

Internet-based applications in agri-food logistics: A survey on the Greek canning sector

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Abstract

In the agri-food industry, Internet-based applications changed the way companies conduct business mainly by facilitating activities that were already taking place, rather by giving birth to virtual networks creation. Due to the specific characteristics of the sector, Internet's huge potential has not been fully exploited yet, still remaining a new communication tool. This paper aims at giving empirical insights regarding the use of Internet-based applications in the agri-food supply chain, by focusing on the Greek fruit canning sector. In particular, the paper identifies companies' perceptions regarding perceived benefits, constrained factors and motivation factors towards the use of Internet-based applications. Results indicate that companies recognise benefits arising from the use of Internet, however they still use traditional ways when communicating with their partners. Regarding transportation issues, while companies' overall satisfaction is rather moderate and differs significantly from the importance placed on a number of criteria, companies are still sceptical in using Electronic Transportation Marketplace*.

Keywords: Internet-based applications; Agri-food supply chain; Greek canning industry

1. Introduction

The last years, significant changes have taken place in the agri-food industry, creating this way a new business era for companies operating in the sector ([Eastham et al., 2001](#) and [Hughes, 1994](#)). One of the most important developments was the introduction of Internet. Internet-based applications in general changed significantly the way companies conduct business mainly in two ways: (a) by facilitating and improving traditional business activities and processes and (b) by adding the "web" dimension for every company, giving birth thus, to virtual networks. In the agri-food context, Internet developments have mostly facilitated some of the activities taking place, without transforming companies into virtual enterprises. This is explained by the fact that the Internet's level of influence on companies varies according to industry's type and structure. In Europe, the food industry has been a follower in the adoption of Internet-based applications, rather than an early adopter, mainly because of its dependence on small-medium enterprises (SME's), which is the predominant institutional type. Nearly a decade after Internet's introduction and Internet-based applications are not anymore jargon for companies. On the contrary, nowadays Internet-based applications are more available and accessible than ever before, for most of the business sectors. However, indigenous characteristics within business sectors differentiate the level and the type of use. Within the agri-food industry, personal (age, education etc.) and business (business size-complexity etc.) factors have been identified, among others, as responsible for differentiating Information Technology (IT) and Internet adoption rates ([Amponsah, 1995](#), [Huffman and Mercier, 1991](#), [Jarvis, 1990](#) and [Putler and Zilberman, 1988](#)). Due to these factors, Internet's level of use in the agri-food industry varies, and a huge gap seems to exist between large and SME's: large companies are moving towards Web-based supply chain integration, while for the majority of SME's, Internet is just another communication tool, finding limited applicability in other companies' activities, such as

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sales, procurement, promotion, transportation etc. ([European Commission, 2002](#) and [Vlachopoulou et al., 2003](#)).

In this paper, empirical information regarding the potential impact of Internet-based applications on the agri-food supply chain, are presented. The paper focuses on one of the most important sub sectors in the Greek agri-food industry, the fruit canning sector and this is justified by the fact that the industry is mainly export oriented, and thus, Internet use and transportation issues receive significant attention. Moreover, the canning sector is of great importance for the Greek economy, since Greece is one of the major producers and exporters in the world in canned fruits. The aim of the paper is to assess the level of Internet adoption by companies and shippers, in the Greek canning sector. Furthermore, perceptions regarding the benefits of the Internet, the constrained factors hindering its use, and the driving forces that will facilitate the adoption of Internet-based applications are identified. Finally, transportation issues concerning the canning industry are examined.

2. Supply chain issues in the canning industry

A typical supply chain of a canning company may consist of a number of entities, such as: farmers, co-operatives, input suppliers, transporters, exporters/importers, wholesalers, retailers and finally consumers ([Fig. 1](#)). Within this environment, each canning company is responsible in collecting, handling and the processing the fruits in the best possible time, since fruits require sensitivity and velocity while being processed. An important characteristic of the sector is that most firms operate during short harvest seasons (2–3 months on the summer) but on the other hand they must finance the inventories of their products throughout the rest of the year. Another distinct characteristic of the sector is that it faces significant uncertainties due to the unpredictable weather conditions and farmers competence that affect yield, cost of production and product quality.

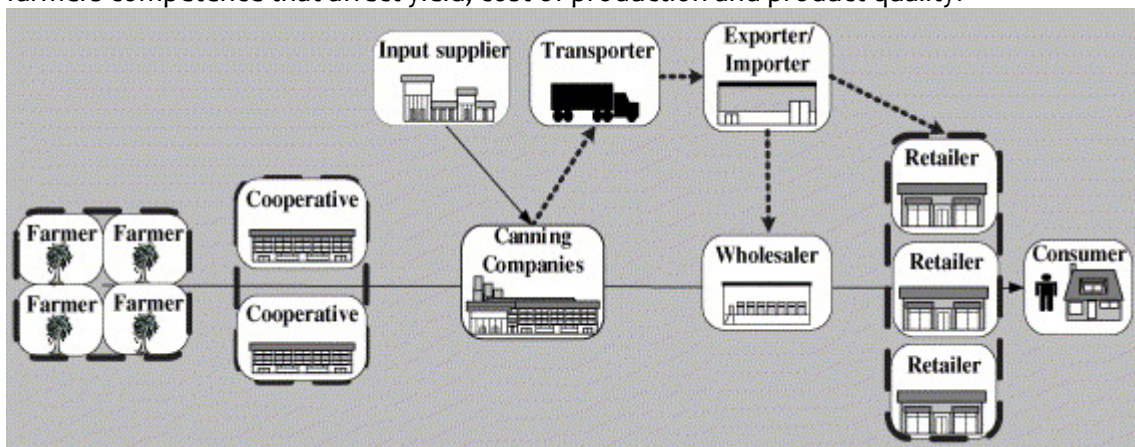


Fig. 1. Canning's industry supply chain.

Nowadays, food processing industries are facing an increasingly difficult business climate, with growth prospects being rather poor ([KPMG, 2000](#)). The high concentration of the retail sector along with the increasing dominance of private or own-label products by retailers have pressured processor margins. In addition, the focus of retailers in providing increased level of services to consumers (e.g. Efficient Consumer Response scheme), but at the same time remaining cost efficient, forces processors to tailor their delivery quantities to meet retailers' requirements. Thus, the emerging need for flexible transportation services, increases transaction costs between transporters and exporters. Given these changes in the agri-food sector, facilitating and improving logistic activities is a necessity for the majority of food processors, and Internet-based applications could be a valuable tool. In addition, the latest demands for transparent agri-food supply chain that enable tracking and tracing of products throughout the chain, can only be met by using Information and Communication Technologies.

3. Internet-based applications for supply chain activities

In the past, Electronic Data Interchange (EDI) applications were enabling companies to exchange information and data and to move towards supply chain integration. However, EDI applications were not affordable for SME's due to cost reasons. After the introduction of Internet, the situation has changed, since Internet-based applications can foster collaboration, through information-data exchange, in a more than ever before, economic way. The development of Internet has brought new ways of dealing with old supply chain problems. Its role in the evolution of supply chains has been already recognized in the literature ([Gecowets and Bauer, 2000](#) and [Lancioni et al., 2000](#)). A basic Internet's benefit is a more efficient way of exchanging information and data, which results in supply chain coordination, and facilitation of logistics activities. Furthermore, significant cost reduction opportunities are created, as a result of the improved supply chain coordination. Finally, another direct Internet benefit is the expansion of target markets and the mass promotion opportunities. Most of the aforementioned benefits have been also recognised in the agri-food context ([Henderson et al., 2000](#), [European Commission, 2002](#), [Poole, 2001](#) and [Vlachopoulou and Manthou, 2002](#)).

One of the most important logistic activities that could be facilitated from Internet is transportation. The agri-food sector is a large user of freight transportation services worldwide therefore the importance of transportation for the agri-food industry is critical, as agricultural production occurs in numerous parts and rural areas worldwide, while the major part of consumption takes place mainly in big cities ([European Communities, 2002](#) and [USDA, 2002](#)).

Applying Internet-based applications in transportation, supported by an Electronic Transportation Marketplace (ETM) can result in many advantages for the shipper ([E-logistics, 2002](#)). ETM supports Internet-based services, provided by intermediaries, in order to bring together buyers and sellers of transportation ([Goldsby & Eckert, 2002](#)). During the season, a fruit canning company, due to the nature of the industry (seasonality of production, perishable nature of product, weather dependency, and difficulties in production and demand forecasting) collaborates with a number of transporters resulting in increased transaction costs and managerial work. By using the ETM, transaction costs are diminished. Another important benefit arising from the use of ETM, is the increased flexibility and availability of transporters. Given, that in the fruit canning industry, intrinsic difficulties in production and demand forecasting exist, transportation planning is also difficult and cases exist where immediate transport of the product is needed in order to satisfy customers. An ETM tool can provide this service. The use of the ETM is also important for the reduction in logistics costs since for every shipment to be made, the best truck is selected in order to maximize truck's loading efficiency, reducing this way the cost for carriers, as well as for shippers.

4. Empirical survey

Agriculture is an important sector in the Greek economy, accounting for about 7% of the GDP, employing nearly 16% of the total Greek work force, and representing almost 30% of the total export value ([Greek Ministry of Agriculture, 2002](#)). The focus on the canning industry, which is just one link in the multi-tiered food supply chain, is justified by the fact that the industry contributes immensely in the Greek economy, since Greece is one of the biggest producers and exporters in the world in canned fruits. Transportation is a very important activity for the canning industry which is heavily export oriented (almost 80%). Greek canning industries are depended on local companies for the transportation of the products.

4.1. Methodology

The paper reports on a research being conducted in the Department of Applied Informatics at the University of Macedonia in Greece, regarding the adoption of new technologies, and new ways of collaboration across the entire Greek agri-food supply chain. A questionnaire survey took place in the Greek food canning industry, from December 2002 to February 2003. Questions are trying to identify

companies' attitudes and perceptions on issues such as: Internet use, benefits arising from Internet-based applications and driving forces facilitating the adoption of Internet-based applications.

The questionnaire consisted of five range scaled questions typically anchored with "Strongly disagree" or "Not at all" to "Extremely", as well as, closed-ended and a multi-response question. A total of 40 questionnaire surveys were sent to companies originated from the fruit canning industry. Twenty four questionnaires were completed and returned, constituting a 60% response rate. The questionnaire survey was disseminated to the participants by post, as well as, electronically by e-mail and questionnaires were addressed personally to the directors of the companies.

For the analysis of the questionnaire a number of methods were used. Apart from descriptive statistics, one sample t-tests were utilized to evaluate statistical differences between companies' responses and mid values. Next, paired-samples t-tests were utilized to evaluate the statistical differences between the importance shippers place on five characteristics of partnerships and how satisfied the shippers are with carriers in each dimension of the partnership. Furthermore, Analysis of Variance (ANOVA) was used to investigate possible relationships between the organisational characteristic of size, and a number of companies' perceptions and attitudes. ANOVA was used because the organisational characteristic of size was segmented into three categories, based on companies' turnover. The level of significance used was that of 0.05 or better. When this criterion was met, further analysis was performed using post-hoc Bonferroni test at the 0.05 significance level, in order to learn about significant differences between groups.

4.2. Findings

4.2.1. Internet use

All responded companies (100%) have Internet access, while the largest majority (70%) states that a Web site has also been developed. Even for those companies that currently do not have a Web site, almost 86% of them intend to develop a Web site in the very near future.

Respondents' perceptions, related to the importance of Web based business activities, were identified. Eight activities were selected: promotion, sales, transportation, information and data exchange, consulting services, procurement (inputs, packaging material etc.), business news (industry news, prices etc.) and general information. Companies were asked to rank the three most important reasons, on a three range scale from 1 (low priority) to 3 (top priority). [Fig. 2](#), [Fig. 3](#) and [Fig. 4](#) present the top priority, second priority and third priority responses, respectively. Results indicate that more than 50% of the respondents consider information and data exchange as the most important activity that would drive companies to use the Internet, followed by the promotion activity with almost 35%. When it comes to the second priority, companies choose the business news activity, (nearly 45%), followed by the promotion activity (25%) and the sales activity (nearly 20%). Finally, as a third priority, companies choose promotion and business news (20%), followed by information-data exchange, and consulting (17%). In [Table 1](#), a different view is given by presenting the average responses. The ratings are based on a four range scale from 0 (No priority) to 3 (Top priority). Mean scores indicate that information and data exchange activity, is considered the most important reason with a score of 1.88. Promotion follows with a mean score of 1.71, and business news with 1.17. Regarding the other activities, companies do not seem to consider them as important. Indeed, mean scores are well below 1 (Low priority) reaching zero. Especially, for the sales and the procurement activities, which are basic e-commerce activities, mean scores are very low, suggesting that companies have not yet recognized the need for e-commerce transactions.

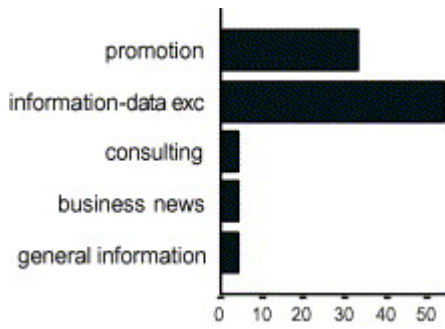


Fig. 2. Web based activities---Top priority.

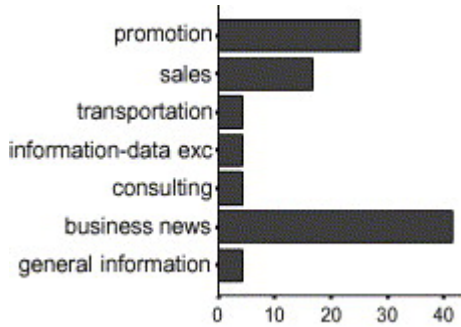


Fig. 3. Web based activities---Second priority.

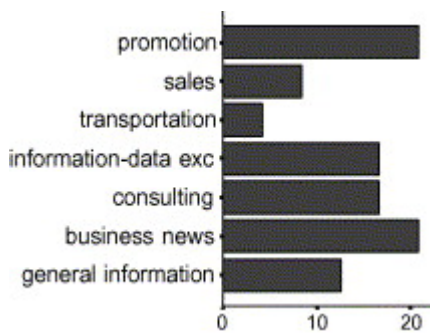


Fig. 4. Web based activities---Third priority.

Table 1. Average Web based activity ranking

	N		Mean
	Valid	Missing	
Info-data exchange	24	0	1.88
Promotion	24	0	1.71
Business news	24	0	1.17
Sales	24	0	.42
Consulting	24	0	.38

	N		Mean
	Valid	Missing	
General info	24	0	.33
Transportation	24	0	.13
Procurement	24	0	.00

Companies' attitudes and current practices regarding the preferred communication methods between the supply chain entities in the canning industry, was a further issue examined in the survey. The IT revolution has increased the methods of communication available. In addition to landline telephones, fax and personal contact, new communication methods have been introduced: mobile phones, e-mail, intranets, extranets, audio-video conferencing. Therefore, companies were asked to identify which ways of communication prefer and in what extend, according to the entity (suppliers, customers, transporters), which they communicate.

While all companies have Internet access and most of them a web site, [Table 2](#) indicates that traditional ways of communication, such as the telephone and the fax, are still the most preferred forms. In fact, the telephone is the most preferred way whether companies communicate with suppliers, customers or transporters, while fax is the second most preferred form, nearly two times less than the telephone. Personal contact is the third more preferred way, followed by e-mail, whereas, communication by post is the least preferred way. Regarding the use of Internet, results indicate that there is a difference in the e-mail way of communication. It seems that when companies communicate with customers they use e-mail almost three times more that when communicating with their suppliers, and six times more than when communicate with transporters. This could be explained by the fact that suppliers are less computer literate and thus, companies prefer traditional methods of communication with them.

Table 2. Communication method preferred

Communication method	With suppliers	With customers	With transporters	Average
Personal contact	24.17	15.63	12.92	17.57
Telephone	36.46	33.13	57.25	42.28
Post	3.46	5.63	1.33	3.47
Fax	26.08	20.83	24.17	23.69
E-mail	9.21	24.38	4.33	12.64
Other	.21	.21	.00	0.14
Total	100%	100%	100%	100%

4.2.2. Constrained factors

One of the most important issues covered in the questionnaire was to identify the constrained factor in the use of Internet. Given that the number of the potential constrained factors could be quite big, the questionnaire focused on four factors: cost of use, lack of knowledge, lack of significant benefits for companies, and finally security issues. Companies were asked how constrained they perceive

these factors are on scale, from 1 (*Strongly disagree*) to 5 (*Strongly agree*). [Table 3](#), presents the mean scores along with those statements that have overall mean values significantly different from 3.0, the midpoint of the scale used. Results indicate that among all factors, security issues are the more constrained. The mean score for security issues is 3.58. The next factor recognized, is the cost of use with a mean score of 2.38. Companies seem to identify that significant benefits exist in the use of Internet that is why the factor no significant benefits holds a mean score of 1.88. Finally, companies appear to be quite familiar with the Internet, since the factor lack of knowledge receives a mean score of 1.79.

Table 3. Internet constrained factors

	Test value = 3		
	Mean	Mean difference	Sig. (2-tailed)
Cost	2.38	-.63	.019
Lack of knowledge	1.79	-1.21	.000
No significant advantages	1.88	-1.13	.000
Security	3.58	.58	.032

4.2.3. Benefits

Regarding Internet benefits and the potential impact upon companies, respondents were asked to indicate their level of agreement regarding the importance placed on the benefits aroused from Internet. The proposed benefits were categorized in six categories: reduction in cost from transactions, work office automation, communication improvement, transaction speed, ordering process convenience, logistics improvement. [Table 4](#) presents respondents' answers along with the mean scores. The table also presents results from *T*-test used, to identify those statements that have overall mean values significantly different from 3.0, the midpoint of the scale used. Results indicate that companies perceive the improvement in transaction speed, as the most important benefit arising from the use of Internet, with a mean score of 4.21. The other benefits that follow are cost reduction (3.75), ordering process convenience (3.63), and work office automation (3.33). The less important benefits as recognized by companies are communication improvement (2.67) along with logistics improvement (2.50).

Table 4. Perceived Internet benefits

	Test value = 3		
	Mean	Mean difference	Sig. (2-tailed)
Cost reduction	3.75	.75	.000
Work office automation	3.33	.33	.103
Communication improvement	2.67	-.33	.119
Transaction speed	4.21	1.21	.000
Ordering process convenience	3.63	.63	.022
Logistics improvement	2.50	-.50	.049

4.2.4. Motivation factors

Companies were also asked to indicate their level of agreement regarding the importance placed on the factors motivating the use of Internet-based applications. The factors identified as motives, were the following five: better customer service, competition, customers' requirements, faster order processing, and logistic processes improvement. In [Table 5](#), respondents' answers are presented along with the mean scores. The table also presents those statements that have overall mean values significantly different from 3.0, the midpoint of the scale used. All motivation factors have mean values that significantly different from 3.0. Results indicate that companies perceive improvements in customer service and competition, as the most important factors towards adopting Internet-based applications, with mean scores close to 5.0, while improvement in logistics processes and in order processing receive less importance.

Table 5. Motivation factors

	Test value = 3		
	Mean	Mean difference	Sig. (2-tailed)
Competition	4.25	1.25	.000
Logistics processes improvement	3.63	.63	.010
Faster order processing	3.75	.75	.002
Customer's requirements	3.88	.88	.000
Better customer service	4.75	1.75	.000

4.2.5. ANOVA analysis

[Table 6](#) presents results, where statistically significant ANOVA's exist, suggesting potential relationships between the size of the company and competition, as a motivation factor towards using Internet-based applications. Table's results indicate also, a potential relationship between companies' size and two types of communication: the personal contact method when communicating with suppliers, and the telephone method when communicating with customers. The above potential relationships were further analysed by using the Bonferroni test, and significant differences between groups were only found in relation to competition. [Table 7](#) and [Table 8](#) present the results of the Bonferroni analysis and the mean scores of companies' responses respectively. Results indicate a significant difference between companies with turnover of 1–5 millions € and those with a turnover below 1 million €. More specifically, companies with turnover between 1 and 5 million € (mean score = 4.75) are more likely to perceive the factor of competition as a driving force towards the use of Internet-based applications, than are companies with turnover below 1 million € (mean score = 3.20).

Table 6. ANOVA-companies' size

		df	F	Sig.
Competition	Between groups	2	5.414	.013
	Within groups	21		
	Total	23		
Personal contact	Between groups	2	3.838	.038

		df	F	Sig.
	Within groups	21		
	Total	23		
Telephone	Between groups	2	3.549	.047
	Within groups	21		
	Total	23		

Table 7. Bonferroni test

Dependent variable	(I) Size of the company	(J) Size of the company	Sig.
Competition	<1 000 000	1 000 000–5 000 000	.012
		>5 000 000	.054
	1 000 000–5 000 000	<1 000 000	.012
		>5 000 000	1.000
	>5 000 000	<1 000 000	.054
		1 000 000–5 000 000	1.000

Table 8. Competition factor-size of the companies

Companies' size (turnover in Euros)	Mean
<1 000 000	3.20
1 000 000–5 000 000	4.75
>5 000 000	4.36
Total	4.25

4.2.6. Transportation issues

In agri-food supply chains transportation is quite diverse and complicated and as a result a major challenge. It is diverse, because of the specific characteristics of the products: for high added value and very perishable products such as fresh produce, transportation must be quick and secure while for low added value products, such as commodities, speed is important but not the critical issue. It is also complicated, because it involves a number of different entities and numerous interactions.

Findings indicate that companies on average outsource transportation up to nearly 95%. The majority of shippers (nearly 70%) responded being involved with more than four carriers partnerships. The overall satisfaction regarding partnerships has been rated as moderate (mean of 3.13 on a scale of

1 = not at all satisfied to 5 = extremely satisfied). For the majority of the companies (96%) transportation costs represent less than 10% of the total cost.

[Table 9](#) provides the ranking of shipper perceptions of the important selection criteria of partnerships. The criteria selected, based on previous surveys, were the following: cost, coordination, reliability, flexibility and availability ([Bardi, 1973](#), [D’Este and Meyrick, 1989](#) and [McGinnis, 1989](#)).

Table 9. Comparison of shipper perceptions of partnerships factor

Criteria	Importance		Satisfaction		Difference Sig. level (p<)
	Mean	Ranking	Mean	Ranking	
Reliability	4.71	1	3.58	1	0.002
Flexibility	4.69	2	3.29	3	0.000
Coordination	4.46	3	3.38	2	0.000
Availability	4.43	4	3.13	4	0.000
Cost	4.04	5	3.04	5	0.000

Results indicate that reliability and flexibility hold the highest importance when shippers select carrier with a mean importance score for of 4.71 and 4.69, respectively. Regarding flexibility, results indicate a significantly lower satisfaction ($p = 0.002$). Coordination and availability criteria follow with a mean importance score of 4.46 and 4.43, respectively. Satisfaction for both is significantly lower ($p = 0.000$). Finally, the cost criterion receives a mean importance score of 4.04, which makes it the least important selection criterion. Latest surveys, have also indicated the diminishing perceived importance of the cost criterion, as a result of the increased logistics awareness ([McGinnis, 1989](#)). With respect to cost, satisfaction level is significantly lower than the perceived importance ($p = 0.000$). The last question of the questionnaire was dealing with the potential level of interest, expressed by companies, towards the use of an ETM, in order to manage the transportation activity. Companies’ responses suggest that the level of interest is rather moderate (mean of 3.04 on a scale of 1 = not at all interested to 5 = extremely interested).

5. Discussion–Conclusions

While the benefits of the Internet are many and undisputed its major potential is only partially exploited, since for most of the companies, across different business sectors, Internet is still popular as a passive information system, than as a bi-interactive one ([ELA, 2001](#)). The use of Internet is only focusing on some basic marketing activities. In the European food industry for example, the use of Internet-based applications is only restricted in the use of e-mail for communication, and on having a web site with limited functionality ([European Commission, 2002](#)). However, situation is changing, and it seems that in the near future the use of Internet-based technologies in logistic activities is undoubtedly expected to increase ([ELA, 2001](#)). Identifying Internet’s impact on the agri-food industry, related perceptions and constrained factors regarding the adoption of Internet-based applications, is a challenge, given the increased number of entities participating in the agri-food industry along with their diverse characteristics, resulting in a very complex business sector. In order to deal with the issue of complexity, the research targeted on a specific entity, fruit canning industry, an important link of the multi-tiered Greek agri-food supply chain, in terms of economic size.

In particular, while companies have recognized benefits in the use of Internet, it is still perceived as a communication tool, even if the use of e-mail is not yet extended, in comparison with traditional communication methods. Regarding constrained factors, security and cost issue have been

recognised as the most important. Motivation factors in adopting Internet-based applications seem to be more externally driven (competition, customer service) than an internal need of the companies to improve their processes (faster order processing, logistic processes improvement). With respect to the factor of competition, it seems that companies with a turnover of between 1 and 5 million € are more likely to perceive the pressure from competition as a motivation factor than companies with turnover below 1 million €.

In general, results have indicated that companies are in a premature stage regarding the adoption of Internet-based applications. At the moment it seems that Internet is more applicable for marketing activities (promotion, advertising etc.) rather than for logistic activities. However, it is expected that in the forthcoming years, there will be an increase in the use of Internet for supply chain activities, either as a need of processors to meet retailers' increased requirements on service levels and efficiency, or as a result of increased Internet adoption rates.

Particularly for transportation, respondents have indicated, moderate interest in using the Internet. Shippers are significantly less satisfied from their carriers, regarding a number of criteria, however their interest in using an ETM is still moderate. As a result, the potential benefit of increased visibility in transportation, due the use of ETM, which is particularly important for agri-food products, remains unexploited.

Comparison with other surveys was not feasible, since no similar research within the specific sector was available. However, comparison with surveys focusing in the agricultural sector, has shown similarities as the use of e-commerce and e-business applications is still limited, and Internet is perceived just as a new communication method (Baourakis et al., 2002 and Salampasis et al., 2003). In conclusion, results illustrate that the impact of the Internet is quite small, and further initiatives and support from authorities are required. We could say that the Internet in the agricultural sector in Greece is still in its infancy, but we expect that progress will be made very soon.

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