STANDARDISATION IN INFORMATION SYSTEMS FOR COMMODITY TRANSPORTATION

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INTRODUCTION

While technical and organisational changes are continually gaining speed, standards look like comforting features with their consistent and timely procedures. The mere fact that they exist helps users to chose among commodities and services more rationally. This feels especially useful for small and medium-sized firms. Existing standards are even deemed as a prerequisite for marketing sophisticated products. However in cases such as the transport industry, the intricate organisational structure makes it difficult to introduce the required harmonization smoothly.

In order to assess these views we will look briefly at the framework of new information technologies for transport, then standardisation processes; the third paragraph is dedicated to few typical examples and the last one to the viewpoint of transport firms.

1 - OUTLINE OF NEW INFORMATION SYSTEMS AND TELECOMMUNICATIONS (IST)

1.1 Current trends in IST

The recent successes of new information technologies stem from the interpenetration of three industries which previously had separate developments: computer, telecommunications and radiocommunications. The interconnection of these systems brings to light the outstanding advantage of network effect: breakdowns no longer exist at the boundaries of each system.

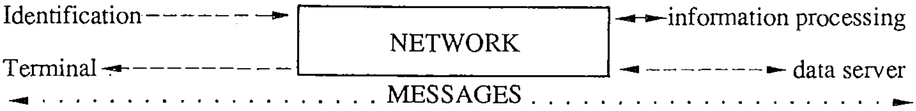
Some interrelated effects also bring decisive technical advantages through the digitalisation of information (voice, image, graphic etc):

- telecommunications: more services thanks to smart networks with numerous computers along the lines and switch boards,
- radiocommnications: eventually reliable through the implementation of telecom procedures,
- computing: open systems with direct access to telephone lines.

The history of telecommunications development is strongly tied to transport systems: the telegraph was first set up alongside railroads and early radio sets equipped vessels. Nowadays radio equipment ensures the safety of all transport modes and streamline operations, implying harmonisation between transmitter and receiver [12].

1 . 2 The components of IST for transport

These components and their relationship can be described with the following generic diagramme:



Transport and the telecommunications systems possess similar organisation with nodes and links that lead to numerous interface problems. The main difference lies in the fact that breakdown and consolidation are now automatically handled for communications, not for goods!

1.3 Radio systems

Cellular radio telephones have caught on in Northern-Europe, and, after a long period of low activity, now in other European countries. Broad cooperation between European PTTs will bring a single new digital mobile phone (GSM) in 1992, that could be the right answer for hauliers' concerns due to its ability to support voice as well as data.

Mobile satellite communications systems are not operational in Europe yet. Various hurdles delay commercial operations launching. There are likely to be two or more different operational systems in Europe by 1992-1993: EUTELSAT and INMARSAT. So it is too early to assess their appropriateness for transport needs.

Private radio is a reliable and cost-effective technology. Such systems may have a range of a few hundred meters (e.g. within the premises of a large manufacturer) to about 30 km (e.g. for radio taxis or locally operating transportation companies). So there is a need to extend the range of these systems to areas of 150 km or more and to share scarce frequencies. Hence new radio technology came to the market: trunk systems, very similar to cellular radio networks, which have ability to share scarce resources like radio frequencies can bring some savings [8, 12].

1.4 Telecommunication networks

The oldest and the most open telecommunications network is the RTC (Réseau Téléphonique Commuté or Public Switched Telephone Network). It carries voice traffic but also digitalized data, for instance written documents (FAX) or data files by using modems between computers and the network. The speed of transfer remains slow (from 1200 bits/s to 9600 bit/s), but usually enough for most transport transactions.

The first dedicated networks for data transmission were the Packet Switched Public Data Networks, recommendation X25 of CCITT. In Europe each country developped its own X25 public network; but crossing borders is still a problem.

To integrate all communications services (voice, text, data or images) into a single network, ISDN (Integrated Services Digitals Network) is being offered in an increasing number of countries. Analogue signals (particularly voice) are transformed into digital signals and the digital transmission technologies make it possible to transmit data at the speed of 64kbits/s. Furthermore ISDN provides a specific channel for transferring signaling purposes. However this new service is proceeding very slowly because numerous users deem that it started too late to meet present requirements for current high-performance information systems. New systems for data communications have emerged recently as Frame Relay or ATM (Asynchronous Transfer Mode) [12].

1.5 Data bases

Data processing is today widely used for management and control, in the largest groups as well as in the smallest firms. The developments of applications were designed for centralized computers in meeting the requirements of software and hardware and specific needs of the firm according to its activities and its organization . To open their centralized data processing and to get or give information in a much quicker way, companies give their clients direct access to their data base for entering trade transactions; for instance the SABRE organization has equipped major travel agencies with a terminal and direct access for booking transactions. In this case the terminal or the direct access is dedicated to a specific application.

With the progress of data-base technology, today some firms are implementing relational data-bases which can be maintained and updated with a standardized 3rd generation language: SQL (Structured Query Language). This technology in data-base designing allows managing several data-bases distributed among different sites [13].

1.6 Messages

Today Electronic Data Interchange (EDI) is a widely held concept. Its function consists of exchanging data in a structured format (called a message) between applications of different firms through telecommunications networks.

There are a lot of interactions between levels of data processing used by firms (hardware, operating systems, telecommunications procedures, data-base ...) that increase difficulties to solve the global issue. The message can be sent by using file transfers, i.e. direct connection with the partner's data processing system, or transmitted through electronic mailboxes which supposes a third party, generally a value added network - VAN - (public or private). The exchanges of messages are asynchronous. The message is sent to a partner mail-box, and it will be read only when the partner's application looks at it. The CCITT have adapted their X400 protocol to EDI under the name of PEDI.

Some trade transactions need to be in real time - booking, for instance. Besides, most firms have developped transactional applications; so far the applications are committed to close systems which will be open only if firms provide their partners with dedicated terminal or direct access. Therefore various standard bodies are investigating EDI transactional protocol [1].

2 - THE STANDARDISATION PROCESS IN IST FOR TRANSPORTATION

2.1 General features

Nowdays the interest in standards spans an increasing area of activities. Standards are widely deemed as processes that bring numerous benefits for the community. But when we think about our everyday actions we can remember the failures of many objects that theorically work together: screws, plugs and sockets, units of measures, sizes of boxes, etc [4, 10, 11].

Standards practitioners are aware that the real work in this field generally addresses a messy, lengthy, unclear and uncontrolled process [3]. Standardization is a traditional activity with its intricate rules and usages that can be opposed to modern economic activity patterns: what is the price of a standard, who pays for it, how can the fitness of standard be assessed with regards to user needs?

The lack of users may be considered as the most annoying problem in the standard process, especially for the transport sector for which service activities are classified as end user. The electronics industry designs and implements standards that carriers and forwarders have to use. Transport sectors only have few representatives in IST standards bodies.

2.2 The pace of changes

It may be too easy to oppose the fast paced electronics business to the slow paced standard process, and the innovative approach of this modern industry to the conventional activity of standardization groups. However the risk of obsolescence of a standard once acheived is not of an academic discussion; several attempts for micro processing architecture have failed in the recent past. The most exemplary instance is this of the TELETEXT standard that was intended to substitute TELEX. Completed too late, this standard never caught on and was replaced by FAX.

In the real data processing world, standards are not widely used. Users are faced with every day problems like keyboard layout, screen, size and format of diskettes, national and special character codes, modem speeds, ... As long as the technological progress in the electronics industry advances quickly the standardization will have some difficulties in mastering the pace of changes.

2.3 Globalization

The globalization of modern economies would imply an increasing use of standards. Products could pass between manufacturers and/or customers all over the world. This discourse is widespread in magazines, technical meetings, and of course in standards setting groups.

The real use of standards is markedly different. They often serve the particular interests of a firm or an industry or a country in a covert or overt way. UNIX exemplifies the modern approach of the process where a commercial product, which is the ownership of ATT, is becoming the platform for open operating systems, as the first standard for the electronic label for containers is the ownership of AMTECH. These recent ambiguities entail conflicts and resistance that make the result of the standardization process increasingly hazardous.

2.4 Consensus

In the course of centuries the process of standardisation maintained the fundamental principle of consensus. First corporations expressed the wish to exclude other people. Then during the industrial revolution this principle guaranteed the freedom of members of an industry who do not want to be implicated in the results of such a process. Nowadays this principle is held because it allows to keep monitoring unclear but profitable procedures for circle of a happy few.

There are two significant exceptions to this principle: safety and competition. It is particularly true in transport that authorities are responsible for the safety of users, making standards compulsory. The conditions of fair competition involve growing political implications as we can observe in the EC. Some directives of the European Commission aim, through standards, to ensure that conditions are equal for all operators, that is, a minimum set of characteristics for products or services. According to recent opinions this minimum should be also a maximum within the current pressure for deregulation.

2.5 - Standards bodies [3]

2.5.1 - International Electrotechnical Commission (IEC)

Formed in 1906, the IEC, a voluntary organisation, mainly deals with the technical aspects of electricity. It produces specification standards that detail the minimum set of acceptable features that each product must conform to or be tested against. It is worth noting that despite its length of service and its notoriety, travellers always have trouble with their electric appliances.

2.5.2 - International Organisation for Standardisation (ISO)

Formed in 1946, it is the most prominent international standards organisation. Based on voluntary actions, it spans almost all technical activities with the exception of telecommunications and electrical sectors. There are approximately 2400 committees, subcommittees, working groups and study groups in ISO that have published over 6700 international standards since 1947.

2.5.3 - Joint Technical Committee 1 (JTC1) from ISO and IEC

A long awaited agreement between the two organisations lead to the establishment of the JTC 1 in 1987 with the scope of standardisation in the field of information technology and whose secretariat is provided by the American National Standard Institute (ANSI). The JTC 1 is composed of four groups (application elements, equipment and media, system support and systems) and 16 standards committees. It is mainly responsible for developing the Open System Interconnect (OSI) model, what denotes more conceptual activities than standards production. Open features imply generic standards that can be interpreted in many ways.

2.5.4 - International Telecommunication Union (ITU)

It is an old treaty organisation which is run under the auspices of United Nations. Its complicated structure reflects its formal nature with many groups, committees, etc. The most important are:

- International Frequency Registration Board (IFRB),
- International Radio Consultative Committee (CCIR),
- International Telegraph and Telephone Consultative Committee (CCITT),

We must make two important remarks about the recent trends of its activities. First, as deregulation proceeds in the domain, activity shifts from PTT regulation to more classical standards and recommendations. Then, as the boundaries between telecommunications data processing blur, its studies span more specialised (professional) items, especially in the field of data communications.

2.5.5 CEN/CENELEC [5]

Since 1971, the Comité Européen de Normalisation (CEN) is the regional equivalent of ISO as well as the Comité Européen de Normalisation Electrotechnique (CENELEC, 1973) correspond to IEC. Different from other similar organisations, the CEN/CENELEC has a quasi-legal status. Thus their published standards are compulsorily endorsed by each member state of the Community. Furthermore, in compliance with the European directives for EC economic union by early 1993, these organisations are trying to monitor the European certification testing houses thereby enforcing their role for stipulation.

3 - EXAMPLES OF STANDARDIZATION IN IST FOR TRANSPORTATION

Standardization can bring benefits adapted to needs, if procedures do not come too late, and if the other circonstances are favorable. We present two case studies: the standardization of EDI and automatic identification systems.

3.1 - Edi standardisation

EDI (Electronic Data Interchange) is the exchange of structured trade information (messages) between different applications of different firms through telecommunication network, in compliance with common specialized syntax and dictionaries [2].

EDI standards are concerned with determining agreed message structures, codes and data. EDI standards are neither telecommunications nor data processing standards but imply some accurate interfaces between them.

By 1960 in the US, the first EDI standard organization was formed in the transport sector with the TDCC (Trade Data Coordination Committee). This association works out standards for information exchanges which were supported and completed to the needs of other sectors by ANSI X12.

Realizing the growth of trade information exchanges, at the initiative of the UK with the Simplification of International Trade Procedures Board (SITPRO) and with the support of UN, the process of standardization for transferring business documents started in the eighties. The work has been in charge of UN/ECE WP4.

By September 1987, ISO standardized the data dictionary (ISO 7372) and the syntax to build messages (ISO 9735). These two standards have be named EDIFACT.

A worldwide structure (including the US) supported by the UN/ECE has been created for EDI standards development named EDIFACT BOARD. The Western European EDIFAC-BOARD is associated with the CEN and it consists of different maintenance groups and sectorial message development groups (MD's). These BOARDS support the following directories:

- UN/EDIFACT syntax rules;
- UN/Trade data element directory;
- UN/EDIFACT composite directory; grouping of functional data such as addresses;
- UN/EDIFACT segment directory; functional grouping of data elements and composite elements (Name and address, Date and Time, Location ...)
- UN/EDIFACT code sets; internationally agreed codes

The directories get a status level: 0 stands for draft document, 1 for trial use, and 2 for United Nation Standards recommendation.

The Message Development group in the transport field (MD2) is in charge of designing multi-modes, multi-functions and multi-activities standard messages. The main message developped, named IFTM-FR is a framework; it is the development basis of other functional transport messages. For the time being, only 6 messages received the status 2, 10 are in status 1, and 10 in status 0.

All change requests proposed by the MD group must be reviewed by the maintenance group, and these groups often give their agreement regardless of the message structures and the actual needs.

The EDIFACT organization was not the only one thinking about data exchange standardization. Early on large multinational organizations or trade consortiums were using electronic transaction systems intensively. For instance, in 1969 the companies grouped in IATA (International Air Transport Association) developped a language and procedures for exchanging freight information: the CARGO-IMP standard which is in its 8th version. This organisation will use CARGO-IMP as an air-freight exchange information standard; in order to open its system, it is designing specific EDIFACT subset messages for its exchanges with air forwarders, based in 90.2 directories.

Because of the slow progress and the shortage of actual EDIFACT standards, because of the ambiguity of existing EDIFACT messages which must meet all modes, functions and activities in transportation, consortiums of trade firms have been created: they designed their own relevant messages which meet their own needs, often specific subsets of EDIFACT messages if the message function existed. They developped their user guideline, and chose their process and networks.

For instance, the GTF group composed of French carriers working in LTL transportation, has developped its own messages and EDI flow procedures based on EDIFACT standards. The retail industry in France as in other countries, built their own EDI system in which the messages are not based on EDIFACT structure, but on EAN (European Article Numbering) codification, and especially in France GENCOD.

In other sectors, one can observe the creation of EDI consortiums: ODETTE in the automotive industry, (which started before EDIFACT, using its own data codification and syntax), CEFIC in chemistry, EDIFICE in electronics, etc.

The formation of an EDI consortiums has become a major characteristic of the EDI environment. They propose entire, sectorial and in some cases international EDI solutions. Often these consortiums supported by large firms look like similar standard organizations. This practice of standards is springing up in other sectors, especially in data processing and data communications where major manufacturers are setting up numerous consortiums which are aimed at establishing specifications quickly and efficiently in order to fix trouble in interoperability that slows down the launching of new products.

As the use of EDI is a major business gamble, users are waiting for an all-inclusive EDI standard. The EDIFACT standard suffers from time delays; EDI standardization is very slow because of an endless tangle of red tape [6].

The experts in MD2 come from transport firms, but in transportation, there exists a wide variety of firms whose involvement and strategy are not the same. Activities are varied too. Operations and needs are different between a carrier, a customs broker, a forwarder and an agent, and also between transport modes. Corporate experts do not have the same level of knowledge about Information Systems and Telecommunications and information flows in the transport chain. At the beginning, and until now, message developments have been based on traditional trade documents. It takes a long time and a lot of meetings to gain a consensus about their adaptation to automatic processing use. Messages suffer from drawbacks: they have become intricate, puzzling, or ambiguous. Many professionals have cast doubts on the prospects of EDI standardization.

For this reason, some large companies, such as consortium design their own messages, often based in EDIFACT structure, in cooperation with their trade partners. They have thus accumulated some expertise. Thus they can impose their own messages as sectorial standards.

Nowadays, in Europe EDIFACT standards in the transport sector are apparently in use with the IFTM-FR message, possibly because CEN is an associated body. The most private EDI developments are based on this message framework, with their own EDI scenario, codification and few functional segments, if they do not exist in EDIFACT directories. Consequently there are no generally accepted standardized transport.messages in use to exchange transport data with any partners.

3.2 - Automatic identification

The aim of automatic identification systems is to make digitilized data available to a computer without human processing. This can be implemented using bar coding, radio tags, character or voice recognition. In this section we shall outline what is done in standardization for bar coding and radio tags which are in use.

3.2.1 - Bar coding

When talking about bar codes, it is important to distinguish between two concepts. The dark and light bars in a label form a symbol, which contains data in coded form. This system of identification have been in use for long time , particularly in the retail sector. Each sector used its own particular system: grocery, chemist, paper-making industry etc [12].

There exists different private symbolisation systems grouped in two types: systems which can be used to represented alphanumeric characters and others that can be used to represent numbers. In addition, it is necessary to distinguish between the discrete code symbolisation systems and the continuous code symbolisation systems. In the absence of an actual symbolisation standard, manufacturers supply equipment able to produce and to read more than one different symbolisation system.

ISO has groups working on that, but no standards are been defined to this day.

The symbolisation systems are always proposed with the data in coded form as a standard bar setting by a consortium of users. In Europe the most usual standards were designed by the retailing industry with the EAN standard, and became a de facto standard in this sector, (FACT is used in US). Recently the CEN structure with the committee n°225 has been studying a standard for the identification of coding data (EAN has the chair of this committee). The first task will be the study of the both the EAN and FACT systems in practice, and to check whether they can be compatible with a few changes.

3.2.2 - Radio tag

The radio tagging systems involve a small electronic device on a object (moving or not) that transmits identifying information to an interrogator or reader. Because of the current price and the dimension of the tag, this system is use only for containers, swap-bodies, waggons, and other equipment.

Two years ago, ISO asked CEN to standardize radio tags based on the documentation of a US radio tag provider. This provider was the only one who could offer radio tags put into use by certain companies. The CEN rejected this standardization because the future new tag makers using this standard would have to pay royalties. On the other hand, the implementing procedures included the use of 900 Mhertz frequency which is not allowed in Europe.

Nine months ago, it was agreed to create an ISO sub-committee working in an open protocol for automatic identification by the radio tag system. And contrary to expectations, the first work will be based on US provider specifications. This sub-committee should design the parameters of using a radio tag: reading distances, speed, hight, frequency, the coded information included, and decide whether they can only be readable, or readable and recordable, etc. The work would be done by August 1992. One supposes that drawing up of standardizations will be ready at the end of 1992. But the real standard will not be effective before 1994-95.

3.2.3 - Future of automatic identification standards

All these means of automatic identification need an agreement on coding data. Nowadays only one standard is defined by ISO and CEN: container identification = container's owner + container's number.

As they are interested in automatic identification for transportation, the firm can offer their clients more and more tracking and tracing systems.

In the last years CEN and ISO, aware of the need, have created a working group for standardization in this area. The studies are performed at different levels (parcels, equipment) and respond to specific requests for automatic identification systems.

AFNOR, following the exemple of EDITRANSPORT (France), is offering ISO a study of an identification meta-model. This model will give a standard for all coding information contained in a medium, necessary in transport operations, and compatible with the use of EDI and all IST systems in transportation.

At the same time the EDIFACT-BOARD are investigatting a single identifier whose name is Common Acces Reference and which can be used in automatic identification systems.

4 - TRANSPORT FIRMS AND THE STANDARDIZATION PROCEDURE

4 - 1 Transport and environment

As is the case for many industries most large transport firms had to develop internal standards for computer uses as they always did for equipment, accounting and most aspects of their activities. This in-house standardization normally covers all facilities of the firm, and is imposed by a central authority.

More than in other industries, transport firms have to deal with many firms of various categories, because of their widespread role in the economy. The growing complexity of transport itself in the last decades has increased that feature even more: nowadays, one third of shipments use two or more vehicles, multiplying the role of many other firms for consolidation, tracking and inventory management. One would expect this to call for increasing needs of standardization, not only in information technology, but also sizes, nomenclatures, procedures, etc [7].

Actually, the size and variety of needs proves itself to be an obstacle. To take the example of EDI, it is well known that the level of difficulty increases proportionally much more than the number and variety of partners. Furthermore, transport firms often have a much lower bargaining power than shippers. This results from frequent overcapacity, intense competition between modes, between types of organizations and between firms. It is not unfrequent that the shipper imposes its own standards on a transport firm. Another consequence of this lack of relative strength is that in most modes transport services are underpaid and the profit margins in the industry are low. Therefore they do not have enough internal resources to buy, and even less to take part in the development of large EDI systems, which could eventually become a well accepted standard.

4 - 2 Rationale and impediments

What reasons would a transport firm have for entering a large standard system? There are indeed many hurdles. The first one is obviously the cost: in equipment adaptations, in hardware and software and - probably the most expensive - to train employees properly. The number and size of costly failures, in EDI among others, also act as a deterrent for firms involved and also for people who hear about these failures. Information through leaflets, articles, books, symposia, and so on is available in such quantities that it soon becomes a full-times job just to keep up to date on it, and only to realize that most of this information is vague, redundant and untrustworthy. The quality of most systems is overstated, especially as far as the ease of compatibility with other systems is concerned. As far as the positive aspects are concerned things are more difficult to assess [9].

The introduction of EDI will probably reduce the cost of paperwork, but the literature currently available is rather vague and does not allow for any type of serious cost-benefit analysis. The frequency and cost of mistakes, losses and frauds could decrease further, but here again, one does not know how to assess the resulting benefits. How can they know, on such bases, whether these benefits will outbalance the cost and difficulties, which are much more foreseeable and assessable?

What remains then is the general thought that an ambitious firm should not miss such a promising train. But the "wait and see" attitude is probably more common, especially for small and medium sized firms.

4 - 3 Achievements

One should not conclude from this dark picture that any standardization project in transport is doomed. Sizes of vehicles, for instance, are normally imposed by governments, or more recently by the EC. There are nevertheless constant fights to modify them in accordance with the contradictory arguments of various special-interest groups. Neither can one exclude a general falling apart of some sets of rules, as can be seen for dimensions of containers.

In the case of EDI, there has been some success, mostly of a rather limited scope. Sometimes it is the product of organized local professionnals, who build a local inlet system, not very ambitious but useful. Big firms are sometimes in a position to impose a system on a whole profession or professions. This proved highly successful for air passenger reservations, but there are also failures in that category. Industrial branches, in the car industry, in chemistry and in electronics managed, after many efforts, to create a standardized set of messages for themselves and impose it on their partners, among which transport firms. Large transport firms have a natural tendency to give priority to standardization procedures with their counterparts in other countries, but operating in the same mode: air, rail, sea shipping. The general uniform universal language is still a long way ahead, and in the meantime the Tower of Babel is still getting higher.

CONCLUSION

The complexity of new technologies and the globalization of current economic exchanges require an increasing degree of international co-operation, while competition is often becoming fierce. Therefore the standardization bodies are traditional and natural forums where interests can be confronted.

Nevertheless this process is slow and cumbersome in such a way that the balance between benefits and drawbacks is unclear for most participants. Given this, the development of technical consortiums appears as a necessary shortcut in fields where the pace of change is rapid, although these consortiums do not not solve all problems.

BIBLIOGRAPHY

[1] BOLLO Daniel, STUMM Marielle, Using Transport Messages, COMPAT91 EDI Europe, Copenhagen 1991

[2] BRIDE Laurie M., FINCHER Judith A., KIDWELL Robert S., PARISOT Charles, EDI's Role in a Strategy for Digital Data Exchange, An Evaluation Report from the CALS Steering Group and the MAP/TOP Steering Committee

[3] CARGILL Carl F., Information Technology Standardization, Theory, Process, and Organizations, Digital Press 1989

[4] FORAY D., Exploitation des Externalités de Réseaux Versus Evolution des Normes, Revue d'économie Industrielle, mars 1990

[5] FRANKEL Karen A., The Politics of Standards and the EC, Communications of the ACM July 1990

[6] INTERNATIONAL CHAMBER OF COMMERCE, ICC Policy Statement on the Development of EDI in International Trade, October 25, 1991

[7] IOANNOU L., EDI: Sharpening the Competitive Edge, Euromoney Marsh, 1990

[8] MANGEMATIN V. The Place of the Standardization in RTI/IVHS Technologie Competition, 24th ISTA Symposium, Firenza, May 1991

[9] PROGINET Joe Mohen, OSI Interoperability: Separating Fact from Fiction, Data Communications January 21, 1992

[10] de ROBIEN Emmanuel, Les Stratégies de Normalisation dans le Domaine de l'Information, Revue d'Economie Industrielle N° 39 1er trimestre 1987

[11] SOLOMON Richard Jay, New Paradigms for Future Standards, Communications & Stratégies, 1991

[12] STUMM Marielle, Tecniques de l'Information et Transport de Marchandises, Rapport interne, septembre 1991

[13] Report on the Open EDI Conceptual Model, ISO/IEC JTC1/SWG-EDI 1991