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THE IMPACT OF INFORMATION TECHNOLOGY ON THE SPANISH TRANSPORT SECTOR

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Abstract

The objective of this study is to provide a broad view on the strategic impacts of information usage and information systems applications in the transport sector. The research is based on a review of existing literature plus field interviews with key informants (both industry players and field experts). It focuses mainly on the effects of applications or systems involving the movement of data either internally within the firm or externally with other organizations (e.g. tracking and tracing, EDI, electronic markets, etc.).

Although an overall industry perspective is provided, some mini case studies have been included to illustrate some of the general issues with concrete examples. Two such cases are included in the appendices. This study is part of a larger project within the IMPACT II programme in the field of information economics of the CEC, DGXIII/E/1, which seeks to analyse the same issues on a broader, pan-European scale.

The paper is structured in sections that reflect the main topics of interest as defined within the framework of the IMPACT project, namely: a country analysis and the impacts on vertical integration, competition, internationalization and SMEs.

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Introduction

The objective of this study is to provide a broad view on the strategic impact of information usage and information systems applications in the transport sector.

The paper is structured in sections that reflect the main topics of the IMPACT project, namely: a country analysis and the impact on vertical integration, competition, internationalization and SMEs. Although an overall industry perspective is provided, some mini case studies have been included to illustrate with concrete examples some of the general issues. Two such cases are included in the appendices.

The writing style is often somewhat terse and even sketchy. This is deliberate, as the authors' aim is to summarize the findings of the research without necessarily providing all the background details.

I. Information technology in the Spanish transport sector

In this section we analyze the situation and the problems of information use and information technology applications in the Spanish transport sector. A special section is devoted to small and medium size companies.

For the purpose of this study, two different types of information technology projects are considered: internal projects and external projects. Internal projects are projects that are initially developed for the internal use of the company, although other parties can connect to these systems. External projects are designed for the use of external agents, regular customers or subcontractors of the company that developed the project.

Although Spain is not one of the European countries in which information technology is most highly developed, it has taken part in almost all of the international information exchange projects: CEFIC, EDIFICE, ODETTE, SWIFT, RINET, ERTIS, OEDIPE, etc. In the transport sector, the majority of information projects are in a developing phase.

Internal information systems:

A great majority of the internal information systems in the Spanish transport sector are adopted by companies that operate worldwide or in a pan-European context. In general

these companies can offer direct access to their information systems to agents and representatives, (e.g. NEDLLOYD, SEA LAND - Naviera del ODIEL, DANZAS, VALOON, etc.). These companies were pushed by their parent companies to adopt information technology. They use systems developed outside Spain and have the advantage of the experience of their parent companies. The majority of these internal systems do not follow any standard, making it expensive for forwarders to simultaneously link with several of them.

In addition, some smaller Spanish transport companies (those that do not have the same geographical coverage as the ones just mentioned) are also starting to implement internal information systems. For example:

- TRANSPORTES CARRERAS (transport company) is starting to implement a trailer tracing system via satellite.

- LABARCA (transport company) and SEUR (door-to-door carrier) offer their clients track and tracing services and access to their data information systems.

External information technology systems:

External projects are those designed for the use of external agents, regular customers or subcontractors of the company that developed the project. The biggest external projects in transportation have been undertaken by the port authorities (e.g. the ports of Valencia and Santander. See appendices: projects EDISAN, ARCANTEL and STED projects), Iberia (national air transport company, SITA project), RENFE (national railway company, HERMES project). Almost nothing has been developed in the road transport sector. Table 1 shows some of the Spanish information exchange projects. Most of these projects use the EDIFACT standard and have an international in scope.

The two most important EDI projects in Spain (in terms of their number of users and their capacity to affect the transport sector) are:

- The ODETTE project: ODETTE is a project launched at European level. ODETTE targets the information exchanged between some car manufacturers and their suppliers. Although some messages have already been designed by the project, none of them has been fully implemented yet. ODETTE's main problem is the unwillingness of some dealers and suppliers to adopt a different system and reorganize their current business procedure processes.

- The AECOM project: AECOM is a service (offered by AECOC, Asociación Española de Codificación Comercial) for the Spanish manufacturing and commercial distribution sector (1). The documents exchanged via AECOM are: orders, order confirmations and invoices. Currently AECOC is preparing to include logistic operators in the AECOM project. AECOM has already designed the messages to be exchanged with the operators; these messages will use the EDIFACT standard. AECOC is helping operators that already use information systems (with no standard) to adopt the EDIFACT standard.

Table 1. Spanish information exchange projects

Project	Sector	Typology	Actors involved	Scope	Status
STED	Maritime	Information exchanged: - Manifest (import)	- Port of Valencia - Shipping agent - Customs authority	Local	Starting test phase
EDISAN (Phase I)	Intermodal	Information exchanged: - C.M.R. - Invoice	- Port of Santander - Road carrier - Forwarder	International	Operating
EDISAN (Phase II)	Intermodal	Clearing house Information exchanged: - Shipping instructions - Customs declaration	- Port of Santander - Shipper - Customs agent - Customs authority	International	Getting ready
- -	Maritime	Information exchanged: - Departure notice	- Port of Barcelona - Port of Geneva - Port of Marseilles	International	Test phase finished
ARCANTEL	Maritime	Network	- Port of Santander - Other 5 Atlantic ports	International	Developing
Network for Transport Management in the Mediterranean	Maritime	Network	- Port of Barcelona - Port of Malaga - Other 6 Mediterranean ports	International	Proposal
HERMES	Railway	Network	- RENFE - Other European railway companies	International	Developing
SITA	Air	Network	- Iberia - Other air companies	International	Operating
SITA	Intermodal	Network	- FEDIS/FIATA - FETEA (Spanish forwarder)	International	Operating

Problems that information systems face in the Spanish transport sector

The most important problems facing information systems in the Spanish transport sector are:

- The low awareness, at manager level, of the possibilities and advantages that information technology offer to companies. Although the level of awareness was even lower at one time, managers are still not fully conscious of the full potential of information technology.

- The changes in the business processes and procedures that the use of information technology imposes on companies. Companies are not ready for, or do not want to adapt to, such changes. The bigger the company, the bigger the changes and also the greater the organizational inertia.

- The relatively low financial support given by the Spanish government to information technology projects: In the transport sector the government has concentrated mainly on modernizing and developing infrastructures such as highways, airports railways.

- The lack of a standard: Although EDIFACT has been widely promoted in Spain, most of the companies that use data exchange systems still do not use the EDIFACT standard. Companies are preparing for the adoption of EDIFACT, but will not change until EDIFACT is confirmed as the universal standard. Companies, such as forwarders, which sometimes work with up to thirty different transport companies, cannot afford to link to thirty different systems.

- Although the TEDIS program (2) is trying to promote the EDIFACT standard, this standard is considered by many adopters as difficult and complicated to implement. Only big service companies (IBM, General Electric, etc.) can "easily" develop systems that use EDIFACT. This difficulty works as an entry barrier for small and medium size companies, as these companies do not have the know-how (and need to look for outside help) to develop such systems.

- Another problem facing Spanish transport companies is their small size compared with other European companies. Some road transport companies consist of only one or two trucks. A separate section is devoted to the impact of information technology on small and medium size companies.

Although information technology is not a criterion in the selection of a transport company, it can help in the selection process. Transport companies are not yet being forced by their clients to adopt inter-company data exchange systems.

Adopting such systems becomes easier with the passage of time, and also as the complexity of such systems decreases.

All the people we interviewed thought that in the future the adoption of information exchange systems would be a necessity. Transport companies that do not offer some kind of electronic data interchange will be out of the market.

Institutions that promote information systems in the transport sector

The low awareness among many transport companies of the potential benefits of information technology has prompted several organizations to actively endorse the use of information systems and information technology. In Spain, the institutions that promote information systems in the transport sector are:

- Fundación CETMO (Centro de Estudios del Transporte en el Mediterráneo Occidental): CETMO's objective is to promote the use of information technology in the transport sectors of the western Mediterranean region (Spain, Portugal, Italy, France, Morocco, Algeria, Tunisia).

- SIMPRO ESPAÑA: The Spanish committee for the simplification of trade procedures.

- AENOR: The Spanish association for normalization.

Conclusion:

Most of the information exchange projects in the Spanish transport sector are in a developing stage. Internal information systems are used mainly by companies that operate worldwide or at European level.

As the use of intermodal transport increases, the use of external systems is also expected to increase. These projects are being developed by the port authorities, Iberia (national air carrier) and RENFE (national railway carrier).

Some of the main problems that information exchange systems faces in the Spanish transport sector are:

- Low awareness of the benefits that information systems offer to companies.

- Companies are not ready for the changes in business procedures that information systems bring to organizations.

- Low usage of the EDIFACT standard.

II. Impact on the transport chain

In this section we first analyse how new trends in consumer behaviour and production philosophies call for new logistic services, and how information systems help in offering these services. We then analyse the impact of information systems on the relationship between different players in the transport chain (producers, suppliers, and transport companies).

Trends in logistics

We define logistics as the overall management of production and distribution processes. These processes include all the stages the goods go through, from raw material to the final product delivered to the consumer.

In recent years, changes in consumer behaviour and in companies' production philosophy have increased the need for better logistics. The changes can be summarized as follows:

1. Consumption trends:

As the final consumer asks for an increase in the range of products that are offered to him, the total quality of the service, not just the quality of the product, plays a more important role. Total quality service in transport is translated in terms of the frequency and reliability of deliveries.

2. Just-in-time philosophy:

The adoption of the just-in-time philosophy means that companies produce only when they receive an order. Companies keep their stock levels to a minimum (in theory zero stock level). Companies need the ability to deliver the correct amount of goods at the right time to the right place. They face more deliveries with smaller quantities of goods. Logistics and information control are key issues in the just-in-time philosophy.

3. Internationalization:

As trade between countries increases, competition between international companies increases. Products can be manufactured on one side of the world and sold on the other. The demand for logistic services increases as the distances and intermodal transport increases (a special section is devoted to internationalization).

All these trends lead to an increase in the frequency, but a decrease in the quantity, of the goods to be transported. Companies need to be able to deliver their goods in the required quantities, at the right time and to right place.

Shippers look not only for transport services, they look for complete logistics solutions (services such as track and tracing, better use of transport capacity, cheaper transport, shorter waiting times). They want to reduce the costs of the physical circulation of goods and offer to their clients a service that can adapt to changes in the market.

As intermodal transport increases, transportation chains (and therefore transportation companies) are playing a greater role in the economic system, specially if they can provide good logistic services. Economies of scale can be obtained by sharing (or subcontracting) distribution systems and using fewer storage points (or even centralising storage places); this requires fast and reliable transport between the factories, stores and warehouse facilities. If shippers want to be more efficient, they need to coordinate with the transportation companies (i.e. they need to be able to access information such as cargo availability, tracing of the goods, etc.).

The development of information systems can be seen as the response to all these logistics needs. Information systems are not a strategy but a tool that helps, among other things, to manage logistics. Advanced logistics requires information systems in order to control the physical flow of the goods.

Information exchange systems offer:

- Faster and more reliable distribution operations: As the number of documents exchanged via paper decreases, the time and errors due to the retyping of data also decreases, thus speeding up the physical flow of the goods.

- A means to implement just-in-time philosophy: As transported goods are seen as stock, deliveries have to be reliable in order to guarantee the production processes of the factories. Companies using information technology are able to meet this kind of demand (i.e. smaller and more frequent shipments).

- Better use of transport capacity: Information technology can improve the utilization of the transport capacity. Information concerning the availability of free space in the transportation fleet can be offered to shippers. Transport companies can take advantage of “empty returns”.

- Track and tracing: This service helps the shipper to monitor the location of goods. The shipper can react faster to unexpected problems and therefore offer a better service to its clients.

- Improved opportunities for intermodal transport: As the distance between the shipper and the receiver increases, intermodal transportation is becoming more common. Information technology offers a means to coordinate the different players in the intermodal transport chain.

In Spain the offer of logistic services by transport companies is limited. International companies, or the Spanish subsidiaries of these companies, are almost the only ones that offer services as track and tracing.

The ODETTE and the AECOM projects arose from the need of better control of the manufacturing and distribution processes. Both projects reflect the need for better communication between company and supplier.

As the importance of intermodal transport grows and as ports become aware of the importance of logistical services, Spanish ports are preparing to offer logistic services to their users. One example is the port of Santander, which is developing the EDISAN and ARCANTEL projects (see Appendix 1). The port of Santander is trying to increase its competitiveness in relation to other ports and other modes of transport by offering logistic services. The final goal of the port of Santander is to become a logistical platform targeted towards goods produced under the just-in-time philosophy.

The use of information systems in other logistical platforms such as airports is somewhat inconsistant. Iberia (the Spanish air carrier) participates in the SITA project (an international network in which other air companies participate); but the customs clearance process in the airports has not yet been developed. The airport authorities are waiting for the EDISAN project to be completed (see the port of Valencia case in Appendix 2) and tested before implementing a similar system in the airports.

Relations in the transport chain

As companies concentrate on their core business, they tend to subcontract many peripheral activities. Closer links between supplier and the producer are therefore needed. This tighter relationship is accomplished by coordinating through information exchange. In this new relationship between the companies, logistics plays a key role. Information exchange systems can help companies to control external operations.

The electronic exchange of information means that companies are now looking for "partners". They are no longer "squeezing" their suppliers, but trying to find suppliers that can offer a more lasting relationship. As a consequence, companies that exchange information via electronic links are likely to reduce their number of suppliers and to have a longer and a more exclusive relationship with them.

Control of the flow of goods is generally not the core business of the companies, logistical and transport services can be subcontracted. Transport companies can benefit by offering these services to their clients. Carriers can specialise in certain types of transport: dangerous goods, chemicals, frozen goods, etc. This can lead to a stronger tie between shipper and carrier. Some companies start to control the production process through the logistics chain.

In the case of the port of Santander (see Appendix 1), the relationship between FAGOR (Spanish manufacturer) and GERTISA (Spanish transport company) has become tighter as a result of the partnership between the two companies.

A closer relation between the companies and their suppliers resulted from the ODETTE and ARCANTEL projects.

Conclusions:

Changes in consumption trends, a new production philosophy and market internationalization have increased the need for logistical services.

In Spain logistical services are offered almost exclusively by international companies. The major Spanish ports are preparing to offer logistical services to their users.

As companies concentrate on their core businesses, the relationship between partners, suppliers and transport companies grows closer. This is the case of FAGOR and GERTISA, and of some of the companies participating in the ODETTE and AECOM projects.

III. Impact on industry players

This section is devoted to the impact of information systems on the industry structure. We define industry players as the different actors of the transport chain: shippers, carriers, forwarders, customs, ports (when applicable).

The actors of the transport chain are affected by applications of information technology in different ways:

Shippers:

Information exchange systems allow shippers to offer a better service to their clients. Shippers can:

- Supply their clients according to a just-in-time philosophy. Just-in-time requires better communication with suppliers and a good logistical services.
- Respond swiftly to short-time orders. Companies can ship orders as soon as they are received.
- Pland and control over deliveries better. Track and tracing offers the capacity to react to unexpected delivery problems.
- Reduce inventory carrying costs. Companies can order parts only when necessary.
- Have more efficient administration. The availability of accurate real-time information supports the decision-making process.

Information exchange systems results in a stronger relationship between producers, subcontractors and all the actors in the transport chain.

Typically producers have more bargaining power than transport companies (the sector is very fragmented in Spain). Manufacturers are thus able to dictate their own systems to transport companies, just as they impose their work practices on subcontractors (e.g. automotive industry).

An information exchange system allows FAGOR (Spanish producer of household appliances among others things; see port of Santander case) to supply its British client with just-in-time philosophy. FAGOR does not need to worry about transportation logistics in this particular chain. The EDISAN and ARCANTEL projects allow FAGOR to reach new international markets on the Atlantic coast that previously could not be reached due to long transport delays.

Carriers:

The use of information exchange systems allows carriers to:

- Use cargo capacity in a more efficiently. Information technology offer carriers the opportunity to avoid empty returns.
- Offer logistical services, such as track and tracing, to shippers. Track and tracing is a key issue in market internationalization and in the use of the just-in-time philosophy.
- Play an active role in production processes. A just-in-time philosophy would not be possible without the use of information technology, and the integration of transport companies.

- Build stronger relationships with shippers. As the investments to build an information system (not only from the economical point of view) are high, the relationship between the parties that collaborate in developing the system become more stable.

- Use intermodal transport chains. Transport chains that previously could not be used due to information flow delays become available.

- Reduce the delays and errors incurred in data retyping.

Information exchange systems helped to create the intermodal transport chain that FAGOR (Spanish manufacturer) uses to deliver goods to its British client (see the port of Santander case in Appendix 1).

GERTISA (Spanish transport company) is able to attract new clients that need the same kind of service as FAGOR (Spanish producer).

Forwarders and other intermediate parties:

The impact on forwarders or other intermediate parties is not very clear. Parties that are simply "bridges" and pass information from one actor in the transport chain to another may suffer a negative impact. Information systems allow the different players to access information that before was only available trough agents. Parties such as customs agents that do not offer a value added service beyond that of information transfer may have difficulties in surviving in the future.

In general, the impact of information exchange systems on forwarders that offer different services from shippers (contracting of carriers and warehouses, customs clearance process, etc.) is positive:

- Forwarders can link to different transport companies (these links are easier if a standard is used) and offer different transport mode options to their clients.

- Forwarders can link to shippers and offer them logistic services (although these services can also be offered directly by transport companies).

- Information technology reduces the number of documents exchanged via paper and the delays and errors incurred during the data retyping.

The two biggest problems that Spanish forwarders face (according to a Spanish forwarder company) are: The lack of companies to link to (cf. section I), and the low usage of the EDIFACT standard. In fact, no Spanish forwarder (to our knowledge) has started the use of external information systems. In Spain, forwarders continued to negotiate prices with transport companies by telephone, making carrier via information technology useless.

Customs:

Information technology allows the customs authorities to speed up the goods clearance process. The goods clearance process is traditionally slow and involves a large amount of rekeying of data. In some cases, goods have to wait up to two days in the ports.

All the information exchange projects developed by the port authorities include at some stage the computerization of this clearance process (see the two minicases in Appendices 1 and 2).

Ports:

Ports are becoming aware of the importance role that information technology plays in creating logistical platforms. Information technology helps the ports to:

- Increase the amont of goods that they can handle. Information technology reduces the throughput time of the goods transported through the port.
- Improve their positioning in relation to other modes of transport. Information technology can increase the competitiveness of the ports. Ports can attract goods that used to be transported by other means.
- Attract shippers and transport companies with the quality and they new services offer. Quality in terms of throughput time; new services such as track and tracing, faster and easier customs clearance.
- Improve they internal operations. Ports are better able to plan and control the use of the installations, warehouses, cranes. etc. Information technology also helps to cut down on paperwork.

All these consequences can be observed in the port of Santander since the EDISAN and ARCANTEL projects were adopted (see Appendix 1).

Conclusions:

Shippers and carriers are the ones that benefit most from the use of information exchange systems.

Industry players such as customs agents will nedd to offer value added services on top of their usual customs clearance operations if they are to survive.

The application of information technology help ports to gain market share vis-a-vis other modes of transport.

IV. Impact on internationalization

In this section we analyse the impact of information technology on international transport.

Competition between enterprises has taken an international scale; products are developed for an international market and are produced in profitable locations. Companies open new branches abroad or seek co-operation from companies in other countries.

The opening of the EEC market is translated in the removal of trade, industry and transport restrictions. A general standardization of products and regulations is under way, facilitating the export of products and thus increasing the movements of goods within the Community. Since January 1, 1993, transport companies have been allowed to contract transport from and to all national markets. For the transport companies this means:

- An increase in competition in the European transport sector: This is more marked in road transport (although government projects promote the use of rail, inland waterways, and intermodal transport): The increase in competition leads to a reduction of transport tariffs.

- Weak and small transport companies will look for cooperation agreements with big transport companies. The small and medium size companies may encounter problems with the internationalization of transport. They lack the knowledge in foreign distribution channels, organization of transport, and administrative procedures. Small transport companies can take advantage of internationalization by cooperating with big transport groups (at the risk of being absorbed) or by specializing in one of the different transport segments (e.g. dangerous goods, chemicals, frozen products, etc.).

- A more efficient use of transport capacity: Empty returns can be avoided. Electronic markets, in which companies can offer their services and consult the demand for transport, can be developed.

- The abolition of administrative work at the borders (for goods transported within the EEC) means a faster physical flow of goods.

- In order to be competitive, companies need to offer a higher quality service –quality in terms of short and reliable delivery time.

All this leads to a need of better logistics (see Impact on the transport chain: Trends in logistics), and therefore to an increase in the internal and external information exchanged by companies.

The use of information systems has a greater impact on international transport than on national transport. In Spain, international companies are the ones whose use of internal information systems is more developed. In addition, most of the external information systems developed in Spain target international markets.

The benefits that information exchange systems offer to international transport included:

- Possibility of more organised intermodal transport chains: As the distance between shipper and receiver increases, the use of intermodal transport chains grows. The use of intermodal transport calls for a better control of information flows.

- The possibility of track and tracing: As the use of intermodal transport increases, goods tracing becomes a complicated and critical service in the transport chain.

- Customs clearance: This process is necessary for products coming out of the EEC, or for EEC products transported by sea.

In Spain, projects such as EDISAN and ARCANTEL (see Appendiex 1) helped FAGOR (a Spanish manufacturing company) and the Spanish transport company GERTISA to control the information flow in their international transport chain more effectively. ARCANTEL will help to establish a port community along the Atlantic coast.

Other projects that are helping Spanish companies to reach international markets are: SITA, developed by IBERIA and other European air companies (SITA also includes FETEA, a Spanish forwarder); and HERMES, a project developed by RENFE (the Spanish national railway company) and other European railway companies. HERMES will help the railway transport at a national and, more importantly, international level.

Conclusions:

Information exchange systems have a greater impact on companies that operate at international level than on companies that operate at national level.

Most of the internal information systems in Spain are used by companies that operate internationally.

Most of the external information systems in Spain target international markets.

V. Impact on the small and medium size companies

In this section we study the difficulties facing small and medium size Spanish transport companies (SMEs) when they try to adopt information technology. We also study the impact of information systems on these companies.

As mentioned in the first section, one of the problems with adopting information systems in the Spanish transport sector is the relatively small size of the transport companies –small, that is, compared whit other European transport companies. The Spanish road transport sector is characterized by the high number of small companies; some of these companies consist of only one or two trucks.

The current financial crisis is one of the problems that the Spanish SMEs have to cope with. It has shitfed companies' attention away from other projects, including applications of information technology. Ssmall companies today, as well as some middle size companies, are struggle to survive.

Spanish SMEs face the following problems when trying to implement information technology:

- The low level of computerization: Companies have to start getting used to computers before trying to implement information exchange systems.

- The low awareness of information technology: In recent years, information technology applications have been considered by many big transport

companies. In contrast, awareness of information technology applications among SMEs is low or non-existent.

- The relatively high costs of implementing an information system: the costs of hardware, software, VAN (value added network) services. The technical dependence on information technology is another monetary cost that small companies have to incur. As small companies do not have information departments, they have to rely on outside expertise.

- Small companies are not involved, or are not invited to become involved, in information technology projects.

- It is easier for small companies to join an information system that is already developed than to develop their own system. This brings a major problem: The companies risk being absorbed or controlled by chains that they thenselves do not control. Small companies have little or no influence on the way the information system project evolves; if there is a change of direction during the project , the small company has no alternative but to follow.

- Small companies are more vulnerable to the lack of interconnectivity between VAN providers. They cannot afford to link to more than one network.

- No “partner” can offer to the small company an information system that offers links with all the current or potential company users. It is very difficult for a small company to select a solution since it cannot know the future implications of the system.

- The lack of a standard: Most of the projects in Spain do not follow any standard and will most probably evolve with time. If small companies join these projects, it will be difficult for them (from the financial point of view) to update the systems.

For SMEs, adopting information technology means adding a new electronic dimension to their paper-based procedures. Most small companies keep these paper-based procedures almost unchanged: orders are printed and distributed, invoices are still stored on paper form. A small company can expect no return from the investment, with the information system becoming an additional overhead.

The benefits that information exchange systems can bring to SMEs include:

- The small company can find a more stable partner: The larger company will help the smaller company, technically and probably also financially, to adopt an information system. A stronger relationship between the two companies will developed.

- Small companies will be guided by and will benefit from the experience of larger partners.

The best and easiest way for SMEs to adopt information technology is by adopting a system developed by a larger trading partner (customer or supplier). The larger organization will open the way by offering technical support to the small company.

Conclusions:

The Spanish road transport sector is highly fragmented.

The main problems facing the introduction of information systems in these companies are:

- The low awareness of information technology.
- The low level of computerization of the companies.
- The high monetary investment that an information system requires.

The easiest way for small companies to adopt an information system is to adopt a system developed by a trading partner (a larger and more experienced organization).

VI. Other issues

In this section we analyse other issues of information technology such as electronic markets, label and bar coding.

Electronic markets

The electronic markets, in which carriers can offer their services or consult the demand for transport, become more valuable as distances increase. Empty returns can be avoided, reducing costs and road traffic.

In Spain, ASTIC (Asociación del Transporte Internacional por Carretera) offers the TELEROUTE system (originally developed in France). This service, which has 20,000 European users in eight countries (Belgium, England, France, Germany, Italy, The Netherlands, Portugal, Spain), proposes around 8,000 offers per day. 200 Spanish companies use the system and proposes around 1,200 transport offers, from and to Spain, per day.

Label and bar coding

Bar coding was initially developed for the recognition of retail merchandise. In the transport sector, bar coding is mainly used by:

- Package transport companies.
- The car industry: Nowadays, car producers try to force their suppliers to adopt bar coding.

One of the most efficient ways, in the transport sector, of using bar coding is by assigning a different codeto the each order. This code is used to access a database that contains all the information concerning the transported goods, such as origin, destination, quantities, etc. This database can be accessed via an data exchange system from anywhere in the transport chain.

The main benefits of bar coding are:

- The goods can be followed automatically anywhere they go (a track and tracing service). As goods pass trough different places, the database is automatically updated (e.g. Federal Express).

- The destination of the goods can be changed at any moment. By simply changing a field in the database, the goods can be redirected.

- All the information concerning the merchandise is available anytime with the goods. Goods do not have to wait for special instructions.

A major problem facing bar coding is standardization. The codes created by one company cannot be read by other companies; different bar codes are generated as goods pass from one company to another.

In Spanish transport sector the use of bar codes is restricted mainly to package transport companies and international transport companies.

AECOC is currently working on two bar coding projects: The first project is the adoption of the EAN-128 standard in the retail sector. This project aims to record all the information about an order consisting of different items in a single code. The second project, in collaboration with CETMO, aims to promote a bar coding standard for the transport sector. This project will enable any company to read the bar codes created by another company.

Conclusions:

The use of electronic markets in Spain is limited to one company that offers road transport.

The use of label and bar coding is in a developing stage. The proposal of a standard in the Spanish transport sector is under way.

VII. General conclusions

The majority of the information exchange projects in the Spanish transport sector are at the development stage.

Information exchange systems have a greater impact on companies that operate in international markets than on companies that operate in the national market. Companies that operate worldwide or at European level are the ones most likely to use internal information systems and offer logistical services to their clients. Most of the Spanish external information systems target international markets.

The main problems facing information exchange systems in the Spanish transport sector are:

- Low awareness of the benefits that information systems offer to companies.
- Companies are not ready for the changes in business procedures that information systems bring to organizations.
- Low usage of the EDIFACT standard.
- The small size of the Spanish transport companies, compared with other European companies. Some road transport companies have just of one or two trucks.

The easiest way for small companies to adopt an information system is to adopt a system developed by a trading partner (a larger and more experienced organization).

The main difficulties facing information systems within the small companies are:

- The low awareness of information technology.
- The low computerization of these companies.
- The relatively high monetary investment that an information system requires.

In order to be competitive, the major Spanish ports are preparing to offer logistical services to their users. Through the application of information technology the ports expect to gain market share vis-a-vis other means of transport.

The industry players that benefit most from the use of information exchange systems are shippers and carriers. Other players such as customs agents will need to offer value added services on top of their usual customs clearance operations if they are to survive.

In Spain, the use of label and bar coding is, like information exchange projects, at the development stage; a proposal of a standard for the transport sector is under way. The use of electronic markets is limited to one company that offers an electronic market service for available road transport available capacity. □

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(1) Reference: "AECOC and its AECOM service", IESE case, 1993.

(2) TEDIS stands for Trade Electronic Data Interchange Systems. It is a research programme of the Commission of the European Communities intended to promote EDI.

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Appendix 1

The port of Santander: The EDISAN and ARCANTEL projects

1. Introduction

Located in the Spanish Atlantic coast, the port of Santander is an autonomous organization under the jurisdiction of the Ministry of Transport.

The port administration is in charge of all that is necessary (equipment, installations...) to improve the traffic conditions of the goods passing through the port.

One of the main objectives of the port of Santander is to become a logistical platform, not only a gateway port, and to offer its users and clients a full logistical services (a "logistical platform"). These services are targeted at goods produced under the just-in-time (JIT) philosophy.

In addition, the port administration manages:

- The port assets.
- The installations connecting the port to other means of transport.
- The administrative part of the services provided by the port.
- The planning and execution of the different projects launched by the port.

Santander has developed several systems involving electronic data interchange. These projects have to be seen as the tools needed to implement the objective mentioned above. EDISAN and ARCANTEL are among the most important projects that the port of Santander has undertaken so far.

2. EDISAN

2.1. Objectives

EDISAN arose as a consequence of:

- The high traffic between the port of Plymouth (UK) and that of Santander (a regular line operates twice a week all year around).
- Santander's objective of becoming a logistical platform.

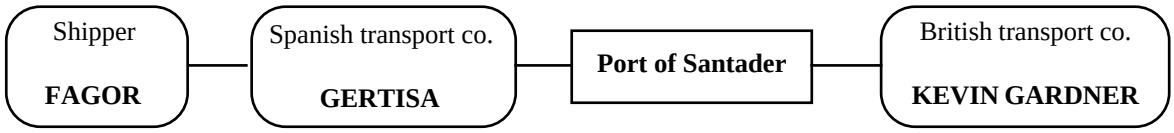
EDISAN's primary objetive was to set up a pilot project for intermodal transport between Spain and the UK, using and EDI system. The goods transported in this chain follow a JIT philosophy and use a Roll-in/Roll-off transportation system (i.e., the truck trailer is taken on board the ship and is picked up at the port of destination by a cabin other than the cabin which left the trailer at the port of origin).

2.2. The players

EDISAN went into operation in July 1991. Nowadays the project involves the following chain (Fig.1):

- FAGOR: Spanish manufacturer of household appliances among other things.
- GERTISA: Spanish transport company; GERTISA accounts for 40% of the Roll-in/Roll-off traffic between Santander and Plymouth.
- PORT OF SANTANDER.
- KEVIN GARDNER: British transport company.

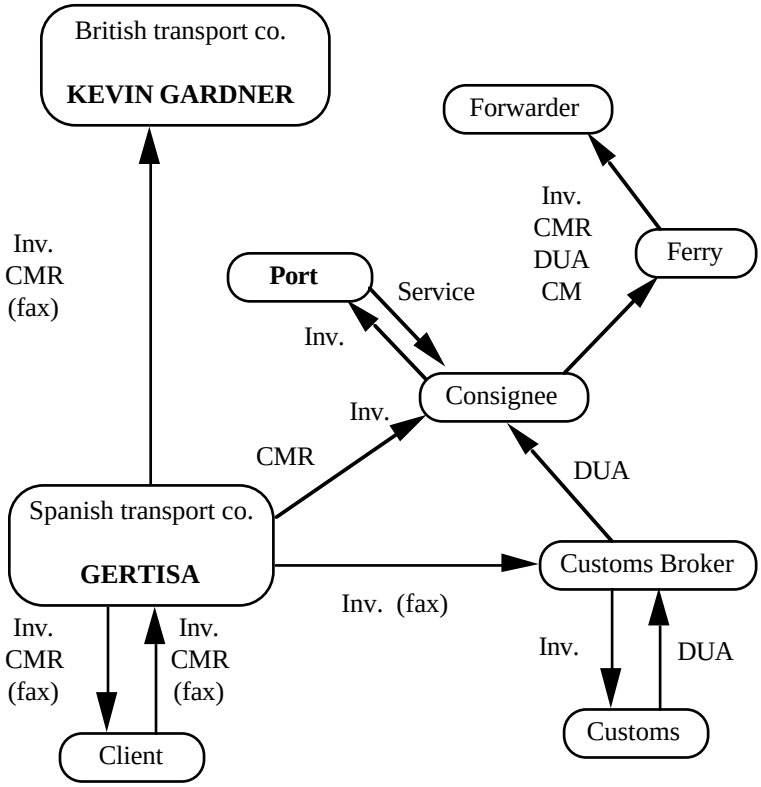
Figure 1. EDISAN transport chain



2.2. Information flow before and after EDISAN

Fig. 2 shows the information flow within the transport chain before EDISAN was launched.

Figure 2. Information flows before EDISAN



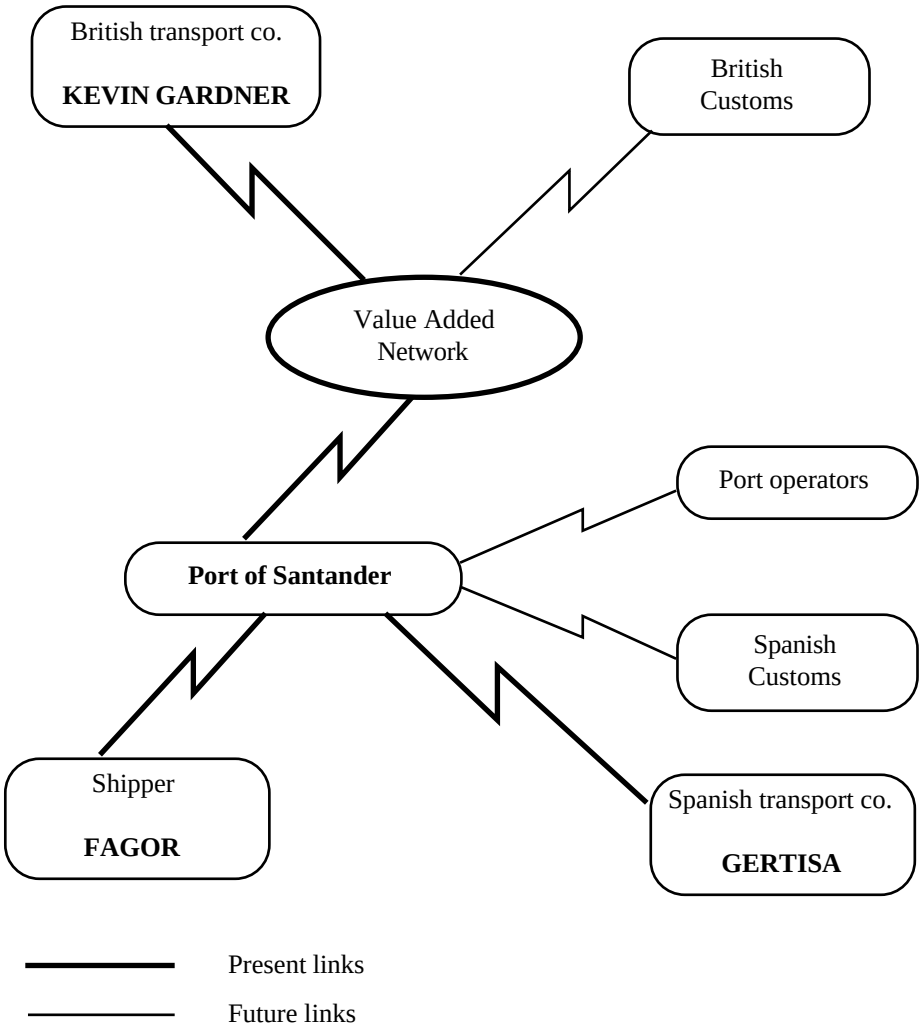
The main documents exchanged between the members of the chain and customs are:

- Invoice.
- CMR: Transportation contract.
- DUA (Documento Unico Aduanero): Customs declaration.
- CM: Cargo Manifest.

GERTISA and KEVIN GARDNER (the two transport companies) used to exchange the invoice and the CMR via fax. The main problems were the transmission time (up to two hours), the errors, and the time spent due to the re-keying of the data.

With EDISAN the data that used to be exchanged by fax is now exchanged via an EDI system. GERTISA transmits the invoice and CMR to KEVIN GARDNER via the port of Santander. Santander and KEVIN GARDNER are connected through a value added chain. In addition, FAGOR is able to track and trace its products throughout the whole transport chain

Figure 3. EDISAN links



With regards to document exchange, EDISAN is not yet completed. At the present, only the invoice and the transport contract are exchanged electronically . In the future, EDISAN will incorporate the other two documents: customs declaration and cargo manifest. Then EDISAN will need the involvement of the customs office, the customs broker and the consignee.

Fig. 3 shows present and future links.

2.3. Results

The impact of EDISAN on the different parties of the chain are:

FAGOR:

- FAGOR does not need to worry any more about transport logistics in this particular chain. FAGOR can respond to shorter notice orders from its British client and can plan and control over its deliveries better.

- The track and tracing service will help FAGOR to monitor the location of goods. With this system, FAGOR is able to react faster to unexpected problems.

- FAGOR's relationship with GERTISA has become tighter. As a result, more goods are expected to be transported trough this chain. The two companies are able to exchange more information than before (e.g. the availability of cargo space).

GERTISA:

- The reduction in communication time was particularly important to GERTISA. GERTISA and KEVIN GARDNER do not use the fax any more for exchanging the invoice and CMR documents.

- EDISAN allows GERTISA to approach new clients that are still not using logistical services (like FAGOR) and offer them all these information services.

Port of Santander:

EDISAN has been a good opportunity for the port of Santander to:

- Acquire experience with EDI.
- Get in contact with the international community of EDI users.
- Start preparing the internal organization of the port and the port community for the changes implied by the adoption of new information technology applications (such as EDI).
- Offer new services such as track and tracing and EDI interconnection to other companies.
- Extend the benefits of these experience to the companies that are using the port.

The whole transport chain:

The whole transportation chain is experiencing the following benefits and costs:

Benefits

- Reduction in time of the physical and data information flow of goods.
- Reduction of data re-keying, fewer errors, and economies in personnel.

The most important costs fall in these categories:

- Software and hardware.
- Communication costs.
- Training.

3. ARCANTEL

3.1. Objectives

ARCANTEL arose as an initiative of CEDRE (European Centre for Regional Development) to prepare the Atlantic ports for European market deregulation.

ARCANTEL's objective is to establish a community of ports along the Atlantic coast to promote:

- The computerization of the Atlantic ports.
- Data communication between the ports.
- Sea transit between ports.
- Intermodal transportation outside the ports.
- Hinterland logistics.
- The business activities of the ports.
- Regional economic development.

ARCANTEL will involve several large ports (Milford Haven, Glasgow, Nantes, Bilbao, Bordeaux, Lisbon...) and around 110 small ports. The experimental phase includes: Bordeaux, Lisbon, Plymouth, Santander, Viana do Castello and Vigo.

Within ARCANTEL a reference model has been developed to assess the information systems and data exchanges involved in a typical port. This model was called ARCANPORT. The goal of ARCANPORT is to evaluate the technological level of the different ports and to define a development strategy. Two different levels of information systems can be defined in ARCANPORT (Fig. 4):

- The first level, related to the port's internal technology, is composed of four different systems that will cover the port's management and operations:

    1. Management information systems: covers administrative processes.

    2. Operations systems: covers the exploitation of the ports and its installations such as the quays, platforms, cranes, warehouses...

    3. Internal communications: concerns the data links within and for the port.

    4. Control system: interconnection all the above.

- The second level, related to the port's external technology, is composed of two systems:

    1. External data processing and communications systems: Collects and processes data, and makes these data available in the form of services to the different agents in the port community.

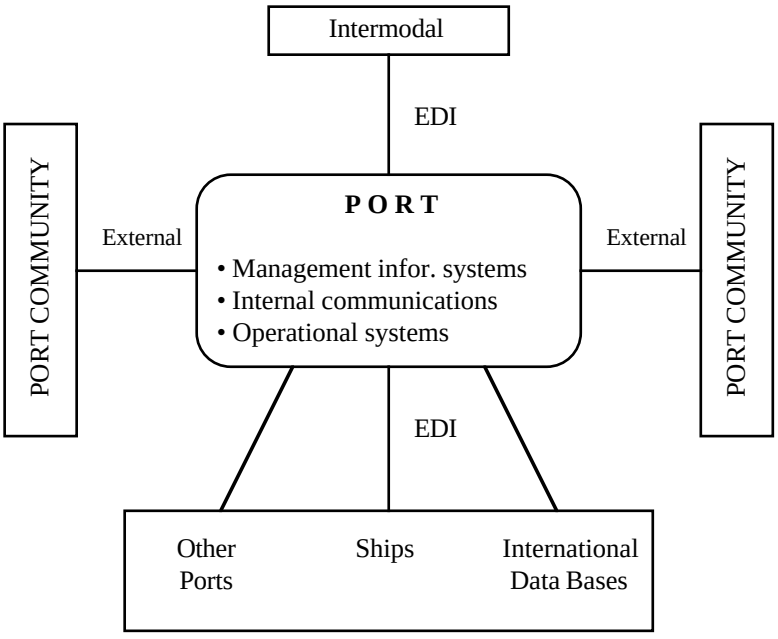
    2. EDI: Interconnects the ports and supports intermodal transportation.

In view the different level of information technology in different the ports, each port authority will be able to adapt the ARCANPORT model to its owns technological capacity.

- The technologically advanced ports will finish their different projects, will develop the interconnection of their internal systems to a standard EDI station, and will start intermodal transportation.

- The less technologically advanced ports will adopt EDI as soon as possible, will develop their internal information system and will start implementing the interconnection of these systems to the EDI station.

Figure 4. ARCANPORT



3.2. Information flow before ARCANTEL

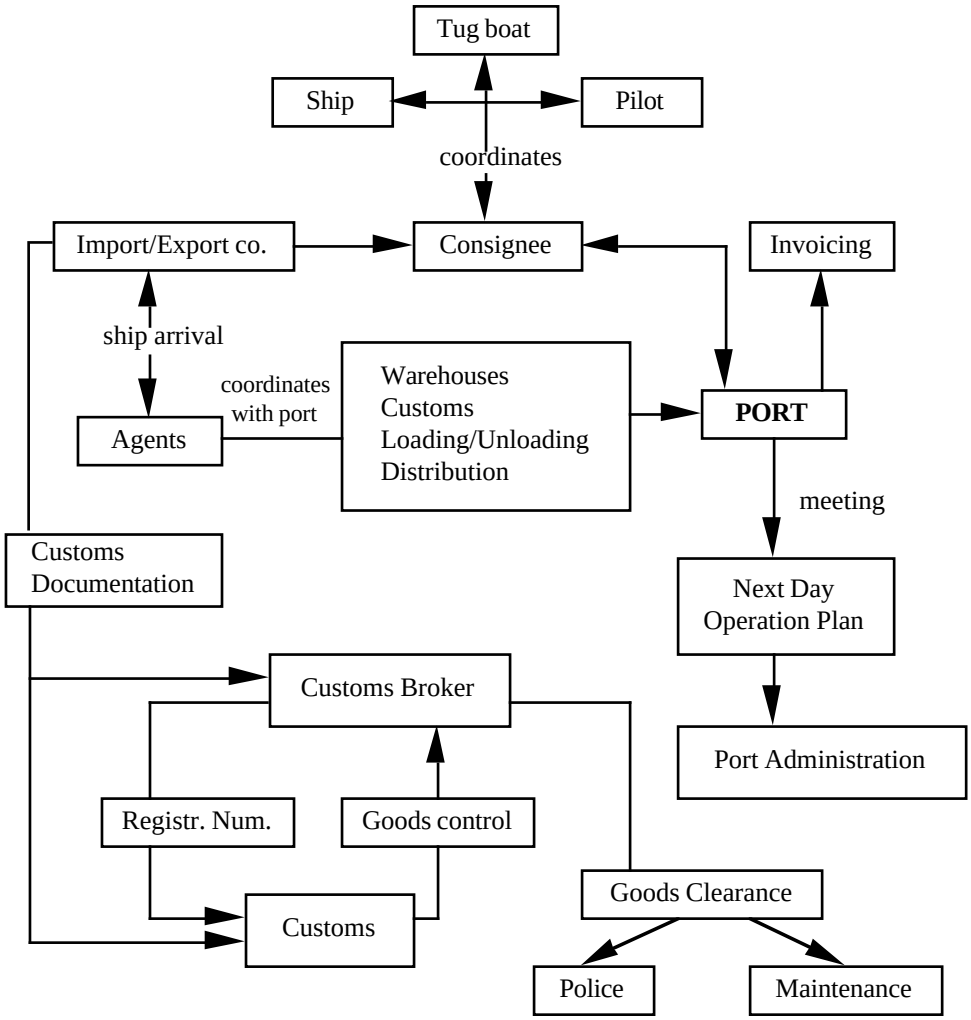
In Figure 5 we can see the port information flow prior to ARCANTEL. The companies and agents exchange information by fax, telex, and telephone. The information flow can be slow and inefficient (due to the data retyping); any delay in the information flow results in a delay in the physical flow of the goods. Different administrative forms are filled

out with the same information; the amount of retyped data is high; delays and errors are incurred during these retyping operations.

3.3. Benefits expected from ARCANTEL

Adopting ARCANTEL should bring important benefits to the port, to companies and to agents. The time spent in exchanging information will be reduced, fax and telex will not be used any more. As the data will be directly available in the computers, the number of errors and the various time spent retyping the data will virtually disappear. The port and the agents will be able to plan and control their installations better; they will have real-time information on the various activities in the port.

Figure 5. Information flow before ARCANTEL



The transport chain as a whole will be faster. This is particularly attractive to shippers that need to deliver with short time notice. ARCANTEL will give easier access to markets in the Atlantic coast; it will also help the shipping companies to get their products to their clients faster. Intermodal transport chains will increase, transport companies will be attracted by the port's interconnection to other countries.

Despite all this potential, the actual development and usage of ARCANTEL so far limited. This makes difficult to asses the ultimate benefits.

4. Conclusions

The adoption of inter-organizational information systems, such as EDISAN and ARCANTEL, by the port of Santander has different impact on each of the parties involved in the transport chain.

Shipper (FAGOR):

- FAGOR can offer a faster time response to its clients. The company can deliver orders at short notice and supply goods in accordance with a just-in-time philosophy.
- The company does not have to worry about transportation logistics; these logistics services are now offered by the transport chain.
- A stronger relationship between the shipper (FAGOR) and the transport company (GERTISA), will be developed; information, such as the availability of cargo space, can be exchanged.
- EDISAN and ARCANTEL will help FAGOR to reach international markets on the Atlantic coast that previously could not be reached on account of the long transport delays.
- The track and tracing service will help FAGOR to follow its goods and respond swiftly to unexpected problems.

Transport company (GERTISA):

- EDISAN has reduced the amount of data retyping and the time and errors incurred by this operation. It has also reduced the time spent in exchanging information with KEVIN GARDNER.
- Closer and stronger relations with FAGOR. GERTISA can respond quickly to FAGOR’s needs.
- GERTISA will be able to organise its transportation fleet more efficiently. Internal reorganization will be needed, as decisions, such as which vehicles to assign to an unexpected job and know many, will have to be taken in a short time.
- Through the ARCANTEL port community, GERTISA can win new clients that need to get into the regions bordering the Atlantic.

Port of Santander:

- Information systems will increase the port's goods handling capacity, EDISAN and ARCANTEL will help to reduce the throughput time of the goods transported through the port.

- EDISAN and ARCANTEL will increase the port's competitiveness. The port of Santander will be more competitive than other transport chains that are used to transport goods to the same destination. The port will be able to attract goods that used to be transported by other means such as road or train.

- Shippers and transport companies will be attracted by the quality of service and the new services offered by the port. Quality in terms of throughput time, and new services such as track and tracing, faster and easier customs clearance, the opportunity to link up to an EDI network and reach other ports in the Atlantic.

- ARCANTEL will help the Spanish companies to reach clients that used to be "far away" in terms of transport time.

- Internally, the port will be better able to plan and control the use of its installations, warehouses, cranes..., and will reduce the amount paperwork.

Agents:

The impact of EDI and ARCANTEL on the agents is uncertain. One example is the future of the customs broker. Once customs can get the documents from the port authority, the role of the customs broker will not be clearly. Agents that used simply to transfer information (from clients to the authorities) need to offer value added services, apart from the information transfer, otherwise these agents will disappear.

Appendix 2

The port of Valencia: The STED project

1. Introduction
2. STED’s objective
3. Information flow between customs and other agents before STED
4. Information flow between customs and other agents after STED
5. Expected benefits
6. Problems encountered
7. Future directions

1. Introduction

Located on the Spanish Mediterranean coast, the port of Valencia is an autonomous organization under the jurisdiction of the Ministry of Transport.

Aware of the growing importance of information technology, in 1991 the port of Valencia started an electronic data interchange system called STED which, among other things, was to help the port authority to reduce the time that goods spend in the port.

A major problem that the port of Valencia, like other ports with high container traffic, faces is the customs clearance process. The information flow in this process can delay goods for up to two days. During this period the goods have to wait for clearance from customs administration. The STED project (the first phase of which will tackle the customs clearance process) started as a specific solution for the port of Valencia, but has evolved as a general solution for the clearance process in the main container traffic ports.

The involvement of the customs administration, as well as companies working in other ports, called for a solution that could be implemented in different Spanish ports, not only in Valencia. Eight port authorities (Algeciras, Barcelona, Bilbao, Las Palmas, Santander, Tenerife, Valencia, Vigo) and the customs administration joined forces to study the problem and find a standard solution.

The company ITP (Informática y Telemática Portuaria) was founded as a result of this effort. ITP's objective is to promote, develop and implement information technology in the ports communities. ITP designed the clearance process information system (messages, procedures, manuals...). It also helped the port authorities and the customs administration to adopt or improve their internal computer systems. ITP offered the consignees and the customs agents different solutions to link into the system.

STED's first phase is due to be tested during the last two months of 1993 and will be launched simultaneously in the three biggest container traffic ports (Algeciras, Barcelona and Valencia) in January 1994.

2. STED's Objective

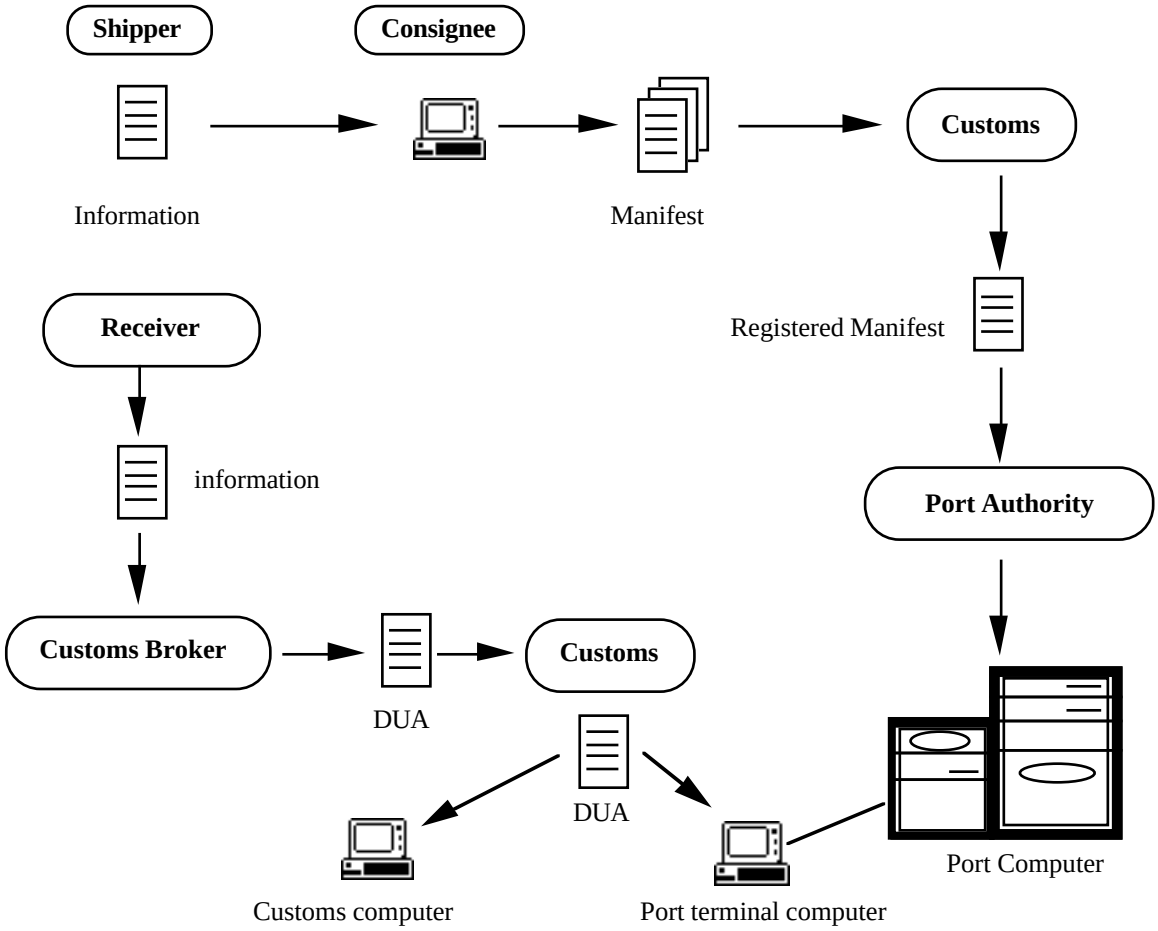
Technological innovations have increased the speed of the port operations –loading/unloading, stowing/unstowing, etc. Nowadays these operations can be performed in less than six hours. As a result, delays in the information flow may lead to delays in the physical flow of the goods.

The objective of STED is to implement an efficient system for handling information flow in the port. STED will simplify the existing system (reduce the amount of data retyping) and exchange data electronically. It will gradually cover all the documents exchanged inside the port community, as well as the documents exchanged with external agents.

3. Information flow between customs and other agents before STED

The customs clearance process involves four parties: customs, the port authority, the consignee and the customs broker. Before STED the information flow was as shown in Figure 6:

Figure 6. Information flows before STED



1. As soon as the consignee receives the information concerning the goods to be delivered, the consignee: enters the information in its computer, fills out a manifest and presents several copies of the manifest to the customs office.

2. The customs office: receives the manifest copies, assigns them a registration number and sends a copy to the port authority (copies of the manifest are sent to the port authority only once a day).

3. The port authority enters the manifest information in its computer.

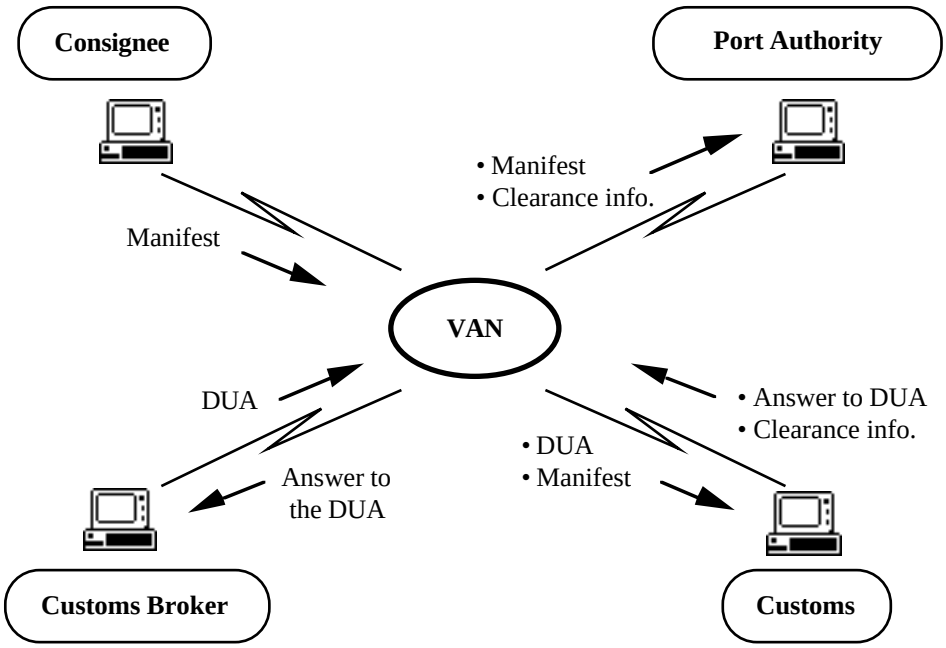
4. The goods clearance process starts when: the manifest information is entered in the port computer (customs can access the information through a port computer terminal available in their office) and the customs receives the customs declaration document (DUA, Documento Unico Aduanero). The DUA is sent by the customs broker on paper. To control the clearance process, customs need to enter part of the DUA into the port computer. Afterwards, the complete DUA is retyped in the customs computer.

Throughout the process, information is available in one computer is exchanged via paper copies and retyped into another computer. The same information is entered not only leading to errors but also increasing the current of time that the goods have to wait in port. The complete process can take up to two days.

4. Information flow between customs and other agents after STED

The introduction of STED allows the information flow to be restructured in the following way (Fig. 7):

Figure 7. Information flows after STED



1. The consignee sends the manifest via EDI to a VAN (Value added chain).

2. The port authority receives the manifest from the VAN and notifies the consignee of receipt.

3. The customs administration receives the manifest and the DUA via electronic link.

4. All the documents coming out of customs are also transmitted to the different agents via electronic link.

5. Expected benefits

The main benefit of STED is the reduction of the time the goods spend in port. This benefits the shipper and the receiver. With the new system, a computer algorithm, based on the documents received by customs, assigns one of three prioritie to arriving merchandise:

- Green colour priority: The merchandise going through this process does not require any kind of inspection by the customs authorities. The goods are processed automatically and do not need the intervention of any of the customs officials (unless an official decides to intervene in the process). It is in this process that information technology has a major impact, as the goods are expected to go through in three or four hours. In Fig. 3 we can see the time reduction with the green colour process.

- Orange colour priority: This process requires an inspection at document level (sanitary reasons, dangerous goods...).

- Red colour priority: The red colour process requires a physical inspection of the goods.

In the orange and red processes, the time that the merchandise takes to be cleared is unknown, it depends on length of the customs intervention.

As an incentive to use STED, the customs authorities offer a 2% reduction in taxes for companies that present their customs declaration electronically through the system.

Other benefits are the reduction in the time and errors involved in the data rakeying of the documents.

6. Problems encountered

The main problems that the STED project has faced came from the customs administration. Problems such as:

- Lengthy negotiation to obtain a commitment from the customs authorities to change and restructure the existing process and accept the STED system.

- The communication lag between the central customs office and the regional customs offices slowed down the implementation process.

- Lack of agreement between the customs administration and the tax authority.

All these problems resulted in project delays. The deadlines were not met by customs office, which at one point even paralysed the project.

7. Future directions

The next processes and documents to be covered by STED have still not been decided. Most probably the project will include another player in the transport chain: the forwarder. The forwarder is an important actor in the logistic operations of the transport chain; among other things, the forwarder coordinates the goods' hinterland transportation. The forwarder will benefit from STED information such as when the goods have been cleared by customs.

Agreeing on future documents and messages to be exchanged may be a difficult and lengthy process. For example, as the forwarders get involved, a standard will have to be developed jointly with the ports.

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