Process Model for Short Term Booking of Customized Products on Online Market Places

Darian Achenbach

Abstract—Within this article a process model is derived that considers challenges concerned with short term booking of customized products on online market places. The process model enables customers to compare between different suppliers nonbinding and quickly. Feasibility of orders is ensured by integrating a load-dependent scheduling approach into the booking process. In order to consider uncertainties connected with production to specification, the derived process model allows online booking with the help of free available (ad hoc) capacities as well as already reserved capacities. Reservations enable suppliers to adapt capacities more suited to demands, whereas recurring customers benefit from reduced uncertainties about available capacities. At the same time both parties are facing more complex decisions. Within literature these decisions are predominantly considered for single companies that are able to analyze huge amounts of data. Proceeding emergence of online markets with access to all kind of participants requires however decision support for suppliers and customers which is adaptable to individual needs and resources. The article highlights important decisions within the described booking process and gives an outlook how customers and suppliers can set up individual decision support systems that help identifying potentials and implementing advantageous actions quickly. The approach is applicable for customers and suppliers within decentralized companies as well as between different companies and individuals.

Index Terms—Customized products, online market place, short term booking, reservations.

I. INTRODUCTION

In recent years there is a growing number of online providers for short term booking of services like hotel rooms, restaurant tables or medical appointments [1]. Successful examples in the field of services suggest further potential for development of online market places, especially for customized products [2]. These markets offer transparency for customers, whereas suppliers benefit from the chance to address many customers and enter new markets. At the same time online markets are accompanied with higher competition and unprecedented problems for both customers and suppliers [3]. Guaranteeing deliveries within seconds is challenging for suppliers, just as choosing between different market places and adapting available capacities. Finding decisions in dependency of current information quickly is in particular difficult with regard to small suppliers that are lacking sophisticated planning- and analyzing resources. But also customers with recurring demands can find it challenging to ensure advantageous fulfillments in an unsteady environment. Within this article a process model is

derived that considers these challenges for short term booking of customized products. The process includes load-dependent scheduling for products that need to be provided up to an agreed deadline. Assuming that customers need to decide for one supplier quickly, fixed prices are considered for short-term booking instead of auctions. However, auctions are considered to agree on reservations in the middle term. These reservations enable suppliers to adapt capacities or materials more suited to demands, whereas recurring customers are able to reduce uncertainties about available capacities. Short term booking is therefore possible using free available (ad hoc) capacities as well as already reserved capacities. The article begins with advantages and challenges for customers and suppliers that are concerned with short term booking of customized products. Related research is evaluated under the aspect of overcoming these challenges. Based on this evaluation the process model is derived. The article ends with an outlook on an individual set up of decision support systems (DSS) that help initiating and evaluating beneficial actions quickly.

II. ADVANTAGES AND CHALLENGES OF ONLINE MARKETS FOR CUSTOMERS AND SUPPLIERS

Suppliers in variable sectors are facing uncertain demand for customized products or services that need to be provided at short notice. In contrast to this demand, required capacities can often be adapted in the middle- or long-term only. As a consequence suppliers need to find compromises between high availabilities and the risk of costs for unused capacities. Depending on these compromises, customers are facing uncertainties about available capacities in the short term. In this context it can be beneficial for both customers and suppliers to allocate orders with the help of online market places. Online information about available delivery dates, appointments or prices enables suppliers to affect the demand quickly. Reduced prices can stimulate the demand for example and contribute to a higher coverage of fixed costs for elsewise unused resources. Online markets with many suppliers offering products and services at fixed prices allow customers to compare different options nonbinding and quickly [4]. Choosing between different offers online within seconds reduces time for personal contacting or waiting for responses. Indirectly a higher allocation of orders to faster or cheaper alternative suppliers relieves bottlenecks for customers that are lacking other allocation options.

Balancing demand and supply this way implies a sufficient amount of customers able to choose between suppliers that are willing to compete online. In order to allow quick choosing suppliers need to communicate guaranteed dates and prices automatically. Automatic generated answers

require standardized assessment of necessary capacities for each order. Current availabilities of these capacities must be checked in dependency of required dates for delivery or order collection. Suitable scheduling approaches and the synchronization of existing plans with available capacities online are therefore basic challenges that suppliers must overcome. Especially when using different online platforms, simple interfaces and a high usability are necessary to keep online information consistent with actual availabilities. In addition suppliers need to dimension available capacities online and determine access conditions [5].

Customers need to decide between available offers, which can be simple in case of different prices for equal products but complex in case of recurring demands and high uncertainty of available capacities. In order to assure sufficient available capacities in the short term, reservations or other framework contracts are necessary. Similar to the dimensioning problem of suppliers, customers need to decide in this case about the extent and conditions of reservations. Finally it needs to be decided for each order whether to use certain reservations or other capacities available at short term.

III. RELATED RESEARCH

In different areas of application a considerable amount of literature has been published on the topic of market based order commissioning [6]-[9]. Extensive support concerning customized production offers the integrated capacity market by Uygun. The web based concept aims to avoid bottle necks and excess machine capacities by trading capacities between not directly competing companies. In the following this concept serves as a reference to examine additional approaches, necessary to meet the described challenges for short term booking of customized products. The original concept is designed for business to business transactions. Its general architecture can be assigned for business to customer market places, however. Necessity for amplification exists in the three areas of automatic capacity checking, reservations and decision support.

A. Automatic Capacity Checking

In contrast to the challenge of quick online booking the integrated capacity market requires time for manual examination and approval of single orders. Suppliers can simulate additional workloads of potential orders within their production planning systems (PPS) [6]. In industrial practice lead time scheduling of these systems is often based on average processing times. Delays arising from current degrees of capacity utilization are therefore not considered directly [10]. In contrast online booking without waiting for responses of single suppliers requires automatic capacity checking that ensures availability or resources. This requires load-dependent scheduling within the booking process [11]-[13]. Several capacity markets in the field of services consider availability of single resources, whereas load-dependent scheduling for customized products must consider several production steps, too. Automatic booking in this field of application requires further integrated checking for materials and transportation, in case of required deliveries. Scheduling of transportations can be conducted based on existing transport structures of suppliers or with the help of connected capacity markets for transportation services [14].

B. Reservations

Whereas the integrated capacity market offers technical support for matching excess capacities and bottlenecks between companies, it does not consider described uncertainties of availability which are generally connected with production to specification [6].

A solution method to overcome these uncertainties exists in the classification of capacities into reserved and free available ad hoc contingents. Reservations ensure customers availability of capacities or materials for expected demands. Additional access to ad hoc capacities allows flexible upward adaption to actually emerging demands in the short term. Higher certainties about future demands allow suppliers adapting capacities or purchasing materials more suited to the demand or at lower cost. Compensational payments for unused reservations help ensuring actual orders [15]-[17].

Considering these benefits, integration of reservations into the booking process of online market places is promising for customers and suppliers. At the same time both sides are facing additional challenges of finding partners for reservations, determine their extent and negotiating prices. Customers are facing the additional question whether to use certain reservations, buy additional ad hoc capacities or abandon single orders in favor of upcoming demands with higher priorities. Suppliers are dealing with the problem of dividing total capacities into ratios for reservations or ad hoc capacities and determine access conditions. Reservations provide certainties about incoming demands, whereas ad hoc capacities tend to promise higher revenues, because of higher willingness to pay.

The research field of Revenue Management deals with this question of dividing total capacities in order to build up different price categories and maximize revenue. A basic question of the discipline is whether to accept orders for limited capacities or decline them to wait for possible future orders with higher revenues [18], [19]. The idea origins from aerospace companies, capitalizing a higher willingness to pay for last minute flights. Today, Revenue Management is applied in many areas of application. Different approaches have in common that an extensive and reliable data basis is required for analyzing demand patterns and deriving most promising actions. The concept is therefore predominantly used by companies that are able to collect huge amounts of data and employ experts for forecasting and optimization [19]-[22]. At the same time many other suppliers could benefit from the basic idea of Revenue Management but are lacking extensive knowledge and resources. Increasing access to online markets for small suppliers demands therefore for more simplified approaches. The same applies for recurring customers that wish to use their reservations most efficiently. In addition only few approaches consider adjustments of reservations within a whole network [15], [19], [23], [24].

C. Decision Support Systems

Interacting on online market places can involve complex problems for both customers and suppliers. Especially when dealing with reservations, finding decisions and predicting their impact often strains cognitive capabilities. In this context Decision Support Systems (DSSs) are helpful for

processing information and evaluating actions [25], [26]. DSSs are computer based systems that support humans during decision making [27]. Blutner et al. distinguish between six types of decision support in order to compare and classify existing DSSs [25]:

1) Generating and reprocessing of information (including filtration),
2) Generating of alternative actions,
3) Evaluating alternative actions (based on criteria defined by humans),
4) Choosing between alternative actions (Decision),
5) Monitoring implementation of actions (Accomplishment of objective criteria),
6) Reviewing implementation.

The authors distinguish further between different levels of task sharing between computer- and human based decision making. Each type of decision support can be either performed manual, computer based or in a combined way [25]. Within literature a number of DSS approaches have been published in fields like transport planning, production or adaption of distribution systems [25], [28], [29]. Different emphasizes on the types of decision support and a huge variety of deployed methods within these examples demonstrate necessity for an individual design of DSSs. In dependency of individual user requirements, resources, goals and the availability of explicit knowledge DSS can be implemented simple or complex for equal problems. Due to this ability DSS are very promising for supporting decision makers on online market places that are characterized by different requirements and resources.

After examination of related research findings it can be concluded that single solution approaches exist for the described challenges concerning short term booking of customized products. However, it is lacking an integrated approach that considers reservations within order allocation and decision support with the help of suitable decision support systems for customers and suppliers. In the following a process for order commissioning is derived that considers spontaneous booking as well as encountering of uncertainties through reservations. The process describes booking of customized production that are requested until certain deadlines which include transportation if necessary. Subsequently to the description of the booking process, connected problems for customers and suppliers are summarized. Afterwards it is illustrated how DSS can help overcoming these problems and thereby match individual needs of participants.

IV. PROCESS MODEL FOR SHORT TERM BOOKING OF CUSTOMIZED PRODUCTS

Due to the described uncertainties of production to specification, the following booking concept for customized products is based on reservations and free available ad hoc contingents. In order to ensure actual orders, customers need to agree on compensation payments for unused reservations. Depending on exclusiveness and prices, required materials are either procured by customers or suppliers. In the second case availability and prices for materials are connected with reservations for machine capacities or bookable within the short term.

Short term booking of customized products starts with nonbinding submissions of order requests in the booking system of an online market. Product specifications must therefore been described in a standardized form that meets evaluation requirements of the participating suppliers. Delivery or order collection is requested by customers either for a desired date or quickest possible. In request on the submission, customers receive offers from none to several suppliers. Single suppliers are able to submit more than one offer which allows different prices for alternative dates or access to different types of reservations and ad hoc capacities.

A. Capacity -Types and -Contingents

In order to allow different price categories and perform load-dependent scheduling that ensures compliance with promised delivery or production dates, capacities of single resources are classified into Capacity types and Capacity contingents. Capacity types determine access conditions for capacities and exist either in form of free available ad hoc capacities or reservations. Determined types are assigned by suppliers to contingents that define capacity amounts. Capacity contingents are used for capacity checking and cover single time horizons in form of several minutes, hours or shifts. Reservations consist out of single or several contingents which can be arranged for example over several weekdays for an agreed period of weeks. Suppliers can divide total amount of ad hoc capacities with the help of contingents in different capacity types which allows implementing different prices and access groups. Access to ad hoc capacities depends on these prices and limitations, whereas access to reservations is exclusive for subscribers. In order to allow comparing offers from several suppliers within seconds, access prices for ad hoc capacities are determined for according capacity types before individual requests arrive. Hourly rates thereby allow automatic calculation of prices in dependency of required capacities for the single resources. Prices for reservations result either from bilateral negotiations or auctions (see below).

B. Automatic Capacity Checking (by Suppliers)

Incoming orders initiate capacity checking for necessary operations over all required resources, which is based on defined capacity contingents. In the sense of rough-cut scheduling no starting and ending points are determined for single resources. Instead operations are assigned to capacity contingents of the resources only. During this process it is ensured that required times for all assigned operations do not exceed total times of the particular contingents. In order to simplify efforts for suppliers, this capacity check can be limited to defined bottleneck resources. Uncritical production steps or internal transportation processes are considered in this case with the help of average processing times only. Load-dependent checking based on capacity contingents ensures feasibility for all assigned operations and leaves flexibility for detailed planning. This flexibility allows reducing set up times through synergy effects within sequence planning. However, flexibility for detailed planning stands in contrast to total processing times. Relatively short capacity contingents promise shorter total times due to reduced waiting, whereas fewer options for synergy effects arise. In addition extensive operations must been split into

different contingents, which can result in further set up times. Potentials for reduced setup times must therefore been analyzed and balanced with individual requirements of total processing times by suppliers. Additional set up times for split operations require rules for maximal splitting or accounting of additional setup costs.

In order to assign operations to capacity contingents, advance times must be maintained that allow detailed planning for required resources. Additional advance times can be necessary for procurement of required materials. Depending on desired dates, scheduling is conducted forwards, backwards or in both ways. In case of requested exact dates for delivery or order collection, backward scheduling is conducted first. If required dates cannot be met, forward scheduling is added, which is performed directly in case of quickest possible dates. In case of orders that require sequel operations using several resources, single operations are assigned to capacity contingents under consideration of defined transition periods. Different combinations between contingents of several capacity types can thereby result in different alternatives for customers.

Within forward scheduling single operations are assigned to earliest possible contingents, beginning with the first necessary operations. Backward scheduling starts with the last necessary operations and assigns all operations to the latest possible contingents of the required resources. This procedure allows keeping free early contingents for subsequent orders that require fulfilment on a shorter notice. Operations that are assigned to later contingents can be drawn forward later by manual planners or planning algorithms. This pre-drawing is initiated during order release for each contingent, which is carried out after the advance times for operation assignment expire. In case of unused capacities pre-drawing possibilities need to be assessed and evaluated at these moments. Whereas pre-drawing can cause additional storage cost for products, it offers the chance to free capacities for subsequent arriving orders.

Pre-drawing can also be initiated by arriving offers that require longer advance times than already accepted orders and therefore cannot be assigned to the earlier contingents. Subsequent orders thereby push operations of other orders to earlier contingents of equal or different capacity types. Occurring additional storage costs for dispatched orders are charged to the pushing orders. The same applies for additional costs that result from assignments to capacity contingents that belong to more expensive capacity types. Dispatching orders from one contingent to another can concern single operations as well as several operations of different orders. Different alternatives can be generated and refused in favor of better alternatives directly. With the help of this dynamic booking, several options can be simulated and offered as alternative booking options to the customers. Subsequent to this automatic process, customers can choose between different options using reservations or ad hoc contingents as well as between different offers for earlier or later dates.

C. Booking Alternatives (by Customers)

Customers need to decide for one supplier within a specified amount of time. This time is determined by the market place operators and can vary for example depending on the frequency of transactions or the remaining time until order fulfilment. Orders are either released directly or parked temporarily. Order release is possible online or requires additional approval, for example by telephone or mail. Whereas customers gain transparency over several suppliers within seconds, additional approval generates commitment and avoids reliability problems concerned with automatic generated answers.

Temporary parking can be necessary for example in order to allow distribution agencies to agree on conditions with end customers. Possibilities and durations for this parking are determined by suppliers. Similar to the conditions for deciding between different suppliers, conditions for temporary parking can vary for example in dependency of remaining times till order fulfillment or current demand.

In case of booking alternatives that require reserved capacity contingents over all required resources only, further parking within the reserved contingents is possible. Before first advance times of the used contingents expire, customers receive release alerts or release orders automatically. Capacities for accepted orders are assured this way, whereas operations can be booked into other contingents flexible, depending on subsequent arriving orders. This procedure allows bundling of similar operations in order to use synergy effects. Pre-drawing of operations from these orders to other reserved contingents allows avoiding compensation payments for unused reservations. Similar to the pre-drawing decision of suppliers, customers need to balance likeability of future orders against storage cost. Pre-drawing initiated by other arriving offers is possible for the solely use of reservations, too. Other orders with shorter advance times are thereby pushed into earlier contingents. Using reservations first reduces the risk of compensational payments for unused resources, whereas pre-drawing maintains flexibility for subsequent arriving orders. Additional costs resulting for dispatching orders can be charged to the pushing orders, too. Even though all orders belong to the same customer, this charging is especially important for distribution agencies.

Pre-drawing is disadvantageous when it would have been cheaper to assign pushed operations to alternative contingents in the first place. This applies when other customers have used cheaper ad hoc contingents in the meantime or advance times for these contingents already expired. Balancing this conflict requires controlling access to reservations, which is possible by implementing quasi-costs. Irrespective of actually charged prices by suppliers, these costs are charged to single orders for using certain reservations [17]. Quasi costs are important for distribution agencies with several individuals representing one customer. However, the use of quasi costs can be too formal for single customers.

Depending on the significance of reservations and possibilities for solely use of reservations over all required production steps, customers can face similar planning problems for self-management of exclusive capacities like suppliers. Both parties need to adapt capacities and determine rules for short term booking in the middle term. Whereas capacity adaption is limited to the booking of reservations for customers, suppliers need to dimension capacities of single resources.

D. Agreeing on Reservations (by Customers and Suppliers)

Due to the focuses on short term booking, allocation of reservations is not considered in detail in this paper. However, both suppliers and customers benefit from reservations within short term booking due to reduced uncertainties about incoming future demands or available capacities. It can therefore be concluded that it is promising to integrate auction for reservations into online markets for the short term booking. Different allocation forms for reservations are thereby accompanied with different advantages for either suppliers or customers. For example suppliers with high demands resulting from locational advantages can afford choosing highest bits for reservations with the help of forward auctions. Suppliers with lower demands can be rather forced to underbid competitors for reservations of single customers in reverse auctions [3]. Depending on individual market situations, online market places must therefore support auction forms that meet individual requirements. Irrespective of chosen allocation forms, permanent allocation of reservations contributes to capacity adaptions that meet single demands at each moment. In order to perform efficiently, suppliers and customers must realize need for interference of existing reservations and derive guidelines for auctions or negotiations, which include maximum or minimum prices for reservations. Based on these guidelines it is possible to adjust capacities and allocate reservations manually or with the help of multi agent systems.

For example customer agents can receive orders to reduce prices with the help of reservations. Goals for cost reduction are described for certain products or product groups that have been procured with the help of ad hoc capacities or expensive reservations before. Guidelines consist out of maximum prices, preliminary lead time for acceptance of orders and periodical dates for order fulfilment. Interacting with other agents and real customers, customer agents can call for tenders or participate in auctions, whereas real customers agree on contracts. In contrast to customer agents, supplier agents manage single resources. These agents can advertise reservation in auctions, submit bids in reverse auctions and propose capacity adjustments or initiate them within given limits.

V. DERIVING INDIVIDUAL DECISION SUPPORT SYSTEMS (DSS)

Within the described model for short term booking of customized products, important decisions for customers and suppliers have been pointed out. Table I summarizes these decisions and distinguishes between different phases of decision making. The phases refer to single resources for suppliers, whereas phases for customers refer to single reservations for customized products or product groups. Customers and suppliers can therefore face decisions in different phases simultaneously.

TABLE I: IMPORTANT DECISIONS FOR CUSTOMERS AND SUPPLIERS

Phase	Customers	Suppliers
Before agreeing on reservations	- Building groups for reservations, based on recurring demands (including necessary technologies) - Maximum prices	- Percentage of reservations and ad hoc capacities, depending on reservation prices - Minimum prices for reservations - Possible capacity adjustments - Possible capacity contingents
Agreeing on reservations	- Extend and period of capacity contingents - Booking conditions (self-management/ dynamic booking) - Prices & duration of reservations - Framework agreements for transportation and required materials	
After agreeing on reservations	- Access to reservations (Quasi-costs)	- Capacity adjustments - Dividing ad hoc capacities into capacity -types and –contingents - Prices for ad hoc capacity types
During short term booking	- Pre-drawing of operations - Using reservations or buying additional ad hoc capacities for single orders	- Pre-drawing of operations within ad hoc capacities and unused reserved contingents

A continuous learning process can help finding best decisions and initiate actions at the right moment. This process starts with an evaluation of potentials for a past booking period, which includes assigned- and not assigned orders. It is followed by a root cause analysis that compares past forecasts with actual demands. Generating and assessing actions in different scenarios is next. Implemented actions affect the next analysis, which is performed periodically or triggered through deviating performance indicators [30]. All steps of the described circuit can be performed with the help of decision support systems in different forms of task sharing between computers and human decision makers. For the short term booking of customized products, need for decision support consists primarily in the two areas of: *Generating and reprocessing information* and *Evaluating alternative actions* [25]. Managing booking processes concerning several reservations or resources is complex even for small customers or suppliers. Generating and reprocessing information is important in order to alert decision makers to intervene in the ongoing booking process. Ideally single alerts already aim to initiate certain actions, which enable human decision makers to generate different action scenarios.

For example it can be alerted that operations of customers are assigned to reservations first but dispatched to other contingents later due to further arriving orders. This alert can suggests a more restrictive access with the help of higher quasi-costs or necessity for extended reservations.

Whereas different actions can be generated easily, evaluation of impacts strains cognitive capabilities even in simple cases. Complex influences combined with uncertainties concerning the behavior of other market participants, requires therefore simulation tools that illustrate possible effects in different scenarios. These scenarios help evaluating risks and potentials for decision makers. Necessary forecasts can be either generated automatically or entered manually. The same applies for the implementation of actions, which are controlled within the next analysis process. Depending on the complexity and requirements for solutions, different methods and tools for analyzing, forecasting and simulation must be chosen.

VI. CONCLUSION

Within this article challenges and advantages for short term booking of customized products on online market places are discussed. Based on the evaluation of existing approaches, a process model for short term booking is derived that considers uncertainties of production to specification with the help of reservations. Important decisions accompanied with this process are summarized for customers and suppliers. The article highlights the importance of individual decision support systems and gives an outlook how these systems can help finding advantageous decisions and initiate actions at the right moment. The described approach is convertible for different degrees of complexity and different kind of horizontal networks, within companies, between companies and between companies and customers. Technical implementation is possible by extending existing web based multi agent approaches.

Additional research is conducted on the topics of linking alerts and actions, evaluation of actions as well as for the allocations of reservations. Whereas the article is dealing with customized products, the concept of reservations and multi-level resources is adaptable to services too. Adapting the approach for services is possible by more restrictive planning with smaller capacity contingents. Due to limited possibilities for dispatching of operations, load-dependent scheduling for services over several resources must focus on avoiding gaps for customers and suppliers.

REFERENCES

[1] M. Stemmer, B. Holtkamp, and T. Königsmann, "Cloud-orientierte service-marktplätze: integrationsplattformen für moderne dienstleistungen und it-dienste," White Paper, Fraunhofer Institut für Software und Systemtechnik ISST, Dortmund, 2011.

[2] H. Wildebrand, *Kundenindividuelle Massenproduktion zur Bewältigung überkapazitätsbedingter Unternehmenskrisen*, Frankfurt a.M., Bern: P. Lang, 2009.

[3] T. Mann, *Die Wichtigsten B2B-Marktplätze in Deutschland: Eine Vergleichende Darstellung*, Marburg: Tectum, 2002.

[4] O. Raabe, *Recht ex Machina: Formalisierung des Rechts im Internet der Dienste*, Berlin: Springer Vieweg, 2012.

[5] H. Corsten and S. Stuhlmann, "Yield management als spezielle ausgestaltung des gap-modells des kapazitätsmanagement," *Schriften zum Produktionsmanagement,* vol. 33, 2000.

[6] Y. Uygun, *Integrierte Kapazitätsbörse: Entwicklung eines Instrumentariums für den Handel mit Maschinenkapazitäten in regional-lateralen Unternehmensnetzen*, Dortmund: Praxiswissen, 2012.

[7] B. S. Reiter and H. Höhns, "Selbststeuerung logistischer Prozesse mit Agentensystemen," in *Produktionsplanung und - Steuerung 2: Evolution der PPS*, 4th ed., G. Schuh and V. Stich eds., Berlin: Springer Vieweg, 2012, pp. 294-335.

[8] J. Helmig, C. Schmidt, and S. Kompa, "Gestaltung der PPS bei elektronischem Handel mit Produktionsleistungen," in *Produktionsplanung und - Steuerung 2: Evolution der PPS*, 4th ed., G. Schuh and V. Stich eds., Berlin: Springer Vieweg, 2012, pp. 232-293.

[9] P. Gomber, C. Schmidt, and C. Weinhardt, "Efficiency, incentives, and computational tractability in MAS-coordination," *International Journal of Cooperative Information Systems*, vol. 8, no. 1, pp. 1-14, 1999.

[10] F. Roth, "Die grenzen klassischer ERP systeme," in *ERP Value: Signifikante Vorteile mit ERP-Systemen*, O. Jacob and D. Doeffinger eds., Berlin: Springer, 2008, pp. 61-74.

[11] W. Dangelmaier, *Theorie der Produktionsplanung und - Steuerung: Im Sommer Keine Kirschpralinen?* Dordrecht, New York: Springer, 2009.

[12] K. Kurbel and A. Endres, *Produktionsplanung und - Steuerung: Methodische Grundlagen von PPS-Systemen und Erweiterungen,* 6th ed., München: Oldenbourg, 2005.

[13] H.-P. Wiendahl, "Grundlagen und entwicklungsstand der belastungsorientierten fertigungssteuerung," in *Belastungsorientierte Fertigungssteuerung: Praxis und Weiterentwicklung,* H.-P. Wiendahl ed., Hannover: Institut für Fabrikanlagen IFA, 1989, pp. 9-47.

[14] B. Sand, M. Schneider, O. Wendt, and M. Schwind, "Dezentrale allokation von transportaufträgen: reduktion des price of anarchy durch lernende agenten?" in *Dezentrale Koordination ökonomischer Aktivitäten: Markt, Hierarchie, Hybride*, H. Corsten ed., Berlin: Schmidt, 2011, pp. 153-179.

[15] K.-H. Ahlert, H. Corsten, and R. Gössinger, "Kapazitätsmanagement in auftragsorientierten Produktionsnetzwerken - Ein flexibilitätsorientierter ansatz," in *Management Logistischer Netzwerke: Entscheidungsunterstützung, Informationssysteme und OR-Tools*, H. O, Günther, D. C. Mattfeld, and L. Suhl eds., Heidelberg: Physica-Verlag, 2007, pp. 113-137.

[16] J. Houtman and H. Isermann, *Reservierung von Kapazitäten: Ein Instrument der operativen Leistungsprogrammplanung und des betrieblichen Risikomanagements*, 1st ed., Wiesbaden: Dt. Univ.-Verl, 2005.

[17] H. Jacob, "Zur optimalen planung des produktionsprogramms bei einzelfertigung," *Zeitschrift für Betriebswirtschaftslehre*, vol. 41, no. 8, pp. 495-516, 1971.

[18] M. Büttgen, "Yield management," *Die Betriebswirtschaft*, vol. 56, pp. 260-263, 1996.

[19] H. Corsten and R. Gössinger, "Revenue management: unternehmensbezogene und unternehmensübergreifende kapazitätssteuerung," *Schriften zum Produktionsmanagement*, vol. 71, 2005.

[20] M. Becher, *Integrated Capacity and Price Control in Revenue Management*, Wiesbaden: Gabler, 2008.

[21] C. M. F. Gruss, *Revenue-Management in der Automobilindustrie: Vorgehenskonzept zur Online-Neuwagendirektdistribution und Produktionsharmonisierung*, Wiesbaden: Gabler, 2008.

[22] S. Rehkopf, *Revenue Management-Konzepte zur Auftragsannahme bei Kundenindividueller Produktion: Am Beispiel der Eisen und Stahl Erzeugenden Industrie,* Wiesbaden: Deutscher Universitäts-Verlag, 2006.

[23] G. Schuh and V. Stich, *Produktionsplanung und - Steuerung 2: Evolution der PPS,* 4th ed., Berlin: Springer Vieweg, 2012.

[24] T. Hegmanns, *Dezentrales Planungs- und Prozesskonzept Für ein Kollaboratives Bedarfs - und Kapazitätsmanagement in Produktionsnetzwerken*, Dortmund: Verl. Praxiswissen, 2009.

[25] D. Blutner, S. Cramer, S. Krause, T. Mönks, L. Nagel, A. Reinholz, and M. Witthaut, "Assistenzsysteme für die entscheidungsunterstützung," in *Grosse Netze der Logistik: Die Ergebnisse des Sonderforschungsbereichs*, P. Buchholz, and U. Clausen eds., Berlin: Springer, 2009, vol. 559, pp. 241–270.

[26] M. J. Druzdzel and R. R. Flynn, "Decision support systems," in *Encyclopedia of Library and Information Sciences*, A. Kent ed., New York: Marcel Dekker Inc., 2000, pp. 120-133.

[27] K.-P. Timpe and R. Baggen, *Mensch-Maschine-Systemtechnik: Konzepte, Modellierung, Gestaltung, Evaluation,* 2nd ed., Düsseldorf: Symposion, 2002.

[28] C. Schwede, M. Toth, and A. Wagenitz, "Integrierte auftragsreihenfolge- und transportplanung: ein beispiel für funktionsübergreifende zusammenarbeit in unternehmen mittels

logistischer assistenzsysteme," *Industrie Management*, vol. 28, no. 3, pp. 25-29, 2012.

[29] A. Kuhn, K. Klingebiel, A. Schmidt, and N. Luft, "Modellgestütztes Planen und kollaboratives Experimentieren für robuste Distributionssysteme," in *Wissensarbeit - Zwischen Strengen Prozessen und Kreativem Spielraum*, D. Spath ed., Berlin: GITO, 2011, pp. 177-198.

[30] T. Heinen, C. Rimpau, and A. Wörn, "Wandlungsfähigkeit als ziel der produktionssystemgestaltung," in *Wandlungsfähige Produktionssysteme: Heute die Industrie von Morgen Gestalten*, P-Nyhuis ed., Garbsen: PZH, Produktionstechn. Zentrum, 2008, pp. 19-33.

Darian Achenbach has a diploma degree in industrial engineering and a BSc degree in business sciences from the Technical University of Dortmund, which he received in 2011 and 2010. Since 2012 he holds a scholarship from the Technical University of Dortmund and is working on his dissertation project (Order placing and capacity management in horizontal networks).