	-0,30	0,41*	0,12
- colleagues glasshouse growers	7,24	**0,00**	0,61	-0,36	0,58*	-0,29
- auction	0,38	0,69	-0,78	0,35	-0,11	0,16*
- traders	1,48	0,24	-0,18	-0,77	0,04	-0,49*
- suppliers plants and seeds	0,14	0,87	0,13	0,11	0,08*	0,00
WRITTEN AND OTHER MASS MEDIA INFORMATION SOURCES						
- own farm accountancy data	0,83	**0,01**	0,37	0,24	0,53*	0,16
- data of consultants	0,91	0,06	-0,08	0,58	0,36*	0,24
- average accounting data C.L.E.	0,89	**0,04**	0,24	0,76	0,38*	0,27
- publications research institutes	0,91	0,06	-0,04	-0,68	0,38*	-0,08
- horticultural magazines	0,94	0,18	-0,14	0,05	0,30*	-0,06
- demonstrations experimental stations	0,94	0,20	0,36	-0,26	0,29*	-0,01

In table 6, the results of the discriminant analysis are presented for the growers of ornamental plants. The probability of the univariate F ratios indicates that when the predictors are considered individually, the auction (p = 0,00), consultants (p = 0,00), data of consultants (p = 0,01) and demonstrations of experimental stations (p = 0,05) significantly contribute to the differentiation between the groups. Two discriminant functions are estimated. The eigenvalue associated with the first function is 0,51 and this function accounts for 60,0 percent of the explained variance. The second function has an eigenvalue of 0,34 and accounts for 40 percent of the explained variance. The value of Wilks's λ is 0,49 with 24 degrees of freedom, which is significant (p = 0,00). Thus, the two functions together significantly discriminate among the three groups. In table 6 the standardized discriminant function coefficients and the structure matrix of pooled within-group correlations between the discriminating

variables and the canonical discriminant function are presented. Variables with correlation coefficients which are larger for function 1 than for function 2 are shown with asterisks, and vice versa. The correlation coefficients indicate large coefficients for consultants (0,50), data of consultants (0,45), auction (0,41) and colleagues glasshouse growers (0,32) on function 1.

Table 6. - Use of external information sources by growers of ornamental plants according to 'product innovation group' membership (three group discriminant analysis)

	Univariate F-ratio		Standardized canonical discriminant function coefficients		Structure matrix correlation coefficients	
	F-ratio	Probability	Function 1	Function 2	Function 1	Function 2
INTERPERSONAL INFORMATION SOURCES						
- accountant C.L.E.	0,71	0,50	-0,60	0,41	-0,03	0,22*
- consultants	9,42	**0,00**	0,55	0,61	0,50	0,51*
- colleagues glasshouse growers	2,25	0,11	0,19	0,13	0,32*	0,02
- auction	5,78	**0,00**	0,65	-0,56	0,41*	-0,38
- traders	0,96	0,39	-0,02	0,15	0,17*	0,15
- suppliers plants and seeds	0,31	0,73	0,16	-0,07	0,12*	-0,02
WRITTEN AND OTHER MASS MEDIA INFORMATION SOURCES						
- own farm accountancy data	0,16	0,85	-0,68	0,05	-0,08*	-0,04
- data of consultants	5,10	**0,01**	0,42	-0,06	0,45*	0,21
- average accounting data C.L.E.	0,65	0,52	0,62	0,06	0,17*	0,03
- publications research institutes	0,56	0,57	-0,44	0,29	0,16*	-0,02
- horticultural magazines	2,33	0,10	0,64	-0,39	0,20	-0,31*
- demonstrations experimental stations	3,00	**0,05**	-0,37	-0,07	0,13	-0,42*

Function 2 has relatively large coefficients for consultants (0,51), demonstrations of experimental stations (-0,42), auction (-0,38), horticultural magazines (-0,31) accountant C.L.E. (0,22) and data of consultants (0,21). Function 1 tends to separate the groups 1 and 2 (highest value) from group 3 (lowest value). Function 2 separates group 2 (highest value) from group 1 (lowest value).

The results reveal that membership of the groups 1 and 2 is positively associated with use of information of consultants, data of consultants, the auction and colleagues growers. Membership of group 1 is positively associated with use of information from demonstrations of experimental stations, horticultural magazines and the auction and negatively associated with use of information from consultants and

average accounting data of the C.L.E..The classification results indicate that 67,4 percent of the cases are correctly classified.

Personal as well as written information sources are significantly less important for the 'laggards'. Contrary to the results of the vegetable growers the group of the 'innovators' and 'early adopters' makes significantly more use of information from demonstrations of experimental stations and horticultural magazines than the 'majority' .

Product innovation and financial performance

For the growers of vegetables, the average available income of group 1 amounted to 122 percent of the average sectoral income during the period 1993-1997, whereas the income of group 2 was situated at 110 percent of the average sectoral income. For the growers belonging to group 3 the average available income amounted to 76 percent of the average sectoral income. However no groups were significantly different at the 0,05 level. Consequently, the hypothesis of the positive association between product innovation and financial performance was not supported for the growers of glasshouse vegetables.

For the growers of ornamental plants, the average available income of group 1 amounted to 184 percent of the average sectoral income during the period 1993-1997, whereas the income of group 2 amounted to 129 percent of the average income. The available income of the growers of group 3 was situated at 37 percent of the average income. The income of the growers belonging to group 3 was significantly lower than that obtained by the growers of the groups 1 and 2. The difference between group 1 and 2 was not statistically significant at the 0,05 level. Consequently, for the growers of ornamental plants one can conclude that the empirical data reveal that the financial performance of the 'laggards' was statistically lower than the income of the other groups.

CONCLUSION

Although the use of information and product innovation will become critical factors in the changing competitive environment, one can conclude that the average Belgian glasshouse grower makes low use of external information for production decisions. However an important variation in information use can be observed among the growers. The empirical findings illustrate that firm manager and firm related characteristics influence the network structure of the glasshouse holdings.

The results indicate that the structure of commercialisation can play an important role in the exchange of knowledge. In general, the knowledge structure is more open in the sector of glasshouse vegetables than in the sector of ornamental plants,

resulting in a higher use of information. However, the emergence of new commercialisation channels in the sector of glasshouse vegetables (traders, direct contracts with retailers, ...) is found to have an impact on the type of information used by the growers. It is found that the most innovative producers of glasshouse vegetables attach more importance to the exchange of information between the partners in the chain ('vertical relationships') than the less innovative growers. Independent of sectoral differences, personal characteristics of the firm manager are found to have an impact on the use of information for production decisions. Especially, the importance attached to 'creativity and innovation' is an important determinant of information use. The results indicate that product innovation and financial performance are associated, however the causal relationship can only be analysed by means of longitudinal research methods.

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