ELECTRONIC BUSINESS AND THE CONCEPT OF DIGITAL BUSINESS ECOSYSTEMS APPLIED TO THE SHIPPING INDUSTRY: THE GREEK SHIPPING CASE

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Abstract. Shipping consists a peculiar market primarily because of the nature of its actors being spread all over the world. Today information and communication technologies are a focal point for managers and ship-owners in the quest of a competitive advantage. This advantage is related to non-traditional approaches to electronic services and software application development and use by shipping companies, towards strategic and operational needs fulfillment. We argue that companies can achieve more efficient information and communication technology (ICT) use in a dynamic business ecosystem. This concept cites companies’ transformation in species of a Digital Business Ecosystem (DBE) by adopting a multi-disciplinary approach based on biology and business models.

The paper initially describes the pattern of ICT adoption and e-business practices in shipping and a general architecture for a DBE model. Next the characteristics of shipping companies concerning their electronic operation are presented and the potentiality of the DBE concept applied to the shipping sector is considered. The electronic services landscape of the Greek shipping companies in the new digital environment are examined, based on fieldwork results.

Key words: Shipping companies; Digital Business Ecosystem; Information and Communication Technology; Digital species; Networkcentric enterprises.
1. **INTRODUCTION**

One main reason international shipping is a peculiar market is because of the nature of its customers, partners, collaborators being scattered all over the world. Apart from the highly needed rapid and timely transfer of information and interactive communication among its partners, in value chain activity today information technologies have become a focal point for ship-owners to gain a competitive advantage over their rivals. This advantage is related to non-traditional approaches through innovative software application development and use by shipping companies.

Is a challenge for shipping industry to achieve widespread and effective take-up of Information and Communication Technologies (ICT) in order to enable shipping companies to become more innovative and competitive in global markets. “Widespread” means that technology take-up actions must address every shipping company according to the charter market features it operates within, while “effective” means that the actions must reflect company’s particular circumstances and needs.

A wide variety of initiatives and actions are underway in many companies helping them to access the benefits of ICT although this effort is taken incrementally under private and sometimes offstage criteria. These range from specific R&D projects, technology transfer of research results, awareness-raising and basic ICT help and advice through to more focused support, such as subsidized consultancy. Real life business cases based on novel technologies, solutions and business practices, can offer important insights into the change process and provide impetus for more widespread adoption.

The aim is shipping companies to be persuaded to invest in order to achieve greater ICT adoption in a dynamic business ecosystem. This idea imposes their transformation in species of a Digital Business Ecosystem (DBE) by adopting a multi-disciplinary approach based on biology and business models to develop an open-source distributed environment that can support the spontaneous evolution and composition of software services, components and applications in shipping industry.

Shipping companies, in coping with digital technologies, should be supported in removing a set of obstacles. This requires a strategic long-term vision and planning. The adoption of ICT of a shipping company follows some phases but in fact is a continuous process with sequential steps of evolution. The completion of each phase demands a respective investment policy in new technologies and that constitutes a major problem especially for small companies.

The paper focus on the ICT adoption of Greek shipping and how this is fitted with an advanced business environment which moves towards a DBE.

2. **THE ADOPTION PHASES OF ICT IN SHIPPING**

The adoption of ICT in shipping companies has started before the last century following three main phases: (1) the “communication”, (2) the “cooperation” and (3) the “coevolution” phase which is related to the development of DBE in shipping. See Figure 1 (Dourmas et al. Jun 2005). Communication and cooperation phases include some specific stages which are connected with chronological evolution. The gradual adoption of ICTs in
shipping companies increases the interchanged value among cooperating (or connected speaking for networks) productive units internal or external to the company. Each stage builds on the previous, steadily approaching the bold vision of an ecosystem of digital species interacting with the business ecosystem. The appeal of this vision is undeniable, partly because the ecosystem metaphor has been used for many years in the business and socio-economic literature and is therefore quite familiar and challenging.

The "communication" phase: When we take a really long term view of business communications in shipping, the Web is not quite as revolutionary as it seems at first sight. Over 150 years the technology for generating and receiving messages has improved - telegraph, telex, fax and now e-mail- but the basic tasks are unchanged. What has changed is the cost, both in terms of communications and the labour required to use them. Both are dramatically cheaper today. A revolution came in the 1960s when a computer could be "inserted" in the cable to allow information to be managed. Previously telegrams and the telephone had relied on operators to handle messages and calls, so messaging were too slow and expensive to run a negotiation involving several charterers/owners. In the 1990s a whole new dimension was opened up when information networks became available. Internet was appeared as a cheap and easy way of communicating between company mainframe and PC networks. The usage of internet for exchanging e-mails leaded to the next phase of cooperation.

![Figure 1. Phases of adoption of ICTs in shipping companies.](image)

The "cooperation" phase: When finally technology allowed the use of Internet to perform economical and commercial transactions on-line between enterprises in a business to business basis a real commercial cooperation started using ICT as a tool, allowing the enterprises to put orders, purchases, sales, e-payments.

The first step was the use of Electronic Data Interchange (EDI) systems, which has occupied a central place basically in the liner business in recent years. EDI is a specific type of inter-organizational information system. It facilitates the transmission of structured machine-readable data from computer to computer memory across organizational
boundaries. Unfortunately EDI is expensive, inflexible and not very user friendly. Each liner company developed a system, supported by a large and very expensive IT department ($10-15 million per annum spend) (Stopford 2000). Compatibility is as much of a problem as cost. It is common sense that businesses in the following years will abandon EDIs for investing more at integrated networks.

The second step was the network development via Internet. In the beginning carriers building networks through mergers have found it difficult to bring affiliated companies under a common information management network. The complexity and cost of investment has created a barrier to entering the deep sea container trade. As the web takes over as the medium for handling information the whole problem will be simplified and one of the major barriers to entry in the liner business will disappear (Stopford 2000).

Internet technology at present has gone far beyond a mere means of electronic transactions becoming a foundation for applications linked to the core business systems. This attributes the concept of e-business. E-business technologies allowed enterprises to effectively directly connect with clients, suppliers and business partners. The connection is recently made easier by the continuous emerge of new interoperability techniques and standards (like XML, ebXML).

Modern ICTs have become a focal point for ship owners to gain a competitive advantage over its rivals by selecting and putting the right partners in their network oriented value chain activities. Installations of electronic networks in firms over the internet among external value chain participants and internal departments today enable companies to coordinate their virtual and physical value chains in order to create added value for their customers, partners and especially for themselves. The Internet provides a universal channel for information and communication flows as it can accommodate all kinds of these flows, except perhaps face-to-face contact, although advancements in the field of virtual reality reduce the requirement for physical proximity (Pisanias and Willcocks 1999). In Figure 2 (Yuruyen 2001), we can see all of these external and intrafirm participants interacted and connected with carriers via Virtual Private Networks (VPNs) and Internet.

**Development of Network centric Enterprises in Shipping**

The whole evolution in this phase develops a Network-Centric Enterprise (NCE). One of main characteristics of NCE is viewing the actors as a continuous adaptive ecosystem. The ability of a competitive ecosystem to generate and exploit competitive awareness (an awareness of one's competitive domain or competitive space) has emerged as main point. Connectivity and awareness about customers, competitors and the environment allow shipping companies to better understand what the characteristics or attributes of their services are or need to be to maximize value. Awareness of customer needs also contributes to improved capacity and logistics planning that, in turn, can improve service availability. In the process for exploring awareness the most significant item is the role of virtual world. The concept of virtual world is the fundamental idea of NCE. Virtual collaboration enables individuals to collaborate in a virtual domain. These individuals can be geographically dispersed which is very common in shipping business. One of the major payoffs of collaboration is an improved product design process—one that is not only faster and less costly, but also produces better designs (Tapscott 1996).
The main task in shipping is the offering transportation services for cargoes and passengers. Shipping stakeholders who cooperate to produce the transport service most of the time are located in different geographical areas. This character composes a distinctive virtual organization. The personnel ashore and onboard may work in virtual teams. These teams support the productive units which are the nodes of a net which may be extended globally. The nodes cooperate and interact by gathering, diffusing and sharing information. These nodes can be parts of a shipping company or belong to other outsourcing companies which participate to the net (permanently or when is needed). The value and productivity each node offers depends on information capacity. Thus, an outcome of this conceptualisation is an information capability based hierarchy. Evaluating nodes in a “value scale” we can characterize as most important node the chartered ship transiting to destination harbour or the head office ashore. It is apprehensible that a ship transiting without cargo is a productive node lower in value scale. A ship which is drydocked for maintenance or repairing has lower position in value scale and so on. Relating the intense of nodes production with capital gain we note that chartered ship returns money to company, the drydocked ship has a limited maintenance cost and a ship which remains unproductive for a long time has high cost for the company. The factor which characterizes the node’s value is the dynamic response to IT environment. The operation of a ship characterises it to belong in a significant node or it can loose its position in the value scale and fall in a lower class. On the other hand the head offices don’t follow the same in value scale but remain in a steady state as long as produce in a permanent and continuous base. According to this concept the rest productive units (in or out the company) can be ranked dynamically in the value scale (Dourmas et al. Oct 2005).

Another contribution of the networkcentric concept is that exploits the use of information to suppress cost and risk. Shipping companies attempt to limit cost and risk by using Management Information Systems (MIS) in most operating procedures. An example is the
implementation of SPS (Ship Positioning System) which takes part in value chain by suppressing costs and risks. Checking ship’s position gives to head office the ability to suggest and order alternative courses in order ship avoids hazardous conditions at sea or harbour which can threat the safety of ship, crew and cargo (e.g. deviation for avoidance bad weather conditions, belligerent zones, terrorist or pirate actions). In addition the head office can give orders to master relatively to commercial activity of the ship such as limit the daily operational cost -by reducing operational speed or changing ship’s course- or take freight -by deviating the ship in a harbour where demand came up-. Even after completion of carrying task, management needs information about results of ship’s commercial activity in order to avoid the repetition of mistakes and record the operation composing background files (Goulielmos 1999).

The “coevolution” phase: The late anthropologist Gregory Bateson (1979) describes “coevolution” as a process in which interdependent species evolve in an endless reciprocal cycle – “changes in species A set the stage for the natural selection of changes in species B”- and vice versa. The same holds true in business. Too many executives focus their time primarily on day-to-day product and service-level struggles with direct competitors. Over the past few years, more managers have also emphasized cooperation: strengthening key customer and supplier relationships and in some cases working with direct competitors on initiatives like technical standards and shared research to improve conditions to everyone (Moore 1997). As a consequence of this evolution, the dynamic networking of the organizations drives to the dynamic cooperation of the players (could be also the competitors) on the marketplace and the connection of the resources in a system, building a community that shares business, knowledge and infrastructures. This will dramatically affect the ways enterprises are constructed and business is conducted in the future and the actual slowly changing organizations will be replaced by more, fluid and often transitory structures based on alliances, partnerships and collaboration.

To support DBE scenario in shipping which envisages the dynamic aggregation of services and organizations, a further stage in ICT adoption is required which exploits the dynamic interaction (with cooperation and competition) of several players in order to produce systematic results in terms of innovation and economic development. The adoption and development of scalable and adaptive technologies, allows new models of business based on the dynamic association of enterprises. The ecosystems are, in fact, characterized by intelligent software components and services, knowledge transfer, interactive training frameworks and integration of business processes and e-governance models. The latter step in the adoption of Internet-based technologies for business, where the business services and the software components are supported by pervasive software environment which shows an evolutionary and self-organizing behavior, will be named digital business ecosystems.

3. CHARACTERISTICS OF SHIPPING INDUSTRY CONNECTED WITH ICT

Information technology and IT revolution has already differentiated the patterns of shipping operation. New tools and new organizational forms allow the rapid information diffusion. However, the cost for the acquisition of information continues to be high. Shipping companies that achieve the situation of information superiority are able to control their operating cost and at the same time to increase the reliability of their services. At the
same time, shipping is an information intensive operation. Information regarding freight rates, freight demand, market forecasting, supply of human resource, port conditions, port state control requirements etc., is vital for the minimization of risk of transactions. The acquisition of the requested information at the proper time and with the optimum cost can vastly increase the competitiveness of a shipping company.

3.1 Integration of Shipping Applications and Communications Systems

The maritime sector represents a diverse set of stakeholders that includes manufacturers and distributors, ship-owners, managers and brokers, terminal operators, port authorities, regional and national governments, consultants and ship builders. Currently, the sector is constrained by the lack of widely accepted standards and by prohibitive cost (especially for the smaller shipping companies) of solutions such as EDI required for e-business. At the moment lack of interoperability between applications from different vendors, prevents shipping companies from maximising the benefits from deploying ICT onboard ships. Since few (if any) vendors of maritime software systems can deliver a fully integrated system, the industry is faced with a manually integrated patchwork of systems. Moreover, several organisations now provide their products in digital form, i.e. digital Electronic Navigational Charts (ENC), weather, traffic, navigational or environmental information. Several initiatives (within the EU and internationally) have established Vessel Traffic Management and Information Networks (VTMIS NET). This signals the opening of a growing demand for integrated ship-office computer and communication system and therefore a close co-operation and interoperability between the information providers and the network or digital service providers.

XML based integration standards can greatly facilitate such task. All future ICT systems supporting a DBE in shipping can be built to be XML capable. Existing applications that do not “speak” XML protocols can be “wrapped” with XML adapters whose role will be to use the native data format of the application to “call” the appropriate business logic of the application and to translate the results of these calls into XML messages conforming to the communication protocol (Karakostas 2002). As we move further up on the integration pyramid, the role of XML as the integrator and orchestrator of business processes across value chains becomes more challenging. XML can provide the basis for a low cost e-business infrastructure for participation in business networks and for carrying out transactions electronically. Approaches for business process integration emerged in other business sectors some time ago. In the maritime industry itself, MeCa (Maritime e-Commerce Association) has proposed MTML, a standard that utilizes the Extensible Markup Language (XML) to encode marine trading transactions.

The introduction of ICT in shipping companies and ships associated with national or international actions (offering offshore or satellite coverage) diffuse information about weather forecasting, navigational hazards, changes in nautical charts, tides and sea states etc. prefaces a new era in shipping. Last years the ICT infrastructures at ships upgraded. New buildings are equipped with satellite systems which give the ability for instant and uninterrupted communication between ship and office. The broad implementation of GMDSS (Global Maritime Distress and Safety System) from INMARSAT multiplies maritime communications. Today there is the ability for connection with wired nets at shore as PSTN (Public Switched Telephone Network), PSDN (Public Switched Data Network) and communication services as ISDN (Integrated Digital Network). Ships are
also equipped with modern radiotelephones VHF/ DSC (Digital Service Call), VHD/ GMDSS, AIRBAND and SSB MF/ HF. According to INMARSAT data most of big shipping companies follow an offensive ICT strategy. About 75% of oceangoing ships have computers in order to communicate with the company. Most of shipping companies adopt modern SMA (Ship Management Applications) with Swedish companies leading.

4. THE CONCEPT OF DIGITAL BUSINESS ECOSYSTEMS

The use of the natural ecosystem as a metaphor for the capitalist economy is used by several schools of thought. “A capitalist economy can best be comprehended as a living ecosystem... Organizations, like organisms, are built in complex hierarchies. One is made up of cells within tissues within organs, within organisms within populations, while the other is comprised of work teams inside departments inside divisions inside business inside industries” (Rothschild 1990).

Moving one step beyond James Moore (1993) introduced the term “business ecosystem” and observed: “The new paradigm requires thinking in terms of whole systems—that is, seeing your business as part of a wider ecosystem and environment... In place of industry I suggest a more appropriate term: “business ecosystem”. Business ecosystems span a variety of industries. The companies within them coevolve capabilities around innovation and work cooperatively and competitively to support new products, satisfy customer needs and incorporate the next round of innovation. To a certain extent, an ecosystem also includes direct and indirect competitors that, as circumstances shift, may also be collaborators. The digital business ecosystem is a “digital environment” populated by “digital species” which could be software components, applications, services, knowledge, business models, training modules, contractual frameworks, laws etc. These “digital species”, like the life species, interact, express an independent behaviour and evolves—or becomes extinct-following laws of market selection.

4.1 General Architecture

The DBEs are based on an evolutionary systemic process; they may be composed of three different layers: the generic infrastructure, the sector-specific ecosystems and the instances of the sector-specific ecosystem (Nachira 2002). Taking account of the specific characteristics of the shipping industry fitted with the DBE general architecture the layers could be:

• The generic shipping ecosystem infrastructure: a common support environment and a generic basic infrastructure, which includes basic service components, generic integrated solutions and infrastructure components.

• The transport sector-specific shipping ecosystems: services, solutions and components specialized for a specific shipping sector according the transport area (deep sea shipping/ short sea shipping) or according carrying units (cargo shipping/ passenger shipping).

• The instances of the sector specific ecosystem applied to a specific shipping market: bulk or liner in cargo shipping and ferries or cruisers in passenger shipping.
The distinction among basic "digital species" or infrastructure is arbitrary and what is considered a basic component belonging to infrastructure depends on point of view and ecosystem's evolution. In shipping DBE some services could be considered required component of basic infrastructure in others are included in the group sectorial shipping or in the shipping market services.

Shipping markets can be divided more in order to cover any shipping market connected with technical characteristic of ship class or carrying units. Thus sector-specific ecosystem can be divided in subecosystems according to ship size (Panamax, VLCC), ship loading facilities (Ro-Ro, Lo-Lo) or cargo characteristics (liquid, dry, specialized). Figure 4 shows the basic ship types according to carrying units (cargo or passenger).
4.2 Facets of DBE in Shipping

There are two overarching principles that are essential to the attainment of the DBE vision (Dini and Nicolai 2003):

- Complementing theoretical research with applied research and engineering to produce a working open-source technological infrastructure.
- Re-thinking complex systems models from Biology and Physics in order to adapt and apply them to software and business.

The shipping community, in order to exploit the synergies of the systemic sharing of community resources should cooperate and share the following facets:

**Technology facet** which depends on the investment in ICT. Internet and network computing are the “critical mass” for digital species to evolve. Technologies as TCP/IP (Transmission Control Protocol/Internet Protocol), HTTP (Hypertext Transfer Protocol), languages as XML (Extensible Markup Language), ebXML and VRML (Virtual Reality Model Language), Web browsers, search engines etc. are the basic components of this facet. These technologies combined with high-speed data networking can lead to the emergence of new DBEs. XML plays an important role in integrating devices and systems onboard ships. Such systems typically support monitoring, navigation, maintenance, safety and so on. XML is becoming the technology for integrating such systems with each other (e.g. monitoring with maintenance systems) and with the various MIS (Management Information Systems) that exist on the bridge and on shore. XML can therefore provide a common ship-wide infrastructure for data acquisition and data fusion. The technology facet includes the ICT environment which has been developed globally in order to support communication and transactions between ships and head offices ashore (as mentioned above an example is INMARSAT organization).

**Business facet** depends on the strategy shipping company follows in order to enterprise profitably in four shipping markets trading in different commodities. The freight market trades sea transport, the sale and purchase market trades second-hand ships, the new building market trade new ships and the demolition market deals in scrap ships. Because the same ship-owners are trading in all four shipping markets their activities are closely correlated. Another serious issue for ship-owners is ship finance. The ability of the ship finance industry to reschedule cash flows is of great interest when is taken in conjunction with the cyclical nature of shipping business. Shipping company’s managers have to implement information based strategies with regards to resources, processes and people (Jelassi and Enders 2005). In the context of digital environment this includes issues such as optimal web services design, hardware and software requirements and usage of ICT in order to create benefit for all stakeholders in a cost-efficient way. Furthermore, this also includes operational effectiveness issues, which are addressed by techniques such as BPR (Business Process Reengineering) and TQM (Total Quality Management) under the regulation framework in shipping.

**Knowledge facet** depends on the need for knowledge sharing among species. A shared knowledge base is the foundation for building a “virtual maritime learning community” with training and competence center. Training and assessment of seafarers issues have be considered by trainers, assessors and maritime administrations when integrating computer-based technologies (Windrow 2002). E-learning offers an on line brokerage and delivery service, linking educators and trainers for the exchange and distribution of learning resources.
Figure 5 illustrates a DBE in shipping, considering the layers and its facets. The bottom layer is common to all instances of the DBE in shipping, the middle layer is specific to a particular sector but common to all shipping markets that sector is present. The top layer represents the different instances of a sector-specific DBE to be found in the different shipping markets.

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<tr>
<th>KNOWLEDGE FACET</th>
<th>BUSINESS FACET</th>
<th>TECHNOLOGY FACET</th>
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<tr>
<td>- Shared knowledge base</td>
<td>- Information based strategies</td>
<td>- ICT Investments</td>
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<td>- E-learning modules</td>
<td>- In 4 markets</td>
<td>- IMARSAT environment</td>
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<td>- Benchmarking</td>
<td>- Freight, secondhand ships, newbuildings, scrapping</td>
<td>- E-Business using XML</td>
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Shipping market implementation

Instantiated ecosystem in a market network of innovation nodes (one in each market)

Shipping sector-specific and infrastructural components

Sector-specific components, systems, services, business models (common to all markets)

Basic network support infrastructure and services

Basic components and services, generic Knowledge (common to all sectors)

**FIGURE 5. View of sector-specific DBE in Shipping.**

5. SURVEY FOR ICT ADOPTION IN GREEK SHIPPING COMPANIES

5.1 Research Design and Methodology

A survey was conducted in 40 Greek cargo shipping companies (SC) in order to research the level and potential ICT adoption and point the major obstacles of shipping companies to move towards DBEs. Shipping companies divided in 4 categories according to the number of ships they operate.

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<th>SC Category</th>
<th>Number of Ships</th>
<th>Sample’s Percentage</th>
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<tbody>
<tr>
<td>SC1</td>
<td>1-5</td>
<td>25%</td>
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<tr>
<td>SC2</td>
<td>6-10</td>
<td>20%</td>
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<tr>
<td>SC3</td>
<td>11-20</td>
<td>25%</td>
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<tr>
<td>SC4</td>
<td>&gt; 20</td>
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The main targets of survey were to research: ICT is commonly used, networking ability in business process and results from ICT adoption related to business performance and the competitive advantage ICT offers. We also inferred about the potentiality of shipping companies to adopt ICT, the benefits, the problems they have to solve, the worries and obstacles they have to confront in order to move beyond and full adopt and exploit modern ICT.
Questionnaires drew up which included different question groups in order conclusions are extracted concerning the targets set at the beginning of the project. It is true that the questionnaires, although requiring and recording opinions about the result, they could not detect the reasons and their causalities with the results. Consequently, straight questions had to be made concerning the reasons why, while we did not omit to ask the participants to express freely their opinion on the subject, inviting them to focus on specific targets and not to stray from the subject. The selection of the participating individuals was made from 4 different working departments (technical, operating, crew and R&D) of a typical shipping organization ashore.

The largest part of the questionnaire was covered by quantity questions requiring a rating by the participants, in order to facilitate the collection and presentation of the results. Open questions were limited in questionnaires but abundant during the interviews, my goal being to achieve a free conversation. As far as the style of the questions is concerned, we preferred to use all kinds, and more specifically the percentages for each type of question were the following: 25% directive questions, 60% deductive questions and 15% hypothetical questions.

5.2 Survey Results

Composing answers according to frequencies the most important results are:
1. Shipping companies target the competitive advantage through cost and risk reduction and suppression of response time trying to offer high quality services and making a good reputation.
2. Companies cooperate with other productive nodes building business nets and acting all together as a team but networking is not fully supported by ICT. Only big shipping companies pioneer to net development, expansion and functions supported by ICT.
3. Networking cost using ICT couldn’t be defined precisely and a considerable percentage (40%) ignored it. Answering to open questions managers admitted that first priority for the company is to cover the cost for communication with the ships paying for satellite connections and infrastructure to ship and head office.
4. Recorded the estimation that networking supported by ICT contributes to company’s viability, market solidification and quality of services but hadn’t confirmed that all above results depend exclusively to networking.
5. Main problems for using ICT are systems compatibility and apprehension, and information management. Interview with mangers from R&D department showed that most companies turn over the organization’s computer center operations, telecommunication networks and software applications development to external vendors who provide these services.
6. Most software systems shipping companies use are related to ship safety and facilitation of its commercial activity. For operating department the first priority is to ensure continuous and safe communications with ships. Thus companies’ investment policy is to adopt modern communication technology. Research showed that most common systems for Greek shipping companies are Internet/ Radio-Satellite communication systems, ship maintenance systems, ship positioning systems and systems for commercial transactions.
7. Main benefits of above systems usage are flexibility increase, time response reduction, information acquisition/exchange and specific services offer. Mangers know that high
frequency of transactions and need for communication imposes ICT adoption to support business process which is based on “sense and respond”.

8. Main problems of usage networked software systems are related to interoperability, incompatibility and frequency of systems malfunctions. Most of shipping companies use software programs and ICT applications that are commercially available for sale as software packages. Main reasons are that software packages are supported by vendors (for installation, updating and maintenance) and can cover common functions for all ships.

9. Main reasons shipping companies don’t use networked software systems are high cost for initial investment, high cost for conversion, shortage of knowledge and skilled personnel, lack of technological solutions and interoperability, and complexity of regulation for e-business.

10. Although most shipping companies continue investing money to install computers and create application and communication systems, interviewers admitted that management demand for a visible and clear relationship between the costs of ICT and ultimate company economic performance.

Composing answers related to 4 categories of company’s size (see sub-section 5.1) the most important results are:

1. Big companies participate to networks with more nodes and don’t have problems with compatibility in reverse to small companies. Of course networking cost is higher for bigger companies.

2. Big companies use almost all referred software systems to support broadly the business process in reverse to small companies which use the necessary systems to support (especially in safety and security issues) ship navigation and communication with head office.

3. The reasons big companies don’t use networked software systems are the worry that personnel will react to the change and software systems will cause declination of standard functions.

4. In reverse for smaller companies most important reasons are high costs for initial investment and conversion, shortage of knowledge and skilled personnel, lack of technological solutions and interoperability and complexity of regulations for e-business.

6. CONCLUSIONS

Revolution in ICT has differentiated the patterns of shipping operation. ICT adoption in Greek shipping companies seems to pass at present from “communication” to “cooperation” phase. Greek shipping companies gradually use Internet, e-mail and small intranets in order to make some negotiations and transactions which refer mainly to exchanging data (e.g. chartering negotiations, bill of landing, procurement negotiations etc.).

In the new information age business environment, Greek shipping companies seems to be hesitant to invest in ICT and exploit thoroughly the ability to get full networked with other nodes implementing e-business practices although their requirements go today beyond that which a traditional portfolio (voice, fax, low speed data) of services may support. Greek shipping companies have to confront common obstacles with international shipping to adopt advanced technology depending on ICT market barriers. The most serious are:
Financial barriers. Consortia of ICT market that spend already billions of dollars have difficulties to find cash to complete systems financing (e.g. AMSS – Advanced Mobile Satellite Systems-). Regulatory issues dealing with different levels of licensing of ICT (e.g. satellite communication market) and bandwidth limitations (e.g. data rate of mobile communication services).

Greek shipping companies, in coping with digital technologies, should be supported to move towards the "coevolution" phase of ICT adoption. On line services for shipping, provided through a number of internet portals, now include news, commodity and foreign exchange prices, legal and insurance services, bunkering, procurement and chartering. The maritime application service providers offer today services related to cargo planning and loading, crew recruitment and scheduling, weather forecasts, medical advice, electronic charts delivery, evaluation of chartering options and even maintenance planning and support. The remote nodes in the maritime chain (e.g. ships) are required to participate in real (or almost real) time in the information exchange process and a lot of effort is undertaken to develop an open architecture that will permit nodes act as species of an DBE.

Implementation of DBE in shipping can drive to a dynamic networking of stakeholders on the marketplace and the connection of the resources in a system, building a community that shares business, knowledge and infrastructure. The goal is to develop a system where the software can increase the efficiency of shipping markets without detracting from the effectiveness of shipping companies which specialize in their marketplace.

The ICT adoption towards DBE potential requires from Greek shipping a strategic long-term vision and planning. Future will show if Greek shipowners will respond to the new challenge to introduce advanced ICT in business process. ICT market although last years shows a delay, competition will lead to new emerging technologies and further cost reduction for users. Possibly next decade is the best time for Greek shipowners to invest venture capital for ICT.

References


