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E-COMMERCE IN PRODUCTION: SOME EXPERIENCES.

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ABSTRACT

In this paper we will report on a number of e-commerce projects at production companies in The Netherlands. We will show that there is not one unique model for the introduction of e-commerce in production companies. Companies can start to use e-commerce at different ends of the organization, with different objectives and with different (positive) outcomes, depending on the market situation and the state of ICT awareness within the company. Objectives might range from cutting costs on purchase procedures to increasing customer intimacy. ICT awareness can range from having one PC for a department and no Internet connection to a completely functioning Intranet and Internet connection for each employee.
The specific topics that will be covered are: solutions for electronic catalog pricing, automatic purchase procedures, supplier and customer relations and logistic consequences of e-commerce.
We will complete the paper with some current trends in e-commerce, especially on the increased use of electronic markets between the companies within the same vertical market segment.
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1. INTRODUCTION

In recent years electronic commerce has been at the centre of interest of many companies and also of many researchers. See the International Journal on Electronic Commerce [2] for current research topics and e.g. [4,5] for an overview. However, after a period of a growing world economy in which electronic commerce was advocated as one of the motors of the new economy, at the moment we experience a set back that makes many people doubt the true value of electronic commerce for the economy. In fact what we are experiencing is the maturing of a new way of doing business based on new paradigms.

Although IT is an important component of electronic commerce, the biggest mistake that many companies have made is that they expected huge benefits from just implementing new IT components that support electronic commerce, without changing their organisational structure. Electronic commerce (or electronic business as some now prefer to call it), however, is primarily a new way of relating to customers and suppliers. In general it means a transformation from a company that is geared towards production excellence or innovative excellence into a company that is geared towards customer intimacy. See [10] for a description of this development. Although IT plays an important role in this respect (think about the Internet and the WWW) it is not the only aspect of this transformation!

A very similar situation is visible in traditional commerce already. There are mail-order companies that sell their products through the mail by means of (paper) catalogs. However, although this opportunity is open for every company, not all companies choose to use this selling channel. In order to reap full benefit of selling by mail the company has to have a certain structure and do business in a way that does not fit with all existing companies. For instance, these companies often give the possibility to pay for products, like clothes, in monthly installments. This is very unusual for companies that sell their clothes through shops. Also mail-order companies have a huge department that handles returns. Something that is of small importance to most companies that sell their products through shop outlets.

Unfortunately there is no unique, successful business model for companies that perform electronic business. The model depends (just as in traditional business) on the products (or services) of the company, the market structure, etc. In this paper we will discuss a number of aspects of electronic commerce which are of interest to most traditional companies in some form and indicate some issues that should be addressed for each aspect. For instance, electronic sales are possible in many industries. Whether the ordering should be done through an on-

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line catalog or based on messages depends on the specific situation.

The results reported in this paper stem for a large part from my experiences in a project performed by the Eindhoven University of Technology in cooperation with 11 partners in the region of Eindhoven. [11] describes the project in more depth (in Dutch). With each of these partners a specific project on electronic commerce was performed that suited best with their current situation. This reached from customer relation and feedback to designing automatic procurement procedures. Although each of these projects is interesting enough to report on separately, rather than discussing each project I will organize this paper around a number of recurrent topics and use the projects to illustrate the points made in each section.

The rest of this paper is organized as follows. In section 2 we will discuss some topics related to customer and supplier management. This includes the supply of information on availability of products, but also feedback in the form of satisfaction reports. In section 3 we describe some developments in electronic sales. Especially, we will concentrate on some items in catalog management and user interface and integration. In section 4 we discuss electronic procurement, especially for large, distributed companies. In section 5 we will show some current developments on electronic markets. The conclusions of the paper and expectations for the future are given in section 6.

2. CUSTOMER AND SUPPLIER MANAGEMENT

One of the biggest advantages for companies to be present on the Internet and the WWW is the fact that the interactions with (potential) customers can easily be monitored and logged. If this data is used properly it provides a wealth of marketing information. Some sites are primarily financed by the companies that may use the information generated by the traffic through the site for their own purposes. A good example of this category is travelocity (www.travelocity.com). Travelocity is a portal that builds up a community around the concept of traveling. It gives lots of independent information to attract customers. The companies that deliver the content of this site are travel agencies, airlines, hotels, etc. They use the data of all people visiting the site and therefore get far more information about the market than in the case that they would operate on their own. As advertising is very expensive and it is difficult to reach exactly the right target group any means to define a group of potential customers and their profiles is very valuable. See [7] for a number of articles on building on-line communities.

Although the above sketched example is very popular on the Internet it might not seem very applicable in business to business commerce. However, the formation of communities with similar interests also happens very often in industry. In traditional commerce this can be observed in branch organisations, usually paid by all members from the industry, that provide independent information about all kinds of new developments to their members. Many of these organisations have played a major role in promoting the use of EDI in the past and are now giving information to their members about the consequences of electronic commerce for their industry. Although communities can be formed within branches it is also possible to form a community with the existing business customers of a company. This is illustrated by the developments at Interbrew Netherlands. This brewery has around 15.000 retail customers that purchase their products (mainly beer). Because beer is not a product that can be sold over the Internet, there is no use to try to sell directly to consumers through the WWW. Retailers also do not change their supplier very easily and therefore the Internet can also not be used to attract new retail customers. However, the Internet can be used to form a community with the customers of Interbrew. They can get more information about products, order new supplies on-line, get on-line information about their orders and Interbrew can eventually even perform statistical analyses for them in order to provide the right supplies at the right time. In this way they are more tightly bound to Interbrew.

Another example of getting into a closer relation with the customers is given by the project performed at DAF trucks. They use the Internet connection in first instance to get feedback from their customers on the product and the transaction performance. Traditionally, it is difficult to get feedback from users once a transaction has been completed. Usually they have little incentive to give feedback or the costs are perceived as being higher than eventual benefits. The use of Internet makes it very easy to give feedback on an order. One can organize it as a simple WWW form that can be filled or even just clicked on. The feedback can also be acknowledged in a subsequent order of that customer and if possible it can indicate what has been done with the feedback. E.g. if the delivery time was too long, the next order can be shipped more accurately or reasons for delays can be given or even a discount for repeating delays can be given. This kind of reaction relies on the fact that the feedback of a customer can be coupled with the profile of that customer and can be (automatically) processed in the departments of the company that are most affected by the feedback. This implies again that the information systems that are used internally have to be connected and synchronised (e.g. through the use of an ERP system throughout the company).

The advantage of the above setting is that the company gets a closer relation with the customers. Therefore customer loyalty will increase and also the company can react quicker and more accurate to customer demands.

The disadvantage of forming on-line communities is that the customers get more power. They get more information from each other about products (both good and bad).

It is also an opening up of the company to the outside world. Members of the community expect more and more up-to-date information about products, orders etc.

In B2B it may lead to selecting a small number of companies with which an intimate relationship is established.

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Within such a relationship feedback might be given on the products and the (order) process (like at DAF trucks). This feedback can be very valuable to optimise products for important clients and to optimize production planning in relation to customer orders.

A different aspect arises for companies that manufacture products that are designed on demand. When products are designed for a specific order, the client usually gives some functional specifications, but does not have the knowledge to provide a complete design. E.g. steel plates for vehicles. Clients know what they want to use it for, what some of the constraints are on the use, but do not know what material is best to use or which shape is optimal.

This knowledge resides with the manufacturer and can be made into a product by itself. If the knowledge is made available to customers in a way that they can decide themselves what is the optimum solution for their problem the manufacturer saves both the time of an engineer that had to determine this solution with the client as well as that they can ask money for disclosing this knowledge.

In general the developments of IT can lead to two different types of relations between organizations. Organizations can form hierarchical relations with a few big customers and/or suppliers. These relations are very tight and ensure high reactivity and usually efficient logistics. This means a decrease in stock and transaction costs. This development takes place in markets with only a few companies or a few very dominant companies (like in retail and car industry).

The IT developments also support the formation of more loose relations. Companies determine which is the best supplier for each order. This is possible if the markets get global and thus more companies compete and if information about the products is readily available and orders can be easily construed on-line. This is the case in markets with standardised products and many global suppliers (like in the computer and telecom industry). See [8] for an analysis of market versus hierarchical relations.

3. SALES AND CATALOGS

3.1 Sales support

The first questions to be answered when deciding how the sales function can be supported by the Internet are:

1. what type of product do you sell? Standardised/commodity products or specialized build on order?
2. what does the market look like? Is it open to new companies, how many suppliers and customers are there, are there long term relations (contracts) between companies or are most transactions one-at-a-time?

These questions determine for a large part in what way products can be sold through the Internet. Of course the answer to the first question is often that products are neither completely standard nor completely customized. Many products are standard, but have a number of parameters that can be varied for each customer. The car industry forms a good example. Although a certain model of a car brand has some standard features the customer can usually still choose the color of the car, sometimes even the type of motor and all kinds of extra's. The crucial aspect actually is whether the products can be described in a standard format, such that a customer can completely determine the product he wants to purchase by indicating a combination of values for all parameters. For these cases the selling process can be more easily performed through electronic means. However, in many cases products are not standard at all and are specifically designed for a certain customer. In those cases the customer only has requirements on the functionality of the product, but the supplier determines how the product will actually look like. Although this process is more difficult to support it can still be supported in some ways. For instance, a catalog can be provided with a number of proto-products or even raw materials, which can be used as a basis from which the customized products are derived. An example is the knowledge base developed for MCB described in the previous section.

The second question determines for a large part the business relations between the companies in a market and the way transactions are usually conducted. If a company only has a few (big) customers it does not make sense to sell the products through an open catalog on the WWW. Probably these customers have a strong relation with the company and need more service than just a passive catalog that can be used by any customer. These customers usually communicate with the supplier using EDI (Electronic Data Interchange) types of communication. In EDI standard messages are used to order products. Often the products are identified through a unique product number, which indicates that this type of automatic ordering can usually only be done for standard products and is not useful for customized products.

The same distinction as shown above between catalog based ordering and EDI (message) based ordering can also be seen in the solutions offered by e.g. SAP. They provide a SAP online store, which is catalog based and which can connect to an internal SAP system to process orders. They provide the SAP business connector for companies that use message based order transactions. It is difficult to combine the two systems or even to migrate from one type of order processing system to the other. This implies that the choice whether orders will be catalog or message based has to be made when IT support for the sales process is started right away.

3.2 On-line catalogs

Once a decision has been made to use an on-line catalog to support the sales process, the following questions have to be answered:

1. Use an on-line catalog and separate ordering system or integrate ordering with the catalog?
2. Sell on-line through Internet, through private VAN or a combination?

3. What information should be provided to (potential) customers? Can this be done in the form of a personalized catalog?
4. If a catalog is used, where should this catalog be maintained? Who determines the format, etc.

Many companies start using the Internet by creating a web-page on the WWW. This web-page gives information about the company. Companies that already publish a paper catalog might decide to publish this catalog on the WWW as well. In this sense it is an extra service to the customer who already use the paper version. Ordering does not have to be coupled to the catalog yet. It can be done through an e-mail in which all information is given for the order or can be by phone or fax. Starting like this familiarizes a company with publishing its data on the WWW. It can also experiment with all types of searching facilities before getting into the complex situation of automatic ordering.

A decision that also should be made early on, is whether automatic orders will be made through a private network connection (Value Added Network) or through the Internet. The advantages of using a VAN are the security of the data and the reliability of the network. However, by definition, these networks are closed and therefore only available for already existing customers.

Suppose the company decided to use an on-line catalog that is visible for both existing as well as potential customers. Then the next decision is what information should be included in the catalog. If there are many companies that supply the same type of products and the products are quite standardised it is more likely that customers want to compare products on price and price information becomes important for online selling.

Most companies, however, try to avoid giving price information to potential customers. They will only provide this information for existing customers. The main reason is that in B2B transactions the services supporting the product are often more important than the price of the product. A dealer in office supplies stated it as follows: Our customers do not pay for the pen or pencil, but for the service of having a pen or pencil at the right time on their desk. I.e. timely delivery, logistic services, etc. become an integral part of the product offered. It is therefore difficult for customers to compare products of different suppliers based on the price for the physical part only.

Another reason not to offer price information in B2B transactions is that prices may depend on long term contracts, quantities ordered and constraints on delivery. In our experience the price information is mostly given to existing customers and personalized for each customer. Mainly, it becomes a service to connect order information to the accounting systems of the customer or a service to compare alternative products from the same supplier. E.g. a client might want to compare the prices of bolts made of different types of steel in order to decide what is the best choice.

Besides determining which information should be available in the catalog, the company also has to decide how the information should be available. Many catalogs still follow a traditional format where products are ordered according to categories that are determined by the supplier. This leads to trees that can be searched by the customer.

However, the modern techniques make it very easy to implement different structures by creating links between products on all levels in the tree. In principle customers will have a different view on the product than the supplier. E.g. instead of first distinguishing between 6 and 8 sided bolts and only later looking at the length or the material of the bolt, they might be primarily interested in the length of the bolt and have no idea whether they want a 6 or 8 sided bolt.

The success of an on-line catalog is largely determined how good the search mechanism connects with the way that the customer wants to find a product. So, this depends on the information contained in the catalog and the indexes on the products. A new development in this area is the personalization of the catalog. The catalog can be completely customized for big customers that only see the subset of products that are of interest for them and maybe in the way (including format) that is most suitable for their situation. This can all be done based on the same basic information of the general catalog. This ensures that all the information is updated whenever the basic catalog is updated as well. A simpler and less labor and cost intensive customization of the catalog is based on keeping track of the customer profile. This profile can be used to first show the products that the customer has shown interest in more often. It can also be used to suggest alternatives or other products based on customers with similar profiles. See e.g. Amazon.com for a good example.

The last issue to be discussed is the matter of where the catalog should reside. At first instance it seems logical that the catalog is residing at the site of the supplier. However, large companies that have many different suppliers and sometimes already use electronic procurement products like Ariba or Commerce-one might want the supplier to deliver the information about its products in a certain (standard) format.

There are also industries where the catalogs are combined in portals, which are maintained by branch organizations. The latter often happens in industries where standardisation is of prime importance and there are no dominant parties in the industry. This is the case, for example, in the Dutch installation tools industry.

Where the catalog is hosted is mainly determined by the power structure in the particular market. The party that has most power will usually host the catalog and/or determine its format.

Whenever catalogs of different suppliers have to be combined, like in the case when the catalogs reside with the customer or at an intermediate party, issues on data integration and accuracy come up. When the integrated catalog resides with the customer, the customer usually dictates the format in which the data should be provided. We will describe this situation in more detail in the next section on electronic procurement.

In portals as e.g. supported by VerticalNet for machine tools, the catalogs of the suppliers are not integrated at all. The

 ISBN 7-900066-39-X

only feature that this portal offers is a uniform format in which information is provided. However, this format is still very free and mainly contains free text fields that describe different aspects of the products and their suppliers. The portal contains a search function that allows a user to search the catalogs based on keywords. The suppliers are responsible for keeping their catalog up to date. Although this seems rather limited one should realise that the integration of independent databases is a notorious difficult problem. The main difficulty lays in the fact that the semantics of database fields with the same names and/or syntax may differ in the databases. E.g. a supplier address in one database might refer to the address to which an order should be sent, while in an other database it refers to the general address of the company (maybe of the head office), which can be quite different. Integration of the data can at this moment only be done manually. However, there are some tools that might be used to assist and partly automate this task. One of these tools is Concept Base which describes both the data as well as the conceptual model in the same format and which allows to write rules to map concepts on to each other. Concept Base [3] is used in the MeMo project [1] in which a broker for B2B electronic commerce is developed. What is required to use this tool is that for each supplier a conceptual model of its catalog is provided. This can be made by experts in a few days. Given these conceptual models the integration rules can be written easily in cooperation with the suppliers of the catalogs.

Another advantage of using a tool like Concept Base is that the actual data can reside with the supplier. The integrated catalog provides a view on this data. This means that whenever suppliers update their catalog it is immediately visible in the integrated catalog. The only major operation comes from a change in the format of the local catalog (e.g. adding a feature to products). In that case the conceptual model has to be adjusted manually and a reintegration performed.

3.3 Integration

Another major issue when using on-line catalogs is the integration of the catalog and ordering process with the back office. We distinguish the following points:

1. coupling of the catalog with internal databases
2. order information and user profiling
3. integration with the customer's back office

Not all people realise that once a catalog is on-line it should be available 24 hours per day and 7 days per week. This means that updating the information in the catalog should be done while it is on-line (or with a very short interrupt)! It also implies that customers will contact the company 24 hours a day. Often this implies that some organizational changes have to be made to capture orders and requests at any time of the day and week.

The second point deals with capturing the order of the customer and relaying it to the order processing system (usually an ERP system). Ideally, the customer can check the availability of the ordered items, before the items are actually ordered. If this is not possible, the client should get a feedback as soon as possible. In the case of Borstlap (a producer of all types of fastening products such as screws, bolts etc.) many customers do not order directly but accumulate orders over a week or month. The main reason is that these products are much cheaper to transport in bulk and therefore it is cheaper for a customer to order one time a big quantity than many small packages. It meant that "shopping baskets" containing potential orders of the customer are kept between sessions. They serve two purposes. First, it is easier for the client to add to his order than having to keep track of all items himself. Secondly, Borstlap could use the information to predict order quantities and therefore ensure availabilities more accurately.

The last issue that is not often addressed is the integration of the ordering process with back office of the customer. Often the order is made from a browser and all information contained in the order is not accessible for the customer after the order has been placed. It means that the customer has to insert the order in it's own system again. Some companies will now send an e-mail confirming an order in a pre-specified format (often using XML), which can be used to insert the order also in the procurement system of the customer.

4. ELECTRONIC PROCUREMENT

In the previous section we have discussed some issues with regard to electronic sales and catalogs, taking a supplier point of view. In this section we will review the transaction from the customer side. First we have to distinguish different functions in the procurement process. There is a strategic procurement function in which decisions on supplier selection are made. In the tactic procurement function decisions are made on contracts and contract renewal. Finally, in the operational procurement function the ordering, delivery and payment process is performed. It is primarily the operational function that is automated in electronic procurement systems. So, these systems assume that there is a contract with a supplier that specifies the price and delivery conditions. They do therefore not offer any negotiation facilities, but only offer order and payments functions and sometimes tracking functions.

The type of products that are most suitable to pilot electronic purchasing on are the ones that have low risk and low influence on the company results. These are the so-called routine products according to Kraljic [6]. Office supplies form a good example. These products only account for a small part of the purchase value, but usually cause a major part of the procurement costs. The main goal in electronic procurement for these products will therefore be cost reduction. For the products that have a low risk in supply but a high impact on company results, the so-called leverage products, a company might look at using electronic markets. For these products price/quality ratio is more important than transaction costs. A good example of these products are commodities that are part of the end product of a company. E.g. most of the components of PC's are of this type. We will come back to electronic markets in the next section.

 ISBN 7-900066-39-X

The products that carry both a high risk in supply and have a high impact on the company results (the strategic products) can also be purchased electronically. However, these products are usually purchased directly through an EDI connection from the ERP system. A good example are the car parts for a car manufacturer. The delivery of these parts has to be in line with the own production, while there is only one (or a few) possible supplier of that part.

The last type of products are the bottleneck products that have a low impact on company results and a high supply risk. The fastening products of Borstlap are a good example of this category. There are only a few suppliers in this market, but the products have a low impact on the end product of the customers (like car manufacturers). For this type of products no readily available solutions are on the market. Most companies experiment with combinations of EDI and web-based ordering.

In the remaining of this section we will concentrate on the electronic procurement of routine products (like office supplies) for which most existing procurement systems are meant.

4.1 Costs and efficiency

One of the benefits of electronic procurement is the reduction in transaction costs. In a company like Oce Netherlands traditional orders will cost between $40 and $60 for handling the complete procedure. This is a rather standard amount in Western Europe and the USA. Although this amount looks large at first sight it is not that high if one realizes it includes the search of the product information, the typing in of an order, checking it, sending it, receiving the confirmation, etc.

By automating the purchase procedure a company can reduce the costs to around $20 per order. This seems quite impressive, but a few remarks are in order at this place. First it should be noted that the costs incurred per order are for a large part labor costs. These are significantly lower outside Europe and the USA. Even though a company might achieve the same relative cost reduction all over the world, the absolute benefits become smaller when the labor costs diminish.

In relative small companies that order maybe at most once each working day the cost reduction will be between $5000 and $10.000 per year. Although this seems an interesting amount for a small company, this cost reduction can only be achieved when the whole procurement process has been automated. Systems that are readily available on the market cost between $100.000 and $1.000.000, which means that a company would take at least 10 years to break even. It is clear therefore that the benefits of cost reduction only arise for large companies that process hundreds of orders each week (or even day).

However, there are at least two more benefits of electronic procurement that are worth discussing also for small companies. The first is reduction of errors. The fact that the whole process is automated means that the input can be checked for consistency and on flagrant mistakes. For instance, the name of a supplier can be taken from a fixed database, which also includes the other data for that supplier. Therefore these facts do not have to be typed anymore and errors are prevented in name of the supplier, address, bank account etc. Also the description of the product can be made unique. Often this is done already by giving products unique identifiers. However, retyping these numbers inevitably leads to mistakes. Using an automated procedure the product data is also input from the electronic catalog straight away, without human intervention. This also prevents mistakes in indicating quantities, which can occur if the quantities in which the product is sold by the supplier are not the quantities in which the customer normally thinks about that product. E.g. “1 stapler” might mean for the supplier “1 box containing 20 staplers”.

The second benefit that electronic procurement offers is that of a reduced lead-time. In a paper administration an order form has to physically circulate through the company for authorisations, checks on budget, accounting etc. before it is sent to the supplier by fax or mail. Each step can easily take a day and therefore a lead-time of 10 days for order processing is very common. Using electronic procurement this can be reduced to around 10 minutes. The time that is needed for the electronic form to be passed through the network. This reduction of the lead-time of procurement can lead to significant changes for the company. Given this short lead-time it might decide to considerably reduce the stock of office supplies that it had to keep.

A last benefit, which can also be stated as being an efficiency benefit is that electronic procurement facilitates the bundling of the procurement. This leads to a better negotiation position with potential suppliers, because volumes are bundled and therefore discounts based on quantities can often be negotiated. The bundling of orders can also lead to logistic benefits. We will discuss this item in the next sub-section.

4.2 Logistics

Logistics form an important aspect of any business transaction. The fact that a transaction is performed electronically might not seem to matter too much. Although this is true if one looks just at one transaction, there are also new opportunities and challenges when considering most transactions being performed electronically.

Let us first look at a development that is taking place at many large companies, the shifting of the stock from the company to the supplier. Due to the rather long lead times in the ordering process, traditionally a company keeps a considerable stock of routine products like office supplies. Once a week (or month) new supplies are ordered to replenish the stock. Due to the dramatically reduced lead times of the order process and therefore the possible quick reaction of the supplier this stock can be reduced to almost zero. Whenever a product is needed it can be delivered within a few days by the supplier to the person who needs it, thus eliminating the need to keep an expensive stock.

Of course this also depends on a quick response of the supplier to an order. This is largely enforced simply by the competition in this type of market. Because routine products are often commodities that can, in principle, be supplied by many

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companies, the suppliers have to compete on more than just the price of the product. Both ASPA (supplier of office supplies) as well as Borstlap (supplying fastening products) indicated that they did not compete on price but on logistics, which was indicated as being far more important for their customers. So, for both companies a quick reaction to an order is important. A consequence of this decision to distinguish oneself on the basis of logistics is that instead of regular large transports in which many orders are bundled, the companies will deliver smaller packages in a higher frequency. In order to keep efficiency this leads again to a new distribution process. Sometimes this may again lead to the outsourcing of the logistics to a specialised logistic company that is able to combine transports of several companies to the same destination. The actual developments in this field depend on the actual volume and geografic spread of the orders that a company has to process. For ASPA, which has a very high volume and big geografic spread it lead to establishing its own distribution centre and logistics department. Companies that have less high volumes might do better to outsource the logistics for efficiency reasons.

There are also some logistic consequences for the customer. First of all, if every order is directly (and decentralised) send to the supplier this might lead to high handling and transport costs. Therefore, companies try to bundle the orders as much as possible. However, the procurement should then keep track where different parts of an assembled order have to be delivered internally. This leads to the concept of "cross-docking", where deliveries of different suppliers are re-assembled into packages for different internal departments. An important aspect becomes the just-in-time delivery of the products and the coordination of the deliveries. If deliveries are not well coordinated or arrive too early more warehouse space is needed than available!

Another aspect that is often neglected is that of wrapping of the products. The wrappings should be done according to the quantities that are ordered by the individual departments. If a number of orders are bundled into one large order which is packed by the supplier as one package, the distribution centre of the customer has to split up that package and repack the parts for internal transport to the departments again. Ideally, the supplier (or logistics company) supplies the products packaged in the way of the customer already. This reduces the costs for rewrapping and wrapping material considerably. For large companies like the RABO bank, but also universities(!) this can lead to considerable cost benefits.

A last issue we will discuss concerning logistics is that of the on-line ordering of perishable products. This is illustrated by the case of on-line retailing where consumers can order their groceries on-line with a supermarket. The logistics of this form of electronic procurement are the critical success factor. Traditionally the consumers take care of the logistics by going to the shop, picking their own order and transporting it home. When a consumer orders on-line the supermarket has to take care of the order picking and either has to transport the products to the consumer or provide storage for the complete order. The costs of these operations are usually relatively high, while the consumer is usually not willing to pay (much) extra for the service. No satisfactory solution to this problem has been found yet.

4.3 Procedures and legal issues

Given the developments sketched in the previous sections can something be said about the procurement procedures and their changes? Three general points have become clear from the case study at the RABO bank where protocols have been designed for electronic procurement. The first point is that roles and associated authorisations play an important role in the procurement procedure and should therefore be modeled in the protocols. The second point is that the protocol should provide for all possible exceptions and deviations from the default process. The third point is that it is important to agree on standard message formats such that the same format can be used for all suppliers.

We will start our discussion with the point on the importance of roles and authorisations. In general the procurement process starts with the selection of a product by the customer. After he composes his order it usually has to be approved by the person responsible of the budget. After this approval, the order can be transmitted. Some choices should be made here right away. One might take the most liberal point of view and let the supplier determine which products are available for the departments to order and offer the same selection to all persons in the company. This leads to a big variety of products on offer, but also demands a careful approval procedure for each order. On the other extreme the company might make its own selection of the products of the supplier to offer in its internal procurement catalog. It might also personalise this catalog such that a person can only compose an order for which he has the authority (or budget). This would eliminate much of the approval procedure. However, it means a more complicated procedure to determine the person, which can order a certain type of product. In practice a mixture of the two extremes is chosen. At the RABO bank, the bank determines itself which products are offered for the procurement. But the same assortment of products is available for all persons within the bank. The procurement system ARIBA offers, contains many possibilityies to assign authorities to departments and persons in order to facilitate the approval procedure. In principle everyone can compose any order, but an order is only send to a supplier if it has been signed (digitally) by an authorised person.

It should be noted that the above procedure only discusses the operational procurement function. For the tactical (and strategic) functions separate procedures and (more important) authorities have to be established. These procedures will determine how products are added and/or deleted form the internal catalog, who will have authority for each product category etc.

The second general point seems almost to be trivial. However, it is surprising how many exceptions (of different

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types) are normally handled by the persons of the procurement department. The default procedure for the procurement is rather simple. First a request for an order is made, then the order is authorised, after the order is confirmed it is send to the supplier, who sends an order acknowledgement. Later a delivery notification is sent, the delivery is received and payment is made. However, at almost every step several alternatives and exceptions can be constructed. For instance, it might be the case that the supplier only has part of the order available. Therefore he might decide to split the order in two parts. The part containing products that can be delivered right away and a part, which will be delivered at a later date (which might not even be known yet). Including this possibility into the protocol has quite some consequences. One of them is that it must be possible to refer to separate order lines and/or products within an order. The different delivery dates should also be noted in the acceptance procedure of the customer such that a delivery is not rejected because it is incomplete!

Another subtle point is that the procedure in general requires actions from both parties in the transaction. However, it is not always sure that the other party will send the right message, in the right format at the right time. Therefore mechanisms should be included to capture these situations. E.g. the procedure might require the supplier to send an order confirmation after an availibility check. It might be that a supplier gets two orders at the same time. He performs an availibility check and would have enough supply for each order separately (but not for both). Now the supplier sends an order confirmation to both customers and then tries to allocate the products to the orders. In the last order he will find out that the stock is not big enough anymore. In a correct procedure it should be possible for the supplier to send a second message to the customer to withdraw the confirmation or to adjust it. This implies that the customer should be able to process such a message at almost any time during the process. Of course the customer may also decide to cancel the order at almost any point in time and the supplier should be able to react adequately to that event.

The third general point that was already briefly mentioned is that an adequate standard message format should be designed. Although certain aspects are quite straightforward some others are less so. As we saw it might be handy to have unique identifiers for orderlines within an order. Also one might want to have place for two product identifiers. One to be used by the customer and one to be used by the supplier. One might also want to include the possibility for repeating orders. That is, products that will have to be delivered repeatedly (every week or month). Ideally a company would like to use the same format for its messages in dealing with all its suppliers. Usually this leads to taking a union of all the fields that are required for each supplier and thus creating a large message that is half empty. (This is the situation in EDI standards like EDIFACT). However, with the rise of XML one can now more readily define a flexible format. The format itself is included in the message and can be used by the supplier to determine the content. See [9] on some recent developments in this area.

The last item that we want to discuss in the light of procurement procedures is the legal issue concerning electronic procurement. If, in an ideal case, the whole procedure is handled electronically it becomes very difficult to prove that the transaction actually took place. This might be beneficial for a company if it wants to avoid paying VAT (Value Added Tax) on the transactions, but it might also cause problems in case of disputes over the transaction. Therefore companies have to check very carefully how the procedures can be designed in a way such that the legal status of the transaction is assured. Under the Dutch law, this means that all electronic orders are compiled and printed once a week. This compiled record will serve as the basis for VAT payment. One should, however, carefully check the national legislation and find out what requirements follow from the law. Especially when the transactions cross national borders this might prove a difficult task, because the countries involved might require different legal documents and might accept different types of evidence. The main conclusion we drew from our projects regarding this point is that efficiency and robustness are prime economical drivers for the design of the procurement procedure, the influence of the legal issues might be of great influence on the actual implementation of these procedures.

5. ELECTRONIC MARKETS

In the two sections above we have discussed transactions from both a supplier as well as a buyer perspective. We have seen that for both sides catalogs are used. For suppliers it means an extension of their advertising and sometimes just another sales channel. The buyers use catalogs to integrate the product supplies of all their suppliers in order to offer a uniform format to all internal customers. We can also see these two forms as instances of electronic markets. Electronic markets can be divided into four types:

1. Web sites. Connect one supplier with one customer.
2. Sales portal. Connect many suppliers with one customer
3. Procurement portal. Connect many customers with one supplier.
4. Exchange. Connect many suppliers with many customers.

In section 3 we have seen examples of web sites, but have not discussed procurement portals. The reason is that none of the companies involved in our project provided this form of market. In B2C this type of market is well known through the auctions at Internet sites such as e-Bay. In B2B this form of market is less often used.

In section 4 we have discussed the use of sales portals, where the portal itself is organised by the procurement department of the customer. We have not discussed exchange markets yet, because this form of market is (usually) not organised by the customer or the supplier, but by an independent intermediary.

At first people had the idea that web sites, which model 1-1 relations between customers and suppliers, would become the prevailing market model on the Internet. The underlying idea was that IT would support many functions that traditionally were performed by intermediaries, therewith eliminating the need for intermediaries on the Internet. Customers would deal directly with the suppliers in a 1-1 format. Although this actually happens to some extent in e.g. the tourist sector where consumers can now directly order tickets from airlines and reserve rooms at hotels, the elimination of intermediaries is still not common in B2B transactions.

Besides bringing supply and demand together (electronic) markets have a number of important functions.

- They often decide on admission of buyers and/or sellers,
- They might determine the quality of the products (this happens often in markets of perishable products like the fish market and the flower market),
- They provide standardised formats for product specification, contracts etc.,
- They provide protocols to arrive at contracts
- They provide logistic facilities
- They provide payment facilities

These functions are also important for electronic transactions. Especially, because electronic market places are often opening up global markets with many unknown participants, ensuring trust and security become important aspects of the role of the electronic market. Therefore the party that organizes the market is of the utmost importance and should inspire trust in all parties trading on the market. Due to this fact there are more examples of sales and procurement portals than of exchanges. Exchanges should in general be organized by independent parties (neither supplier nor customer in the market) that is trusted by all parties involved. In some cases this role can be fulfilled by a branche organisation, but also e.g. financial institutes and Internet Service Providers try to take up this role. However, it is not yet clear which will be the most successful in establishing exchanges.

In the other hand the sales portal already has taken hold. Sales portals are for some part implemented as procurement systems for big companies. By organizing the procurement in this way, they can standardise supply information and have centralised control on procurement, while the actual buying of products can take place decentralised. A pre-condition for this situation is that the company has enough buying power to force the suppliers to trade through its portal.

Another popular way in which sales portals are realised is by closed markets where a number of companies bundle their procurement and thus establish leverage against the suppliers. A good example is Covisint (www.covisint.com), the virtual market place for the car industry. In these markets competitors cooperate in their procurement, because for a large part they use the same components for the products they produce. Their competition only arises in the way they add value to the components during assembly, etc. of the products.

Another type of market uses tendering (reverse auctions). Auctions are very popular on the Internet, because the protocol to reach a contract is very simple (fixed message orders and only a few types of simple messages are exchanged). In this case the customer provides a (standard) product specification and all suppliers can provide a bid to supply the product. This type of auction is mainly used to reduce the costs of purchasing routine products. It should not be used to purchase products for which a close connection with the supplier is necessary, because for each tender a different supplier may come out as the winner.

At last we want to give one example of an exchange market that is set up in the insurance branche. The reason for setting up this exchange was mainly to avoid unnecessary transaction costs and VAT costs. Many insurance companies also invest huge amounts of money in many different financial products and derivatives. In their trade they often exchange products between themselves. Instead of trading everything through the official stock markets they decided to exchange some of these products through a private exchange. At the end of the day, the positions of all parties are cleared and the differences are traded through the official market. Because the volumes that these companies trade are huge, the use of a private exchange that actually functions as a clearing house is very beneficial.

6. CONCLUSIONS

In this paper we have discussed our experiences in a number of projects on electronic commerce in different types of industry. Had there been a uniform model to perform electronic commerce (even in B2B or in industry) we could have discussed our results in the light of such a framework. However, just as in traditional commerce, there is not one business model that fits all companies across all industries. Different aspects of electronic commerce are important in different degrees depending on the type of products that are traded and the type of market structure existing in a particular industry. Because all business transactions at least include a buying and a selling party we decided to structure our experiences into a sales part and a procurement part. Connecting the two in section 5 on the electronic markets themselves.

The experiences that we had all point out that the type of relationships that a company has (or wants to have(!)) with its suppliers and customers is the most important determinant of how to start electronic commerce. If a company has relations with only a few suppliers and there are not many more potential suppliers of the same products, the company wants to bind those suppliers and form tight relations with them. This can be done by the introduction of a feedback system for individual suppliers (like at DAF Trucks) or through incorporating supplier catalogs in a procurement system (like at the RABO bank and the mental health care centre in Eindhoven). In these cases it would not make much sense to start an electronic auction or tendering system for procurement.

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If the company has only a few (big) customers or a fixed set of customers it might want to tighten the relation with thos customers. This can be done through providing them with extra information and giving them the opportunities to order on-line (like was done at Interbrew Netherlands). Also one might enhance the service level in order support by making the knowledge that is needed to select the right product available through the WWW (a first step in this direction has been taken by the MCB steel company). In the B2C market this can be seen at many sites of financial institutions and insurance companies that are now offering on-line support to choose the product that fits your situation best (see e.g. www.egg.com and www.mrfinch.nl).

Companies that supply products that fall in the category of routine products are likely to feel a stiffening of the competition. The use of electronic commerce makes it possible for the customers to reach more suppliers and get more information to compare the products. One way to distinguish one self is by adding services to the products such that price comparison becomes more difficult and also the relation with the customer becomes tighter. This can be done e.g. by offering logistic services and guaranteeing fast and accurate delivery. This has been done by both ASPA for office supplies as well as by Borstlap, providing fastening products.

From the other side, a company that wants to reduce procurement costs might(!) reduce the transaction costs of procurement considerably by installing an automated (and centralised) procurement system. This will reduce the labor costs involved, but also serves to bundle strategic procurement functions while decentralising operational procurement functions. This can lead to better contracts with suppliers, while at the same time leading to logistic benefits. Some examples of this approach are RABO bank, Oce, the mental health care centre of Eindhoven and the townhall of Eindhoven.

Throughout the paper and our experience it became clear that if a company wants to experiment with electronic commerce a good start is with routine products such as office supplies. These products have less strategic impact and therefore the company is less likely to be hurt if the project fails.

It also became clear that a company can only gain clear benefits from electronic commerce if it restructures its organisation such that the relationships with suppliers and customers become central for its every day functioning..

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