2 CONCEPTUALIZING THE ORDERING PROCESS

2.1 Introduction

As discussed in the first chapter, the ordering process is an important logistical interface process in which demand and production must be matched. In literature, the ordering process is often considered as a business process. According to Davenport and Short (1990), a business process is “a set of logically related tasks performed to achieve a defined business outcome” (Davenport and Short 1990 p.12). They further argue that a process has two main characteristics: it includes both internal and external customers and goes beyond organizational (functional) boundaries. These characteristics apply to the ordering process as this process consists of a number of succeeding activities that are performed to achieve pre-defined performance objectives and which relate to different functional disciplines. According to Ould (1995), the ordering process is one of the core business processes because it concentrates on satisfying external customers and directly adds value in a way perceived by the customers. The ultimate goal of the ordering process is to satisfy the customers by delivering the ordered goods according to the order agreements. Starting point for our research is that the ordering process is a business process that involves various activities and is executed by various (functional) parties. Furthermore, it is an interface process in which demand and production must be matched.

The aim of this chapter is to conceptualize the ordering process in order to obtain a better understanding of the complexity and dynamics of the ordering process and the dimensions of the ordering process relevant in studying possibilities and consequences of formalization of the ordering process.

First, we give an overview of the literature with respect to the ordering process. In this literature study we focus on defining the scope attributed to the ordering process and the activities belonging to this process. This overview is reported in Section 2.2 and is consolidated by a definition of the ordering process. Section 2.3 discusses the influence of the customer order de-coupling point on the ordering process in order to discuss the differences in ordering processes per production situation. In Section 2.4 we argue that three different dimensions are significant for structuring the ordering process, namely the logistical decision-making, the information processing and the organizational setting and that these three dimensions are therefore relevant in studying formalization of the ordering process. The first dimension concerns the logistical decision-making and is discussed in Section 2.5. In Section 2.6 we elaborate the information-processing dimension of the ordering process and in Section 2.7 the organizational setting is discussed. This chapter ends with a summary and a discussion.
of the relationship between the customer order de-coupling point and the three dimensions of the ordering processes (Section 2.8).

2.2 The ordering process: an overview

The ordering process is discussed in literature from various fields such as operations management, information management and marketing as well as in more general managerial literature. On the basis of several theoretical notions concerning the ordering process this section starts with a discussion of the definition and the scope of the ordering process.

In many cases the terminology with respect to the ordering process is rather confusing and ambiguous. The ordering process is referred to as the order fulfillment process, demand management, order processing, the order cycle and order management (Ballou 1999; Lin and Shaw 1998; Vollmann, Berry, and Whybark 1997; Waller, Woolsey, and Seaker 1995; Shapiro, Rangan, and Sviokla 1992; Bowersox, Closs, and Helferich 1986). Not only the terminology but also the scope attributed to the ordering process differs. Shapiro et al. (1992) take a broad definition in claiming that the ordering process starts with forecasting and capacity planning and ends with after sales activities like repair and maintenance. In this definition forecasting demand and planning capacity at medium term are included. Furthermore, in the study of Shapiro the ordering process concerns the complete course that an order goes through in a particular company. Other authors take a more narrow point of view by defining the ordering process from the moment a particular order enters the company (see for example Ballou 1999; Vollmann, Berry, and Whybark 1997; Bowersox, Closs, and Helferich 1986). They consider the administrative tasks concerning order processing as well as the physical activities like manufacturing as part of the ordering process. But, they all seem to emphasize other specific activities that take place within the ordering process. Waller et al. (1995) stress order quoting as the starting point of the ordering process. Vollmann et al. (1997) mention order-delivery-date promising as important part of the ordering process, while Lin & Shaw (1998) stress the planning of production, material and capacity. Ballou (1999) also pays attention to physical activities like extracting ordered items from inventory, and producing ordered items. Shapiro et al. (1992) explicitly name billing, returns and claims as part of the ordering process.

We notice that the activities mentioned by the various authors are mostly described in a chronological sequence from the moment a customer order arrives at a company until the customer order leaves the company in the form of finished goods and invoices. Therefore, we have clustered the different activities mentioned along with their chronological position in the ordering process in pre-sales, order processing, order
fulfillment and after-sales activities. Table 2.1 gives an overview of all activities addressed by the various authors.

**Table 2.1 Overview of activities within the ordering process**

<table>
<thead>
<tr>
<th>Author</th>
<th>Pre-sales Activities</th>
<th>Order processing activities</th>
<th>Order fulfillment activities</th>
<th>After sales activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shapiro et al. (1992)</td>
<td>Order planning: Sales forecasting capacity planning</td>
<td>Order generation</td>
<td>Pricing</td>
<td>Order receipt</td>
</tr>
<tr>
<td>Vollmann et al. (1997)</td>
<td>Forecasting</td>
<td>Order entry</td>
<td>Order delivery-date promising</td>
<td>Physical Distribution</td>
</tr>
<tr>
<td>Waller et al. (1995)</td>
<td>Quotation Order Receipt Order acceptance Order entry Order Routing</td>
<td>Order assembly</td>
<td>and picking Shipping Installation</td>
<td>Invoicing</td>
</tr>
<tr>
<td>Bowersox et al. (1996)</td>
<td>Order transmission Order processing Order selection</td>
<td>Order transportation</td>
<td></td>
<td>Customer Delivery + Follow-up</td>
</tr>
<tr>
<td>Ballou (1999)</td>
<td>Order preparation Order transmittal Order entry</td>
<td>Order filling</td>
<td></td>
<td>Order status reporting</td>
</tr>
<tr>
<td>Lin &amp; Shaw (1998)</td>
<td>Order receipt Confirmation Planning of production, material and capacity Shop floor control</td>
<td>Inventory control</td>
<td>Transport</td>
<td></td>
</tr>
</tbody>
</table>

In order to obtain a more detailed picture of the ordering process we will first describe the clusters of activities, as ideal types.
Pre-sales activities
The first group of activities is not directly linked to a specific customer order and can be
defined as pre-sales activities. According to Shapiro et al. (1992), order planning is the
first step in the order cycle. In their point of view the ordering process starts before
there is an order or a customer. It begins with making a sales forecast by Marketing or
Sales and a capacity planning by Operations or Manufacturing. The sales forecast
specifies what Sales anticipates to sell in the next periods. The capacity plan specifies
the capacity availability in the next period and results in plans concerning how much
inventory will be created and how many people will be hired. These plans are examples
of planning on the medium term in aggregated terms; they are not concerned with the
details of individual orders or individual products offered.

Order processing activities
The order processing activities concern activities that are directly related to the handling
of individual customer orders. This cluster of activities contains order quotation, order
acceptation, order entry and order scheduling. We will discuss each of these activities in
more detail.

Order quotation is related to specifying to the customer the product configuration,
price and delivery time that matches the customer requirements (Waller, Woolsey, and
Seaker 1995). When a product has to be configured to match the customer wishes, a
product configurator is often available to select or configure the appropriate product.

Order acceptance is the activity in which order information of the customers is
checked and is entered in the order information system. The checking of order
information concerns (Ballou 1999; Waller, Woolsey, and Seaker 1995):
- the accuracy of the information such as item description, item number, quantity and
  price,
- the customer’s credit limit and
- the availability of the requested items.
In production situations in which production is triggered by a customer order it is
necessary to check if the requested delivery date is realizable or if a due date has to be
assigned to the specific order. Vollmann et al. (1997) call this activity the order-
delivery-date promising. If the company has a backlog of orders for future deliveries,
the order-promising task is to determine when the delivery can take place.

After checking the order information and the delivery date the order is mostly
entered in an order information system. Often, an order confirmation form is produced
and the order is officially accepted (see Waller, Woolsey, and Seaker 1995). Sometimes,
for example in cases of capacity shortage, it is necessary to make an order selection and
prioritization (Shapiro, Rangan, and Sviokla 1992).

In most order-driven manufacturing companies, the next activity in the ordering
process is the planning of production, materials and capacity (Lin and Shaw 1998).
Shapiro et al. (1992) call this activity scheduling and refer to it as the step in which the
orders get slotted into an actual production or operational sequence. The customer orders have to be planned in a production scheme. This scheduling is an important input for purchasing, producing materials, and planning capacities on the short-term. Often, the scheduling of customer orders is the activity in which the order information is translated into production orders or work orders for the shop floor. Depending on the production scheme these production orders are released to the shop floor.

**Order fulfillment activities**
After the order is administratively processed the next main activity is fulfilling the order. The fulfillment activity is the physical activity to acquire the items requested through production, purchasing or stock retrieval, to pack them for shipment, to ship them and sometimes to install the items at the location of the customer (Ballou 1999; Waller, Woolsey, and Seaker 1995). Associated activities are the scheduling of the shipments and preparing the shipping documentation.

**After sales activities**
The last activity is the actual delivery of the products ordered to the customer. But also billing or invoicing is sometimes mentioned as part of this activity (Waller, Woolsey, and Seaker 1995; Shapiro, Rangan, and Sviokla 1992). Ballou (1999) pays attention to order status reporting, which refers to tracking and tracing the order through the order cycle to keep the customer informed about the order status and possible delays in order processing or delivery. This tracking and tracing is also important in finding possible errors during the process when handling returns and claims (Shapiro, Rangan, and Sviokla 1992). Shapiro et al. also consider post sales services like maintenance and repair as part of the ordering process.

**Discussion**
As mentioned before, starting point for this study is that the ordering process is an interface process in which demand and production must be matched. Analysis of the activities of the ordering process as described in the literature studied, shows that a very broad range of activities is attributed to the ordering process. Only the second cluster of activities, the ‘order processing activities’ are directly related to the processing of a customer order and are also concernred with the coordination between demand (as specified in customer orders) and production.

Analyzing the pre-sales activities we see that these activities take place before actual orders arrive at a company and are not directly related to the processing of specific customer orders. We do not consider these pre-sales activities as belonging to the ordering process itself. The order fulfillment activities take place after customer specifications are translated into a production order and are not concerned with coordinating demand and production. These activities are related to the manufacturing process and as such are not considered as part of the ordering process. The after sales
activities include delivering the product, invoicing and possibly returns and claims. It is clear that these activities are important in dealing with customers and are closely related to the customer service. But, they are only indirectly involved in the processing of orders and the coordination between demand and production. The after sales activities are also not considered as part of the ordering process.

In this section, we described and analyzed the scope of the ordering process. We limit the scope of the ordering process to the processing of specific customer orders. More accurately, we define the ordering process as the business process in which customer orders are translated into production orders to attain realizable order agreements. In other words, by means of the ordering process the company and the customers create a commitment to product specifications, order quantities and the timing of delivery.

2.3 Influence of the customer order de-coupling point (CODP)

In translating customer orders into production orders and realizable order agreements the ordering process has a central role in coordinating demand and production. This role depends on the position of the customer order de-coupling point (CODP), as the CODP indicates how far a customer order penetrates in the goods flow (Hoekstra and Romme 1987). Based on the position of the CODP1 four production situations can be identified:
- Engineer-to-order (ETO): products are specifically designed, developed and produced for a particular customer.
- Make-to-order (MTO): products are manufactured on the basis of mostly standard raw materials.
- Assemble-to-order (ATO): products are built of standard modules, but the final assembly is based on specific customer orders.
- Make-to-stock (MTS): products are standard and are produced on stock.

Figure 2.1 shows these four production situations for the basic goods flow of a company. Viewing from the CODP all upstream planning activities (towards the supplier) are based on forecasts and all downstream planning activities (towards the customer) are based on customer orders.

With respect to the production situations, it should be noted that in practice manufacturing companies might have varying mixes of CODP-positions. The CODP-positions may vary for different product groups or product-market-combinations and even for individual customer orders.

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1 Hoekstra & Romme (1987) define also a fifth position of the CODP, namely make and ship to stock.
The position of the CODP determines which planning activities are based on forecasts and which activities are based on customer orders. The activities on the customer side of the CODP are referred to as ‘online’ activities that can only be started once a customer order arrives at the company (Bozarth and Chapman 1996). Depending on the position of the CODP, a customer order has more or less direct influence on production-related activities. According to Bozarth and Chapman (1996), in ETO-situations a customer order not only triggers the order processing activities, but also activities regarding procurement, design, manufacturing and finished goods inventory. On the other side, in MTS-situations the customer order only triggers the order processing activities and the activities regarding finished goods inventory. On the other side, Table 2.2 sums up the relevant activities triggered by customer orders per position of the CODP.

The overview in Table 2.2 demonstrates that individual customer orders have the most direct influence on production in ETO-situations and the influence decreases when the CODP is positioned more downstream. In order to process customer orders in an ETO-situation, it is necessary to exchange information with Procurement and Design to be able to decide on order acceptance. But, to process a customer order in an MTS-
situation, it is only necessary to check the availability of the ordered items in the finished goods inventory. As a consequence, the coordination between demand and production will be more complex in ETO- and MTO-situations than in ATO- or MTS-situations and therefore the role of the ordering process in achieving coordination between demand and production will be more complex. In general, we conclude that the position of the CODP affects the complexity of the ordering process, in terms of number and interdependency of decisions and parties involved. In other words, we argue that the CODP is a main indicator of the order-processing situation and influences the structuring of the ordering process.

**Table 2.2** Activities triggered by customer orders per position of the CODP

<table>
<thead>
<tr>
<th>Activities</th>
<th>ETO</th>
<th>MTO</th>
<th>ATO</th>
<th>MTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order processing</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Procurement</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Component Manufacturing</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assembly</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Finished good inventory/distribution</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

*Based on Bozarth & Chapman, 1996, p.65*

In the remainder of this chapter we will further elaborate the dimensions relevant in structuring the ordering process and thus relevant in the formalization of this process.

2.4 Three dimensions of the ordering process

In further exploring the structuring of the ordering process we study the ordering process from different perspectives. The perspectives are related to the definition of the ordering process. In order to deliver the right products at the right time, customer demand must be translated into production orders by means of the ordering process. We argued that to attain realizable order agreements demand and production must be coordinated and that the ordering process thus has an important role in coordinating demand and production. The role of the ordering process is visualized by modeling this process as an input-output system on a rather abstract level (see Figure 2.2).
From this model it is clear that within the ordering process information of customer demand has to be processed and matched with information of production constraints to specify production orders and come to order agreements with customers.

Coordinating demand and production is in the first place a logistical decision-making process. Decisions must be taken concerning accepting orders, allocating capacity and materials, promising delivery times and prioritizing orders to arrive at realizable order agreements. In order to make these decisions, frequently, a huge amount of information must be processed and exchanged between the actors involved in the ordering process. These actors are often part of different functional disciplines depending among others on the organizational setting of the ordering process. It can therefore be concluded that the logistical decision-making, the information processing and the organizational setting are three important dimensions of the ordering process.

Distinguishing between these three dimensions is particularly helpful to explore further the complexity and dynamics of the ordering process, as coordinating demand and production consist of the logistical decisions to be taken and the associated information processing and information exchange between the actors involved. By discussing the logistical decision-making, the information processing and the organizational setting of the ordering process we are able to explore in more detail the structuring issues per dimension that are relevant in further investigating formalization of the ordering process. The three distinguished dimensions are therefore considered as the foundation of our framework to describe and analyze formalization of the ordering process. In the following sections we address the three dimensions of the ordering process to discuss the relationships between the dimensions and structuring the ordering process.
2.5 The logistical decision-making dimension

From the point of view of logistical decision-making, the ordering process can be considered as a set of interrelated decision functions with the purpose to coordinate demand and production. The issue of coordinating demand and production is discussed by different authors in operations management literature and is often referred to as the coordination of Sales and Production (Whybark and Wijngaard 1994; Kingsman et al. 1993; Bertrand, Wortmann, and Wijngaard 1990). This coordination takes place at different levels of control. For our study we distinguish between structural coordination and operational coordination, following Bertrand et al. (1990).

**Structural coordination**
According to Bertrand et al. (1990), structural coordination refers to agreements between Production and Sales on an aggregated level about, for instance, sales and production per family of products, delivery conditions and average inventory. Thus, the structural coordination concerns the managerial agreements to coordinate sales wishes and production possibilities. These managerial agreements may be laid down in budgets that set the parameters for a logistical concept. A logistical concept can be defined as a coherent set of planning rules that fits with the demands of the market and that is tuned to the characteristics of the production process and products. As a consequence, the definition of the product-market combinations and the position of the customer order de-coupling point (CODP) per product-market combination are preconditions for the logistical concept. Because the CODP divides the order-driven and planning-driven activities it influences the algorithms necessary for planning the activities at either side of the CODP (Hoekstra and Romme 1987).

**Operational coordination**
The operational coordination concerns the operational decisions and seeks to make realizable order agreements based mostly on trade-offs between using available capacity efficiently and realizing delivery times. The operational decisions that must be made in the ordering process are: accepting customer orders, allocating materials and capacity, promising delivery times and prioritizing customer orders.

These operational logistical decisions are dependent on the production possibilities, because realizable order agreements can only be made taking into account the available capacity and materials. When there is a lack of coordination between Sales and Production about these decisions it often results in a poor logistical performance like long delivery lead times, poor delivery reliability or poor capacity utilization (Hagdorn-van der Meijden, van Nunen, and Ramondt 1994; Kingsman et al. 1993). The coordination of these operational decisions is partly arranged by the embedment in the structural coordination between Sales and Production.
**Relationship between structural and operational coordination**

The structural and operational coordination between Sales and Production are closely related. The structural coordination serves as a framework by giving objectives and restrictions for the operational coordination of Sales and Production (Bertrand, Wortmann, and Wijngaard 1990). In other words, the structural coordination defines the goals and plans within which the operational decisions must be made in the ordering process. The coordination subjects dealt with in the ordering process relate to specifications, volume, mix and timing of the products (Konijnendijk 1992). Regarding these subjects coordination takes place on a structural level by setting goals or plans per product group or product-market combination (PMC) and at operational level, per individual customer order. For example, concerning the subject of timing the structural coordination may arrange for agreements on fixed delivery times per product group. These fixed delivery times are the basis for deciding on delivery time promising per customer order. Table 2.3 presents the main issues in structural and operational coordination for the ordering process per coordination subject (De Vries 1999; Megens 1999; Rho, Hahm, and Yu 1994; Kingsman et al. 1993; Konijnendijk 1992; Bertrand, Wortmann, and Wijngaard 1990).

**Table 2.3**  
Main issues of structural and operational coordination with respect to order processing, elaborated per coordination subject

<table>
<thead>
<tr>
<th>Subject</th>
<th>Structural coordination</th>
<th>Operational coordination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specifications</td>
<td>Agreements on specifications with respect to products, modules and/or components</td>
<td>Accepting orders</td>
</tr>
<tr>
<td>Volume</td>
<td>Agreements on inventory levels and varying capacity</td>
<td>Allocating materials and capacity</td>
</tr>
<tr>
<td>Mix</td>
<td>Planning structure and agreements on allocating capacity</td>
<td>Allocating capacity; prioritizing</td>
</tr>
<tr>
<td>Timing</td>
<td>Agreements on delivery times per product group or product-market combination (PMC)</td>
<td>Delivery time promising</td>
</tr>
</tbody>
</table>

Bertrand et al. (1990) argue that the operational coordination is often a one-way coordination in which the sales function determines the required delivery patterns for the end-items, taking into account structural agreements, but neglecting the actual production possibilities (work-in-process, inventory and materials availability). In practice, this kind of one-way coordination is often not suitable because capacity and material availability is uncertain, and procurement lead times are not completely reliable. Thus, a more extensive and two-way operational coordination between sales wishes and production possibilities seems to be necessary.
This point of view is also stated in the study of Kingsman et al. (1993), who extensively researched the field of production planning and especially workload control. They found that in make-to-order companies a poor performance of the ordering process (long delivery lead times, poor delivery reliability or poor capacity utilization) is also caused by wrong commitments of the sales function in the quoting of orders. They argue that many problems regarding detailed production scheduling can be avoided by integrating marketing and production planning at the customer enquiry stage. “The aim has to be to use the process of quoting for orders to try to mould the order book into a shape that can profitably be produced by the production side. The mechanism for this has to be the prices and delivery lead times quoted to potential customers.” (Kingsman et al. 1993 p.57)

On the basis of the previous discussion, we argue that the ordering process can be seen as a set of interrelated decision functions with the purpose to coordinate demand and production. The coordination takes place at different levels of control. Within the ordering process the coordination of demand and production concerns the operational logistical decisions about order acceptance, allocating materials and capacities, delivery time promising and prioritizing. In general, all these logistical decisions are embedded in the structural coordination of the company, one way or the other. The operational decisions and the structural coordination (especially the logistical concept) are important issues in structuring the logistical decision-making in the ordering process and therefore will be the basis for studying formalization of the logistical decision-making (see Section 3.3).

2.6 Information processing

The processing of information is a second important dimension of the ordering process. As we argued in Section 2.4, information on customer requirements has to be translated into production orders and order agreements. Thus, information has to be exchanged between the parties involved in order to attain realizable order agreements. Information processing concerns both a procedural part, the workflow, and a content-related part, namely the information requirements and information processing capabilities (e.g. Albino, Pontrandolfo, and Scozzi 2002). We will first discuss information processing as a workflow and then address the information requirements and information processing capabilities.

Information processing as a workflow

The ordering process can be considered as an information flow (see for instance Lin and Shaw 1998; Waller, Woolsey, and Seaker 1995; Erens and Hegge 1994). Customer orders contain much information about the demand specified by customers. All these
specifications should be translated to other areas of the organization in order to react adequately on customer demand (Shapiro, Rangan, and Sviokla 1992). From this point of view, the ordering process is a sequence of information processing activities: order quotation, order acceptance, order entry, scheduling of orders, and generating order documents. Considering the ordering process as a sequence of information processing activities it can be referred to as a workflow. The workflow of the ordering process can be defined as the transformation of data to translate customer requests into work orders or production orders. Thus, the workflow consists of a number of defined operations that take place at certain work places and/ or by automated systems (Brand and Van der Kolk 1995). For the ordering process this means that a customer order is received by an organization, data is checked, the order is accepted and translated into one or more production orders and scheduled in the production scheme. At the same time, the order is confirmed to the customer in a set of realizable order agreements. The order confirmation and the production order can be seen as the information products that are the end products of the ordering process.

The ordering process is considered as a workflow by different authors who concentrate on the concept of re-engineering. In discussing the problems and opportunities for ordering processes they focus on the processing of information per activity (Waller, Woolsey, and Seaker 1995). This is not surprising as in the literature on Business Process Reengineering information technology is treated as the optimal solution to reconsider processes by breaking with old rules and creating new ways of working (Hammer 1990; Davenport and Short 1990), as we already discussed in Chapter 1. Lin & Shaw (1998), for instance, focus on reengineering the ordering process in supply chain networks. According to them, the ordering process concerns the coordination of various activities that normally take place in different business units. Their main focus is to reach agility in the ordering process to handle uncertainties from the environment by modeling the ordering process according to the information-processing activities. From a more logistical point of view, Ballou (1999) also studies the ordering process as a workflow. He focuses on how information processing should be structured to reduce the order processing time.

Information requirements and information processing capabilities
The information-processing dimension also has a content-related part. This content-related part concerns the information requirements (information needed) and the information processing capabilities (the availability and accessibility of information).

The information requirements of the ordering process depend on the specific order-processing situation as defined by the position of the CODP. As argued, in the ordering process information with respect to customer demand and the state of the production system must be matched (Bertrand, Wortmann, and Wijngaard 1990). In MTS-situations information requirements concern the availability of inventory of finished goods, but in MTO-situations information requirements concern material and capacity
needed and material and capacity availability. In these MTO-situations, Sales and Production must exchange information in a rather early phase of the ordering process to be able to efficiently use available production capacity and at the same time assign realizable delivery times (Kingsman et al. 1993).

Information-processing capabilities should match information requirements, according to adherents of the information-processing view of organizations (Albino, Pontrandolfo, and Scozzi 2002; Tushman and Nadler 1978; Galbraith 1973). The information-processing capabilities with respect to the ordering process are mostly described in terms of ICT. In this respect, ICT may have three different functions, namely processing of information, decision-making and communication. We will briefly discuss the ICT-capabilities related to these functions.

The first function of ICT is the processing of information. Information transactions in the ordering process may be supported by transaction processing systems. Bertrand et al. (1990) distinguish state-independent and state-dependent transaction processing systems. According to them, ‘state’ refers to the state of orders and materials in the goods flow. A state-independent processing system is a data base system in which data of, for instance, products, manufacturing equipment, personnel, customers and stock locations are recorded (Megens 1999). These kinds of systems thus allow the recording of standard products, bills of material, routings, standard lead times and so on. A state-dependent transaction processing system concerns variable data about products, customers and stock and the associated application software monitors the state and state-transitions of the materials and orders. For instance, “customer orders may start as prospects, and are transformed into confirmed orders, completely specified orders, shipped orders, invoiced orders and finished orders” (Bertrand, Wortmann, and Wijngaard 1990 p.118). Clearly, the transaction processing systems support the information flow through the ordering process. Transaction processing systems are part of ERP-applications. Shtub (1999) argues that through the use of an ERP-system information about the customer, the order, material availability and sometimes production planning and capacity availability are part of the central database of the computer. The actors involved in the ordering process can consult this information at any time. Information needed to decide, for instance, on order acceptation in different phases of the ordering process can be directly consulted in the information system used (Shtub 1999).

The second function of ICT is related to decision-making. Decision-making in the ordering process may be supported by structured decision systems or decision support systems. Structured decision systems are systems that process data according to formalized procedures. Therefore, structured decision systems are based on a model, a structured problem, for which all, relevant variables and the relationship between these variables are known (Bemelmans 1991). The structured decision systems are able to
perform a decision-making process without human intervention. Examples of structured decision systems are stock control by specified rules, invoicing and monitoring due dates.

In decision-making situations that are difficult to analyze, because the relationships between variables or some of the variables relevant for the decision problem are unknown, it is not possible to completely structure the decision problem. Therefore, decisions may be based on intuition and experience and may be supported by so-called decision support systems. Decision support systems are meant to help the human decision-maker in making decisions by supporting them with useful data and, for instance, ‘what-if’ simulations. As discussed in chapter 1, the actors involved in the ordering process may be confronted with situations that cannot be completely structured. It is interesting, therefore, to examine in the empirical study how and in which order-processing situations decision-making is supported by decision support systems and to what extent.

The third function of ICT is related to communication. In this respect, we are interested in communication related to order processing that is enabled by the use of Internet and Intranet. According to Albino et al. (2002), the use of Intranet systems and Internet can be considered as technologies to support the coordination between various actors involved in order processing. The use of Intranet and Internet may accommodate the information processing between actors involved in the ordering process. Of course, information can also be transferred in a more traditional manner by, for instance, written documents or face-to-face communication. In our study we are interested in the use of Intranet as a means to support information processing, because it may not only speed up information processing in the ordering process, but it may also have a formalizing function in the sense that agreements made between the actors involved are written down.

On the basis of the discussion of the information-processing dimension we argue that the ordering process is a sequence of information-processing activities to translate customer orders into production orders. Regarding the content-related part of information processing we distinguished between information requirements and information processing capabilities. The workflow, the information requirements and the information processing capabilities are important issues in structuring the information processing of the ordering process. These issues are therefore relevant in further studying the formalization of the information processing within the ordering process (see Section 3.4).
2.7 Organizational setting

The third dimension of the ordering process is the organizational setting of this process. We already mentioned that different functional disciplines are involved in the ordering process and for that reason we called this process an interface process. In most of the studies on the organizational context of order processing it is implicitly assumed that organizations are functionally organized. The focus of these studies is on the issue of coordination and on the influence of a functional separation of the departments involved in the ordering process (Crittenden, Gardiner, and Stam 1993; Shapiro, Rangan, and Sviokla 1992; Konijnendijk 1992). Shapiro et al. (1992) argue that cooperation within the ordering process is hindered by functionally organized organizations, because the various departments have conflicting interests and because they know too little of what goes on in the other departments. The study showed that when there is a problem with an order, different departments argue about who is responsible for the problem and who should be correcting the problem (Shapiro, Rangan, and Sviokla 1992). It is interesting to further explore the organizational cooperation within the ordering process in relationship with the degree of formalization because formalization may be used to structure the organizational setting. In discussing the organizational setting we consider the variables that determine the organizational cooperation between logistical parties, as argued by De Vries (1999). These variables are the actors involved, the relationship and the degree of interdependence between these actors, and the associated tasks and responsibilities.

The actors involved

As mentioned above, there are different actors involved in the ordering process. Actors are considered to be individual employees working for a specific department or representing a functional discipline. Depending on the positioning of the CODP different functional disciplines may be involved in the ordering process: Design, Engineering, Sales, Procurement, Planning and Production. These disciplines are involved in one of the activities triggered by customer orders, as we visualized in Table 2.2. In MTS environments products are mostly sold ‘off the shelf’, so only the sales function is involved in the ordering process. In ATO environments not only Sales but also Planning or Production are involved in order processing and in coordinating demand and production to fit the final assembly schedule. In MTO environments Procurement and Engineering are often also involved in the ordering process because design or configuration of the end item and purchasing of customer specific components may be part of the ordering process. Finally, in ETO production situations design and engineering of the products as well as purchasing raw materials play an important role in the ordering process. In these ETO environments all functional disciplines are involved. In all production situations the most central functional disciplines involved are Sales, Planning and Production. In this respect, the study of Nauta et al. (2002)
shows that in the semi-process industries Sales and Production often not communicate directly, but that the logistical coordination takes place through an intermediate function, namely Planning (or Logistics).

Although the actors involved in the ordering process can be part of different departments or teams, in processing the orders the actors form an operational network (Wijngaard, De Vries, and Nauta 2004). The operational network for the ordering process can be defined as a group of actors that, for instance, work together by exchanging information on particular orders to decide on realizable order agreements.

Relationships and interdependency

In defining the organizational setting, it is useful to obtain a better insight in the relationships, formal as well as actual, that exist between the actors or groups of actors involved, according to De Vries (1999). These relationships are not only related to the hierarchical structure, but also to power, negotiation and communication (De Vries 1999). Formal relationships are mostly represented by the hierarchical structure, while the operational network of the ordering process represents the actual relationships. These actual relationships may also be more or less formalized. The relationships themselves are influenced by many factors among which the task interdependency between the actors involved.

In the ordering process Sales and Production are functionally interdependent because Sales provides the customer with products made by Production (see Parente 1998). The relationship between Sales and Production might be hindered by the potential conflict as a result of the difference in interests between both functional areas. In several studies the conflict between Sales and Production is further studied. Especially the sources of the conflict and the possible ways of dealing with the inter-functional relationship pass in review (Hagdorn-van der Meijden, van Nunen, and Ramondt 1994; Crittenden, Gardiner, and Stam 1993; Konijnendijk 1992; St.John and Hall Jr 1991; Clare and Sanford 1984).

Crittenden et al. (1993) elaborated on the differences in interests and defined three major areas of conflict between Sales and Production: managing diversity, managing conformity and managing dependability (Table 2.4). Interesting in this research is the finding that, although agreements could be made in these areas on a strategic level, it turned out that in daily practice of order processing several conflicts between Sales, Planning and Production arose. According to St. John and Hall (1991), Sales and Production may agree on the goal of the organization but, at the same time, they may not agree on the way of accomplishing these goals. As mentioned in Chapter 1, Sales and Production are confronted daily with ambiguous situations in which they have to make trade-off decisions between customer responsive action, such as accepting a rush order, and cost-conscious action, such as adhering to the planning. These trade-off
decisions occur in the conflict areas between Sales and Production and can be related to the conflicting objectives, as presented in Table 2.4.

Table 2.4  A typology of conflict areas between Sales and Production

<table>
<thead>
<tr>
<th>Area of Conflict</th>
<th>Sales objective</th>
<th>Production objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managing Diversity</td>
<td>Many and complex models</td>
<td>Few and simple models</td>
</tr>
<tr>
<td>Product line length/breadth</td>
<td>Customer specifications</td>
<td>Standard models</td>
</tr>
<tr>
<td>Product customization</td>
<td>Immediate product changes</td>
<td>Planned, necessary changes</td>
</tr>
<tr>
<td>Product line changes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managing conformity</td>
<td>Constant change</td>
<td>Inflexible</td>
</tr>
<tr>
<td>Product scheduling</td>
<td>Accept all orders</td>
<td>Critically evaluate ‘fit’ of orders</td>
</tr>
<tr>
<td>Capacity planning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managing dependability</td>
<td>Immediate; large inventory</td>
<td>As soon as possible; no inventory</td>
</tr>
<tr>
<td>Delivery</td>
<td>High standards</td>
<td>Reasonable control</td>
</tr>
<tr>
<td>Quality control</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adapted from Crittenden et al., 1993

The study of Konijnendijk (1992) shows that the interdependency between Sales and Production is influenced by the production situation. The operational interdependence between Sales and Production in MTS environments is formed by the fact that Sales must sell what Production has produced. In ETO and MTO environments Production must produce what Sales has sold, according to Konijnendijk (1992). Important in this respect is the leeway that Sales gives Production and vice versa. This leeway will depend on the amount of power that both parties have in the company. In customer-oriented environments Sales will be the more powerful party, because Production must produce according to the order agreements they made with the customers. For the ordering process in particular this implies, for instance, that when Sales is the more powerful party Production has to accept rush orders more frequently (Nauta et al. 1998). According to Clare and Sanford (1984), the more powerful party may also be less inclined to recognize the need for cooperation than would be the case in a more equally balanced power distribution.

Tasks, competencies and responsibilities
In structuring the organizational setting it is relevant to study tasks, competencies and responsibilities associated with order processing. Tasks and responsibilities related to the ordering process can be defined as follows. A task is a collection of activities linked with an often well-defined objective. Competency is the authority (the right) to perform certain activities related to order processing. Responsibility is the duty of an actor or a
group of actors to give account to a direct superior in the hierarchy or to an actor who is a superior based on a functional relationship (De Vries 1999). An important aspect of structuring tasks and accompanying competencies and responsibilities is the clarity about and the balance between them. This clarity about and balance between the order-processing tasks and responsibilities is related to the hierarchical structure. In the ordering process tasks and responsibilities may differ per type of order. For example, processing a standard order can be clearly defined beforehand, but processing a rush order may ask for competencies and responsibilities that are not foreseen and are not clearly described. As actors of different functional disciplines are involved in order processing it may cause difficulty when responsibilities in deciding on trade-offs are not clear (Shapiro et al., 1992). From several studies it became clear that the interdependency, the cultural differences and the power distribution between the actors involved in the ordering process may cause an unbalance in tasks and responsibilities, which may result in not realizable order agreements (Konijnendijk 1992; Clare and Sanford 1984; Shapiro 1977).

On the basis of the previous discussion of the organizational setting of the ordering process we argue that the ordering process is an interface process in which various functional disciplines participate that can be highly interdependent. With respect to structuring the organizational setting it is interesting, therefore, to further examine not only the actors involved and the interdependency between these actors, but also the consultative structure used in coordinating demand and production and the hierarchical structure and related tasks and responsibilities involved in order processing. These structuring issues regarding the organizational setting are relevant in further studying formalization of the organizational setting of the ordering process (see Section 3.5).

2.8 Summary and discussion

In this chapter we started with a discussion of the definition and scope of the ordering process. We limited the scope of the ordering process for this study to the processing of specific customer orders and defined the ordering process as the process in which customer orders are translated into production orders to attain realizable order agreements. On the basis of this definition we argued that the ordering process has an important role in the coordination between demand and production. We further argued that the role of the ordering process depends among others on the position of the CODP. When the CODP is positioned upstream, individual customer orders directly influence production activities resulting in a more complex coordination between demand and production than in a downstream position of the CODP. Therefore, the position of the CODP is a main indicator of the order-processing situation and also indicates the influence of the customer on production control.
Conceptualizing the ordering process as a process in which coordination between demand and production plays a central role resulted in identifying three dominant dimensions of the ordering process, namely logistical decision-making, information processing and organizational setting. These dimensions are intertwined: in order to make logistical decisions with respect to coordinating demand and production, information on customer orders and production constraints have to be processed and exchanged between the actors involved in the ordering process.

Combining the insights obtained regarding the influence of the position of the CODP on structuring the ordering process and the three dimensions of the ordering process, we argue that the position of the CODP influences the structuring per dimension. With respect to the logistical decision-making dimension, we assume that the CODP affects the interrelationship between logistical decisions and the level of logistical coordination (Konijnendijk 1992; Bertrand, Wortmann, and Wijngaard 1990). Regarding the information-processing dimension, we assume that the CODP influences the degree of standardization of the workflow and the uncertainty regarding information requirements at order arrival (Ruffini 1999; Bozarth and Chapman 1996). With respect to the organizational setting of the ordering process, we assume that the CODP influences the number of actors involved in the ordering process and the interdependency between these actors (Konijnendijk, 1992; Nauta et al. 1998). The assumed relationship between dimensions of the ordering process and the position of the CODP results in different characteristics of the ordering process per CODP-position. We elaborated this for the opposite CODP-positions in Table 2.5.

**Table 2.5** Assumed relationships between position of the CODP and the three dimensions of the ordering process

<table>
<thead>
<tr>
<th>Logistical decision making</th>
<th>Downstream: MTS</th>
<th>Upstream: ETO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard products</td>
<td>Decisions embedded in logistical concept</td>
<td>Decisions highly interrelated and based on operational coordination</td>
</tr>
<tr>
<td>Customized products</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Information processing</th>
<th>Downstream: MTS</th>
<th>Upstream: ETO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workflow standardized</td>
<td>Workflow not standardized</td>
<td></td>
</tr>
<tr>
<td>Information required is known</td>
<td>Information required is not known</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organizational setting</th>
<th>Downstream: MTS</th>
<th>Upstream: ETO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales and Production</td>
<td>Design, Engineering, Procurement, Sales, Planning, Production</td>
<td></td>
</tr>
<tr>
<td>Interdependency low</td>
<td>Interdependency high</td>
<td></td>
</tr>
</tbody>
</table>

Based on the characteristics of the ordering process per dimension, as presented in Table 2.5, it is clear that the ordering process in MTS-situations concern other
structuring issues than in ETO-situations. In MTS-situations with standard products, a 
standardized workflow and a relatively low interdependency between the parties 
involved, the coordination of demand and production will be structured differently from 
ETO-situations with highly interrelated decisions, a non-standardized workflow and a 
high interdependency between a relatively large number of parties involved.

The discussion of the influence of the CODP on the various dimensions of the 
ordering process shows the relevance of these dimensions for studying formalization of 
the ordering process. We use the insights obtained so far as a framework to 
conceptualize and operationalize formalization per dimension of the ordering process, 
as will be discussed in the next chapter.