FORMALISATION OF THE ORDERING PROCESS

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Abstract
In this article a conceptual framework of the ordering process, especially the formalisation of this process, is presented. The fundaments of the framework are grounded on the observation that due to information technology and the necessity of reducing control complexity, companies often try to standardise and formalise the ordering process. At the same time, however, companies are forced to operate in a flexible way to be able to act more customer-oriented. Especially in those cases where orders have to be split up the ordering process can be quite complex and hard to formalise. So, in this respect companies have to deal with what we call the formalisation paradox: by speeding up information processing by means of ICT many organisations try to treat customer demand more quickly and more flexibly. But the use of ICT supposes a certain degree of formalisation that in turn can easily lead to inflexibility and rigidity. Exploring this formalisation paradox we applied the line of thought of the contingency approach by identifying the situational factors that influence the structuring of the ordering process, especially the degree of formalisation of the ordering process. We argue that the complexity of demand, production system and process are the contingencies of the ordering process and influence the degree of formalisation of this process.

Two explorative case studies are conducted to illustrate the presented framework. The findings of the two case studies confirm our assumptions that the characteristics of demand
and the characteristics of the production system influence the degree of formalisation of the ordering process. Furthermore, it is shown by the case studies that the extent of formalisation can differ on three dimensions of the ordering process: the decision-making structure, the information processing structure and the organisational setting.
1 Introduction

As a consequence of increasing competition and higher market demands organisations are forced to act more and more customer-oriented. As a result, the classical conflict between external objectives such as delivery reliability, speed and the necessity of a broad product range on the one hand and internal objectives like low stock levels, short throughput times and large batches on the other hand seems to become really manifest within companies. In trying to find a proper balance between the internal and external objectives many efforts have been made to improve logistical interfaces both within and between organisations. It is probably also for this reason that organisations today focus more than ever on the use of Information and Communication Technology (ICT). By speeding up information processing and opening up information by means of ICT companies try to deal with customer demand more quickly and more flexible. It is interesting to note however, that the use of ICT at the same time supposes a certain degree of formalisation that in turn can easily lead to inflexibility and rigidity. We will term this problem the formalisation paradox. One of the logistical processes to which this so-called formalisation paradox between flexibility and formalisation specifically applies is the ordering process. Within the ordering process the issue of co-ordination between customer wishes and production possibilities plays a central role (Parente, 1998; Konijnendijk, 1992). It is by means of the ordering process after all, that demand requirements and production capacities have to be matched.

In this article we will further explore the issue of the formalisation paradox regarding the ordering process by taking a contingency approach. The central thought of the contingency approach is that organisational effectiveness results from a fit between the situation in which the organisation operates and the structure of the organisation (Donaldson, 2001). When the situational factors (contingencies) change the organisation will have to adopt new organisational characteristics to avoid a misfit. Applying this general idea on the issue of order processing, we see that market demands are changing over the last years, asking for a more flexible order processing.
Organisations are confronted with changing contingencies and are forced to change their organisational structure. Organisations are seeking for the right way of structuring their ordering process in answer to the changing market demands. What we see is that organisations are using ICT as a possible solution to their problems. According to this line of thought, organisations are using formalisation as structuring variable to cope with the issue of flexibility posed on the ordering process. Through our study we will try to get more insight in which situational factors influence the structuring of the ordering process, specifically the degree of formalisation of this process.

Within the scope of this article we will focus mainly on constructing a conceptual framework from which the formalisation paradox can be described and analysed more precisely. In the first sections we will define the ordering process more accurately and we will discuss the complexity of the ordering process as fundamental concept in defining the situational factors. Then we will consider the different perspectives from which the ordering process can be studied in relationship with the degree of formalisation. Finally we will present our conceptual framework. In the last sections of this article the results of some explorative case studies are discussed. One of the central issues of these case studies is the problem organisations are facing in making a proper balance between the formalisation of the ordering process and the necessity to create flexibility regarding the processing of orders, in other words the formalisation paradox. We conclude this article by summing up the major findings of our study and by presenting a research agenda concerning the ordering process.
2 The ordering process

The ordering process is described and defined extensively within logistical literature. In many cases the terminology with respect to the ordering process is rather confusing and ambiguous. The ordering process is, for example, referred to as ‘order processing’, ‘order management’, ‘demand management’ and ‘the order fulfilment process’. Not only the terminology but also the scope that is attributed to the ordering process differs. According to Lin & Shaw (1998) the ordering process starts with receiving customer orders and ends with delivering the finished products. Other authors share this rather broad point of view (see for example Bowersox et al, 1986; Vollman et al, 1997; Ballou, 1992; Shapiro et al, 1992). Various authors emphasise at the same time specific activities that take place within the ordering process. Forecasting demand, delivery time promising (Vollman et al, 1997), and the planning of material and capacity (Lin & Shaw, 1992) are some of the activities that are stressed in particular. Ballou (1992), at the other hand, emphasises the more physical activities while Shapiro et al (1992) are mainly interested in the co-ordination and interface activities between Sales and Production.

The various authors, although having different opinions on which activities are included in the ordering process, agree on the view that matching market demand and production capabilities is a fundamental aspect of the ordering process. This co-ordination of market demand (customer wishes) and production possibilities will be our central focus. We will define the ordering process as the process in which customer orders are translated into production orders. By means of the ordering process, the company and customers create a commitment about product specifications, order quantities, and the timing of delivery. The overall logistical performance of the organisation therefore is to a great extent determined by the way that the ordering process is structured. To describe the ordering process more accurately we can model the process as an input-output system on a rather abstract level (see figure 1).
In order to deliver the right products at the right time, demand requirements need to be translated by means of the ordering process into production orders. It will be clear that in order to attain realisable order agreements production capacity and customer demand needs to be matched. Thus, the parties involved in order processing are Sales and Production. They are functionally interdependent (see also Parente, 1998). Sales and Production often have to exchange a huge amount of information on different levels of control regarding the specification, volume, mix and delivery time of the product. Depending on the context of the ordering process this information is co-ordinated at different levels of control. According to Konijnendijk (1992), different production control structures not only ask for other elements to be co-ordinated in the ordering process but also vary in the need for co-ordination on different control levels. His study shows that in engineer-to-order environments the focus of the operational co-ordination regarding the ordering process is mainly on the definition of proper specifications, for make-to-order environments the focus is mainly on delivery time and for make-to-stock situations the focus is more on volume agreements. Although reality is far more complex than suggested in the study of Konijnendijk, his study illustrates that contextual influences on the ordering process can be very different which makes the structuring of this process a very complex issue.
We are interested in the structuring of the ordering process. Following the contingency approach the structure of the process has to fit with the situational factors. To get a better insight in these factors we introduce now the concept of complexity. According to De Leeuw (2000), complexity is a central concept in management studies because organisations not only seek to reduce complexity but they also have to be structured depending on their complexity. So, we suppose that the degree of formalisation of the ordering process is dependent on the complexity of the process. We will now explore the complexity of the ordering process by using the characterisation of complexity as described by De Leeuw (2000).
3 Complexity of the ordering process

According to De Leeuw (2000), complexity is a multidimensional concept that concerns interdependency, uncertainty, controllability and heterogeneity. We will discuss each of these dimensions applying them to the ordering process. In terms of De Leeuw (2000), the ordering process can be seen as a system (see also figure 1).

The first dimension of complexity is the interdependency. De Leeuw (2000) argues that a system is complex when a strong interdependency exists between the separate elements of the system. Whenever a complex system is decomposed into several subsystems this decomposition evokes a need for co-ordination between the elements where the interaction is interrupted. With respect to the ordering process we will consider Sales and Production as subsystems. We argued before that in the ordering process Sales and Production in one way or the other are reciprocal interdependent in the sense that Sales provides the customer with products made by Production. Depending on the production control structure Sales must sell what Production has produced (make-to-stock situations) or Production must produce what Sales has sold (make-to-order and engineer-to-order situations). Important for the concept of reciprocal interdependency 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. For the ordering process this implicates for instance that when Sales is the most powerful party Production has to accept rush orders more frequently. On the other hand, when Production has more power Production will hold on to the production planning and will not easily accept rush orders (see also Nauta e.a., 1998).

The second dimension of complexity is uncertainty (de Leeuw, 2000). The complexity of the ordering process can be characterised by the degree of uncertainty faced in this process. Whenever both demand as well as production are characterised by a high degree of unpredictability, the ordering process in general will be facing a lot of uncertainties. In ordering processes we often see that it is possible to estimate
demand on an aggregated level but that it is impossible to predict demand accurately on a high level of detail. We already mentioned the fact that companies nowadays are forced to act more customer-oriented. In practice this results in a broader product range and the need for more flexible delivery times. This in turn implicates that organisations in many cases are facing a higher degree of uncertainty in the ordering process. Another indicator of uncertainty is the ambiguity of the order-processing situation. Ambiguity refers to the existence of several perceptions of the situation. In this respect, we want to draw the attention to the differences in interests between Sales and Production. As Konijnendijk (1992) states, it is often in the interest of Sales to realise maximisation of turnover while it is in the interest of Production to realise cost minimisation e.g. efficiency. Therefore, Sales will in general have a large drive to accept as many orders as possible and to accept delivery times that are sometimes hard to realise. The ultimate goal of Production on the other hand is to make every effort for an optimal capacity utilisation, for example by means of large batch sizes and long production runs. Crittenden et al (1993) elaborated on these differences in interests and found seven areas of conflict between Sales and Production e.g. the range of products, product customisation, changes in the range of products, production planning, capacity planning, delivery and quality control. Interesting in their research is the finding that although agreements could be made in these areas on a strategic level, it turned out that in the daily practice of processing orders several conflicts between sales, planning and production arose. So in general it can be concluded that the complexity of the ordering process not only refers to uncertainties to be faced in this process but also to the existence of different perceptions of goals and interests with respect to the ordering process.

A third important dimension of complexity is the controllability of a process. In the ordering process a lot of information has to be handled to control the process of matching demand and supply of products. On the one hand information needs to be processed about customer requirements. On the other hand there is a necessity for information about the constraints of the production system regarding for instance the flexibility to react effective and efficient on customer orders. Furthermore there is a great need for co-ordination between the parties involved in the ordering process. The
control complexity of the ordering process is also stressed by Bertrand et al (1990) who elaborate that co-ordination between Production and Sales is one of the design parameters for the logistical control structure. Especially in more customer-oriented companies the controllability of the ordering process can be quite difficult because every order calls for a new trade-off between logistical decisions. This is confirmed by the research of Konijnendijk (1992) that shows that tactical co-ordination is more usual in make-to-stock situations than in make-to-order or engineer-to-order situations. Because of the fact that in make-to-stock situations products are often more standard, a control framework based on these standards can be determined more easily for the operational level. The research of Konijnendijk also indicates that in general it is more difficult to define such a framework for make-to-order situations.

Finally, the complexity of a system can be a result of a high degree of dissimilarity between the distinctive elements of the system. With respect to the ordering process we see for instance often a combination of standard products and specialities to be delivered. Standard orders can in general be treated according to standardised rules and procedures while customer specific orders often implicate a non-standard set of logistical decisions to be made. A combination of orders with distinctive characteristics will normally result in an increase of control complexity with respect to the ordering process. In practice this is often the case.

From the above, it can be concluded that the ordering process can be quite complex due to the different parties involved that are often strongly interdependent but at the same time have different objectives and often conflicting interests. Furthermore, the unpredictability and the heterogeneity of demand influence the complexity of the ordering process strongly. Many organisations are confronted with the question how to structure the ordering process in such a way that they are able to cope with the complexity of this process.
4 Reducing complexity by information technology: the formalisation-paradox

To reduce the complexity of the ordering process many organisations try to use Information and Communication Technology. ICT offers different kind of information systems (like ERP) which are able to speed up the processing of information. As a result customer demands can be treated more quickly and more flexibly. In terms of order processing it can be concluded however that logistical information systems in general and ERP-systems in particular do not always function adequately in practice. The functionality of ERP-applications to check actual capacity availability for example is still insufficiently covered (see IPL-TNO, 1998). Checking of actual capacity availability is an important activity in the ordering process, namely to be able to give customers realisable delivery dates for individual orders. Especially in capacity-oriented companies, in which the planning of production orders is controlled more by the available capacity than by the available materials. This means that solely on the basis of information systems adequate decisions regarding due date promising cannot be made. These malfunctions of ERP-applications seem to be caused by some fundamental shortcomings and weaknesses in the information system as shown by the fact that experts in this field are still trying to develop new software applications to solve these kind of problems. In this context we refer for instance to the issue of Advanced Production Scheduling (APS). We suppose, however, that companies have to deal with a more fundamental issue in this respect, namely the ability to automate a process by means of an ERP-application implicates a necessity to formalise certain elements of this process. But a high degree of formalisation can at the same time easily lead to inflexibility and rigidity (see Mintzberg, 1979). When, for example, there is a fixed delivery time for accepting customer orders it will be difficult to react flexibly on a customer demand to deliver within this time frame. We will refer to this problem as the formalisation-paradox of the ordering process.
We assume that the degree of formalisation of the ordering process is related to the complexity of the order management system. In the next sections of this article we will further explore the relationship between the complexity of the ordering process on the one hand and the degree of formalisation of this process on the other hand.
5 Formalisation of the ordering process

We will define formalisation as the degree to which activities, decisions and behaviour are governed by formal rules and standard procedures (see Daugherty et al, 1992; Mintzberg, 1979). These rules and procedures are written down. In other words, formalisation of the ordering process is concerned with the rules and procedures in respect of the activities, the decisions and the behaviour within this process. Formalisation is a means to standardise activities.

As mentioned before, various authors have emphasised different elements of the ordering process. Based on an extensive literature study, three dominant dimensions concerning the ordering process can be distinguished. The ordering process can at the same time be considered from a logistical control point of view, an information processing perspective as well as from an organisational scope. These three dimensions will now be discussed further to elaborate on the formalisation of the decisions, activities and behaviour regarding the ordering process. It is from this discussion that we will derive a conceptual framework of the ordering process.

5.1 Order processing as an issue of logistical control

The ordering process is a vital link between Sales and Production. It is especially the operational co-ordination between Sales and Production within this process that is of great importance. Considered from this point of view, the ordering process can be seen as a collection of decision functions with the purpose to co-ordinate production and sales decisions. Logistical decisions that are part of this process concern strategically decisions, for example the co-ordination of product quantities and delivery times (see Bowersox et al, 1986). At the same time more operational logistical decisions concerning order acceptance, determining of delivery time per order and planning of production, materials and capacity for the purpose of individual
customer orders are part of the decision-making process regarding order management (see for example Vollman et al, 1997; Lin & Shaw, 1998). Questions about prioritising orders in cases of capacity bottlenecks or accepting rush orders are some interesting examples of these operational decisions to be taken within the ordering process.

In general, all the logistical decisions will be embedded in the logistical control concept of the company. A logistical control concept can be defined as a coherent whole of planning rules that fits with the demands of the market and that is tuned to the characteristics of the production process, products and markets. In other words, a logistical concept of the organisation concerns the managerial rules between all parties involved, e.g. Sales, Production and Procurement. These rules not only include operational planning algorithms but also guidelines on a more tactical and strategic level within the organisation concerning the overall control structure of the material flow into, within, and out of the organisation. The decisions to be made within the ordering process and the degree of formalisation regarding these decisions can usually be derived from the logistical concept of the organisation. In cases of a highly formalised logistical concept, decisions and managerial rules concerning the processing of orders are often highly formalised too. It can be hypothesised that a close and direct relation exists between the formalisation degree of a logistical concept of the organisation and the existence of formalised agreements between Sales and Production concerning the processing of orders. It is interesting to notice that these agreements themselves are influenced by the interdependency and power relations between Sales and Production (Nauta e.a., 1998).

We believe that especially the interdependency between Sales and Production, the ambiguity and the controllability of the ordering process characterise the complexity of the decision-making structure. We also assume that in more customer-oriented companies Sales and Production are highly interdependent, because every customer order may call for a new trade-off between logistical decisions. So Sales and Production need to exchange a lot of information about every order; the controllability of the ordering process can be quite difficult in these kinds of situations. It means that it will be more difficult to formalise the managerial rules.
5.2 Order processing as an issue of information processing

The ordering process can not only be considered as a decision-making process but also as an administrative process. It is obvious that customer orders contain a lot of information about the demand specified by customers. All these specifications should be translated to other areas of the organisation to be able to react adequately to the customer demand. The accuracy of entering the data is essential for the administrative processing, acceptance, planning, production and delivery of the products. From this point of view, the ordering process is not only a complex decision-making process but also a sequence of information processing activities consisting of preparation, receipt, entry, acceptance, confirmation, planning and scheduling of orders. These administrative activities can be laid down in written procedures, but also in procedures that are embedded in the computerised information system used.

Within the ordering process, information with respect to customer demand is matched with information about the state of the production system. So, not only information about demand specification has to be handled within the ordering process but also information about production constraints to make agreements with customers on specifications, volume and timing of the orders. The matching of information is highly influenced by the logistical control concept of the organisation: if managerial rules are clearly defined Sales generally has more insight in the overall state of the production system and the constraints enforced by the production system. In practice, matching production and demand information takes place on highly structured and well-defined base. It may often be necessary to get information about the actual capacity and material availability to handle for instance rush orders.

From an information point of view, the formalisation of the ordering process not only refers to all decisions that have to be made but also to the way data is processed within the ordering process. On the one hand the processing of information can be highly standardised and formalised by means of well-defined procedures, a clearly defined sequence of activities and distinctive measures in exceptional cases. At the
other hand the processing of information can also be rather ad hoc, fragmented and not clearly defined. We suppose that the complexity of the information processing within the ordering process is especially characterised by the predictability and the heterogeneity of demand and production capacity. We assume that it will be easier to define procedures with repeating orders and little exceptions, and vice versa.

5.3 Order processing as an issue of organisational co-operation

Different departments and logistical parties are involved in the ordering process e.g. sales, (production) planning, procurement, manufacturing, and expedition. Often, the customer himself also plays an important role in the ordering process. In most of the studies on the organisational context of order processing it is implicitly assumed that organisations are functionally organised. The focus of these studies is on the issue of interface and co-ordination and on the influence of a functional separation of the departments involved in the ordering process (Shapiro, 1992; Konijnendijk, 1992; Crittenden et al, 1993). Shapiro (1992) argues that co-operation within the ordering process is hindered by functionally organised organisations, because the various departments have conflicting interests and because they know too little of what goes on in other departments. It is therefore not only important to examine the behaviour of the actors involved but also the organisational embedding of the ordering process. This includes questions like: what departments or actors are involved, who is responsible for delivery time promising, and are the different actors familiar with all the activities to be performed. This is in line with variables that determine organisational co-operation 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, the existence of clear and well-defined logistical goals, the division of power between the actors, and the clarity in tasks, competencies and responsibilities. From organisational literature we know that a high degree of formalisation is appropriate in cases of a certain environment, highly standardised processes, and a low degree of ambiguity about goals and outcomes (see
Burns & Stalker, 1961). Related to the ordering process it can therefore be hypothesised that a high degree of formalisation of the ordering process in terms of the variables mentioned above must fit into the context of the ordering process. A highly formalised organisational embedding of the ordering process in other words is only suitable in situations of a stable environment. From organisational literature we also know that in uncertain and ambiguous situations additional organisational measures in terms of co-ordination have to be taken. Task structures and task-related interactions in these cases are often flexible and poorly defined while the interdependence between group members is high. We suppose that the earlier mentioned complexity characteristics that especially concern the organisational embedding are the interdependency between the actors, the ambiguity in goals and interests, but also the uncertainty of the situation. We assume that in complex order processing situations formalising by well-defined logistical goals and clarity in tasks and responsibilities will not be sufficient. Other forms of co-ordination are necessary to be effective.

To summarise, the degree of formalisation of the ordering process can be operationalised by the three dimensions. At the same time, we suppose that the complexity characteristics as discussed before can be applied to the different dimensions of the ordering process. It is clear that these dimensions as well as the variables that determine the complexity are intertwined.
6 A conceptual model of the ordering process

Until now, we have examined the variables which determine the complexity of the ordering process and the dominant dimensions of the ordering process on the basis of which it is possible to explore the degree of formalisation of this ordering process. Based on the discussions in the previous sections we now can conceptualise the ordering process more precisely. The variables of complexity and the above mentioned dimensions of the ordering process are the fundaments of our conceptual model that is used to explore the relationship between the complexity and the degree of formalisation of the ordering process in more detail.

Figure 2 gives an overall view of the variables and dimensions related to the issue of formalisation regarding the ordering process. One of the central ideas behind this conceptual framework is that the predictability and the heterogeneity of customer demand determine to a high degree the complexity of the input of the ordering process. The characteristics of the production system at the other hand greatly influences the possibility to react adequately on this complexity, especially the fact if the production system is capable of reacting in a flexible way. This concerns the mix flexibility, the volume flexibility and the delivery flexibility of the production system (see Slack, 1998). The flexibility characteristics therefore form a second major input of the ordering process. These flexibility characteristics reveal themselves in the characteristics of the production system like the amount of production lines, the interchange-ability of these production lines, lead-time, set-up times, and the multi-functionality of employees.

The complexity of the ordering process is not only influenced by the complexity of the input, but also by the complexity characteristics of the process itself, as we discussed before. These characteristics cannot be ignored. We assume that the characteristics of demand and the characteristics of the production system
influence the structuring of the ordering process and in a way determine the interdependency, the ambiguity and the controllability of the ordering process.

**Figure 2** Influences on the formalisation of the ordering process.

The basic idea behind the model as presented in figure 2 is that both the necessity as well as the possibility to formalise the ordering process is highly influenced by the complexity of the customer demand and the flexibility of the production system. As discussed before, the ordering process can be described as the process of making order agreements and is in this context conceptualised by three dimensions e.g. the
logistical decision-making structure, the processing of information, and the organisational setting regarding these order agreements. We further assume that the degree of formalisation with respect to these three dimensions will vary resulting from the specific combination of customer demand characteristics and characteristics of the production system. One of the underlying questions regarding the formalisation issue of the ordering process is how this process should be structured. Starting from the conceptualisation as outlined in figure 2 and applying the idea of the contingency approach it can be hypothesised that a fit should exist between the structural characteristics of the ordering process and the input of this process as depicted in figure 1. An adequate fit is then defined as the most suitable co-ordination of internal objectives (efficiency) and external objectives (flexibility, delivery reliability). Some indicators of a misfit are a poor logistical performance, instabilities in the production process, frequently re-planning of production runs and strained relations between employees involved in the ordering process.

Whenever demand is well defined, predictable and characterised by standard products, the ordering process can be highly formalised. This high degree of formalisation is enforced by a high degree of flexibility of the production system involved. The existence of over-capacity, small set-up times, flexible allocation of product to product-lines and multi-skilled employees will have undoubtedly a formalising effect on the ordering process also, especially on the information processing and the organisational setting. We expect, however, that when predictable demand is combined with little flexibility in the production system the decision-making structure will have to play an important role. The production capacities have to be planned precisely and accurately to be able to react on the known customer demand.

The ordering process will be more complex and less easy to formalise in cases of a high variety of demand, customer-driven specifications and increasing uncertainties. The interdependency between Sales and Production and the control complexity will be high. In these cases structuring the ordering process will be even more complex whenever demand has to be matched with a production system that is characterised by
a numerous amount of uncertainties, complex interrelationships between capacities used, and a poor defined planning structure. In these cases formalisation will probably only be possible on a higher level of aggregation. The operational co-ordination of individual orders within the order management is almost a creative process in which formalisation most likely would only bring about rigidity.

It will be clear that the interrelationships between the variables as mentioned above are far more complex in practice than as suggested in figure 2. In the context of this article unfortunately only an overall outline can be presented with respect to the formalisation paradox and with respect to the influence of demand and production characteristics on the way the ordering system is structured.

Based on the conceptual model as presented above, in the next section the results of some explorative case studies are presented. The central issue of these case studies was to further explore the formalisation forces with respect to the ordering process as described. Ultimately this insight needs to lead to a deeper understanding of the main structuring issues concerning the ordering process.
7 Two case studies

7.1 Methodology

The case studies have been performed by
- interviewing all actors involved in the ordering process at different levels of control
- participating in meetings concerning the order processing
- following the information flow through the company
- studying relevant documents.

For the interviews the same topics and questioning lists have been used for the interviewees with comparable functions. In the first company the data gathering took 9 days in a period of three weeks. In the second company the data gathering took 6 days in a period of 2 weeks.

The two companies explored are situated in a make-to-order environment and are processing standard as well as customer specific orders. The companies are medium sized and in both cases there are distinctive functional areas like sales, production and procurement. Furthermore, they both use a logistical information system for order processing. In the next sections, some of the results of the two case studies are discussed. We will mainly focus on the question how the degree of formalisation of the ordering process is influenced by demand characteristics and the characteristics of the production system. In doing this, we will use the conceptual model as presented in figure 2. In addition, some aspects of the degree of formalisation regarding the ordering process as presented in the previous sections are applied. Finally we will give some preliminary findings on the formalisation paradox that the companies studied encounter in structuring their ordering process.
7.2 Air Technique

Air Technique is a company that produces air channels, registers and all equipment necessary to control the climate in a building or room (ventilation). The company is divided in three main commercial companies and one production company. Each commercial company handles their own order flow until order acceptation and then sends these orders to the production company for planning and production.

The company has been growing enormously the last few years, resulting in an increasing amount of incoming orders. Part of the production is make-to-stock, part is assemble-to-order and part is make-to-order. In total there are about 200 employees working at Air Technique.

For this paper we use the data of one of the commercial companies. The turnover of this company was 11 million Dutch Guilders in 2000. There are about 25 employees working at the commercial company. In the production company there are about 80 employees. They supply 10 different product groups. The company delivers standard products (80%) and specials (20%). The standard products are partly held on stock. Specials are made to order and are mostly standard products with some customer specific modifications. Demand is in general characterised by a high variety and an unpredictable quantity ordered per product, which in turn results in an unequal workload at the different production units. Air Technique especially experience difficulties in processing orders that combine standard products and customer specific products because of differences in delivery time.

The production process can be characterised as labour-intensive because most of the operations have to be performed manually. This in itself creates however a certain degree of flexibility in the production system. The production system is further characterised by short lead times (max. 5 days), very short set-up times, comparable work methods and versatile employees. An increasing demand, a high degree of capacity utilisation and an unpredictable character of products ordered causes at the same time however capacity shortages in different production units.
Within the ordering process order acceptance and delivery time promising is the responsibility of Sales and is solely based on an estimation of the throughput time of the products. Sales, however, lacks adequate insight of all the incoming orders neither do they have full access to the production planning and the actual production capacity available. Sales tries to cope with this lack of insight by using slack in delivery time promising, without telling planning. After orders are accepted, they are sent to the planning department that makes a feasibility check regarding the delivery time given. When the delivery time is not feasible because of capacity shortages Planning consults Sales in trying to postpone the order. Starting point in the discussion between Planning and Sales is to protect Production from planning nervousness that only would enlarge capacity shortages. Sales wants to realise short delivery times and thinks of Planning as a rigid, non-co-operative department. So, Planning and Sales have to exchange a lot of information especially about the delivery time of individual orders. There is no formalised way of taking this logistical decision. The information system used mainly facilitates the administrative processing of orders but does not support the production planning. Furthermore, the responsibility for prioritising in order acceptance is not clear and the actors involved have no managerial rules to decide on the delivery time of individual orders in cases of capacity shortages. This often results in a typical Sales-Production conflict that, in fact, is fought out at the highest level in the hierarchy of Air Technique and in most of the cases end in accepting the order.

Air Technique is able to react very flexible on customer demand and they realise short delivery times, but the organisation has to cope with internal problems like instabilities in the production process, frequent re-planning, daily rush orders and strained relationships between the different parties involved. These are indicators of a misfit between the characteristics of demand and production system on the one hand and the structuring of the ordering process on the other hand. The degree of formalisation is low on every dimension: there are some basic agreements on delivery time promising and the administrative order processing is formalised by the information system.
Demand is complex, but not uncontrollable and the production system seems to be flexible enough to react adequately on the complexity of customer demand. But the

**Figure 3** Structuring of the ordering process at Air Technique.

Demand is complex, but not uncontrollable and the production system seems to be flexible enough to react adequately on the complexity of customer demand. But the
planning is poorly structured and is not being used as a co-ordination tool between Sales and Production. Furthermore, Sales is the most powerful party in the sense that the orders accepted have to be produced one way or the other and for that reason Sales does not seem to be very eager to formalise managerial rules. Formalisation of the decision-making structure would diminish their leeway in prioritising customer orders. We would expect that the lack of formalisation of the logistical control structure would be compensated by a formalisation of the organisational co-operation, but this is not the case at Air Technique.

In summary, it can be concluded that Air Technique tries to formalise the order processing by using some basic agreements on delivery time promising and by using the information system for the administrative order processing. In case of rush orders or capacity shortages these basic formalisation rules however, are not sufficient in managing the ordering process properly. So, Air Technique has not yet found a way to deal with the formalisation paradox: the ordering process is flexible but only at the expense of efficiency.

7.3 Furniture

Furniture is a company that produces all kinds of furniture for schools and offices that represents two different markets. The turnover of Furniture is about 50 million Dutch guilders and there are 220 employees working at the company. For this article we focus on the data gathered on the market regarding school furniture.

About 80% of their products are standard and 20% are customer specific variants. Demand is rather predictable at product group level. At the level of individual products demand is uncertain and extremely difficult to predict. With respect to the product assortment a great variety in models, sizes and colours per product exists.

Furniture has to deal with orders existing of products from different product groups. These so-called composed orders are even more complex when standard and customer specific products are combined in one order. In the ordering process, customer specific products have to be manually translated in a bill of material before
final order acceptation can take place. Furthermore, these products often require the procurement of specific parts. The production system is quite flexible and exists of multi-functional equipment and machinery with short set-up times (max. 15 min.). Bottleneck capacities are operated in two shifts and the employees are multi-skilled within their production unit. The products themselves are rather standardised because of a modular product design. The order lead-time is about six weeks of which four weeks are reserved for the production, namely one week per operation. The planning concept of the company shows all characteristics of period batch control and includes some slack to combine comparable production orders or to rearrange orders on a detailed planning level.

Within the ordering process of Furniture order acceptation and delivery time promising is a centralised responsibility and allocated to the head of the planning department. He has to agree on delivery times as proposed by Sales before orders are confirmed to the customer and released for further processing. After the order is released the order is first broken down into different production orders for the different production units. This is done by means of a formalised logistical information system that is based on MRP-characteristics. These production orders have to be authorised by Planning before they are actually released to Production. In order to point out and control problems in the order processing and to keep informed about the actual capacity availability, there is a meeting between Production and Planning every two days.
**Demand characteristics:**
- demand predictable at product group level but unpredictable at the level of individual products
- great variety in models, sizes and colours per product
- 80% standard / 20% customer-specific

- **Process characteristics:**
  - interdependency regarding due date promising
  - little ambiguity
  - information processing via system
  - centralised co-ordination between Production and Sales

- **Characteristics of production system:**
  - multi-functional equipment
  - short set-up times
  - different production units
  - employees multi-skilled per PU
  - long lead time (6 weeks)
  - standardisation by product modules

- **Degree of formalisation:**
  **Logistical control:**
  - managerial agreements on delivery time
  - planning rules defined by MRP-system
  - formalised use of slack

  **Information processing:**
  - administrative order processing and material planning control via information system
  - information about actual capacity discussed every two days with actors involved

  **Organisational co-operation:**
  - job instructions via ISO-procedures
  - responsibilities order acceptance clear and centralised
  - formalised meeting between production and planning
  - one central point of co-ordination between Production and Sales

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**Figure 4** Structuring of the ordering process at Furniture.
Furniture realises a good delivery reliability and is able to react adequately on customer demand under the given lead time of 6 weeks. The company is not able to be more flexible in timing of the order. There is a fit between the structuring of the ordering process and the characteristics of demand and the production system. Demand is complex, but again not uncontrollable. The production system is able to cope adequately with the variety in demand by modularization. The well-defined planning structure, the use of slack and the formalisation of the co-ordination between Sales, Planning and Production are fit to deal with the uncertainties of demand. But the degree of formalisation on the different dimensions of the ordering process is relatively high and for that reason almost resulting in a rigid order planning system. Rush orders can be accepted, because there is a formalised amount of slack in the planning. But reducing the lead-time for certain products is seen as impossible. The formalisation of the planning system by MRP results in a given throughput time of one week for every production unit. The effective throughput time is often shorter than one week. It should be possible to realise differentiation in order processing by planning on actual capacities rather than on the planning rule of one week per operation. So, by structuring the planning in another way it should be possible to react more flexibly in timing wishes of customers.

To summarise, Furniture has formalised the ordering process by centralising the delivery time promising, by using slack as a planning method and by using an MRP-system for material and capacity planning. Flexibility is maintained by the fact that planners have to authorise the production orders and because of the slack used in planning. At the same time the use of slack at different levels of the production control structure causes a certain degree of inflexibility in delivery time: the actual throughput time of an operation is often less than the planned lead time for that operation. The flexibility created in the ordering process at Furniture is formalised to such an extent that it is almost impossible to react flexibly on customer demand.
8 Conclusions

Our conceptual framework of the ordering process is based on the central idea that the complexity of customer demand and the flexibility of the production system influence highly the degree of formalisation of the ordering process. The case studies so far confirm this idea. An interesting finding is the fact that the degree of formalisation seems also to be influenced by other complexity characteristics. As we saw in the case of Air Technique, for example, the different goals and interests of Sales and Production is enforces by the fact that Sales has more power than Production. Sales can actually force Production to accept customer orders that do not fit in the planning. As a result, Sales is not willing to formalise managerial rules, because they would lose at least a part of their power.

Also interesting are the preliminary findings of the two case studies concerning the degree of formalisation of the ordering process, namely that it can differ along the three dimensions distinguished e.g. decision-making structure, information processing structure and organisational setting. This notion may be helpful for organisations that are struggling to find the right balance between formalisation and flexibility. For example, formalising the administrative information processing does not have to be automatically associated with formalising the planning structure. As shown by the case Furniture, the relatively high degree of formalisation of the planning structure leaves little room for flexibility in delivery time for individual products.

Further research is needed to elaborate the formalising and the non-formalising forces with respect to the ordering process. To be able to construct a generally applicable diagnostic framework for organisations on how to balance the degree of formalisation on the three dimensions discussed, it is necessary to conduct further research in more companies to get a better insight in the relationships between the variables of the conceptual model.
REFERENCES

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