# E-Logistics applications in the Food Industry: Issues and Considerations for Agribusiness Management

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**Abstract**

Logistics is one of the most important agribusiness functions due to the idiosyncrasy of food products and the structure of food supply chain. Companies in the food sector typically operate with poor production forecasting, inefficient inventory management, lack of coordination with supply partners. Further, markets are characterised by stern competition, increasing consumer demands and stringent regulation for food quality and safety. Large agribusiness corporations have already turned to e-logistics solutions as a means to sustain competitive advantage and meet consumer demands.

There are four types of e-logistics applications: (a) Vertical alliances where supply partners forge long-term strategic alliances based on electronic sharing of critical logistics information such as sales forecasts and inventory volume. Vertical alliances often apply supply chain management (SCM) which is concerned with the relationship between a company and its suppliers and customers. The prime characteristic of SCM is interorganizational coordination: agribusiness companies working jointly with their customers and suppliers to integrate activities along the supply chain to effectively supply food products to customers. E-logistics solutions engender the systematic integration among supply partners by allowing more efficient and automatic information flow. (b) e-tailing, in which retailers give consumers the ability to order food such as groceries from home electronically i.e. using the Internet and the subsequent delivery of those ordered goods at home. (c) Efficient Foodservice Response (EFR), which is a strategy designed to enable foodservice industry to achieve profitable growth by looking at ways to save money for each level of the supply chain by eliminating inefficient practices. EFR provides solutions to common logistics problems, such as transactional inefficiency, inefficient plant scheduling, out-of-stocks, and expedited transportation. (d) Contracting, a means of coordinating procurement of food, beverages and their associated supplies. Many markets and supply chains in agriculture are buyer-driven where the buyers in the market tend to set prices and terms of trade. Those terms can include the use of electronic means of communication to support automatic replenishment of goods, management of supply and inventory.

The results of the current applications of e-logistics in food sector are encouraging for Greek agribusiness. Companies need to become aware of and evaluate the value-added by those applications which are a sustainable competitive advantage, optimisation of supply chain flows, and meeting consumer demands and food safety regulations. E-business diffusion has shown that typically first-movers gain a significant competitive advantage and the rest companies either eventually adopt the new systems or see a significant decline in their trading partners and perish. E-logistics solutions typically require huge investments in hardware and software and skilled personnel, which is an overt barrier for most Greek companies. Large companies typically are first-movers but small and medium enterprises (SMEs) need institutional support in order to become aware that e-logistics systems can be fruitful for them as well.

## 1. Introduction

Logistics is a relatively new concept for Greek business as well as academics. Georgiadis (2000) pointed out that although great progress has been made during the last decade, logistics in Greece are practiced by large corporations while academics, SMEs still have long way to go.

Logistics operations are critical in agribusiness management due to the high consumer standards for food quality and safety. For example, the physical distribution put food products in distress and many products degrade while on the move. Food products have short life cycle – typically between 25 and 90 days – thus, short shelf cycle which makes warehousing management a time-critical operation. In particular, the food, beverage and tobacco industry, or simply the food industry, is characterised by unique features than differentiate it from the rest sectors of the economy.

1. Current food quality and safety standards require *food traceability* which is the continuous monitoring of products and agricultural supplies throughout the supply chain. Further, food, due to its high perishability, requires a time efficient supply chain. These two factors create a considerable demand for automation in supply chain by using advanced information and communications technologies, e.g. Electronic Data Interchange.
2. There is a considerable supply variation due to seasonality of agricultural production, weather conditions and the biological nature of agricultural products which results in input variation and unpredictability (Salin, 1998). Vertical alliances often aim at smoothing supply variation and guarantee the planned delivery of supplies.
3. The international trade of food products in Greece, and, in EU, in general, contributes significantly to GDP. On the one hand, a considerable portion of products from food sector is sold to a significant number of international markets. This implies a huge distribution challenge for food industry when taking into account only EU's markets, which are diverse and geographically dispersed. On the other hand, raw material and product imports are also sourced from a significant number of countries. For example, the 99% of seeds used in Greek agricultural production are sourced from abroad.
4. Markets for food and beverages have long experienced considerable pressure for price reduction. This market condition is a relative advantage for multinational food manufacturers who have the ample purchasing power to buy and sell in bulk so to bargain prices on their own benefit. However, manufacturers have to control prices with big retailers who are often involved in price competition.

E-logistics solutions offer advanced solutions to agribusiness solutions. Next session presents the shift from traditional logistics operations to e-logistics. Then, the applications of e-logistics are discussed and analysed in detail in four sub-sections: (a) vertical alliances (b) e-tailing, (c) EFR, and (d) contracting. Conclusions and recommendations for future research are presented in the last sessions.

Furthermore, there are significant changes that affect the European food sectors:

- Concentration on fewer, more powerful players in food sector
- Market saturation which prohibits product innovation and marketing investment
- Large-scale distribution at regional or even European level becomes dominant.
- Entry barriers for new products – in the form, for example of listing fees.
- Consumers become more demanding for value for money in terms of quality, freshness, 'healthy' options and niche products.

## 2. The Shift from Logistics Operations to E-logistics

The Council of Logistics Management, cited by Lambert and Stock (1993) defines logistics as: *'the process of planning, implementing, and controlling the efficient, cost-effective flow and storage of raw materials, in process inventory, finished goods, and related information from point-of-origin to point-of-consumption for the purpose of conforming to customer requirements'.* Figure 1 depicts the logistics concept including the e-logistics applications in the food sector. As can be shown by Figure 1 logistics is a broad term, which extends from strategy to operations and from supplier to customer, covering issues such as physical distribution management, materials handling, and supply chain management. E-logistics refers to e-business applications in logistics operations. Table 1 presents e-business applications to logistics operations.

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The 2000 Logistics and Transportation Survey measured the transportation and distribution processes as they evolve from traditional operating models to e-Logistics. Table 2 presented the results of the previous study on the shift from traditional logistics operations to e-logistics. The majority of listed logistics elements are significantly enhanced by the application of information and communication technologies. E-logistics adds flexibility to operations management allowing for smaller lots of orders and shipments, real-time inventory replenishment, and shorter order cycle time and subsequently shorter lead times. Even more significant is the shift to responsive and flexible customer service which is a value-added of e-logistics systems.

<<Insert Table 2 about here>>

This is an important derivation from the traditional way of communication and coordination in the Supply Chain. Traditionally, the way of communicating demand for products or services across a supply chain was the following: every supply partner transmits only current demand volumes to his suppliers and keeps the rest internal data hidden, regarding, i.e. sales patterns, stock levels, stock rules, and planned deliveries. This phenomenon, in which orders to the supplier tend to have larger variance than sales to the buyer and the distortion propagates upstream in an amplified form is called the Forrester Effect or Bullwhip Effect (Towill, 1996). Forrester (1960) showed that the effect is a consequence of industrial dynamics or time varying behaviors of industrial organizations and the lack of correct feedback control systems. Figure 2 shows an example of the Forrester Effect repercussions in the vehicle production and associated industries for the period 1961-1991 (Mason-Jones and Towill, 1999). The rational of the Bullwhip Effect is attributed to the non-integrated, autonomous behavior of supply partners. For instance, processors and retailers incur excess materials costs or material shortages due to poor product forecasting; additional expenses created by excess capacity, inefficient utilization and overtime; and mostly excess warehousing expenses due to high stock levels (Vorst et al., 1998; Lee et al., 1997a).

<<Insert Figure 2 about here>>

The Bullwhip Effect has been also examined in the food industry. Thomas et al. (1995) gives a detailed analysis of demand distortion and amplification in the grocery supply chain, which are linked to inefficiency within this supply chain. The grocery industry uses buying practices, such as forward buying, that exacerbate the Forrester effect to a considerable 40–50% account of distributors' inventories (Lee et al., 1997b). Clark and Hammond (1997) argued that the application of E-business solutions can leverage process re-engineering in

food supply chains. In particular, Electronic Data Interchange (EDI) is a technology which facilitates electronic continuous replenishment, enabling in this way the reengineering process.

## 3. E-Logistics Applications in Agribusiness Management

The advent of advanced information and communication technologies has created a multitude of challenges and opportunities in western food industries. E-business applications have received particular consensus given the fact that food industries depend on effective logistics systems in order to meet diversified consumer demands, short delivery times, back-order chains, applying FIFO, and imitated chains (Iijima et al., 1996).

During the last two decades, large companies, especially retailers and manufactures, have used e-business applications to gain power in agrifood supply chains by increasing customer service, creating economies of scale, reducing logistics costs, and facilitating the efficient flow of food and information. For instance, European food retailers have gain power over their suppliers increasing the market concentration (Bell et al., 1997). This achievement was strategically leveraged by information communication technologies such as EDI that enhanced the performance of food chains in terms of cost, time and accuracy of deliveries, and at the same time, assuring food quality and safety. Another study by Vorst et al. (1998) investigated the impact of Supply Chain Management in food supply chains who found that the availability of real-time information systems (i.e. Quick Response systems) was a requirement of an efficient and effective food supply chain. Myoung et al. (2001) pointed out that the successful implementation of SCM in agriculture means that all involved parties in production, distribution, and consuming should trust each other in order to gain by information sharing. However, the competitive advantages from the implementation of IT in logistics may be distributed evenly among the members of any logistics chain [Loebbecke and Powell (1998)]. Food companies can use web-based e-business solutions to exploit niche markets and create new market segments by gaining sporadic, low volume suppliers and customers at low marginal cost. For example, Greek wineries can advertise and sell their products using the Internet as an exhibition stand, a communications means, and a marketing channel.

Four types of e-logistics applications can be distinguished (a) vertical alliances (b) e-tailing, (c) EFR, and (d) contracting. They are discussed in the following sections.

### 4.1. Vertical Alliances

Vertical alliances are a typical form of collaboration in food supply chains in order to create economies of scale, and enhance cost-effectiveness and time-efficiency. Agribusiness companies in the food supply chain include suppliers, production, logistics, marketing, and sales. There is consensus that information and communication technologies can help achieve these goals in a profound way (Vlachos, 2002a). Following EU directives for food safety, packaging processes, and the control of quality are increasingly being targeted for improvement. A recent trend in EU food markets is joint ventures where products are produced under license or in collaboration with regional producers which allows the direct (international) supply of required product, thus overcoming any intermediaries operate in alternative distribution channels. According to Fearne and Hughes (2000), Sainsbury's and Tesco, UK leading retailers, regard among others complete electronic integration and information sharing as key indicators for the development of successful partnerships in the fresh produce supply chain.

There are two types of integration in the food supply chain which can result in vertical alliances: upstream integration and downstream integration. Upstream integration focuses on the control of suppliers and their production processes and verifying the quality of the raw materials. This type of vertical integration has been supported in UK by the 1990 Food Safety Act which requires buyers to take all "reasonable steps" to ensure that the food they receive from upstream suppliers is safe. Downstream integration of logistics system are progressively

moving from the factory to the distribution centre or retail store through a system of automatic re-ordering that reduces the inventory replenishment level without increasing the risk of lost sales due to stock breakages (Figure 3).

<<Insert Figure 3 about here >>

There are two patterns of e-logistics diffusion in food sector: (a) the 'hub and spokes' phenomenon and (b) a critical mass of partners. The 'hub and spokes' phenomenon is characterised by a large agribusiness corporation i.e. a big retailer performing substantial work in order to create electronic links with its trading partners. The retailer (the 'hub') often uses its power to force its suppliers (the 'spokes') to adopt e-logistics systems with the threat of discontinuing paper-based procurements. UK big retailers are known to have used this technique in order to automate its distribution chain. For example, Tesco has recently formatted of a "hit squad", empowered to call on any supplier, day or night, to test their compliance systems (Fearne and Hughes, 2000). Jimenez and Polo (1996) found evidence of EDI diffusion in Europe that indicates that initially its diffusion follows the pattern of hub and spokes. Then, as EDI becomes known among companies due to that phenomenon, more and more firms adopt it on their own initiative. The 'hub and spokes' phenomenon is suitable for leading companies with huge capital investments in ICTs but not for food companies of a smaller scale for which vertical alliances is a means to sustain long-term competitive advantage. However, a critical mass of agribusiness companies is necessary in order to overcome barriers such as the capital intensive investment of e-logistics hardware and software (Vlachos, 2002b). This pattern of e-logistics diffusion is already observed in EU, where large food companies and those involved with products that suffer from perishability are already upgrading their warehousing systems in order to deal with shortcomings such as storage capacity, stock breaches, prolonged lead times, and delivery inaccuracy (Ebusinesswatch, 2002).

### 4.2. E-tailing

Electronic shopping refers to consumers' ability to order food such as groceries from home electronically i.e. using the Internet and the subsequent delivery of those ordered goods at home. In USA, retailers, such as Peapod, Streamline, Netgrocer and American Stores and in Europe leading retailers such as Tesco, Sainsbury and Albert Heijn have only recently introduced web-based grocery shopping services.

E-tailing appears to grow rapidly in US and UK. Reports indicate that 42% of shoppers in the US and Europe are willing to order groceries from home (Narayanan, 1997). This trend, which has significant logistics consequences, is attributed to two dominant factors: (a) the convenience out of on-line shopping and home delivery of groceries and (b) the significant demographics pressure for saving time by skipping regular visits to a retail store. For example, Verhoef and Langerak (2001) found two dominant advantages of e-tailing: (a) consumers perceive the reduction in the physical efforts an important advantage of electronic shopping, and (b) busy consumers consider e-shopping as a means to reduce the time pressure associated with traditional in-store shopping. However, the necessary demographics to uphold e-tailing widespread diffusion yet occur only in few developed countries. For instance, Raijas (2002) found that, in Finland, e-grocery do not produce any real value added for the majority of consumers and could facilitate only niche marketing.

There are three significant logistics implications to e-tailing:

- Firstly, consumers are reluctant to shop on the Net due to prolonged delivery time. Reports indicate that online customers had their orders delivered either much later than they expected or not at all (Keh and Shieh, 2001).
- Secondly, daily schedules are hard to predict and retailers should achieve full geographic coverage in a competitive cost.
- Thirdly, e-tailing is more difficult to achieve for food products than other convenience goods such as books or clothing due to the low value-to weight ratio of

groceries and short shelf time of perishable goods. A cool supply chain from producers to end-consumers can meet this condition though it requires advanced but expensive delivery systems i.e. equipment with temperature controlled storage.

**A case of grocery E-tailing and its logistics implications**

Peapod is one of the leading U.S. online grocery shopping from 1998 (see Keh and Shied (2001) and www.Peapod.com). Peapod, which was founded in 1989, initially started operating as a phone and fax order service. In line with current demographic trends, Peapod promotes its service as 'Smart Shopping for busy people'. This company serves about one hundred thousand customers in five major U.S. metropolitan areas Customer base consists of 68 percent women (75 percent among the heavy users). The average Peapod customer spends about $100 every two weeks. Peapod is now a wholly owned subsidiary of international food provider Royal Ahold, based in The Netherlands. Ahold is the second-largest retailer in the world.

Peapod has strategically shifted from traditional logistics operations to e-logistics systems. The shift from paper-based systems, such as employees filling orders by picking items from local groceries, towards computer-based automated warehouses has enabled Peapod to cut prices and reduce lead times. Peapod, when it first started its online operations, relied on supermarket partners in local markets to fulfil orders. Nowadays, Peapod operates its own distribution system that allows for local same-day deliveries.

Peapod employs a centralized distribution model with two distinct formats for large and smaller markets. In large markets, orders are picked, packed, loaded and delivered from a free-standing centralized fulfilment centre. In smaller markets, Peapod establishes "fast-pick" centralized fulfilment centres adjacent to the facilities of its retail partners. According to Peapod's reports, proprietary transportation routing system ensures on-time delivery and efficient truck and driver utilization. Groceries can be delivered as soon as the next day after placing an order. Customers have the option to select the delivery time of their choice. In most markets, customers have a choice of At-Home or Unattended Delivery. Unattended Delivery means that the customer does not need to be home but instead designates a safe place for the Peapod driver to leave the groceries.

Peapod has in place a cool supply chain which ensures that grocery items remain the proper temperature – "so when a customer unpacks his or her order, the ice cream is hard-frozen and milk is still chilled". Peapod's shopping and delivery service has no monthly fees but charge a fee depending on the market and the size of the order (in early 2002, fees ranged from $2.95 to under $10).

### 4.3. Efficient Foodservice Response (EFR)

Efficient Foodservice Response (EFR) is a strategy designed to enable foodservice industry to achieve profitable growth by looking at ways to save money for each supply partner by eliminating inefficient practices. EFR originated in USA where foodservice, known as the "food-prepared-away-from-home", represents the half of the food supply chain.

The foundations of Efficient Foodservice Response were built on Quick Response and Efficient Consumer Response (ECR), two logistics management tools that had already proven fruitful in US food industry. Quick Response includes building partnerships between customers and suppliers and having the ability to share electronically inventory and sales information to the benefit of both partners. Efficient Consumer Response (ECR) is a consumer oriented system, in which all partners of the food chain work together, in order to satisfy consumer needs with the lowest possible cost. ECR has shown exceptional results in US grocery industry. ECR applications include cross-docking, category management, continuous replenishment, activity based costing and electronic data interchange.

The EFR initiative was developed in order to handle the repercussions of industrial dynamics in US foodservice supply chain. Those problems related to the effectiveness and efficiency of logistics operations, such as transactional inefficiency, inefficient plant scheduling, out-of-stocks, and expedited transportation. Figure 4 shows that communication errors in paper-based systems increase by the number of functions involved in communications activities. As members of the supply chain communicate with each other, each must cross-reference its

product number with the other party's product number. As each function within a company uses this process, the chances for errors inevitably increase. Each function and partner propagates the possibility of transactional error in paper-based systems.

<< Insert Figure 4 about here >>

Efficient Foodservice Response has conceived five strategies which target specific problems in supply chain (EFR, 2001). Those strategies and their initiatives, which are presented in Table 3, are the following:

- **Strategy 1: Equitable Alliances**
  Equitable Alliances is a strategy based on the idea that by reducing non-value-added costs, supply partners, and, ultimately, the end-consumers, would benefit. A fundamental initiative of this strategy is activity-based costing (ABC). This process uncovers the true cost of functions within the supply partners' own operations.
- **Strategy 2: Supply Chain Demand Forecasting**
  This strategy is based on the principle that the whole supply chain serves one goal: satisfy consumer demands. Therefore, every supply partner should collaborate with each other in order to arrive at safe forecasts of consumer demand coupling with demand creation.
  Initiatives within this strategy include standard product identification and bar coding, common product information databases, demand and planning information sharing, and market-level reporting and forecasting.
- **Strategy 3: Electronic Commerce**
  Electronic Commerce is the largest EFR initiative in terms of quantified benefits. Most of these benefits come from reduced administrative cost resulting from streamlining the revenue cycle processes between supply chain buyers and sellers. The five integrated initiatives include business process simplification, revenue cycle EDI, electronic funds transfer, and invoice-less payment.
- **Strategy 4: Logistics Optimization**
  Logistics optimization is a set of initiatives aiming at streamlining the supply channel and optimizing the total supply chain costs throughout the supply chain. Forging of strategic alliances is a facilitating strategy in line with logistics optimisation. Initiatives within this strategy deal with physical flows from point of supply to point of consumption and include direct shipment, consolidation, shared distribution, coordinated transportation and cross-docking.
- **Strategy 5: Foodservice Category Management**
  This strategy includes initiatives to profitably manage the inherent complexity of a supply chain that moves vast amounts of different products in a variety of service configurations. Initiatives within foodservice category management include balanced variety, product deletions, new products, and centralized conversion.

**Standard Product Identification and Bar-Coding**

Efficient Foodservice Response (EFR) initiative relies on Standard Product Identification and Bar-Coding for exchanges of product information through the foodservice supply chain. Standard Product Identification is a system of referencing a product using a unique number which is commonly used by all supply chain partners. Standard product identification, which is issued by the owner of the label, typically the manufacturer, follows specific rules that allow the number assigned to the product to be unique anywhere in the world. This is referred as the Global Trade Item Number or GTIN. Bar-coding allows the accurate, consistent and expedient interchange of information in the foodservice industry. Bar-coding and e-business solutions strongly rely upon a standard identification number for a product.

**A Case on Food Supply Integration: The FRESH Project**

FRESH, which stands for 'Food industry RE-engineering pilot to achieve Supply cHain integration', was an agribusiness project, part-funded by the EU through the ESPRIT programme, aiming to re-engineer the primary logistics chain of a pilot diary company (user).

The FRESH project developed new ways of implementing efficient consumer response (ECR) concepts in the food sector. The FRESH framework, which is depicted by Figure 5, had the following objectives (a) increase sales levels by at least 5.5%, thanks to the combined effect of more on-time deliveries, of reduced order fulfilment lead time and of increased product freshness and shelf-life at points of sale, (b) reduce stock levels along the primary logistics chain by 30% and (c) reduce total costs of the primary logistics user by at least 4.5%.

FRESH aimed at re-engineering the supply chain of the user by integrating material management throughout the supply chain, from raw material suppliers to customer delivery, thus significantly reducing lead-times and increasing flexibility. The integration included suppliers, sub-contract suppliers, in-house production processes, shipping, transportation, distribution warehouses, and end customers.

The project objectives come to achievement thought a set of actions such as: (a) implementation of a continuous replenishment process supporting re-order processes through optimisation algorithms that balance the service level to be guaranteed and the logistics limitations of the manufacturer; (b) bar code based tracking to support warehouse operations including product tracking and truck loading; (c) a warehouse management system; and (d) the measurement and visualisation of the logistical performance indicators.

### 4.4. Contracting

Contracting is a means of coordinating procurement of food, beverages and their supplies. It is a mechanism for coordinating production and delivery of products ensuring food safety, keeping detailed production and logistics records. The advantages of contracting include: (a) reducing financial, quality, quantity, and price risks, (b) lowering transaction costs, and (c) faster and more flexible response to changing customer demands.

Many markets and supply chains in agriculture can be characterized as buyer-driven where the buyers in the market tend to set prices and terms of transactions. This occurs either because of buyers' size versus suppliers or because of traditional market workings. For example, a multi-store retail chain imposes the terms of trade to its suppliers. Those terms can include availability, prices and discounts, and the use of electronic means of communication to support automatic replenishment of goods, management of supply and inventory.

Contracting can facilitated by the use of e-business applications that reduce prior inefficiencies that occurred due to its complexity and cost. E-logistics solutions inherently entail coordinating activities between suppliers, buyers, and logistics agents in between. In order for partners to reap the benefits of contracting, they must go beyond a contract statement. Contracting needs an integrated data storage, management and retrieval system (Leroux, 2001). E-logistics solutions have the capacity to support contracting activities by creating a virtual integration of the supply chain. Quick information flow between supply chain participants leads to reduced financial risk, lower costs, better decision making, market access and faster responses to changing consumer demands (Hayenga, 2000).

Figure 6 depicts an application of e-logistics for the supply chain management of olive oil, a project under development based on the infosociety programme. In this project, contracting is developed as system with electronic modules for selling, procuring etc (Vlachos, 2002a). The software application is based on a electronic warehouse management system which supports every necessary transaction such as market reports, market intelligence, finance, auctions, etc. By doing so, the whole (olive oil) supply chain is enhanced from producers to retailers and caterers. Particularly, the e-logistics olive oil system would:

- Improve and simplify logistical processes, such as consolidation of consignments, item trailing using bar-coding, etc.
- Improve cash flows by earlier invoicing and earlier payments.
- Match market demand to production capacity. The losses associated with production operating without accurate information can be enormous.

- Reduce data entry costs and improve efficiency at each stage of the supply chain
- Eliminate data re-entry along the supply chain resulting in cost savings
- Reduce telecommunications costs (phone and fax costs).
- Apply Business Process Re-engineering (BPR).

## 4. Discussion

E-logistics is a relatively new technological innovation that challenges the way agribusiness operations are being conducted. Large European and US agribusiness corporations have already adopted e-logistics applications such as e-tailing, EFR, and supply chain management in vertical alliances. Large retailers and manufacturers use e-business to leverage their power in the supply chain in order to gain a competitive advantage over competing companies and alternative supply channels.

However, although e-logistics can be a competitive advantage for first-movers, current market trends indicate that for the majority of agribusiness companies, which are Small and Medium Enterprises (SMEs), these applications would be a competitive necessity. The food sector differs from the other sectors of the economy due to the food products' characteristics (freshness, perishability, volatility of production, etc) and the health concerns of end-consumers. Food quality and safety, which attracted considerable attention due to the recent food crises and altered consumer awareness, require a reliable food *traceability* which can be safely applied using standard product identification and bar coding, the cornerstones of ECR/EFR. Further, the perishability of food products, the life cycle of which could be few weeks short, requires a time efficient supply chain from the 'field to plate'. E-logistics have the capacity to address these issues effectively.

There are four types of e-logistics applications suitable in agribusiness applications. Firstly, Vertical alliances are a rather common type of strategic alliances in agrifood chains. For example, joint ventures proliferate in EU markets, producing food under license or in collaboration with regional producers. In this way, retailers achieve to skip any intermediaries in alternative distribution channels and get supplies directly from producers. The result is a reduction in distribution costs due to the lack of intermediary overheads, a benefit that retailers gain almost exclusively. In order to make these ventures a success, retailers require from their partners complete electronic integration and information sharing. This upstream integration is based on a system of automatic continuous re-ordering that reduces the inventory capacity without increasing the risk of lost sales due to stock breakages. Secondly, e-tailing, a Business-to-Consumer (B2C) e-commerce application which initially flourished and come to a rather abrupt mature, refers to consumers' ability to order food such as groceries from home electronically i.e. using the Internet and the subsequent delivery of those ordered goods at home. Consumers perceive the reduction in the physical efforts an important advantage of electronic shopping. In particular, busy consumers consider e-shopping as a means to reduce the time pressure associated with traditional in-store shopping. Current demographics show that e-tailing can serve only a niche market in most countries, apart from US and UK. Thirdly, Efficient FoodService Response (EFR) is a strategy designed to enable foodservice industry to achieve profitable growth by apply cross-docking, category management, continuous replenishment, activity based costing and electronic data interchange in order to eliminate inefficient practices and generate gain for every supply partner. EFR have developed five strategies: Equitable Alliances, Supply Chain Demand Forecasting, Electronic Commerce, Logistics Optimization, and Foodservice Category Management. The keystones of EFR are Standard Product Identification and Bar-Coding. Fourthly, contracting is a means of coordinating production and delivery of food, beverages and their supplies and at the same time ensuring food safety, keeping detailed production and logistics records. Contracting can facilitated by the use of e-business applications that reduce prior challenges occurred due to its complexity and cost. E-logistics solutions, i.e. integrated data storage, management and retrieval systems, inherently entail coordinating activities between suppliers, buyers, and logistics agents in between. In this way, involved partiers gain

from reduced financial risk, significant cost-savings, and faster responses to changing consumer demands.

Greek food sector has long relied on the quality of Greek agricultural products, due to climatic conditions and the traditional nature of Greek agriculture, to its craft competitive advantage which has repeatedly shown in its dynamism in domestic and foreign markets. However, changing consumer demands and intense competition create a new business environment where competitive advantages are determined by innovation, cost-effectiveness, and long-term supply base alliances. In such an environment, Greek agribusiness companies can only gain by the e-logistics applications. Large-scale agribusiness enterprises have already become to adopt e-logistics i.e. Delta, a diary leading company has recently a warehouse management system for its Yoghurt distribution centre. However, the majority of Greek agribusiness companies are SMEs which typically are late adopters of technological innovations i.e. e-logistics. In such cases, the role of the government have been found repeatedly primal to motivate SMEs towards technological innovation by giving direct incentives, lowering barriers to entry, providing financial alleviations, and cultivating a stable business environment. The creation of a critical mass of agribusiness companies that have achieved superb performance by the use of e-logistics applications would be a significant push to rest companies to the Greek food sector to seek a sustainable competitive advantage in e-logistics applications.

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Table 1 Application of e-business in logistics operations

| Business Functions | E-business applications | E-business tools |
|---|---|---|
| Marketing | Product promotion, new sales channels, direct savings, reduced cycle time, customer services | B2B e-commerce, Internet ordering, Website for the company |
| Purchasing | Ordering, fund transfer, supplier selection | EDI, Internet-purchasing, EFT |
| Design | Customer feedback, research on customer requirements, product design, quality function deployment, data mining and warehousing | WWW integrated CAD, Hyperlinks, 3D navigation, Internet for data and information exchange |
| Production | Production planning and control, scheduling, inventory management, quality control | B2B e-commerce, MRP, ERP, SAP, BAAN, Peoplesoft, IBM e-commerce (web integrated) |
| Sales and distribution | Internet sales, selection of distribution channels, transportation, scheduling, third party logistics | Electronic funds transfer, On-line TPS, Bar-coding system, ERP, WWW integrated inventory management, Internet delivery of products and services |
| Human resource management | E-recruiting, benefit selection and management, training and education using WWW | E-mails, interactive web sites, WWW based multimedia applications |
| Warehousing | Inventory management, forecasting, scheduling of work force | EDI, EFT, WWW integrated inventory management |
| Supplier development | Partnership, supplier development | WWW assisted supplier selection, communication using Internet (e-mails), research on suppliers and products with WWW and intelligent agents |

Source: Gunasekaran et al. (2002)

Table 2 The Shift from traditional logistics operations to e-logistics

| | **Traditional Logistics** | **e-Logistics** |
|---|---|---|
| **Orders** | Predictable Variable | Small Lots |
| **Order Cycle Time** | Weekly Short OTD | Daily or Hourly |
| **Customer** | Strategic | Broader Base |
| **Customer Service** | Reactive, Rigid | Responsive, Flexible |
| **Replenishment** | Scheduled | Real-time |
| **Distribution Model** | Supply-driven (Push) | Demand-driven (Pull) |
| **Demand** | Stable, Consistent | More Cyclical |
| **Shipment Type** | Bulk | Smaller Lots |
| **Destinations** | Concentrated | More Dispersion |
| **Warehouse Reconfiguration** | Weekly/Monthly Continual | Rules-based |
| **International Trade Compliance** | Manual | Automated |

Source: Adopted from Thompson et al (2000).

Table 3 EFR Strategies and Initiatives

| Strategy | Initiative | Description |
|---|---|---|
| **1. Equitable Alliances** | *Activity based costing* | Through this process, trading partners can get to know the true cost of functions within their own operations. With this knowledge, they understand the cost of doing business, from placing an order to correcting a mis-shipment |
| | *Initiative bundling* | Trading partners make an investment in technology that the others will benefit from, and these are bundled together so that all trading partners may gain |
| | *Value based incentives* | This concept provides clear economic incentives to participants for reducing the costs of their business transactions with trading partners. |
| **2. Supply Chain Demand Forecasting** | *Standard Product Identification and Bar-coding* | Bar codes on unit, case and pallet packages provide the communication brokers framework for logistics processes and information systems that act as connectors between manufacturers, distributors and operators. Bar codes are a predicate for many of EFR principals. Standard product identification is a fundamental bar-coding concept and crucial to EFR's effectiveness. |
| | *Common product databases* | An evolution of bar-coding, this initiative calls for the creation of a central network from which buyers and sellers can access consistent product information |
| | *Demand data sharing* | This represents a direct link between supply chain trading partners and consumers. Opening the flow of information about consumer foodservice sales back up the supply chain will allow distributor and manufacturer trading partners to plan accurately |
| | *Market-level forecasting* | Suppliers can reduce inventory as more accurate and complete demand information allows them to better manage production and replenishment cycles. |
| **3. Electronic Commerce** | *Simplified business practices* | The sale of products can be a simple three-step process: order, shipment, and payment. |
| | *EDI product maintenance* | Accurate product, price and promotion information, readily available up and down the supply chain |
| | *Revenue cycle EDI* | Smooth, continuous information flow through the use of automated, standardized transaction formats |
| | *Invoice-less payment* | Payments can be made electronically without physical invoices when trading partners have the right information at the right time |
| 4. **Logistics Optimization** | *Direct shipment* | For fast-moving products, the most cost-effective and efficient transportation may be direct shipment from manufacturer straight to distributor. |
| | *Slow-mover consolidation* | Slow-moving products from many suppliers can be consolidated at a redistribution facility and shipped together as full truckloads. |
| | *Shared distribution* | When two manufacturers have less than a truckload and share the same destination point, they can cut waste from the system by coordinating and sharing transport space and cost. |
| | *Coordinated transport* | Maximizing the transport routes so as to accomplish multiple tasks |
| | *Cross-docking* | Coordinating delivery and pick-up times, production schedules and demand cycles to create a system in which there is no need for storage at a distribution point. |
| 5. **Foodservice Category Management** | *Balanced variety* | Improved product varieties can be achieved through cooperation between operators and their distributor trading partners. |
| | *Product deletions* | Understanding when sales of a product amount to less than costs is a key in evaluating product retention. |
| | *New product introductions* | Technology and market information should be used to gauge the timing and likelihood of market receptivity to a new product. |
| | *Centralized conversion* | Moving food preparation tasks to the most efficient point in the supply chain is an important concept. Fully prepared or partially prepared produce is a good example of this initiative in action. |

Source: EFR (www.efr-central.com)

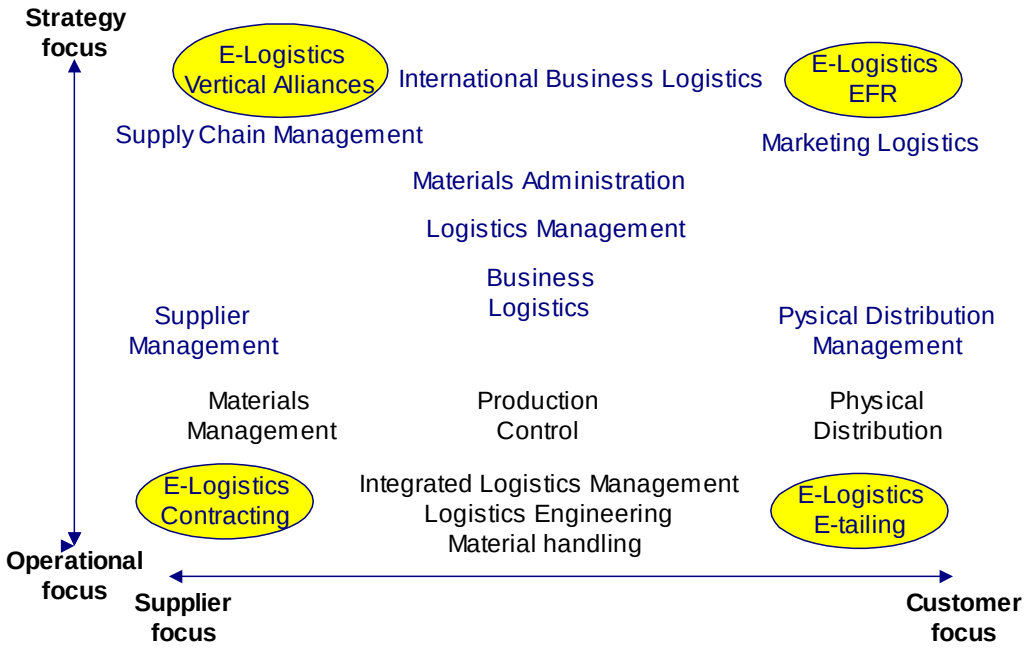


Figure 1 The Concept of Logistics

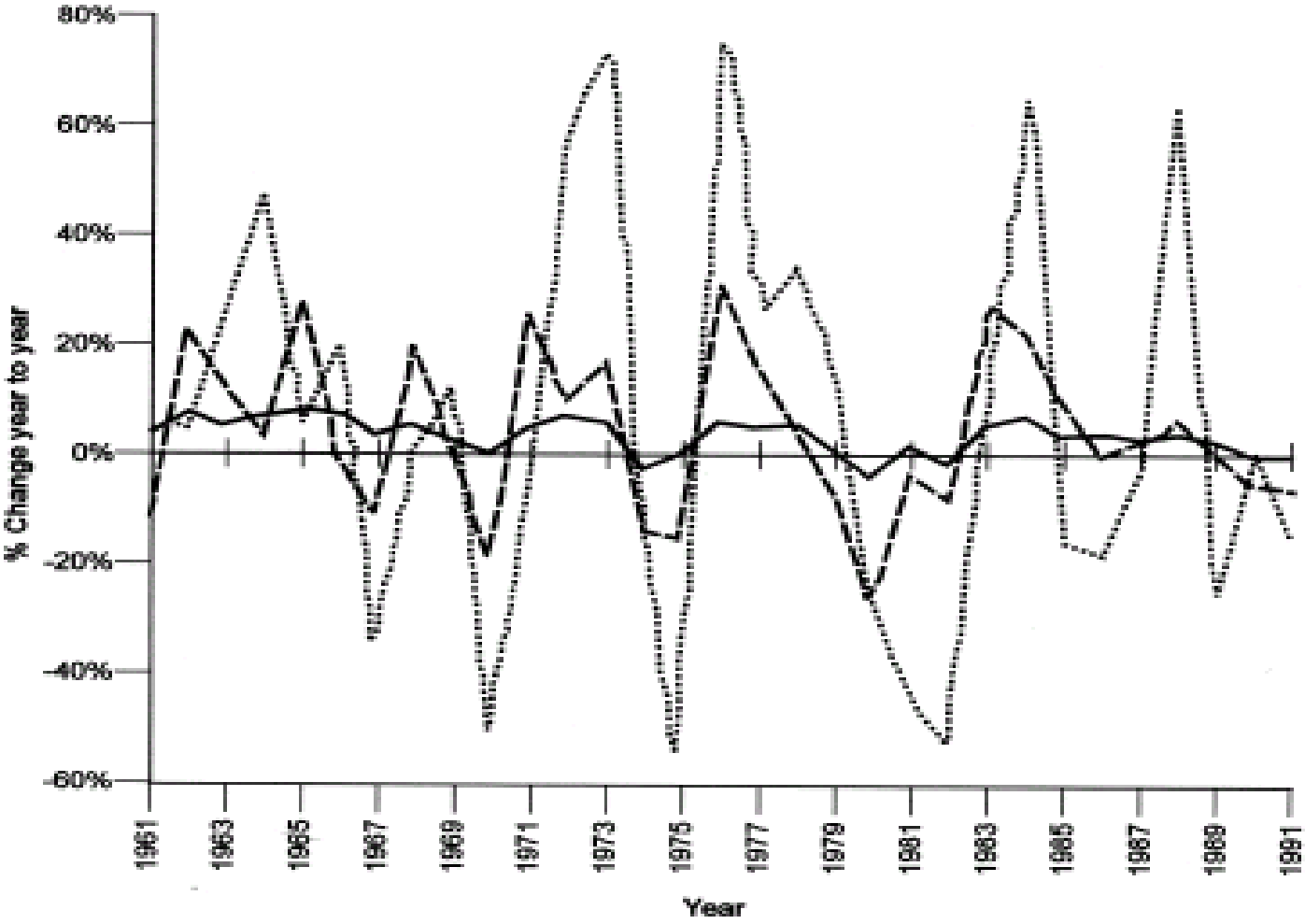


Figure 2 The Forrester Effect (Supply Chain Bullwhip)

——————— % Change GDP
– – – – – – – – % Change Vehicle Production Index
..... % Change net New Orders Machine Tool Industry

Source: Fine, C. (1998) *Clockspeed: Winning Industry Control in the Age of Temporary Advantage*, Reading, MA: Perseus Books.

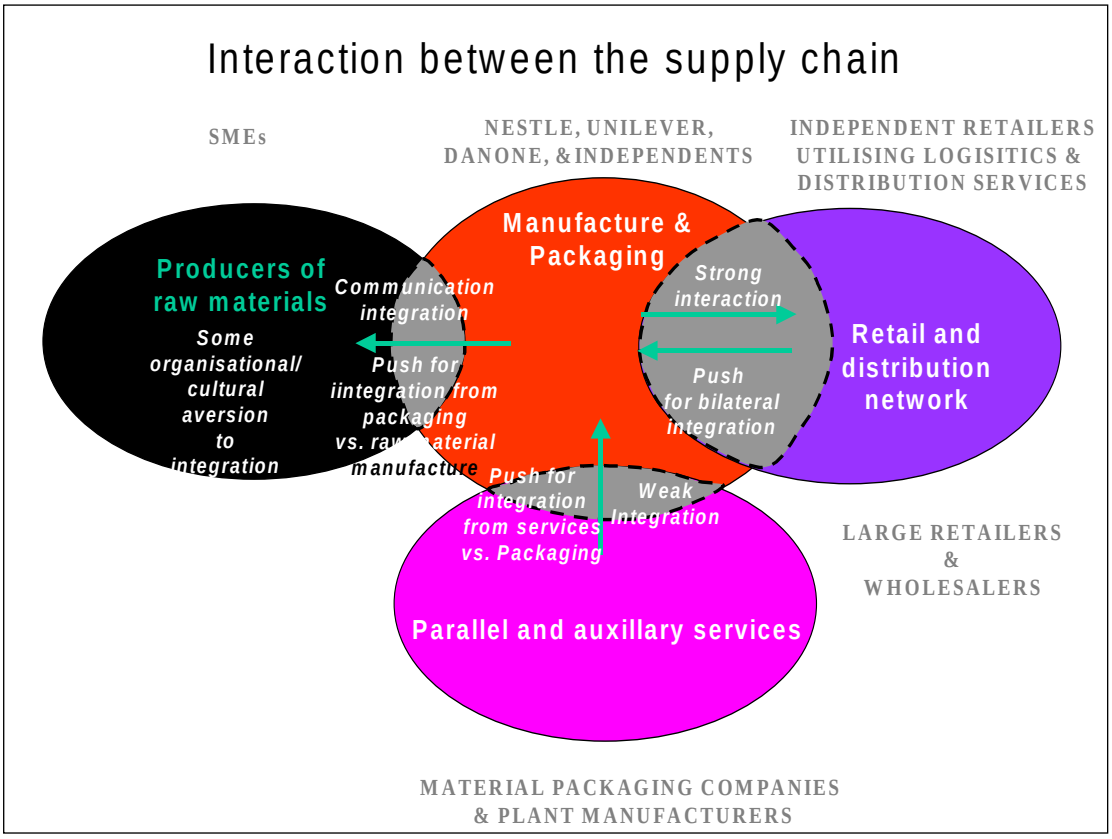


Figure 3 Supply chain interactions in the food and beverages industry

Source: Databank Consulting (www.ebusinesswatch.com)

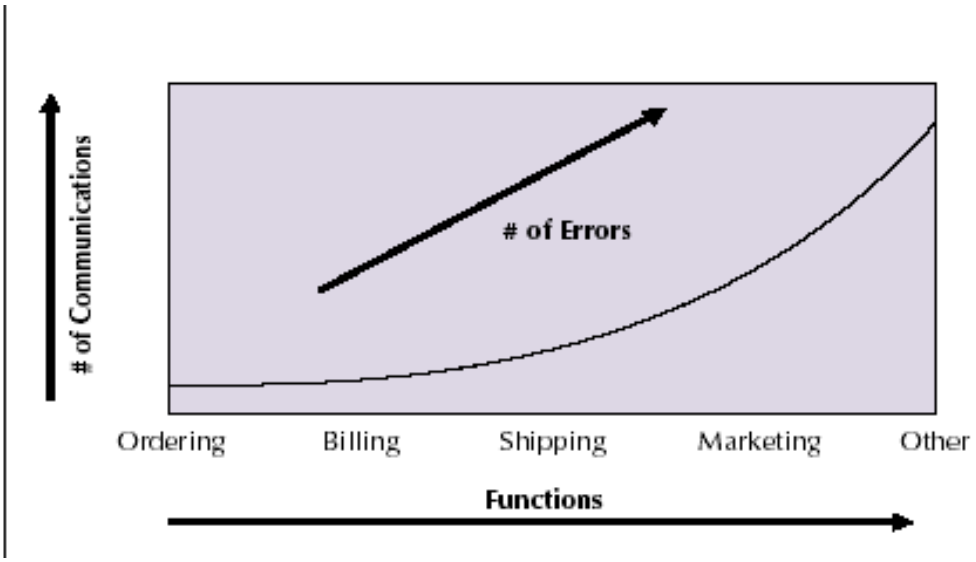


Figure 4 Errors by Business Functions due to paper-based systems

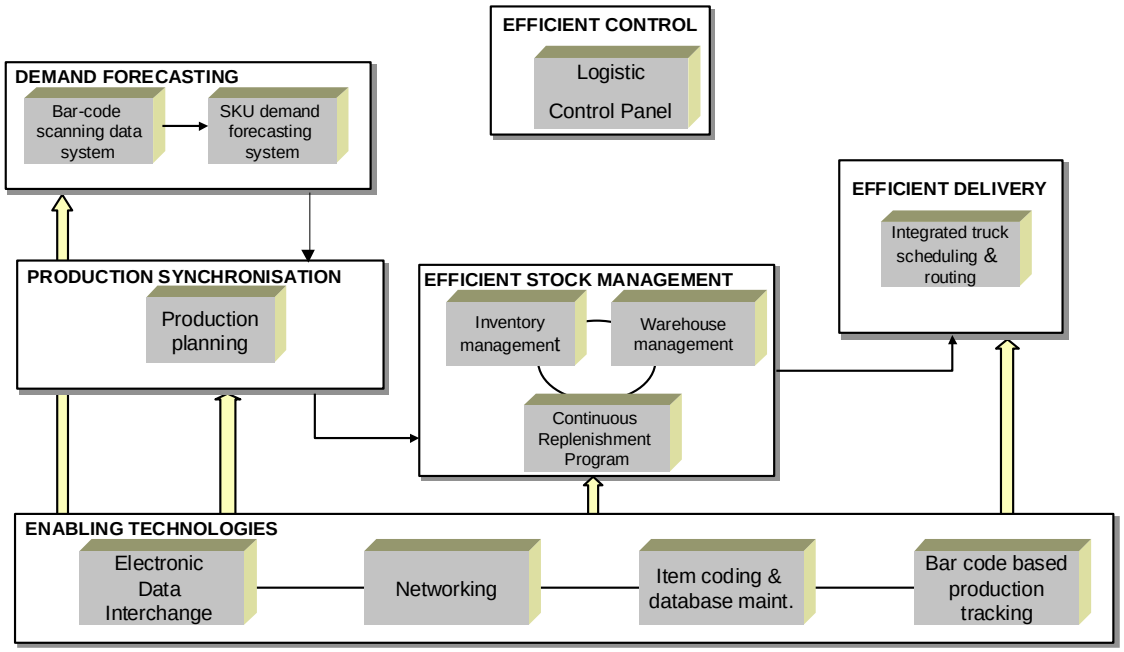


Figure 5 E-Logistics model used in FRESH project
Source: The FRESH project (www.txt.it)

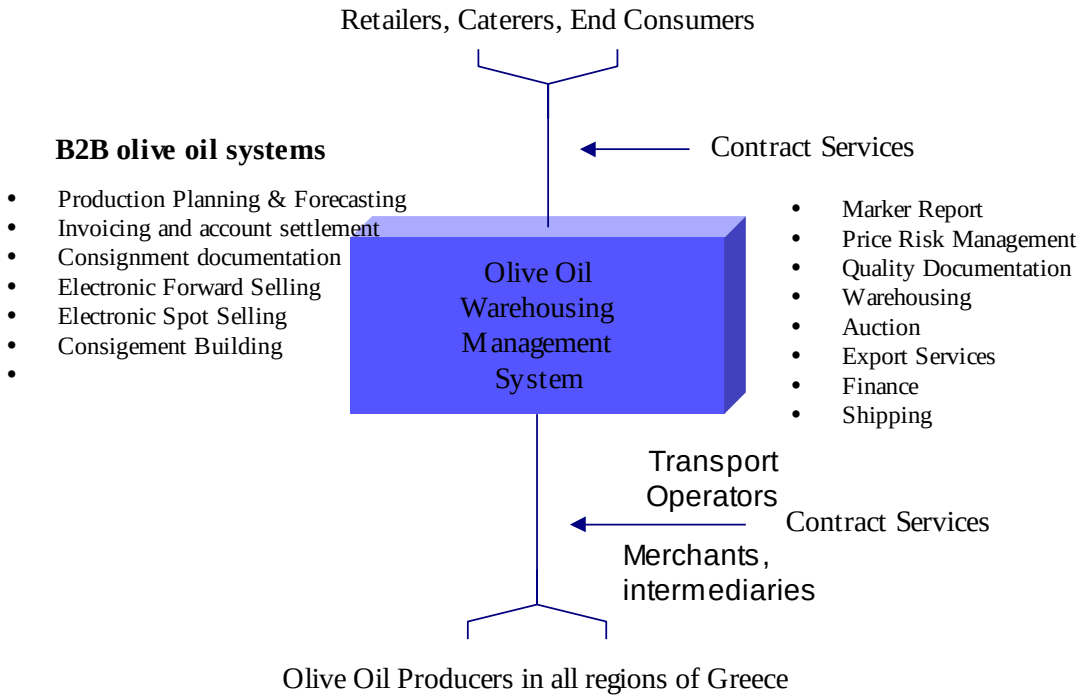


Figure 6 A Warehousing Management System for Greek Olive Oil Supply Chains