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CUSTOMER-CENTRIC REVENUE MANAGEMENT IN MANUFACTURING - A DECISION SUPPORT SYSTEM

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Michael Mohaupt and Andreas Hilbert, 2014, "CUSTOMER-CENTRIC REVENUE MANAGEMENT IN MANUFACTURING - A DECISION SUPPORT SYSTEM", Proceedings of the European Conference on Information Systems (ECIS) 2014, Tel Aviv, Israel, June 9-11, 2014, ISBN 978-0-9915567-0-0
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CUSTOMER-CENTRIC REVENUE MANAGEMENT IN MANUFACTURING – A DECISION SUPPORT SYSTEM

Prototype

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Abstract

Manufacturing providers aim not only for a revenue maximizing allocation of their limited production capacity but also for the establishment of long-term customer relations. Due to long-term contracts and strategic reference customers, users of traditional revenue management systems already account for varying worthiness of clients, and intuitively ignore or override booking control suggestions, such as order's denial or pricing level, in order not to endanger customer relations. So with a view to a holistic approach, the integration of both management concepts, each of decisive competitive impact, is advised. However, an implemented IT-system, that provides the revenue analyst with greater insights, higher accuracy, quality and trust in decision process, is still missing in manufacturing industry. This reflects the common frustration of managers and analysts in practice when dealing with conflicting ideas or theories generated by research community. We believe our prototype is the first to supply analysts with formatted and summarized information to make transparent and comprehensible control decisions, suggesting specific booking control actions based on simulation results and integrated usage of provided data. It also accounts for the strategic dimension of the problem when confronted with these partly diametric objectives of revenue vs. customer relationship management.

Keywords: Decision Support System, Revenue Management, Customer Relationships, Manufacturing.

1 Problem Statement

The answer to the question of whether business companies are willing to accept a loss in revenues would obviously be negated – unless this short-term tolerance in revenue loss could indeed lead to higher (long-term) revenues. Embedded in the age-old problem of efficiently allocating the firm's limited capacity resources utilized to offer products to customers, this imaginary experiment concerns the trade-off between sole revenue maximization vs. long-term customer relation, i.e. the establishment of a long-term profitable customer base for the provider. Such balancing and decision-making has been around as long as management and leadership, probably longer (Bennet and Bennet, 2008). Decision support systems (DSS) as a core subject area of the information systems (IS) discipline can assist managers and analysts here (Burstein and Holsapple, 2008). This research area is focused on improving managerial decision-making, and makes an effort to develop and deploy IT-based systems to support decision processes (Arnott and Pervan, 2008). As a subject of research and practice, it continues to grow along ever-widening horizons (Burstein and Holsapple, 2008). In manufacturing, today's providers are expected to offer, price and deliver material goods in an efficient, standardized but also customized way. So, firms face a non-trivial decision problem how to sophisticatedly use their limited, inflexible and perishable production capacity to provide their products to an uncertain and heterogeneous demand from different market segments (Talluri and van Ryzin, 2004 as standard reference

work). Revenue management (RM) is concerned with the theory and practice underlying this type of problem by controlling incoming booking requests to maximize revenues, i.e. booking control governs the resource allocation, products' availability and pricing, e.g. order acceptance (Cheraghi et al, 2010).

It has a long tradition that most companies followed the paradigm of maximizing shareholder value by a short-term optimization of their operating profits (Buhl et al, 2011). That is why transaction centrality based on short-term willingness-to-pay (i.e. revenue of order) as sole control criterion (Martens, 2009) is prevalent in RM (see Mohaupt and Hilbert, 2013a for an overview of manufacturing approaches in recent years). However, not only the financial crisis made obvious that such a strategy can destroy shareholder value and compromise the establishment of long-term profitable business relations, as goal of customer relationship management (CRM) (Hippner, 2006; Martin, 2010; Buhl et al, 2011). But due to long-term contracts, strategic reference customers and increasing intensity of competition, a relation-oriented perspective is vital in manufacturing (Spengler et al. 2007; Sucky 2009). It is therefore surprising that potential customer conflicts and long-term effects of the provider's decisions on the value of both the client and the firm are still not addressed adequately in daily tasks (Wirtz et al, 2003; Martens, 2009). Even though users of the RM system are already aware of the diverse worthiness of clients, they are only left with the option to intuitively ignore or override booking control suggestions in order not to endanger customer relations (Becher, 2008). Nonetheless, the desired integration of RM and CRM, each of decisive competitive impact, but with partly diametric goals (Martens and Hilbert, 2011), in the form of an implemented IT-system providing the revenue analyst with greater insights in order to make transparent and comprehensible booking control decisions is still missing in manufacturing. So, we developed a software tool to aid such decisions, accounting for the strategic dimension of the problem. The DSS supplies the analyst with formatted and summarized data based on simulation results and integrated usage of provided information.

The paper is organized as follows. In section 2, we position our work in the body of existing literature and show why prior theory and practice are insufficient. We then discuss design objectives considered in the prototype's development (section 3). In section 4, central aspects of the prototype to support the analyst's decision-making are then examined. Section 5 discusses results and ends with a conclusion.

2 Status Quo

RM in manufacturing is a relatively young scientific discipline compared to services industry, where research is concerned with the optimal usage of limited capacity resources since the end of the 70's (Chiang et al, 2007). Nonetheless, an increasing number of recent research contributions (Rehkopf, 2006; Defregger and Kuhn, 2007; Spengler et al, 2008; Wiggershaus, 2008; Sucky, 2009; Hintsches et al, 2010) sees manufacturing industries as promising environments for capacity control to gain competitive advantages. In particular, considerable potential is attested to oil, chemical and pharmaceutical industry, and steel, paper and aluminum industry (Gray, 1994; Kolisch and Zatta, 2009).

If demand exceeds production capacity on a regular basis, the manufacturer faces the challenge of adequately selecting the best orders to maximize overall profit (Spengler et al, 2007). The customer's participation represents an uncertain influencing factor for the provider regarding amount, value and arrival of requests and the client's reaction if desired material goods are not available. Even though facing these uncertainties and the rigidity of available capacity in the short run and the tension areas of excess demand vs. idle capacity costs (Hintsches et al, 2010), a decision for each incoming request whether to accept or deny is needed. So the absence of an adequate policy can result in a situation where the majority of resources is reserved for early, but low-class requests, available capacity is overbooked or unutilized, i.e. problems of *revenue displacement* vs. *revenue loss* (Martens, 2009).

However, capacity control in manufacturing is mainly transaction-based so far (Hintsches et al, 2010; Buhl et al, 2011). The order's acceptance decision is thereby primarily determined by the price of the requested material good (Sucky, 2009). By contrast, relationship-based marketing postulates the con-

sideration of value-oriented success indicators to establish long-term relations to profitable customers (Rudolf-Sipötz, 2001). In accordance with such a long-term and strategic perspective, the decision horizon should be broadened from one transaction to the client's lifetime value (Lederer and Yeoman, 2003). Then, the manufacturer can reduce the risk of misleadingly declining prospective customers (low current, but high potential future contributions) or reference customers (not necessarily high own but high induced contributions of other customers; Kuhlmann, 2004; Martens, 2009). Hence, *customer value*, i.e. total profit provided during the relationship with the firm (Kumar and George, 2007), is a determining factor for management decisions and is regarded as being closely connected to shareholder value (Berger et al, 2006; Martens and Hilbert, 2009). So, in order to make the limited capacity available for the most valuable customers (Lindenmeier, 2005) an adequate differentiation of the provider's (booking control) actions is needed (Noone et al, 2003). The decision to accept short-term higher-paying customers but not necessarily the most loyal ones (Wirtz et al, 2003) should take *opportunity costs* in terms of lost customer values into account if in return the denied prospective customers will reduce their future purchases (e.g. buying frequency, product change, amount of cross selling) or even abort the relationship with the firm (Pak, 2005; Kim et al, 2006).

So in a holistic approach, the integration of both RM and CRM is suggested (Martens and Hilbert, 2011), Cross et al. (2009) call for a customer-centric capacity control. The incorporation of value-related revenues into booking control in manufacturing is desirable, but a solid scientific foundation of this additional need for decision support and an implemented (prototype) IT-system, that provides the revenue analyst with greater insights, higher accuracy, quality and trust in the decision process (Holsapple, 2008), are still missing in manufacturing, even though it is recognized what a decisive role analysts play in RM process by contributing significant incremental revenue (Chiang et al, 2007). Only the works of Rehkopf (2006), Spengler et al. (2007) and Sucky (2009) identify this urgent need for research, but solely refer to the theoretical appliance of minimum contingents or service levels for customers that should be served with priority. By proposing a model for a customer lifetime value-oriented capacity control, Buhl et al. (2011) illustrate the promising application for an exemplary company in semiconductor industry, although it is based on a numerical example with one decision period only. To the best of our knowledge, there are only two works developing DSSs for RM in manufacturing. Rehkopf (2006) developed a simulation tool with interfaces to Excel and optimization software Lingo informing the analyst about resulting bid-prices, contribution margins, and remaining production capacity, given a constellation of input parameters for a manufacturer in iron and steel industry. Hintsches et al. (2010) presented case study results for capacity control at ThyssenKrupp in make-to-order steel manufacturing. Based on an implemented bid-price control and simulations of different demand scenarios, the sales agent gains further insights and a threshold value to decide whether to accept or decline a request. Unfortunately, both papers concentrate on short-term profit maximization only, long-term value-related revenues and effects of capacity control on future customer behavior are not considered. It is remarkable that Rehkopf (2006) himself refers to situations in manufacturing with predominant strategic partnerships or limited number of customers and states that a DSS solely focusing on short-term success will not be adequate. So, strengthening relations to the *right* clients is vital as only loyal customers are profitable in the long run because of high costs of acquisition. Results of simulation studies in the services industry show already that a disregard of clients' long-term contributions can produce counterproductive effects (Martens, 2009; Mohaupt and Hilbert, 2012, 2013b). An increased attention has to be paid not only to consequences of booking control on customer loyalty, e.g. decrease in loyalty as a result of the request's denial (Wirtz et al, 2003), but also to an adequate pricing that incorporates customer's worthiness when suggesting a bottom price level during common iterative price negotiations in manufacturing (Rehkopf, 2006; Becher, 2008; Hintsches et al, 2010). Even though revenue maximizing systems have become a competitive necessity (Power and Sharda, 2007), a (prototype) DSS accounting for both short- and long-term revenue potentials in manufacturing is desirable, but still missing. Referring to future directions and challenges, Power et al. (2011) point out that analysis capabilities are coming back to the forefront and more time has to be spent on decision analysis and definition. So, future DSSs will have to deal

with integrating, analyzing, and acting on disparate information on customers. The next section highlights implications on DSS design objectives of such endeavor that goes beyond previous prototypes that only focus on short-term revenues and do not integrate customer-related measures and effects.

3 Design Objectives and Set-up of Decision Support System

In practice, sales agents of the manufacturer face a difficult task to master the complexity of the order acceptance decision problem (Hintsches et al, 2010). So, when designing the DSS to support the analyst, i.e. defining a system's technical and non-technical features in an attempt to affect the structure and execution of the decision-making process, priority is given to successfully achieving the **design objectives** while avoiding undesirable side-effects (Silver, 2008). As designing is therefore always an intervention into the processes by which decisions are made (i.e. deciding how to decide), the ultimate outcome of DSS design is not the system itself but the system's consequences. So on the one hand, we want to encourage analysts to support their gut instinct about the sensible integration of customer values with key measures provided by the DSS. This decisional guidance is the degree to which a DSS enlightens, guides or directs its users in constructing and executing the decision-making processes by assisting them in choosing and using its functional capabilities (Silver, 2008; Adya and Lusk, 2012). On the other hand, the DSS is also intended to ensure awareness and to sensitize the analysts to the justification of a long-term perspective in RM, i.e. breaking them out of their routines and to move them from their current decision-making behavior in a specific direction, toward preferred behavior, in order to make them more innovative and creative (Silver, 2008).

Our aim has been to design a DSS so that sales agents of a manufacturing company are supported in the field of tension between efficient utilization of limited production capacity and strengthening of long-term customer relations. The software prototype can take an **informative role**, supplying analysts with formatted and summarized data to make transparent and comprehensible control decisions (Talluri et al, 2009), and play a deeper role as well, **suggesting** specific booking control **actions** based on simulation results and integrated usage of provided data (Adya and Lusk, 2012). As RM implementations should be viewed from the perspective of strategic management not as a tactical activity only (Okumus, 2004; Eom, 2008), the alignment of DSS's goals with business strategies is of major importance in order to help the provider to realize its business objectives and compete more effectively (Lederer, 2008). A quantitative model, such as decision analytic, optimization, or simulation model, is the basis for the system's decision support function (Power and Sharda, 2007). In a companion paper (Mohaupt and Hilbert, 2013a) we elaborately formulate the optimization problem with increased focus on the booking control approach whereas this paper presents the design objectives and prototype's features and GUI in detail. By emphasizing access to and manipulation of the quantitative model, our model-driven prototype assists in **formulating** alternatives, **planning** activities, interpreting and **anticipating** the effects of specific resource allocations, **assessing** the consequences of actions and **selecting** appropriate options (Power, 2009; Power et al, 2011). To achieve this, the prototype has to assist the analyst in all three **stages** of model-based decision support: formulation, solution, and analysis (Shim et al, 2002). Please see Figure 1 for the flow from user input to model calculations to the output and DSS's components. **Formulation** relates to the generation of problem and domain models (Viademonte and Burstein, 2006). Converting the decision-maker's specification of the RM decision problem into an algebraic form understandable by a booking control algorithm is a key step in the model's use (Shim et al, 2002). The **solution** stage refers to the algorithmic solution of the model, including techniques from operations research (Viademonte and Burstein, 2006). The **analysis** stage relates to the "what-if" analyses and interpretation of model's solution and outcomes to enhance the sales agent's ability to analyze and understand the problem and the solution.

Following the design science paradigm (Hevner et al, 2004; March and Storey, 2008), we use Matlab to construct an IT-artifact as a model's instantiation (March and Smith, 1995) because it meets our requirements placed on development environment. Matlab is a high-level language and interactive

environment for numerical computation, visualization, and programming (MathWorks, 2014a). Due to its built-in math functions, easy expandability with many available solvers and output analysis (e.g. statistical toolbox), it is **already common** for complex simulations in RM (Bertsimas and Popescu, 2003; Perakis and Roels, 2007; DeMiguel and Mishra, 2008; van Ryzin and Vulcano, 2008; Meissner and Strauss, 2010), signaling certain **analysts' experiences**. Not only does Matlab offer a numerical computational framework to prepare data and analyze results (Goh and Sim, 2011), but it also contains built-in functionality to design and create a custom **graphical user interface (GUI)**. In addition, the DSS can be distributed for different platforms (MathWorks, 2014a), i.e. **unrestricted portability**.

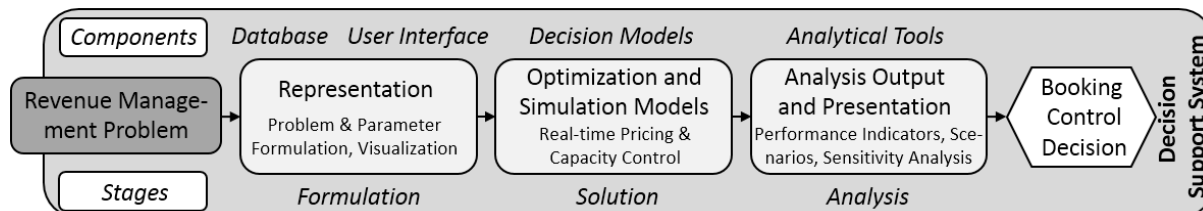


Figure 1. Flow diagram of steps, stages and DSS's components in supporting revenue management decisions (Shim et al, 2002; Power and Sharda, 2007)

During *simulation mode* (sections 4.1, 4.3), we see **exploratory learning** where decision makers gain knowledge of their environment by experimenting with the system (as added objective of DSS design; Silver, 2008). Running a broad range of scenarios through a simulation model can help the analyst to get a better feel for the business' dynamics. In settings mode, the analyst can further specify amount, variability and arrival of requests, deviations in forecasted customer values and number of scenarios for each control method. Forecast errors (if assumed and real, but unknown parameters differ) may be included, e.g. relation between willingness-to-pay and customer value or client's reactions in case of order's denial (see Mohaupt and Hilbert, 2013a for further specifications). By not constraining **function's parameterization** the user can express preferences and make clear judgments. This informative guidance allows for providing factual and unbiased information, such as **visual** or text based **display** of data, for selecting among alternative displays, and thereby empowering the user to choose the best course of action (Adya and Lusk, 2012). During *real-time mode* (section 4.2), the DSS recommends an ideal procedure to the user such as by comparing available methods and recommending the booking control action deemed to be most suited. To avoid that the analyst may struggle to structure an effective decision-making process (Silver, 2008), **layout** is another key objective in design (Kendall and Kendall, 2008). So a logical, uncluttered screen is required to make it easily comprehensible for the analyst, presenting decision data on a single page, known as information **dashboard** (Eckerson, 2005; Few, 2006). The user may decide to limit the variety and number of graph, chart, and table styles (see (6) in Figure 3 for selectable fields), so **key information** can be absorbed quickly and accurately (Kendall and Kendall, 2008). Hence, associated items are grouped together and system's suggestions and warnings may be highlighted. In the following sections, central aspects of the DSS are discussed.

4 Features of the Prototype

4.1 Decision Support in Problem & Parameter Definition, and Visualization

In order to make the DSS accessible to often non-technical specialists, the GUI's design and capabilities are of enormous importance (Power and Sharda, 2007). To further specify the decision problem and guarantee its conversion into a form understandable by the solution algorithm (see formulation stage in Figure 1; Shim et al, 2002; Power et al, 2011) the analyst can graphically and numerically (re)adjust certain and uncertain quantities (e.g. amount of segment's demand), probability

distributions, monetary values and estimates, preferences and priorities, e.g. weighting of short- and long-term measures, or constraints such as minimum total short-term attainable profit for reasons of liquidity (Power and Sharda, 2007). As an accurate forecast is an essential element of any RM system (Talluri and van Ryzin, 2004), the prototype processes general information (e.g. customer segment, date of order and delivery), production details (e.g. start of production, capacity consumption), and commercial information (e.g. price, costs for sales, transport, material and production) for each order (Hintsches et al, 2010) to identify demand patterns. Looking for true integration that is achieved with a system integrating data from each department and synchronizing analysis (Skugge, 2002; McGuire and Pinchuk, 2009), the DSS offers data import functions and allows for transfer of values, e.g. customer segmentation patterns identified in data mining (Vazan et al, 2011b; Gröger et al, 2012).

In simulation mode, the analyst is supported in interpreting and anticipating the effects of specific resource allocations and how results will change if parameters are changed slightly, i.e. “what-if” analysis in section 4.3. So in each Monte Carlo scenario, requests with varying long-term worthiness are randomly generated and each activated booking control method with individual weightings of short- and long-term measures automatically decides on their acceptance or denial. The revenues are then averaged over all simulated booking periods. For ex-post analysis, (visual) animation of revenue development in multiple formats, e.g. value tables, box plots (Power, 2009), is provided and results can be exported to MS Excel for further exploration. In Figure 2, it can be seen clearly that the revenue surplus of a method m_{02}^{trans} maximizing current profits ri only, often comes along with a long-term revenue loss, compared to method m_{03}^{ek} optimizing predominantly to be expected future revenue ek . So, the analyst can successively review past period(s), is sensitized for effects of specific parameter combinations and gets an insight into balancing between short- and long-term requirements.

4.2 Real-time Decision Support

In practice, the analysts have to make non-trivial decisions on order acceptance and pricing - without knowledge of future requests and their worthiness (Talluri and van Ryzin, 2004). So in real-time mode, relevant metrics and suggestions of stored methods are calculated based on incoming request’s parameters (see (1) and (2) in Figure 3). Please refer to our companion paper Mohaupt and Hilbert (2013a) how order details and customer history are used to define holistic evaluation dimensions and then segment clients accordingly. On this basis, a final recommended action (with adjustable weighting of individual elements and easy-to-read green vs. red highlighting) for current order is generated (see (4) and (5) in Figure 3; solution stage; Shim et al, 2002). The stream of all requests, their characteristics, the DSS’s suggestion and user’s ultimate decision are updated at the screen’s top (1). At the bottom (3), all revenues of the *main* method are summed up, adjusted with certain weighting factors, and compared with a trivial first-come-first-served control and a hypothetical method *recom* showing expected revenues if the user had followed all DSS’s suggestions, illustrating associated costs of recommendation’s deviation to enable a critical reflection of intended converse action.

During iterative price negotiations with clients, the averaged revenue over all simulated scenarios that leads to a change of booking control decision, e.g. alteration from denial to acceptance, is of central importance. If a customer of lower-class segment, whose order actually has to be denied due to under-compensated opportunity costs, is prepared to pay a surcharge, she/he then can counterbalance a lack of future potential (case of skimming current willingness-to-pay). Given a high-class customer instead, this difference may be the provider’s tolerance of revenue loss in order to maintain the option of a long-term relationship with this client. As an acceptance may lead to an increase of customer’s loyalty (e.g. higher repurchase probabilities), it even can be reasonable to accept reservations with a negative short-term contribution (Buhl et al, 2011). But if the revenue delta is too large, even a disestablishment of long-term unprofitable customers (by denying their requests) should be in the set of options. On the other hand, the analyst can get a feeling of how much to invest in a business relation if opportunity costs are sufficiently outweighed. So, a high-class customer only interested in a low-class product at

present time may be (re-)activated by means of a higher discount up to this delta, a voucher for future orders, a product upgrade or express delivery at no charge. Hence, the DSS will inform agents how the potential revenue scope during price negotiation can be best capitalized in terms of overall goal and also notifies if customers are classified as liable to churn to anticipate avoidable costs for reactivation.

Besides high variance in order-specific capacity consumptions and products' demand (Hintsches et al, 2010), the incorporation of future-related revenues, i.e. changes in customer value, is affected by uncertainties as well (Berger et al, 2006). A major step in developing a risk-averse RM tool is to understand the extent of (financial) risk and volatility associated with an inventory control policy (Lancaster, 2003). Thus, the prototype enables the analyst to consider uncertainty through stochastic programming at the solution stage (Shim et al, 2002). Using risk measurements in planning and strategic decision-making, such as Sharpe Ratios (SR), helps to ensure that production assets are tactically controlled in a more stable manner (Laubsch, 1999). As each method has its individual response and risk profile, revenue managers do have an opportunity to manipulate policy and strategy to achieve more financially stable results (Lancaster, 2003). By pair-wise ranking alternatives, the analyst will be guided towards the selection of less risky capacity allocations (see (4) SR main v1-3 in Figure 3).

As customer value is a long-term measure that entails predictions of future transactions, thus causing some degree of subjective or statistically inferred uncertainty, the frontier between valuable and non-valuable customers does not possess sharp and clear boundaries (Sicilia and Garcia, 2003). This can result in a misclassification, leading to a cannibalization of customer segments with revenue displacement (Phillips, 2005). So a special and differential treatment for clients near the segment borders can thus become problematic. This may be the case if predominantly to be expected revenue ek of requesting customer (classified to segment k) is close to the value continuum of an adjacent segment of different worthiness (Werro et al, 2006), or if a change in future buying behavior can be assumed, i.e. low current, but high potential future contributions (Martens and Hilbert, 2011). In practice, such a situation can occur, if a request of low segment value is recommended to be denied, but given it was of high worthiness, an acceptance would be suitable instead (see (4) in Figure 3). Of course, this remains valid for contrary case (acceptance of high-class customer, but tendency of denial in case of attributed low value only). Provided with the modified decision in dependence of the segment classification, the analyst is sensitized to critical cases (apart from clear and unambiguous situations) and may think about likelihood of divergent segment membership. Therefore, the DSS will alert analysts if altered recommendations are to be expected because of the request's classification to possible other segments.

4.3 Decision Support in Analysis

One cannot overrate the importance of analysis as the final stage of the process in model-based decision support, enhancing analyst's ability to gain further insights into the interdependence of different factors by studying the set of solutions (see Figure 1; Shim et al, 2002). The performance indicator system appropriately operationalizes objectives, and measures the degree to which targets are achieved. In the B2B-context of manufacturing, both capacity and relationship-based figures focusing on performance of individual booking periods vs. long-term estimates for a combination of such periods (Kimes, 2005; Martens and Hilbert, 2011) are of interest. So besides load factor and revenue per available inventory unit, predominantly to be expected revenue of customer per booking, prospective buying frequency, and duration of customer retention are part of the prototype's report generating functionality (Venkatesan and Kumar, 2004; Gupta et al, 2006; Martens, 2009). In order to establish a long-term profitable customer base, a frequent monitoring of the overall worthiness of all clients and its past development (customer equity; Kumar and George, 2007) is reasonable as well.

The DSS also provide support to estimate long-term measures. In a retrospective view, the development of buying behavior as a result of varying booking control decisions can be analyzed (Mohaupt and Hilbert, 2012). Such uncovered relations can also be enriched with customer surveys on planned budget for manufacturing products (with share-of-wallet for provider) and potential reactions of clients

in case of denial (Wang and Bowie, 2009). So at highest level of detail, clients can be prioritized and (re-)classified to segments suitably capturing their characteristics, or selected for marketing actions.

The formulated performance figures can also be used for “what-if” scenarios, and post solution and sensitivity analysis (see Figure 1; Shim et al, 2002). Often neglected in favor of more attention paid to optimization itself instead of required inputs (Weatherford and Belobaba, 2002), a systematic variation of a sole parameter can gain a better understanding of revenues’ overall stability and robustness. The analyst can then evaluate the multiple solutions with revenue distributions (i.e. confidence intervals) in detail, in relation to ex-post optimal revenue, first-come-first-served control or other methods (Martens and Hilbert, 2011). To support this type of analysis, the prototype is ready to execute simulation runs for evaluation purposes without influencing calculations in the present booking period.

5 Discussion of Results, Future Research, and Conclusions

The paper contributes to theory through providing a more comprehensive view for a complex decision-making problem in manufacturing by integrating a range of research streams from different perspectives (see section 2 for scientific foundation). It addresses the common frustration of managers and analysts in practice when dealing with conflicting ideas or theories generated by research community. The integration of RM and CRM with partly diametric goals is of high relevance to practice, especially when provided with an implemented (prototype) IT-system (as a design objective in IS; Mertens, 2005), supporting the solution of management problems by utilizing data, providing an easy-to-use interface and allowing for decision maker’s own insights (Turban, 1995; Power, 2009). As not the system itself but the system’s consequences are important (Silver, 2008), we are interested in sensitizing the analysts to the justification of a long-term perspective in RM, i.e. breaking them out of their routines, and in providing them a well-conceived bottom price level during negotiations accounting for customers’ worthiness (Becher, 2008). Along with the assistance in all stages of decision support, our prototype goes beyond the preliminary short-term focused and stand-alone systems (see design objectives and features in sections 3 and 4). As a result, a knowledge environment is generated that maximizes customer value and measures, monitors and provides intelligence to the firm and customer performance profitability (Jackson, 2006). By enabling a huge revenue potential, we hope to moderate Arnott and Pervan’s (2008) findings of most research in DSS discipline being disconnected from practice. Of course, the emerging opportunity may be hampered by restrictions of legacy systems that decide about interfaces, availability and quality of data needed. We therefore truly welcome any efforts to develop standard interfaces to integrate all manufacturing applications (Leong et al, 2006; Johansson et al, 2007). By using the Database Toolbox (Mathworks, 2014b,c), the DSS is ready to exchange data with various types of database. Our current focus is on data warehousing as a source for discovering non-trivial information and patterns through Data Mining and On-Line Analytical Processing (Vazan et al, 2011a). By accompanying the Extract, Transform, Load (ETL) process for information integration into data warehouses, the subsequent use of specific information in the DSS would be easily possible (Halenar, 2012). In order to support analysts to modularly specify further optimization models and to consider final adaption to the firm’s unique characteristics and analysts’ preferences, we plan to integrate a free toolbox that allows easy formulation and rapid prototyping of optimization problems within Matlab (Löfberg, 2014). Whereas users can concentrate on high-level (constraints, objective function), Yalmip takes care of the low-level modeling to obtain as efficient and numerically sound models as possible. As a whole, the paper and prototype form the basis for further research and practical stimuli on long-term oriented revenue maximization in manufacturing. Due to the essential importance of reference and prospective clients for sustainable business, we would argue for an (initial) integration in a small manufacturing environment. But as all firms with limited capacity resources face the challenge both of an efficient utilization and strengthening of customer relations, we trust that the prototype can inspire applications in other business fields and our prototype’s demonstration at ECIS can contribute to an improved competitiveness not only of manufacturers.

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Appendix

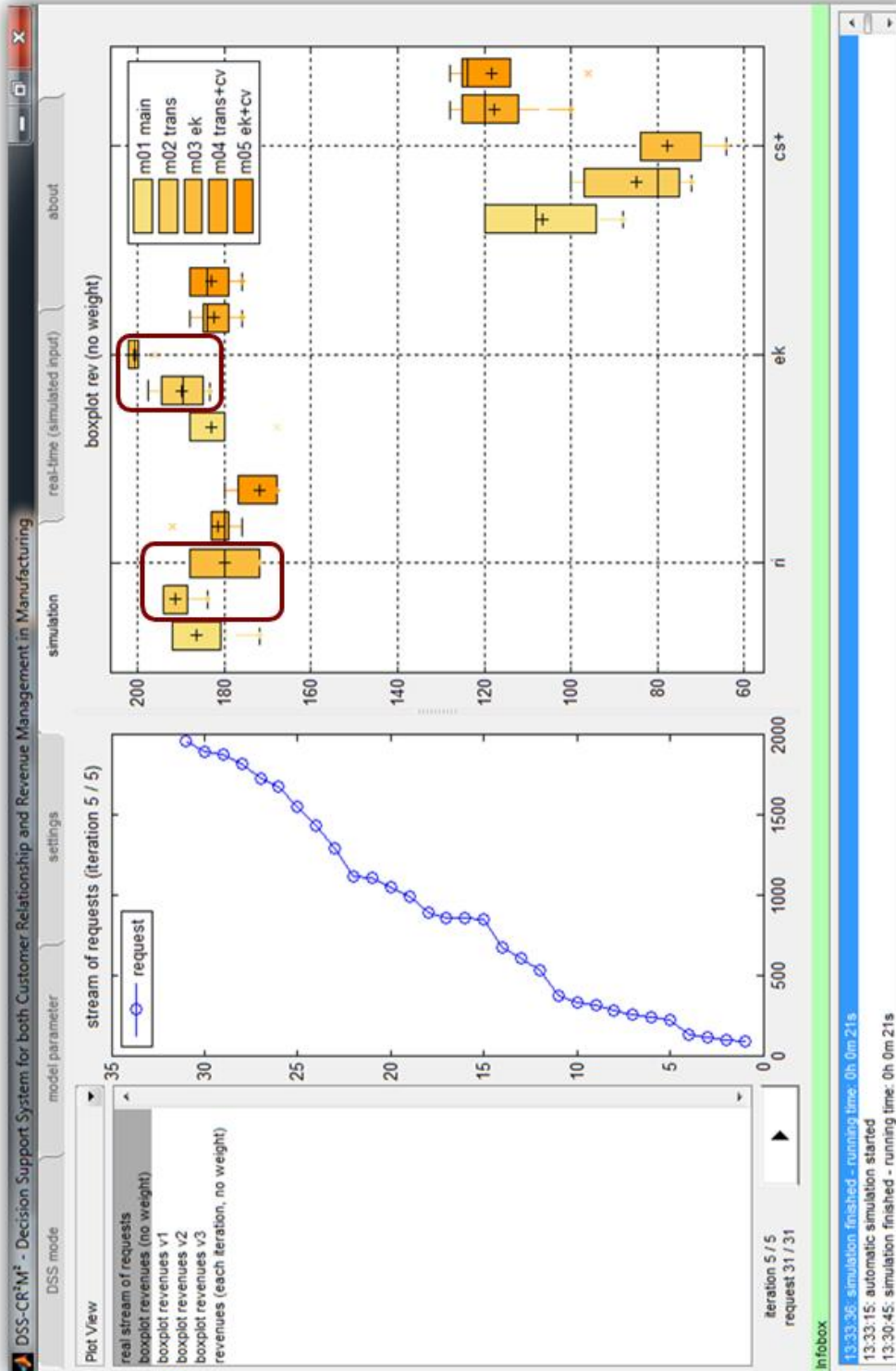


Figure 2. Simulation Mode of Decision Support System

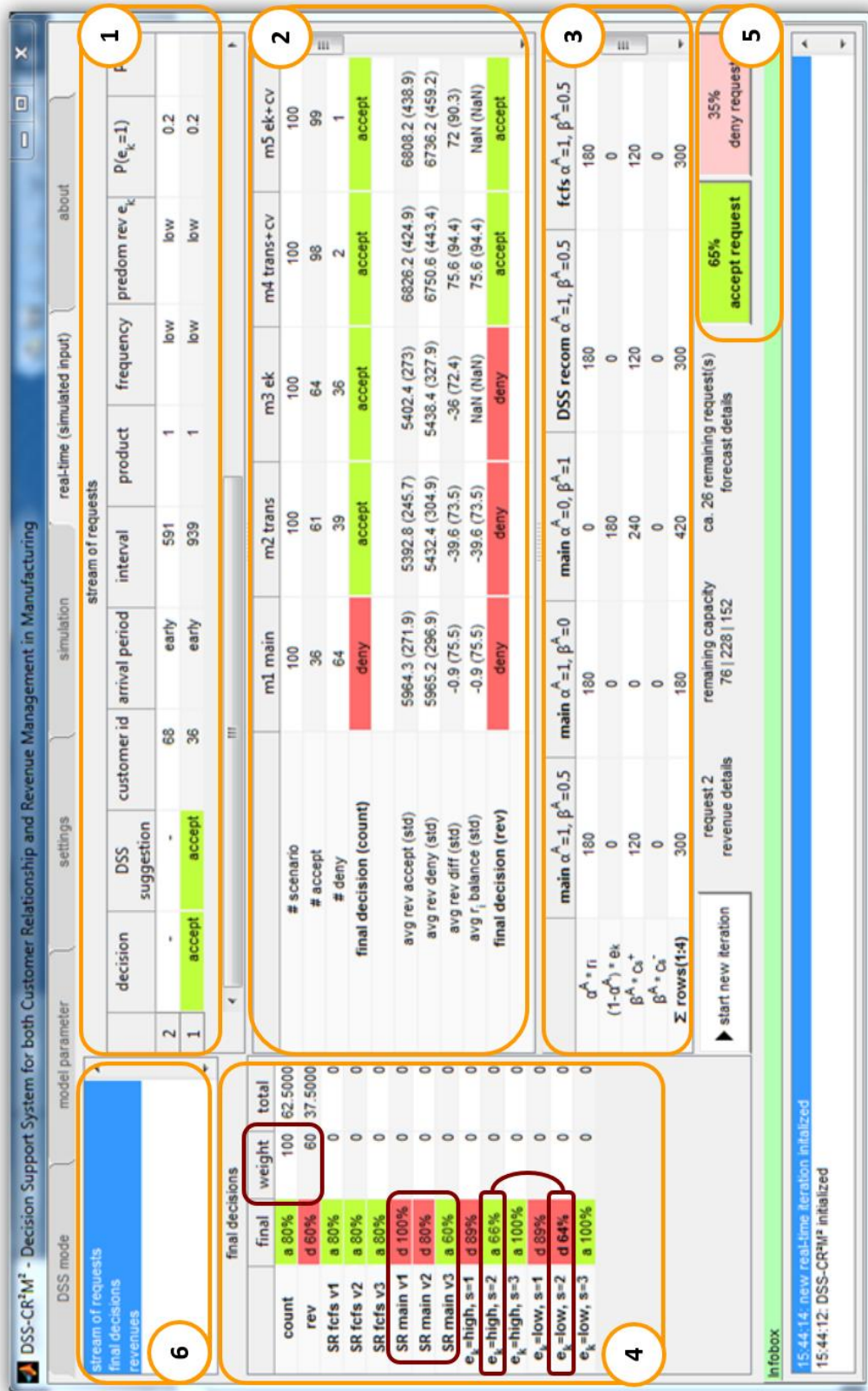


Figure 3. Real-time Decision Support (with full level of detail enabled)