

Standards facilitating adoption of electronic exchanges

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Abstract

Electronic data exchange has made the logistics and supply chain faster and more efficient. However, the technical departments of companies are getting bigger because of the lack of interoperability of messages and the need to create bridges between different business processes, syntax and data elements. Recognized international standards can facilitate these exchanges and ensure better understanding between all parties in the logistics change exchange of information. This paper concentrates on the standards of UN/CEFACT, the United Nations Centre for Trade Facilitation and Electronic Business under the UN Economic Commission for Europe.

Keywords: digital technologies; standards; UN/CEFACT; UN/EDIFACT; semantics; electronic messages

1. Introduction

In today's context, practically all information has at one time or another been on a computer – but have we really reaped the full benefits of computerization? Too often, information is input into a computer system, then printed to be sent onto a partner who will have to input the information into their own computer system. When a system to system exchange is put in place, it often implies creating bridges between the systems in order to interpret the meaning of each element of data; any changes from the original bridge mappings can result in misunderstandings, delays and errors.

Full use of computer systems in the logistics information exchange and throughout the supply chain has the potential of reducing or eliminating human error when capturing the data, to speed up the process as the exchange can be system to system and distribute to multiple relevant parties in the click of a button. If everyone uses the same computer system, this would be easy... However, most actors on the supply chain will have different computer systems according to their own needs – warehousing, dispatching, scheduling, client relations, invoicing... And this multitude of systems encourages a free market to bring cost-efficient solutions. But the interoperability of these solutions may cause problems.

Standards are intended to simplify the understanding between partners, but which standards to choose? There can be as many standards as there are computer systems as each may define their own internally. The problem is when the information leaves one solution and needs to be integrated into another solution. Using internationally recognized standards is a solution but there are a multitude of choices.

Four factors need to be considered when choosing an international standard. 1) Is the standard used in the industry or will it require a change management from the current business processes? And is it a standard which can be trusted (that the maintenance will be insured)? 2) Who develops the standard and how are experts permitted to join the development process? Is it necessary to pay in order to participate in the development – in which case there may be strong commercial interests influencing the results? 3) Who approves the standard? What is the process for a project to become considered a standard? Who are the deciders here? Again, if this is influenced by a small group of commercially-motivated organizations, the results might be influenced to their interests. And finally, 4) are the results for pay or available free of charge? A robust standard that comes at a high cost may inhibit its use and definitely discourage smaller stakeholders from using it.

This paper considers the standards of the United Nations Centre for Trade Facilitation and Electronic Business, UN/CEFACT (under the United Nations Economic Commission for Europe, UNECE). Testing this organization's standards against the four points above, they satisfy accessibility and unbiasedness. 1) The base standards such as UN/EDIFACT are used on a daily basis by thousands of companies and administrations worldwide. The UN/CEFACT XML standards are progressively used across the globe. 2) Any private or public sector actor can participate within UN/CEFACT standards development as long as they are approved by their country – this process is without a cost and experts are not paid for their contributions. 3) All member states of the United Nations ultimately validate the standards; this process should eliminate all potential bias. And 4), all standards are published free of charge on UN-maintained public websites.

2. Buy – Ship – Pay

This paper concentrates on shipping and logistics standards, however this is only one link in an entire supply chain of events. Without commercial transactions, there would be very few shipments. And it is necessary to satisfy regulatory procedures in order to cross borders. Though often complex in nature, the entire supply chain process can be schematized as Buy – Ship – Pay, that is the commercial transaction, the execution of delivery or service and the payment. This model was developed by UN/CEFACT almost twenty years ago. (International Supply Chain Reference Model, 2001)

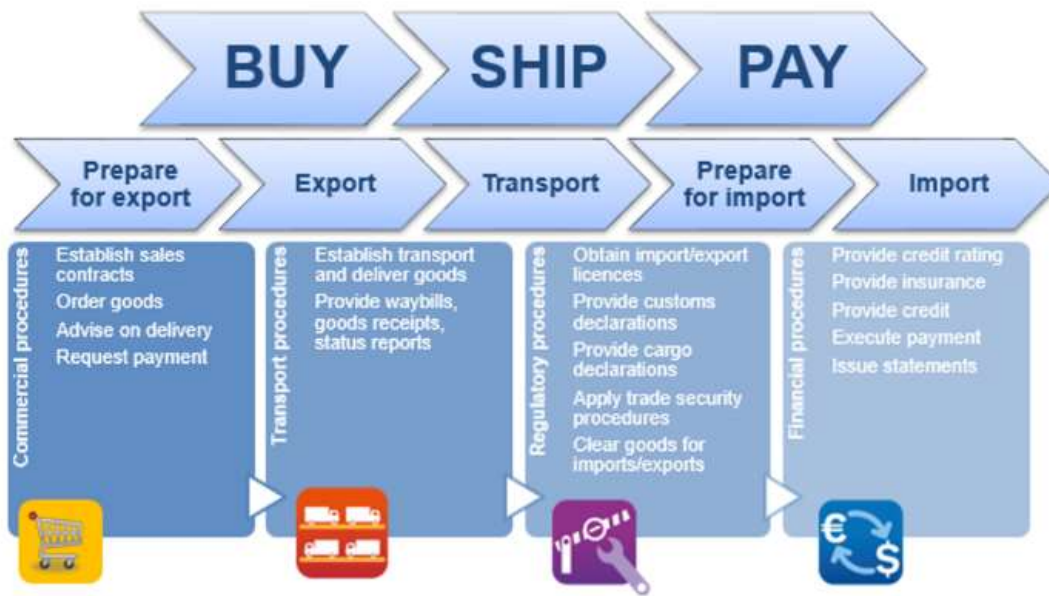


Fig. 1 Buy Ship Pay Model, International Supply Chain Reference Model, UN/CEFACT

The information within this supply chain of events will be constructed at each stage of the buy, ship, pay process. Information must be shared between these three stages and additional information will be added. Solutions or standards that will only consider one of these stages must remember that their information must be reused in other stages. For example, the regulatory information which must be transmitted to customs agencies or other government authorities will be using information that is exchanged in the context of other, commercial interactions such as purchasing, shipping or payments. Likewise, information transmitted for rail or air transport will result from a preceding commercial transaction and further exchanges like regulatory declarations or payments will take place after the transport. No single part of the Buy-Ship-Pay model can be taken in complete isolation of the others, which is why UN/CEFACT takes a wholistic approach.

3. Interoperability of standards

Some systems or some sectors of activity have traditionally used a specific standard which will not be the same as those used by other supply chain actors. Or, for commercial reasons, multiple systems each with different standards may be desired. In these cases, interoperability from one system to another will be essential in order to capitalize on the potentials of electronic data exchanges. Interoperability can be considered on four levels: semantics, business process, syntax and legal. (UNECE Recommendation 36, 2017).

3.1. Semantic Interoperability

Semantics is the base definition of each individual data element contained within a message. These base definitions are usually aligned to the United Nations Trade Data Element Directory, or UNTDED. This was later brought to the International Standards Organization, ISO in order to be jointly maintained (ISO7372). This directory lists every business term which had been previously been defined on the UN Layout Key (UNECE Recommendation 1, 1971 revised 2017). The directory is very complete, however, some terms might have different meaning when used in a business context. (UNTDED 2005, ISO7372, 2005)

UN/CEFACT has therefore worked on an encyclopaedia of all data for cross border exchanges, and has also defined these in their relevant business context; the result is the UN/CEFACT Core Component Library or CCL. Through the CCL, there can be no confusion between the city name from the address of the exporter and the city name from the address of the transporter as each are uniquely identified. Through the Memorandum on eBusiness concluded between UNECE, ISO, the International Electrotechnical Commission (IEC) and the International Telecommunication Union (ITU), UN/CEFACT is identified as the body that should centralize the base semantic definitions of all data elements. Alignment has been done with other standards organizations such

as the World Customs Organization (WCO), the International Air Transport Association (IATA), the Open Application Group (OAGi)...

Why is semantics so important? In exchanges, we might use the same words, but each party understands what these words mean differently. In the resulting exchange, we may provide information in good faith thinking that it means something that the receiver does not recognize or worse, misinterprets. If a common base semantic definition is used by all parties, then the information is understood in a consistent manner. This becomes essential when the information exchanged is shared by multiple parties. At the outset, the information may be provided with the intent to only be used by one partner. In a contract with an obligation of results, it is common to subcontract without the original consignor or ultimate consignee being aware of these arrangements; a common definition of data is essential. Likewise, information provided to the transporter may subsequently be used for regulatory formalities; again, a common definition of data is essential to avoid unnecessary recapture or establishing bridges between data sets.

3.2. Business Process Interoperability

The exchange of information is in the framework of a business process. This exchange can be in the form of a full paper document, or snippets of information. The business process itself can be assimilated to the choreography of exchanges and the actors making those exchanges. In order for the information to have meaning to the parties, it needs to be received or transmitted within the context of an understandable choreography of exchanges. This is essential in all exchanges; however, it is even more so in an electronic exchange because information being received outside of the context of a known exchange will not be useable.

When putting in place an electronic exchange, two partners must agree on the appropriate choreography of exchanges; this is logical. However, if an entity needs to deal with multiple partners and each one defines a different business process exchange, a good deal of investment will be necessary in order to establish, maintain and execute these processes. This could be simplified and facilitated by using internationally defined business processes. UN/CEFACT continues to develop such choreographies, called Business Requirement Specifications.

3.3. Syntax Interoperability

Syntax is the structure of the electronic message. The business process tells us when information is shared and who shares it; the semantics tells us what is shared; the syntax tells us how to share it. It is impossible to have an electronic exchange between two parties without both agreeing to a specific message structure or syntax. So, this is inherently solved when implementing dematerialization. Why bother with interoperability or standards?

Here again, we will recognize that there will be multiple partners to any supply chain activity, usually accompanied by a number of message exchanges, either because of their role in the Buy-Ship-Pay model, or because of the number of parties involved in the single transaction between order, purchase to deliver and payment. If each exchange is taken independently, it could result in multiple syntax. Similarly, one single actor, like a freight forwarder, might have a very large number of clients, each requesting a separate syntax. This will result in the need to have a team of specialists just to ensure the implementation and maintenance of these messages.

International standards can here again significantly facilitate and harmonize the processes. There are several syntax languages such as UN/EDIFACT, XML or JSON just to name three. But these languages can have their own variations which are not necessarily mutually understandable. XML for example can have as many different variations as there are business partners. And just like certain electronic gadgets that will force you to use their own adapters and plugs, it will be impossible to interchange with other messages. UN/EDIFACT here is different as it is centrally maintained and published by UN/CEFACT and UNECE. UN/CEFACT does propose a number of XML messages, some of which have been very successful despite opposition from some special interest groups.

3.4. Legal Interoperability

This final level of interoperability finds its importance in cross-border trade and establishing legal acceptability of information in case of litigation. It is not necessarily pertinent to purely business-to-business documents that will never be used in a court of law. Each government defines what can and cannot be accepted as legally

binding and private-sector actors are bound to work within the framework of each jurisdiction within which they are working.

Interoperability here would be at the government level and would provide legal assurance to the various companies that if they use a specific electronic message for a particular business process, it will be acceptable. This is not necessarily the case today; some countries may accept an electronic invoice as part of the documentary requirements for regulatory processes while some other countries may not accept these. The result is that the electronic data flow is interrupted and paper documents must be generated from the electronic flows.

Governments considering legal acceptability of electronic messages in the logistics chain and the supply chain would help to reduce the administrative burden on companies. Such legislation will often cite the pertinent standards that must be used for such exchanges where we find again the importance of the three other layers of interoperability as well as the four factors of international standards organizations from above.

4. UN/EDIFACT and Code Lists

UN/EDIFACT is probably the most widely used syntax daily across the globe. Most maritime carriers, road transport, freight forwarders... send thousands of messages each day. It is also used in the commercial, regulatory, finance, insurance... to name just a few. It provides a level of stability and reputability which may not be found in a number of other standards since it is centrally maintained by UNECE – UN/CEFACT. Certain messages may be developed outside of UN/CEFACT, but in order to be published as the UN/EDIFACT standard, it is necessary to be harmonized with the existing messages.

Integrated into the UN/EDIFACT messages are a number of standardized code lists for everything from types of documents to types of packages and traders' roles to date-time formats. Most electronic messages will use these code lists in their message exchanges. Some of these have been integrated into UNECE recommendations. Code lists are just as important to interoperability as the four levels listed above.

In an international context, if all of the data to be exchanged is textual, we will soon be faced with differences caused by language. A textual explanation of the type of package in Turkish may be completely incomprehensible for a trader in Mongolia or for the Indian transport company. This is true even in a same language where there can be variations to explain the same thing such as a pallet (slab, board, palletized, GMA pallet, honeycomb slate...). To the initiated depending on the context, these may all be interchangeable, but to a computer system that has not been programmed to recognize these similarities, they will each be something different.

UNECE Recommendation 2 advocated that all information that can be codified should be codified. By using brief codes instead of textual explanations, we can facilitate the understanding between actors on the data exchange chain. In this way, we are sure that the correct information is being understood the same way by all parties that will receive the data.

5. Event-driven information exchange and Reference Data Models

The UN/CEFACT Core Component Library (CCL) has the pretention of being a semantic hub for all commercial, electronic data exchanges. This covers all areas of activities from the initial commercial information such as catalogue or offers, through the transport and logistics processes such as packing lists, waybills, berth management, regulatory requirements such as permits, certificates, declarations, but also sector specific information related just to agriculture, automobile, insurance, utilities...

The UN/CEFACT-CCL aims to put all of the relevant data not only with its base definition but also in its business context. By doing so, the information is put into a hierarchy of information. An example of this can be an address; the address will almost systematically contain lines, a city, a postal code, a country and often a contact person and telephone or email. But an address can also be part of a larger grouping to describe a consignee or a transport company... So, a city name in an address will be in the context of a full address which is itself in the context of its business use with a consignee or transport company. All of this is developed according to very strict design rules in the UN/CEFACT Core Component Technical Specifications (CCTS).

The result, however, becomes larger and larger with each new business process and the current library has more than 20,000 elements. When a party wants to use the library for a transport and logistic message exchange, they

need to download the entire library and then sort through data entries that have nothing to do with the business process they want to implement. So, UN/CEFACT has developed logical subsets in order to restrict this huge encyclopaedia into just the chapter that are necessary.

5.1. UN/CEFACT Reference Data Models (RDM)

UN/CEFACT Reference Data Models (RDM) are subsets of the CCL to include just the information which is pertinent to a specific area of activity like transport/logistics or like supply chain (commercial aspects). These two areas are currently defined in RDM: the Supply Chain Reference Data Model (SCRDM) and the Multi-Modal Transport Reference Data Model (MMT-RDM). These are both a little more than 1000 elements each, about 5% of the full library. These subsets present the data as well as the hierarchical structure of the information and present subsets of the corresponding code lists as well (so in types of documents, traveller's insurance or utilities declarations would not be presented either), thus simplifying the reuse of the data pertinent just to these areas of activity.

The RDMs also prepare the information for an event-driven approach to data exchange. The CCL and the RDMs can be easily converted into an XML structure using the Core Components Business Document Assembly and UN/CEFACT's XML Naming and Design Rules. The information contained in the RDMs can therefore easily become electronic messages as a data ensemble as opposed to a traditional business document (or electronic equivalent of a traditional business document). It is not necessary to send the entire reference data model with each message, but to just exchange whatever information is pertinent and the party receiving should be able to fully understand by using the standard.

5.2. Event-driven information exchange

Traditionally, when we talk about electronic messages, we are referring to the exchange of a traditional document via electronic message exchange. Within the message, we find all of the information pertinent to that document. This is logical evolution and still very pertinent in today's business environment; not everyone will have access to all of the data all of the time, so they need the information contained on a traditional document in order to perform their activities.

However, event-driven – otherwise referred to as process-driven – information exchange will be required for several key evolutions. Blockchain is a new authentication methodology which will record the data exchange in an encrypted message that is distributed on multiple servers – the integrity of all of the servers and the identical information on all of them produces the equivalent of a high-level authentication. In order to optimize the use of blockchain, an event-driven approach will often be the most effective. Though it is possible to exchange full electronic documents via blockchain, the exchange of snippets will correspond better with the technology.

Single Window implementation should also require an event-driven approach as opposed to a complete document-driven approach. According to the UNECE Recommendation 33, if the information being communicated to the Single Window is presented in electronic format, it should only be submitted once. However, on a traditional document, there is up to 75% of the information which is repeated from previous procedures (the parties, the merchandise information, the logistics information...). To date, most Single Window implementations are document driven and even though the information is electronic, the submitter must repeat the same data multiple times in the system. To truly correspond to the Recommendation 33 definition, an event driven approach should be adopted. This is facilitated through the UN/CEFACT Reference Data Models.

6. Pipeline

Several customs agencies had identified that one of the main problems in the data they received on declarations was the poor data quality. The concept of rubbish-in, rubbish-out meant that getting poor data on declarations meant that their risk analysis and other administrative processes were equally poor. Somehow, it was necessary to get the information from the source of the information and thus improve the overall data quality. The concept of data pipeline was created. (Hesketh 2010. Hesketh 2012)

The basis of the Data Pipeline as it was developed in the EU project Cassandra and Core is that information is captured at its source and stocked on a virtual pipeline of information. Each actor in the supply chain and logistics process adds information to this virtual pipeline for their actions in the chain, without modifying the

information already captured. In this way, the information which is received at destination is as close to the reality as possible.

The event-driven approach of UN/CEFACT's RDMs clearly support this new method of data sharing. UN/CEFACT has launched a project in order to clearly explain the business processes and all the potential data being exchanged and thus creating a standard for the data pipeline concept. The EU FP7 project, Core created such a standard based on the UN/CEFACT Multi-Modal Transport Reference Data Model and this is now being proposed as an international standard of this organization. The EU H2020 project, Selis is going even a step further, presenting separate pipelines for commercial and logistics points of view. The former is based on a shipment – from buyer to seller / commercial – view of the exchange of information; the latter is based on a consignment – from consignor to consignee / logistics – view of the exchange of information. As the information is constructed as the goods move along the supply chain, this allows for a multiple to multiple relationship between the shipment and consignment views.

7. eCMR

The international « Convention relative au transport international de Marchandise par la Route » has foreseen an electronic version of this paper document, which normally accompanies the merchandise, however it did not prescribe a standard to be used. UN/CEFACT is working closely with the IRU in order to provide a standard electronic version of this for facilitating its use and ensure compatibility between electronic solutions.

One of the main challenges of this project is the speed at which it needs to be done. Standardization through a body like the UN, with the approval process of the member countries' representation, requires a certain amount of time. However, the industry is moving forward already with solutions within Europe. If these solutions are done point-to-point, then the industry will be faced with multiple methodologies to do the same process and perhaps need to implement a number of these.

By using international standards such as those proposed by UN/CEFACT for an electronic equivalent to the CMR, adoption of the electronic messages will be facilitated as they are available to all freely and have been developed by the main stakeholders. It avoids any single company having a monopoly on the segment and ensures a common understanding of the entire process and all of the information to be exchanged.

8. Smart Containers

Certain movement of goods require temperature control or special care during carriage. Devices have been created that can be attached to a container in order to transmit specific information such as temperature, pressure, shocks, opening of the doors... This allows the actors to remain connected to their goods throughout the logistics process. However, this information is usually not transmitted as a complete 'document' and the communication standards may be developed independently by each producer of devices.

UN/CEFACT has launched a project to standardize these data exchanges based on its Multi-Modal Reference Data Model, facilitating the adoption and ensuring a common understanding of all of the information that could potentially be exchanged for supply chain actors as well as for the regulatory agencies that could eventually use this information to expedite controls and border crossings.

9. Conclusions

Standards are an integral part of electronic message exchanges. Choosing a standard or developing an in-house standard can always be a difficult process. However, these decisions must not be taken lightly. The data exchange context must be considered as well as the lifecycle of the data itself – is it to come from upstream processes or will it be used for downstream data exchanges? The levels of interoperability need to be thought through. The base for every data exchange will be the semantics of the data it is to transmit; using clear, international definitions will ensure ease of understanding between all involved. The business processes and syntax will also be key in defining how much investment each partner will need to invest in electronic exchanges – the lower the interoperability on these levels, the more costly these implementations will be across the board.

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