Aspects of the external integration of production management systems with EDI

Integration in Production Management Systems
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Aspects of the External Integration of Production Management Systems with EDI.

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Abstract

Electronic Data Interchange (EDI) can truly be seen as one of the major developments in communications technology over the past few years. The advent of EDI standards makes the integration of different companies' systems a feasible enterprise. As is the case with any technology, EDI is not a purpose in itself, but a means to improve inter-company processes. A clear logistic or administrative purpose is required to achieve a successful and lasting EDI implementation. From a technical point of view the introduction of EDI is not difficult. But many aspects need to be taken care of, in order to achieve a successful integration of production systems. This paper addresses some of these aspects.

Keyword Codes: C.2.4; J.7; K.4.3
Keywords: Distributed Systems; Production Management Systems; Organizational impacts.

1. INTRODUCTION

Electronic Data Interchange (EDI) is the electronic exchange of information between the computers of parties that are engaged in business transactions [1,2].This exchange is done by highly structured and standardized messages. Application programs need to be adapted to achieve this. The EDI messages must be generated from an application program at the sending side and must be received by an application program at the receiving side. With the introduction of EDI, automation extends beyond the boundaries of the individual firm.

EDI is message oriented. In a way, therefore, it is a relatively loose coupling of computer systems. With EDI, there is no such thing as one integrated information system, that encompasses several companies in a business supply chain. Each firm has its own autonomy and its own independent computer application programs. The exchange of information however is achieved in a way that is standardized and agreed upon between parties.

The introduction of EDI is not a purpose in itself, nor is it primarily a technical problem. It fits within a process of external integration and intensified relations between a production firm and its suppliers, in order to improve the underlying logistical and business processes. This requires stable and long term business supply relations to exist between parties [3,4].

In an ideal end situation the planning processes of a production firm and those of its suppliers have been interconnected. The production firm feeds via EDI the mid term material requirement forecasts (e.g. the result of its MRP-runs) several times a week directly into the suppliers' production planning processes. Suppliers can thus with greater reliability and with lower stock levels fulfil the frequent (e.g. daily and just in time) material call offs, that are being received via EDI. Suppliers have improved their production control process such, that at goods

reception quality control is no longer necessary and goods can be moved directly to the production lines of the buying firm. Suppliers label their shipments with barcodes and send details on the daily shipments via EDI to the production firm. By barcode scanning at reception, the information flow is synchronised to the physical goods flow. This offers complete visibility on both sides as to types and quantities delivered. Because prices have been set as part of the long term business arrangements between firms, daily invoices are not required: the production firm sends out its payment orders based on goods reception. The high call off frequency would otherwise have led to congestion problems in the administrative process.

It is obvious that such a logistic and administrative integration between firms takes time and attention. It heavily affects the various departments and procedures involved. It is also obvious that the introduction of the technology EDI is only a small, albeit necessary part of this integration process. EDI offers the means to achieve this kind of integration. The introduction of EDI in this way challenges the strategic redesign of current business processes.

Effective integration of production systems can only be achieved within the context of a stable and long term partnership relation, with frequent and/or voluminous exchanges of goods and information. Only then the arrangements and investments required will pay off. But it is not just the investment that matters. Implementing Electronic Data Interchange between partners formalizes to an even greater extend the business relationship between the companies involved. It makes this business relation more rigid.

The result of the integration and its detailed, differentiated and rapid information exchange and automatic processing is a more flexible response to the market. So flexibility to the market is achieved, at the expense of rigidity and stability in supply relations.

2. RESTRUCTURING THE PURCHASING PROCESS

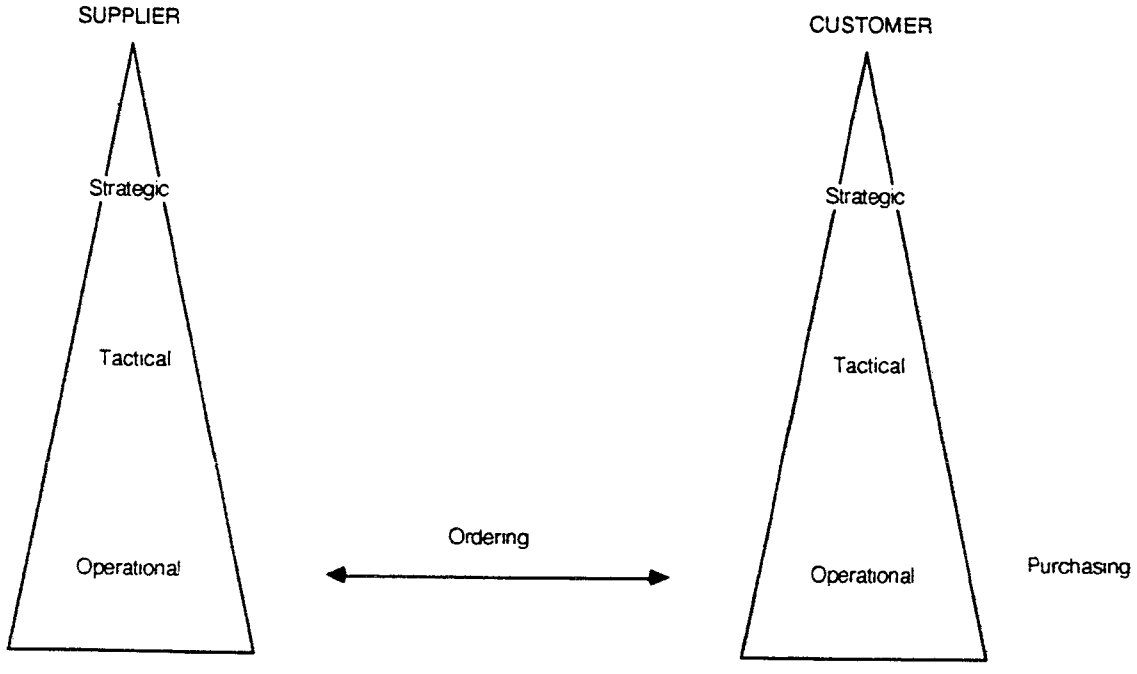


Figure 1. Communication between customer and supplier in an 'incidental' way

In the traditional purchasing practice ('shopping behaviour') a company time and again searches the market and requests for bids from suppliers. It will negotiate with several suppliers and select that one supplier, that can deliver the requested quantity at the lowest cost within the

required time frame. Contacts with suppliers are more or less 'incidental'. All contacts and information exchanges are at 'operational level', between the sales force of the supplier and the purchasing department of the buying firm. The information is exchanged in relation to this one specific order: along with the order goes enough information, to ultimately deliver the ordered quantity (batch) of products (See figure 1).

Essentially a company only wants to buy those goods that can be sold for certain. It wants those goods to be in stock for the shortest possible period, if they need to be in stock at all. But in many industries the need for flexibility and fast delivery towards the client has led to a chaos on the purchasing side. The client is protected from this chaos by large stocks. EDI can only play a role in solving these kind of problems, if and when it becomes part of a fundamental redesign of the purchasing process [5,6]

2.1. Rationalise the supplier base

It is well known, that a much better logistic performance can be achieved if and when a company seeks closer cooperation with a limited number of suppliers [7]. The supplier must be seen as a part of the production process that is equally important as any other part. This can only be achieved if the number of suppliers is limited. The fear of increasing dependence upon one another makes reducing this number often difficult.

Both parties must realise that they have a common interest in a good and long lasting relationship. The supplier benefits from a buyer who can compete in his own market. Unjustly raising his prices means affecting the market position of the buyer and therefore affecting one's own position. The buyer must realize that he will not profit from 'squeezing' his supplier. This will reduce supplier-performance and in the long run it'll cost more than the money saved by the one 'profitable' contract.

2.2. Towards multilevel information exchange

If supplier and customer strive for integration of their production systems, changes in the information exchange are necessary. In a close partnership relation buyer and seller will no longer incidentally exchange order information at the operational level, but there will be a continuous exchange of information on all levels of management. We call this multilevel information exchange (see Figure 2)

At the highest and strategic level of management, buyer and seller will settle the long term strategic partnership arrangement and will agree on production capacity and general delivery terms. Commercial contracts will be settled and renewed every (half) year or so, detailing also the exact prices for each product to be delivered.

On a lower level production planning information will be exchanged. This can be done at several levels, giving first rough estimates on a family or group of products, followed at a later stage by detailed planning information per specific product type.

At the lowest operational level the daily or even hourly logistic material call off's will be exchanged, directly from production control system to production control system, without any purchasing- or even human interference.

In this situation the information exchange regarding planning and call off is perfectly suited for Electronic Data Interchange. The long lasting strategic partnership and the terms of the underlying commercial contract create the stable environment required to implement the automated information exchange.

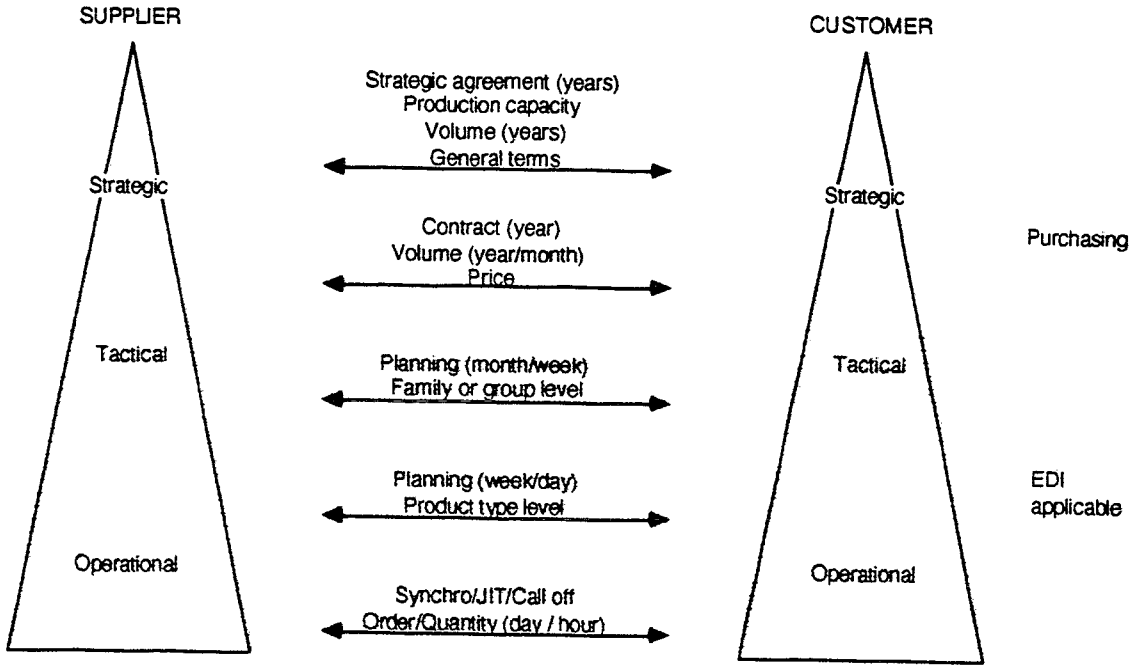


Figure 2. Multilevel information exchange

2.3. Separate purchasing and logistics

In order to let the operational processes proceed as planned there should be a minimum of uncertainty in these processes. Arrangements on strategic and tactical level must provide a situation where delivery time and cost involved in fulfilling material requirements are known as they arise.

This means that separation of purchasing and logistics is required. Ordering will no longer be part of the purchasing function but will become a logistical task (call off instead of order). The information exchanged in the call off at operational level will be no more than an *identification* of the:

- required product
- quantity
- date of delivery

All the other information needed to deliver a product must already be in possession of the supplier. This is not only information about required quantities over a longer period of time but also information on product specifications. Such a simplification of the exchange of information at the operational level creates possibilities for the application of EDI. The agreements on the strategic and tactical levels will then have created a situation where no human judgement is necessary any more. It often takes a cultural change to convince the purchasing department that they should let the orders run freely, but it is worth the effort.

2.4. Rationalise the component base

It is clear, that exchange of planning information and automatic call off's are quite possible in industries, that produce relatively identical products over a longer period of time. If identical products are ordered repeatedly from the same supplier, ordering is being reduced to a reference to known specifications. Manufacturers of non identical products or smaller series however

seem to be forced to negotiate and specify each time they buy a product. This way Electronic Data Interchange of ordering data is not possible.

Before a product can be identified, it has to be specified. First of all functional specifications must be defined. These are translated into technical specifications. And finally the production process has to be specified.

These phases need not all be done by the same party. One extreme is that the supplier dictates all specifications while the buyer chooses from these products (commodities or Catalog items). The only information that the supplier needs from the buyer considers quantity and dates of delivery. It is also possible that a product is designed according to functional specifications of the buyer or that the buyer specifies the whole article. The other extreme is the situation where the buyer dictates all specifications, including the process and the machinery to be used. The specifications drawn up by the buyer must be exchanged to the supplier. In figure 3 the various situations are listed.

	Functional design	Technical design	Process design
Catalog items	supplier	supplier	supplier
Customized items	buyer	supplier	supplier
Designed parts	buyer	buyer	supplier
Outsourcing	buyer	buyer	buyer

Figure 3. Division of responsibilities in the design process

The same kind of product can be specified in different ways. A bolt can for instance be chosen from a Catalog. The buyer can also specify the maximum torsion and the diameter of the bolt. It this situation it is up to the supplier to design a bolt that meets the needs of the buyer. Finally the buyer can design the entire bolt. The supplier produces it then according to the drawing delivered by the buyer.

Specifications that cannot be left up to the supplier, must be exchanged as soon as they are known. This gives the supplier the possibility to anticipate to the production of those products. At the moment a product is required one should be able to refer by identification to the information already exchanged.

Catalog items

Buying Catalog items means that the supplier only needs to receive information on quantities and dates of delivery requested. The other information is by definition already in the possession of the supplier. This type of items is directly suitable for EDI. Reduction of stocks can be achieved by closer co-operation, mutual adjustment of processes and the exchange of planning information via EDI, in order to create a predictable situation.

Customized items

The purchasing function becomes more technical when the buyer outlines his functional specifications. The supplier will propose technical specifications. Both partners will have to confer with each other, in order to come to agreements on the product as it will be ordered. After reaching this agreement the product is known and can be identified by a code. Changes in specifications must be realized independently from the client orders. This situation also demands close co-operation and frequent exchange of information in order to let the supplier be able to deliver promptly without high stocks.

Designed parts
In case the buyer designed the parts, drawings are often sent along with each order. This should be avoided. The drawings and the technical specifications should be given to the supplier as soon as possible and remain in his possession. This way the buyer can refer to his own drawing. At reception of the orders interpretation of the drawing is no longer necessary and "engineering" is ready. At ordering time, the requested product can be identified by means of a code.

Outsourcing
Outsourcing in its most extreme form means that the buyer even prescribes the way a product should be made. However, if a product is repeatedly ordered it will be logical to let the supplier decide how he will manufacture the product. Because EDI can only be applied in repeatable orders, outsourcing is not interesting from this perspective.

This classification is mentioned in order to show the various situations that exist. The most important message is that one should try to treat all purchased items equally at the moment they are ordered.

2.5. Do more than separation of purchasing and logistic

Separation of purchasing and logistic is not always possible in existing situations. Repeatability and simplicity at the operational level are preconditions to a controllable logistical process. There are several ways to increase repeatability and simplicity.

Functional buying
The exchange of information becomes more complex if the buyer wants to prescribe more himself. However, by letting up to the supplier as much of the specifications as possible the exchange of information towards the supplier can be limited and the buyer can concentrate on his own specialties. This results in a situation where less and less goods will be treated as "designed parts". The purchasing function will buy functions instead of products.

Standardization, normalisation and modularity
Repeatability can also be increased by standardising on the components used in the final products. This might lead to extra costs at the moment of component design. One will have to realize that this is compensated by savings in stocks and lead times.

Overdimensioning
Many parts are exactly tuned to the function they have to fulfil. A large diversity in the possible final products will then result in a large diversity in components and materials used. One way of standardising on components used, is overdimensioning. The repeatability and simplicity of the exchange of information increases as a result of this.

3. DATABASE ALIGNMENT

Many EDI projects fail at the beginning, because data and data structures differ between companies. Their databases have simply not been designed to meet other firms' requirements. Companies need to adjust their master files to each other before any automatic processing of received EDI messages becomes feasible.

In the current way of working this does not impose problems, because the human is involved in every step. The human interprets the data and takes the appropriate actions. Data in the internal databases of companies is currently retrieved and interpreted by human personnel. It

is transferred to paper documents that are posted or faxed to other companies, which paper documents again are interpreted by human personnel. If and when EDI is implemented and the computer of some other company has to interpret the data, many difficulties might be encountered. Actually there has been created a heterogeneous distributed database system between companies [8].

A lot of these problems concern article data in the ordering system of the buying company. Some of these problems will be addressed here.

Most companies use internal article identifications. In an automatic ordering process via EDI. the use of the suppliers' article numbers might however be preferable.
In the ordering database, the suppliers' article numbers may however be:

- *not available*

  Currently this is not required, because of human interpretation of the item description at suppliers' side.

- *erroneous due to manual data entry*

  Currently this does not pose any problem, because of human interpretation of the item description at suppliers' side.

- *prefixed for uniqueness*

  The use of supplier article numbers for internal purposes leads to article identifications that are not unique. Therefore they are often prefixed with the suppliers identity. This prefix has to be stripped of in external data exchange with EDI.
  Currently this is not a problem due to human interpretation

- *formatted incorrectly*

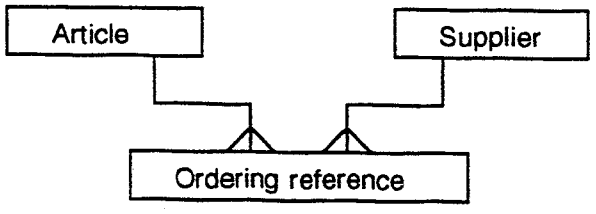
  Suppliers' article data is being copied from a printed Catalog. But for reasons of legibility the supplier has formatted the printing of the article identification with e.g. extra spaces, hyphens or slashes, not present in his internal systems' database.
  Currently this is not a problem due to human interpretation.

- *at a lower decomposition level*

  What a buying firm sees as one component, may constitute of different articles at the suppliers' side. E.g a firm orders an M10-fixing assembly as one item; at the suppliers' side however this is composed of a bolt, a nut and a washer.
  Currently again this is not a problem due to human interpretation.

The only proper solution to these situations is the insertion of a translation table in the database of the ordering system, in order to translate from the internal article identification to the one to be used in the external data exchange. There is only one way to properly fill this table and that is by down loading the data on tape, diskette or EDI from the suppliers.

The required data structure for this translation is:



The entity Article represents the internal article identification and any attribute that is required for internal purposes only. The entity Ordering reference represents for each supplier the identification to be used at ordering plus any attributes that are specific to this article for the given supplier, like price, minimum ordering quantity, quantity per package etc.

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