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ELECTRONIC DATA INTERCHANGE IN PORT MANAGEMENT THE EXPERIENCE OF THE PORT OF BARCELONA*

1. INTRODUCTION

Every port is unique. Although all ports exist for the same basic purpose (to act as an interface in the transfer from one mode of transport to another), no two are ever organized in the same way.

Ports may be classified according to:

- **Physical** conditions: location (geographical position, man-made or natural harbour, estuary location, difficult weather conditions, tides, etc.) and size (large, small or medium-sized).
- **Use**: commercial (general cargo, bulk solids, bulk liquids, oil, break bulk, mixed), passenger, sport and leisure, fishing, mixed, etc.
- **Ownership**: private, municipal, regional or State-owned.
- The Port Authority's role in **management** of the port:
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    - **Overall control,** i.e. the Port Authority plans, sets up and operates the whole range of services.
    - **Facilitator**, i.e. the Port Authority plans and sets up the infrastructure and the superstructure, but services are provided by private companies.
    - **Landlord**, i.e. the Port Authority allows private companies to be responsible for the superstructure and provide port services.

Different combinations of port types will therefore give rise to different kinds of organization and different information flows, which means that the associated information systems may differ significantly from port to port. Since this paper relates to the port of Barcelona, with its own specific characteristics, the contents may not always be applicable to other ports.

As has frequently been stated elsewhere, it is clear that information technologies are changing the future every day. No-one remains --or indeed can remain-- unaffected by the latest developments in software produced for ever more powerful and ever cheaper computers, or by the continual improvements that are taking place in the field of telecommunications.

Ports cannot lag behind in this respect either, but are forced to keep pace in a world where information technologies are essential tools for raising the competitiveness of companies in general, and companies involved in the transport chain are no exception.

Concretely, the competitiveness of a commercial port with a large throughput of general cargo depends on the

following main factors:

- **Geographical location**. Clearly, a favourable geographical location with a large hinterland may be a key factor in the attainment of a high growth rate for the port.
- **Infrastructure and superstructures.** Well laid-out quays, with adequate depths, spacious stacking areas and well-marked, ample entrance channels, as well as the availability of suitable cargo-handling equipment and storage sheds, greatly aid cargo-routing.
- **Landward communications.** It is vital to be able to distribute goods rapidly and reliably through the hinterland, and the hinterland itself can be expanded as the infrastructure improves.
- **Security.** Two factors that owners of goods in storage or in transit through the port normally insist on are the security and safety of their goods.
- **Costs.** It goes without saying that costs may in many cases be decisive to a port's competitiveness.
- **Speed of throughput.** In a world increasingly dominated by sophisticated logistical techniques, the ability to cut delivery times to a minimum is vital for certain goods.

A recent market survey revealed that it is the last three factors that most concern users of the port of Barcelona. In all three cases, information technologies offer the most effective means of achieving the desired standards. A specific example is electronic data interchange, which can not only speed up throughput of goods but also cut the administrative costs associated with handling.

The speed with which goods are dispatched depends largely on the efficiency and flexibility of administrative and documentation procedures, which can be improved by electronic data interchange in any of its many forms, such as EDI, fax, audiotext, Internet or electronic mail.

2. THE CONCEPT OF ELECTRONIC DATA INTERCHANGE (EDI)

To begin with, it may be useful to review the concept of EDI -- which, although it is the leading data-exchange technology, is perhaps the least well-known-- and to look at the differences between it and other similar concepts such as e-mail.

EDI is the exchange of structured messages between computers, with no human intervention in the reading or recording of these messages. The boom it is enjoying at present is a logical outcome of the information load companies now labour under. A glance at the procedure for sending a bill of lading, for example, or a bay plan, shows that in most cases all the data the documents contain are output from the forwarder's computer onto paper or some other medium and sent by post, e-mail, fax, courier or other means to the consignee, who reads the message and immediately inputs the relevant information into a computer. Thus, the chief difference between EDI and e-mail or fax is not the means of transmission but the fact that EDI circumvents the slowest, most error-prone procedures, namely those involving human intervention.

However, if two computers from different companies are to be able to understand one another without human intervention, the format of the messages to be transmitted needs to be agreed upon beforehand. This is relatively straightforward in two-way communications, but when a large number of people, including some from different countries, wish to communicate, it is a more complicated matter. In order to solve this problem, the United Nations developed its "rules for Electronic Data Interchange for Administration, Commerce and Transport" (EDIFACT), now the most widely used language for standardizing EDI messages relating to commerce and transport. Many documents that are commonly used in goods transportation, such as cargo manifests

(IFCSUM), customs declarations (CUSDEC) and bay plans (BAPLIE), have now been standardized. Electronic document exchange can of course take place using either EDIFACT or any other language the parties may agree upon, but as mentioned above EDIFACT is the most widely accepted standard in commerce and transport.

For the two computers to understand each other, however, it is not only the message format but also the communications protocol to be used and the times the computers are to be connected that must be agreed upon --no easy matter for a large number of parties with different systems or even in different time-zones. In order to solve this problem of connectivity, clearing centres have been set up. These are simply computers that function as "letter boxes", handling the message exchange and carrying out the checks needed in order to ensure their integrity. Clearing centres may be private --i.e. set up by a specific group to serve its members-- or public --i.e. belonging to value added networks offering this service to the public at large. Examples of private clearing centres are the Port of Rotterdam International Transport Information System (INTIS*)* or Port of Antwerp EDI System (SEAGHA), while public EDI clearing services are offered by value added networks such as the General Electric Information Systems (GEIS) or the IBM Information Network (IIN).

3. THE DOCUMENTATION FLOW IN MARITIME GOODS TRANSPORT

Close examination of the goods dispatching procedure used in the Port of Barcelona, which for the most part is the same as that used in any other port, reveals an extremely complex flow of documentation in which more than 40 different documents are exchanged among the various port operations (shipping agents, forwarders, customs agents and storage terminals) and public authorities (Customs, inspection services, the harbour master and the Port Authority) involved in maritime goods transport.

For the sake of simplicity, the overall maritime transport document-exchange procedure can be broken down into four major message categories.

The first and most critical category comprises messages between port operations and Customs, primarily cargo manifests and customs declarations (combined administrative document). The content, format and transmission procedures for such documents are normally laid down by the Customs Administration and, understandably enough, are identical for all the ports in one State. In Spain, all port-Customs EDI messages are part of the COMPAS (Port-Customs Manifest Transmission) project, which is described in more detail below.

Another category of messages includes those between shipping lines and shipping agents and often, in the case of containerized cargo, between shipping lines and stacking terminals. The former are basically bills of lading and customs declarations, while the latter are mainly bay plans. Shipping lines need to be in contact with all ports where their ships operate and thus cannot afford to be bound by the particular document-exchange system used in each one. Until recently, each line devised its own communication system, but there is now a trend towards standardization. An example of this is the Information System Agreement (ISA) concluded by eleven large shipping lines and establishing the EDIFACT format to be used for EDI messages to shipping agents and terminals. The container terminal at the Port of Barcelona, for instance, uses EDI to send the bay plan to different shipping lines.

The third category of messages covers all inter-port communication. At present, aside from communications such as those between forwarders and their agents elsewhere, or inter-bank communications between different countries, which do not deal strictly with port business, and simple business communications between an agent

and its offices in different countries, there is as yet no regular inter-port communication. However, the growing concern over the control of hazardous substances has prompted the European Union to initiate a number of projects --such as Meditel and the Network for Transport Management in the Mediterranean (NTMM), in which the Barcelona Port Authority has participated-- defining EDIFACT messages regarding the departure and arrival of ships carrying dangerous cargoes, for transmission between the Port Authorities. It is not inconceivable, then, that some kind of inter-port communication will exist in the future, primarily among ports in the same geographical area.

The final category of messages comprises communications among the various agents and organizations within a single port community. It is this category that has caused EDI to be introduced in the world's major ports. These messages can, in turn, be subdivided by procedure: "contracts between forwarders and shipping agents", "documentation of goods entering and leaving stowage terminals", "documentation of hazardous goods", "information exchange between shipping agents and terminals", "requests for port towing operations or for a ship to sail", etc. As described below, the Port of Barcelona has embarked on the task of reengineering these procedures and defining new document-exchange systems, chiefly in order to speed up the passage of goods through the port.

4. PORT-CUSTOMS DOCUMENT INTERCHANGE: THE "COMPAS" PROJECT

As mentioned above, COMPAS is a system providing procedures for electronic transmission of manifests and customs declarations between the port and Customs. The messages and procedures are defined by the Customs Administration, the internal revenue service, the State port authority and the Barcelona and Valencia Port Authorities.

The system works as follows: shipping agents may submit manifests, either on paper or by EDI, to the Port Authority, which in turn forwards all manifests to Customs by EDI. So far, procedures and messages relating to unloading manifests have been established, and work is under way on those relating to loading manifests. Customs declarations, too, may be submitted by customs agents to Customs either by EDI or on paper. Those using EDI will receive, also by EDI, a customs release or a notification of physical or documentary inspection. The progress of the Port of Barcelona's implementation of the system is described below.

In June 1994 EDI transmission of Customs export declarations officially came into operation. Customs agents may send Customs declarations to Customs either directly or through the Customs Agents' Association. The latter also provides an EDIFACT translation service, which now has more than 80 clients. In both cases, transmission is supported by the IIN value added network. EDI transmission of Customs import declarations is currently in the testing phase.

In addition, as of April 1994, the Barcelona Port Authority accepts import and export manifests from shipping agents via EDI. To date, interchange agreements have been signed with 29 agents and tests are being conducted with a further four. In this case the Port Authority accepts interchanges via a number of value added networks. The Port Authority-Customs manifest interchange has been in operation since 1 December 1995. As yet only import manifests can be transmitted, but EDI transmission of export manifests is now at an advanced stage of development. This interchange, too, makes use of the IIN network.

The Barcelona Port Authority now receives 92% of import manifests from shipping agents by EDI, while import-manifest interchanges between the Authority and Customs are now carried out entirely by EDI, which means that

Barcelona Customs is completely paper-free in this respect.

Once the COMPAS system is fully operative, the hope is that the dispatch time for merchandise not subject to inspection will drop from one day to two hours, assuming all documents are submitted before the ship's arrival. As a point of reference, it should be noted that only 5% of all containers are presently subject to physical inspection. Customs currently takes around 1.25 working days less to approve manifests sent by EDI than to approve those submitted on paper. The use of EDI also brings other secondary benefits, as the need for manual data input in Customs and the Port Authority disappears (or is substantially reduced, if some operators and agents continue to use paper) and the number of errors thus declines.

5. REENGINEERING PROCESSES UNDER THE QUALITY IMPROVEMENT PLAN

On the basis of a detailed study of the shortcomings users noted in the process of moving goods through the port, the Port Authority has drawn up an innovative quality improvement plan in collaboration with all the private companies and public organizations operating within the port.

Under this plan, and in parallel with many other initiatives, an Information Guarantee Committee was established to develop and implement in the Port of Barcelona a system that would complement COMPAS by speeding up and optimizing the exchange of documents among the different agents and bodies involved in maritime goods traffic. This committee is composed of representatives of the Forwarders' Association, the Shipping Agents' Association, the Customs Agents' Association, the container terminal, the internal revenue service, Customs, the Maritime Transport Users' Association (under the aegis of the Chamber of Commerce), the CETMO Foundation and the Port Authority.

The first step in preparing the definition of this system was to carry out two parallel studies: a full, in-depth analysis of the Port of Barcelona's document-interchange procedures and a market survey of the different technological alternatives for electronic data interchange. Reengineering of each of these processes is now getting under way and a number of new document-interchange procedures are being defined in the light of current needs and technologies.

The approach treats the port community as a large virtual organization, as it were, whose members have commercial links and yet retain their independence. For the various "departments" of this organization, EDI is an appropriate tool for organizing information flows so that they can perform their tasks. In addition, EDI allows the final user (importer or exporter) an unobstructed view of all those involved in the process, which is vital now that transport aims increasingly at "door-to-door" service. Attitudes change, too, as each participant in the process comes to perceive itself as simply one element in a chain whose slowest or least efficient link affects the whole outcome. The process is one of cooperation among all the links, even though some are in fact competitors. This is perhaps one of the most important characteristics of EDI.

EDI is not, of course, the only tool for document interchange that exists and a decision needs to be made as to the most appropriate procedure and technical medium for each purpose. The Port of Barcelona, for example, on re-examining the whole process of document-interchange relating to ship entry and exit, designed a new system that greatly simplified the old one and that was based on fax transmission, since there was no added value to justify introducing EDI in this case. In reengineering other procedures, alternative technological media have been used, such as Internet for information on cargo manifests' contents, or audiotext for information on their status. For procedures relating to handling of dangerous goods or booking, however, EDI is considered the most

suitable document-interchange medium.

Lastly, it should be borne in mind that before the quality improvement plan was introduced, steps had already been taken to implement partial document-interchange systems, and that these will eventually be incorporated in some way into the overall system resulting from the reengineering exercise. Examples of this are the communication system linking the container terminal with the forwarders who use it, and the stevedore-contracting system operating between the State stowage company and the terminals.

6. CONSIDERATIONS TO BE TAKEN INTO ACCOUNT WHEN INSTALLING AN ELECTRONIC INFORMATION-INTERCHANGE NETWORK. EXPERIENCES FROM OTHER PORTS.

The first step in installing an electronic information interchange system should be to define its purpose. In the case of the Port of Barcelona, the main aim is to speed up the despatch of goods, and it is on that basis that priorities have been assigned to the procedures to be optimized.

One important consideration concerns the specific nature of the port environment, that is, all the companies and organizations involved in maritime transport there. What most distinguishes ports from other environments employing some form of electronic information- interchange system is the lack of any clear customer-supplier relations, which means that companies of very different kinds must agree among themselves on volumes and objectives. In addition, because these agents cannot be forced to adopt a particular system, paper and electronic media exist side by side in organizations such as the Port Authority, which further complicates administrative procedures. Lastly, the need for some agents to interchange documents with foreign shipping lines makes it necessary to envisage solutions allowing access to other systems.

It is also important, when specifying an electronic information-interchange system, to consider what technological and administrative models to use. In European ports that have their own system, the administrative solution that was applied in most cases involved forming an association of all the companies in the port (including the Port Authority, which was usually a minority partner), while the technological solution applied in every case involved setting up an EDI clearing centre to serve the port community. Other ports, such as New York, with a newer system than that of the European ports, have opted to contract the clearing service out to a private company whose performance is constantly monitored by the users' association, and the technological support is a public value added network. The service that can now be offered by public value added networks and the effectiveness of their interconnections raises the possibility of ports establishing systems based on third-party services rather than setting up their own infrastructure, which generally demands high initial investment.

There are a myriad factors to be considered in terms of the advantages and disadvantages of each possible model, but the best solution will always be the system that most closely matches the needs and specific features of each case.

7. PRINCIPAL OBSTACLES TO IMPLEMENTATION OF AN EDI SYSTEM. THE EXPERIENCE OF THE PORT OF BARCELONA.

EDI has proved an effective tool for speeding up the port's merchandise-despatch procedures. Nevertheless, the newness of the technology and the change in mentality required by the lack of paper have made its introduction

anything but simple. The main technical and organizational obstacles encountered in implementing EDI in Barcelona are described below.

Organizational problems - The first and possibly the most important problem is getting the parties involved to agree on message and procedure definition. This is particularly difficult for ports communities since they include very disparate groups and companies with different --even, at times, opposing-- interests and no clear customer-supplier relationship. Agreements should therefore be the product of a consensus.

- Another obstacle is the change in company or organization mentality that EDI requires. Some see EDI as a threat to particular jobs, others see it as a panacea. This is due to ignorance of the technology and to the fact that suppliers and the media have created false expectations as to what EDI really is.

- The legal aspect is yet another problem: how to draw up an interchange agreement that all parties can subscribe to and that will give legal sanction to a document interchange with no documents and no signatures. For documents relating to public authorities such as Customs it is sometimes necessary to alter certain aspects of the current legislation to bring it into line with the new method of document interchange.

- Administration of codes and message versions is another problem that needs to be addressed. One organization or company should be put in charge of administering the codes and implementing message amendments, so that changes can be coordinated among all users. If this is not done, messages may be rejected because of differences between databases. By the same token, it is also important to use the same message versions and codes for as long as possible, as every change presents problems for all users of the system.

- Lastly, it is essential to be aware that, for implementation of an EDI system, trained staff need to be hired, or else existing staff need to be trained properly.

Technical problems - EDIFACT messages that are an exact match with the message content defined by the parties are not easy to find. Strict adherence to EDIFACT standards means that content has sometimes to be subordinated to syntax.

- One of the major problems as long as all value added networks are not interconnected is that all parties must agree on one such network to use; in addition, most networks still leave something to be desired in terms of reliability or customer service.

- Other problems encountered during implementation of an EDI system are ones relating to the application of a young technology: suppliers are hard to find and poorly trained; technical staff in the other companies involved in the document interchange may also be untrained; and the software products, which are often first versions, have design faults. For example, it has been extremely hard to find a sufficiently fast EDIFACT translator for AS/400.

- The main technical difficulties with designing in-house applications are, on the one hand, achieving automatic operation that is 100% reliable and, on the other, obtaining a fast system- response time, which depends on, inter alia, the speed of the translator, of the communications systems, and of the computer's central processor.

- When the use of EDI is optional, the fact that some parties send documents by EDI while others use paper creates great technical and administrative complications.

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