Information system design for demand-driven supply networks – Integrating CRM & SCM

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Abstract: Many of the current initiatives for the practical, IT-supported employment of the concept of mass customization are generally based on the exploitation of modular designs, which limit the customer's choice largely to a guided configuration of the end product, without being able to take substantial influence on functions such as design, fabrication, assembly and distribution. To overcome these shortcomings and to provide a direct link from the customer interface to all relevant functions for fulfillment throughout the whole production network, this paper introduces the concept of demand driven supply networks and lays out the concept for a data and process model integrating multiple sales channels and the customer relationship management (CRM) function on the one hand with supply chain management (SCM), product data management (PDM) and logistics functions in a supply network on the other hand. This proposed process model aims to serve as a basis for designing integrated information systems that support mass customization in demand driven supply networks.

Keywords: Mass customization, CRM, SCM, integration, demand-driven supply network

1 Introduction

The advancement of web-based technologies has moved the concept of mass customization in the focus of both the scientific and the business community. First introduced by [Davi1987] primarily as a strategic marketing concept in 1987, mass customization has been more broadly defined by [Pine1993] in 1993 as a means to deliver goods and services, which on the one hand largely meet individual customers' needs but on the other hand are being produced with near mass production efficiency without a considerable price premium for those goods and services. In this definition, the borderline between mass customization and single-item production is generally defined by a threshold value for cost per unit of output [Pill1998]. If the costs per unit of output for an individual product are not higher than approximately 10-15 percent of a comparable mass product, this is considered mass customization.

This broader definition already implies the inclusion of multiple operational functions within an enterprise and on an inter-enterprise level to deliver customized products or services. In fact, [Pine1995 p. 103–114] point to this integration issue by postulating that "mass customization calls for a customer-center orientation in production and delivery processes, requiring the company to collaborate with individual customers to design each one's desired product or service, which is then constructed from a base of pre-engineered modules that can be assembled in myriad ways." Ideally, there should be a direct link from the customer interface to all relevant functions for fulfillment - primarily research and development, sourcing, assembly, delivery and services - to enable the customer to interactively influence development and provision of the product or service.

Demand-driven supply networks

As a consequence, when switching to mass customization, business functions such as product development, market research, sales, production, delivery and services are affected and have to be adjusted and integrated not only within a single company but rather over multiple tiers of suppliers to fulfill a more individualized demand, i.e. whole supply-networks have to be re-adjusted to be demand-driven. With the advancement of innovations in information systems and technology such as the Internet with respective applications, which e.g. opened up new sales channels and provided an efficient and effective means for integrating business functions, a growing number of companies started introducing variations of mass customization as an operating model. Among the most prominent examples is PC-manufacturer Dell who started online-sales of PCs on its website in 1996, thus giving its customers the option to freely configure their computer system and generally having those customized systems produced and shipped within five days.

However, it remains questionable whether those approaches already constitute a real adaptation of the concept of mass customization with demand-driven supply networks. As [Gool1998] points out, many of the current initiatives - including Dell - rather constitute a customized standardization, where the customer is given the choice to order from a limited set of standard mass component products instead of real customization. Companies that employ this concept generally exploit modular designs and advance in modularity-building of a more complex product from smaller subsystems [Bald1997, p. 84–93]. With that approach, the customer's choice is largely limited to a guided configuration of the end product, without being able to take substantial influence on functions such as design, fabrication, assembly and distribution. One of the main reasons for this can be found in the fact that the above mentioned information systems, while enabling the concept of customized standardization, do generally not support demand-driven supply networks as pre-requisite for mass customization.

The fulfillment gap

Application systems, especially systems for production planning and control (PPC), are important means for a cost-oriented mass customization. However, today's PPC-systems are more oriented on supporting mass production than single-item production and widely lack the ability for integration over multiple tiers in a supply network. Therefore, to enable the above mentioned kind of mass customization, information systems have to support customized fulfillment in demand-driven multitier and multichannel supply networks by providing a direct link from customer requirements to respective research and development-, sourcing-, manufacturing-, delivery- and service-functions throughout the network. I.e., customers need a way to describe what exactly they want to purchase. Among time limits and quantities this encompasses product characteristics as colors, performance or geometry. That information has to be translated into terms that can be understood by production planning, manufacturing, and engineering functions throughout the network [RauT1999, p. 777-783].

As a consequence, multiple process flows between customers and the supply network have to be streamlined and integrated to be able to model an information system that truly enables customized fulfillment for mass customization. In particular, an integrated process model that links customer oriented functions with fulfillment oriented functions as described above has to be developed. To address this challenge, this paper introduces the concept for a data and process model integrating multiple sales channels and the customer relationship management (CRM) function with supply chain management (SCM), product data management (PDM) and logistics functions in a supply network. This process model can then serve as a basis for designing integrated information systems that support mass customization in demand-driven supply networks.

In a first step, the detailed integration has been focused on the CRM and SCM functions as the focal points of demand and fulfillment. For the definition of supply chain management, the authors refer to [Houl198 p. 22-38], [Jone1985, p. 16-22], who give a rather operative interpretation. According to their work, main tasks include the optimization of forecast and planning accuracy, and the optimization of material flows (sourcing, production and delivery) over the whole supply chain. Main aim is the minimization of inventory and lead-time.

For customer relationship management, the authors refer to [HipW2001, p. 211–231] who emphasize the integrative aspect of CRM to create customized marketing-, sales- and service-concepts. In this definition, CRM consists of three main parts: Communicative CRM comprises the support and synchronization of all customer oriented communication channels. Operative CRM primarily consists of applications for marketing-, sales- and service automation. Analytic CRM primarily deals with data mining and data warehousing.

In chapter 2, the methodology to develop the integrated model is introduced and illustrated. In chapter 3, the process as described in chapter 2 is exemplified with the integration of the CRM function *Handling of specific* order and the SCM function *Capacity planning*.

2 Methodology

As illustrated in chapter one, the main focus of CRM is demand-driven whereas the primary focus of SCM is supply-driven. Those differing directions can be found in IT-applications for CRM and SCM as well. To utilize the full potential of both approaches and to design integrated information systems that support mass customization in demand-driven supply networks, collaboration between the respective applications is inevitable. Therefore, the interfaces between CRM and SCM functionalities have to be analyzed and integrated. To achieve this, a three-step approach has been taken, in which the notations have been partly based on the ARIS framework developed by Scheer [Sche1999].

In a first step, to identify the interdependencies and the interfaces between CRM and SCM functions, a thorough functional decomposition of both approaches, decomposing CRM and SCM in functions, sub-functions and elementary functions, has been conducted (see figure 1 for modeling methodology). Since both CRM and SCM comprise a huge amount of functions, the approach will be exemplified in chapter 3 with the CRM function *Handling of specific order* and the SCM function *Capacity planning*, where the CRM function addresses the question, whether a specific order configuration is practicable, when the order will be executed and how much the order will cost. In contrast the respective SCM function primarily deals with production planning and scheduling.

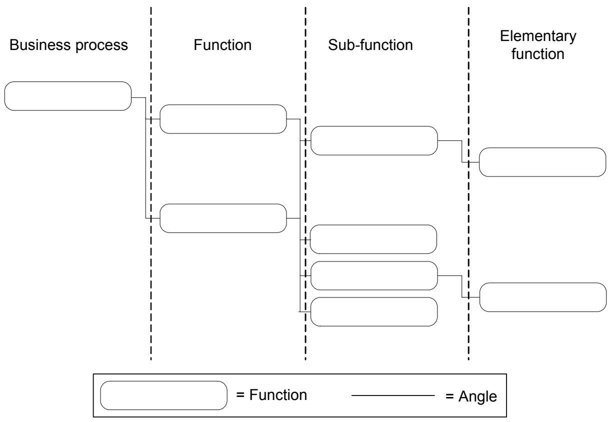

Figure 1: Functional decomposition diagram

In a second step, the information objects linked to the elementary functions have been identified and classified. In a third step, these information objects, for both CRM and SCM on the respective elementary function level, have been compared to identify concurrences in information objects that both CRM and SCM systems have to refer to. Based on those concurrences in information objects, the interfaces between CRM and SCM that are relevant for the design of an integrated system have been identified and have been represented in an information-flow model, which constitutes the basis for an end-to-end process model as prerequisite for the design of an integrated information system that supports mass customization in demand-driven supply networks.

3 Functional coherence of the CRM-function "Handling of specific order" and the SCM-function "Capacity planning"

As illustrated in chapter 2, as first step in identifying the interfaces between CRM and SCM with relevance for integration, a thorough decomposition of functions is necessary. In the following, this functional decomposition will be illustrated with the examples of the CRM function *Handling of specific order* and the SCM function *Capacity planning*. The respective CRM-function is part of the CRM process S*ales*. Other typical functions within the sales-process are *Sales management* [Alth2002], *Sales planning, Management of order*, O*rder entry*, etc [Ober2000]. Typical SCM-functions of the process *Planning,* besides the function *Capacity planning* are *Production planning*, *planning of batches*, etc. [Thal2001].

As shown in figure 2, the CRM function *Handling of specific order* is a function of the CRM process *sales*. The rectangles in the chart show the information objects appending to the elementary functions. *Configurable sales orders* is an important sub-function of this function. This sub-function consists of elementary-functions such as *In making with multi-level bill explosion*, *In making with* s*ingle-level bill explosion* and *In making without bill-explosio*n. *Configurable sales orders* in this context stands for customer orders which meet individual customers' needs. The appending information object for all three elementary functions is the customer order with its *Characteristic values* as color, size, etc. These characteristic values are not fully equivalent to a bill of material explosion which specifies the composition of a product from structural components and parts [Schn1993, p. 159]. Another sub-function of the function *Handling of specific order* is *Creation of the order*. The object *Delivery date* is among the relating information objects.

The functional decomposition for SCM as shown in figure 3 focuses on the function C*apacity planning*. In this paper, we will concentrate on the sub-function *Capacity scheduling* to illustrate the functional coherences between CRM and SCM. The sub-function *Capacity scheduling* exemplarily comprises the elementary functions *Calculation of period of operations*, *Calculation of* o*perating time* and *Planning of resource allocation*. *Capacity scheduling* as a part of *Capacity planning* is largely based on the scheduling results of material requirements planning. In the elementary function *Calculation of period of operations,* set up, execution and shut-down of the production order and of the planned order have to be calculated. Furthermore, standby time, transport time, etc. have to be determined. The result of these calculations is the information object *Duration of the process*. The elementary function *Calculation of operating time* determines the exact time when the order has to be executed. The appending information objects for this elementary function are *Time schedules*. The elementary function *Planning of resource allocation* determines the start- and the end-date for production

A comparison of information objects reveals that the information objects of the CRM-elementary function *Confirmation of the order* are also needed by the SCM-elementary function *Planning of resource allocation* and vice versa. As a result, the information object *Start- and end-date for production* indicates an interface between the CRM- and the SCM-process that is relevant for the coupling of both processes. Figure 4 illustrates the process flow around the identified interface

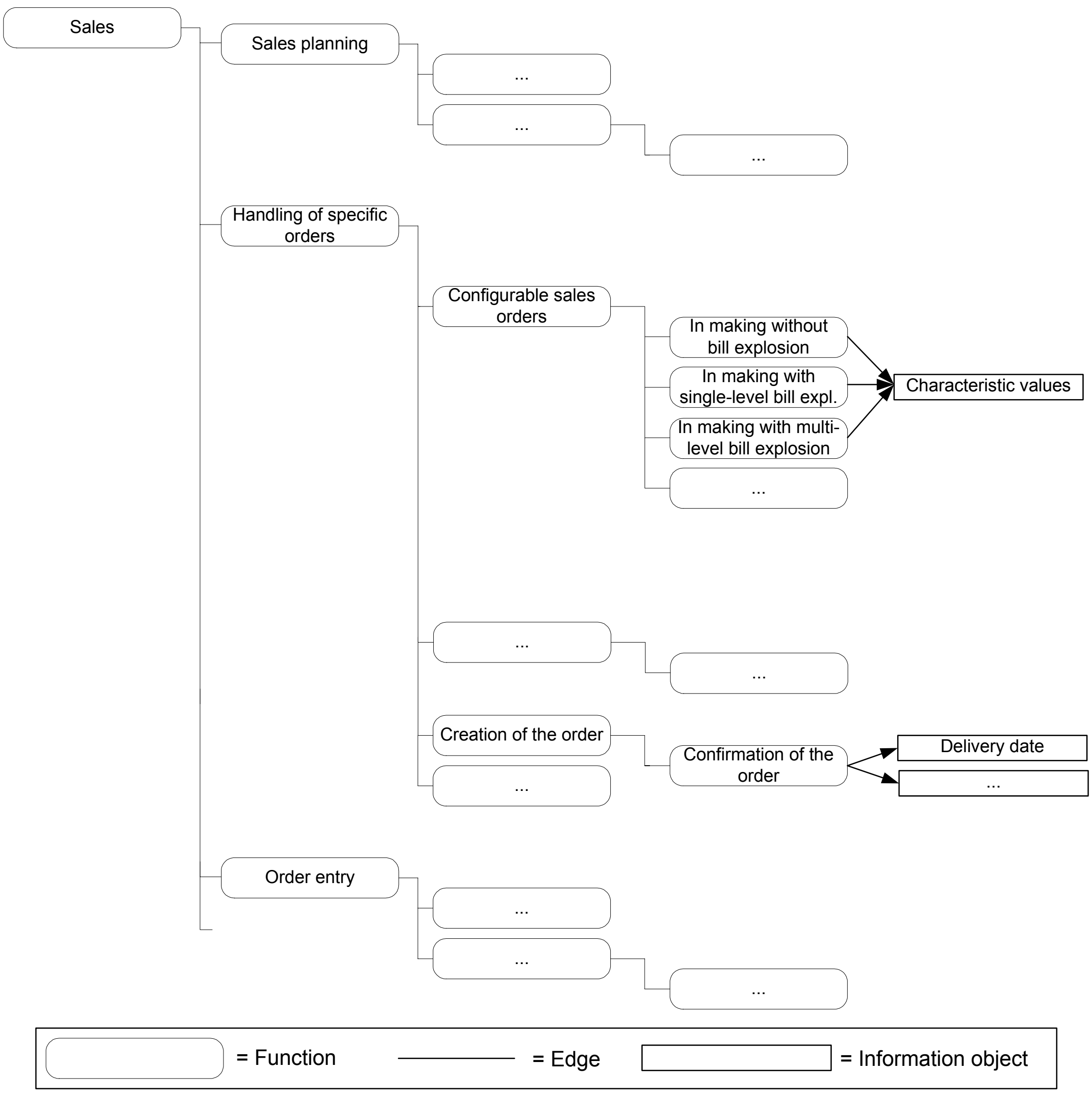

Figure 2: Extract of the functional decomposition diagram for the CRM-process sales

allowing for time schedules etc.. The appending information object is the *Start- and the end-date for production*.

In the next step, based on the analyses as described above, both functional decompositions are combined and mapped as illustrated in figure 5. By this, the functional view and date view get compounded. The link between the functional decompositions of CRM and

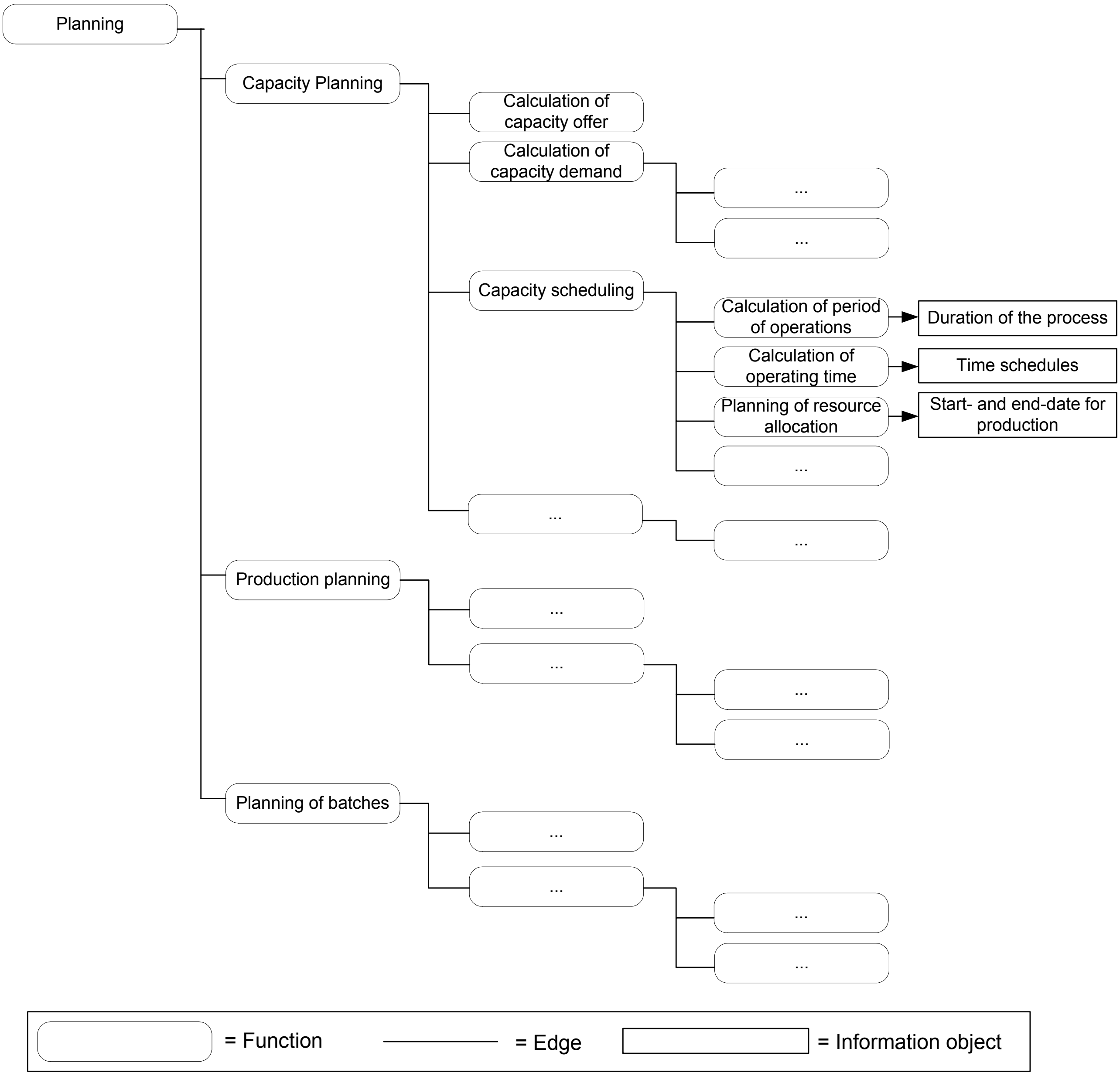

Figure 3: Extract of the functional decomposition diagram for the SCM-process planning

SCM is constituted by the information objects, which are referred to by elementary functions of both functional models and which have been identified as described in the process of functional decomposition. The circle in the middle of figure 5 exemplarily shows the interface for the illustrated process between CRM and SCM and the integrated model for the selected subfunction, which allows to offer customized products with regard to customers' choices, including delivery date.

4 Conclusion

To design information systems for mass customization in multi-tier demand driven supply networks, an integrated model for all relevant business processes is among the most important prerequisites. In this article, the methodology for the development of an integrated information flow and process model has been introduced and illustrated with the CRM function *handling of specific* order and the SCM function *capacity planning*. The result proves that a coupling of both processes

- CRM and SCM - through the information objects used by elementary functions of both processes is feasible.

In a next step, all relevant SCM and CRM functions have to be included in this model and an integrated information flow and process model for CRM and SCM has to be developed. In a further extension, related processes such as product data management (PDM) and logistics functions have to be included. This process model can then serve as a basis for designing integrated information systems that support mass customization in demand-driven supply networks.

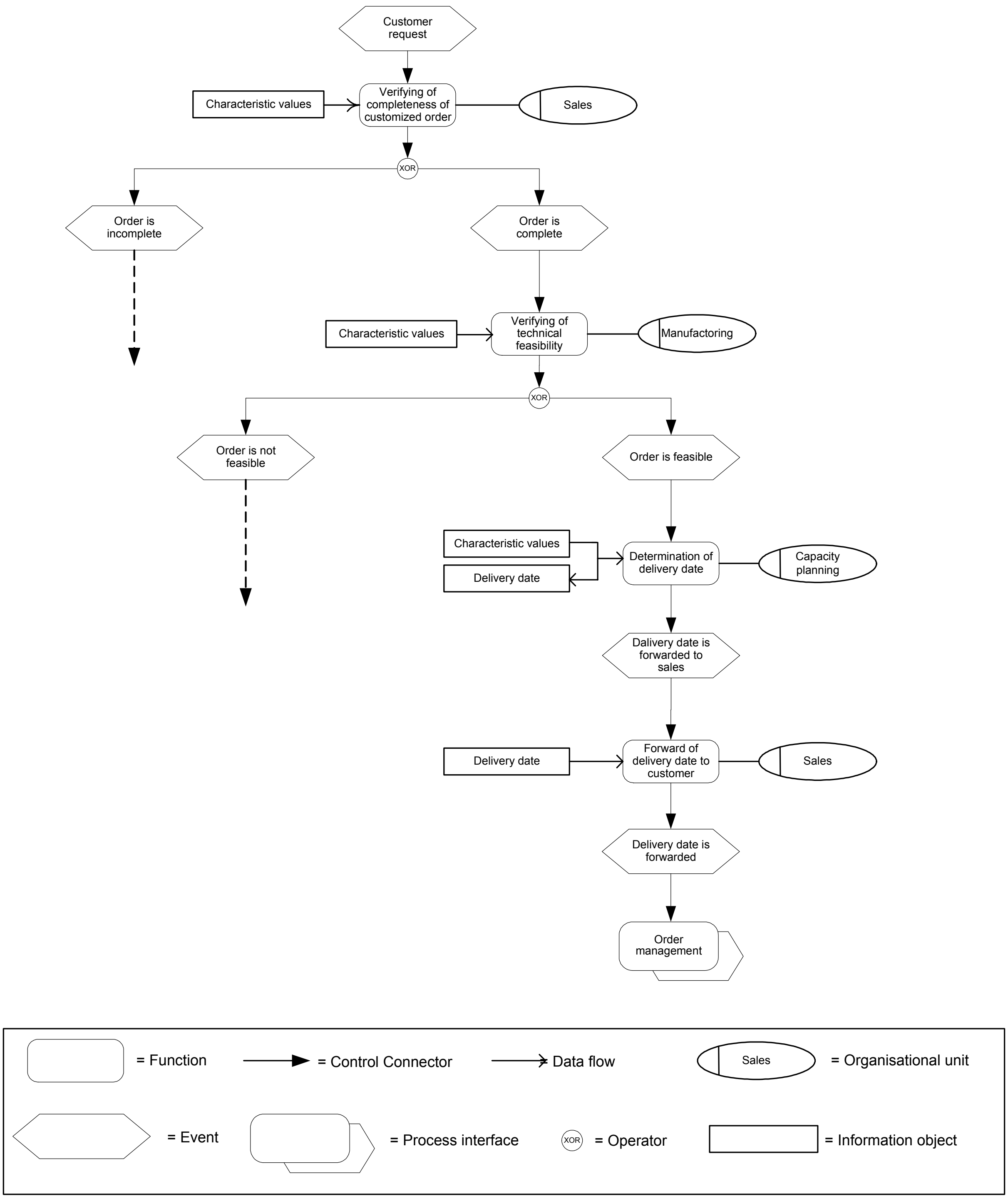

Figure 4: Process model for handling of specific order

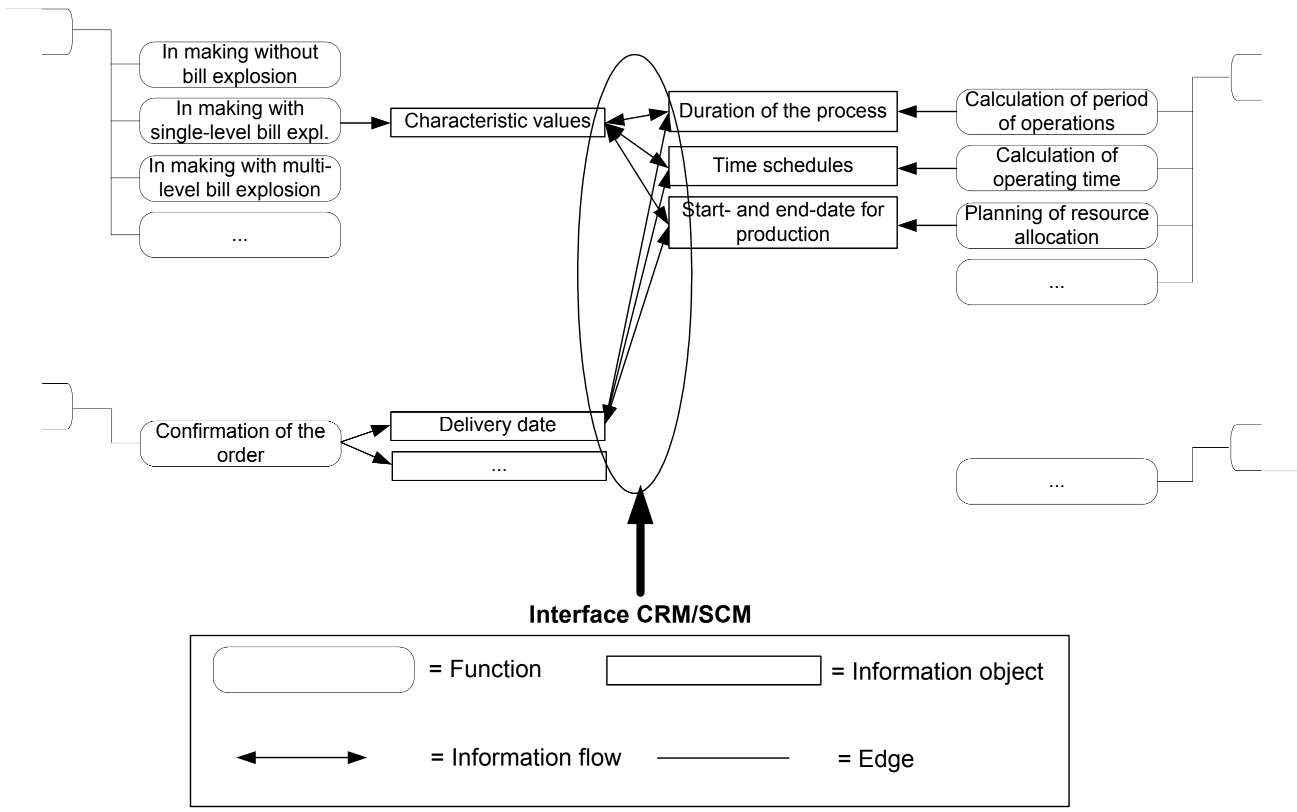

Figure 5: Extract of the functional interface CRM-SCM

References:

[Alth2002] Althans, M.: Konzeption eines Vertriebs-controlling-Informationssystems für Unternehmen der liberalisierten Elektrizitätswirtschaft; Cuvillier Verlag, Göttingen, 2002.

[Bald1997] Baldwin, C. Y., Clark, K. B.: Managing in an Age of Modularity. Harvard Business Review, Sept-Oct 1997 ; p. 84-93.

[Davi1987] Davis, S. M.: Future Perfect. Addison-Wesley, Boston, MA, 1987.

[Gool1998] Gooley, T. B.: Mass customization: how logistics makes it happen. In: Logistic Management & Distribution Report, April 1998.

[HipW2001] Hippner, H., Wilde, K. D.: BRM - Ein Überblick. In: Helmke, S., Dangelmaier, W. (Hrsg.): Effektives Customer Relationship Management. Instrumente - Einführungskonzepte - Organisation, Gabler, Wiesbaden, 2001; p. 211-231.

[Houl198] Houlihan, J. B.: International Supply Chain Management. In: International Journal of Physical Distribution and Logistics Management 15 (1985) 1; p. 22-38.

[Jone1985] Jones, T.; Riley, D.: Using Inventory for Competitive Advantage through Supply Chain Management. In: International Journal of Physical Distribution and Logistics Management 5, 1985; p. 16-22.

[Ober2000] Oberniedermaier, G.; Vertriebslogistik mit SAP R/3; Addison-Wesley Verlag, München, 2000.

[Pill1998] Piller, F. T.: Kundenindividuelle Massenproduktion: Die Wettbewerbsstrategie der Zukunft, Carl Hanser Verlag, München 1998.

[Pine1993] Pine II, B. J.: Mass Customization - The New Frontier in Business Competition. Harvard Business School Press, Boston, MA, 1993.

[Pine1995] Pine II, B. J., Peppers, D. and Rogers, M.: Do You Want to Keep Your Customers Forever? In: Harvard Business Review, March-April 1995; p. 103-114.

[RauT1999] Rautenstrauch, C.; Turowski, K. (1999): A Virtual Enterprise Model for Mass Customization. In: S. Nahavandi; M. Saadat (Hrsg.): Proceedings of the Second World Manufacturing Congress (WMC'99), International Symposium on Manufacturing Systems (ISMS'99). Durham; p. 777-783.

[Sche1999] Scheer, A.-W.: ARIS - business process framework. 3rd edition. Springer, Berlin, 1999.

[Schn1993] Schneeweiß, C.: Einführung in die Produktionswirtschaft. 5. Aufl., Springer, Berlin, Heidelberg 1993; p. 159.

[Thal2001] Thaler, K.: Supply Chain Management, Prozessoptimierung in der logistischen Kette; 3. Auflage; Bildungsverlag EINS GmbH; Troisdorf 2001.