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Customer-Specific Transaction Risk Management in E-Commerce

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ABSTRACT

Increasing potential for turnover in e-commerce is inextricably linked with an increase in risk. Online retailers (e-tailers), aiming for a company-wide value orientation should manage this risk. However, current approaches to risk management either use average retail prices elevated by an overall risk premium or restrict the payment methods offered to customers. Thus, they neglect customer-specific value and risk attributes and leave turnover potentials unconsidered. To close this gap, an innovative valuation model is proposed in this contribution that integrates customer-specific risk and potential turnover. The approach presented evaluates different payment methods using their risk-turnover characteristic, provides a risk-adjusted decision basis for selecting payment methods and allows e-tailers to derive automated risk management decisions per customer and transaction without reducing turnover potential.

Keywords

Risk management, customer value, customer risk, payment, online retailer, e-commerce

INCREASING TURNOVER POTENTIALS AND RISKS IN E-COMMERCE

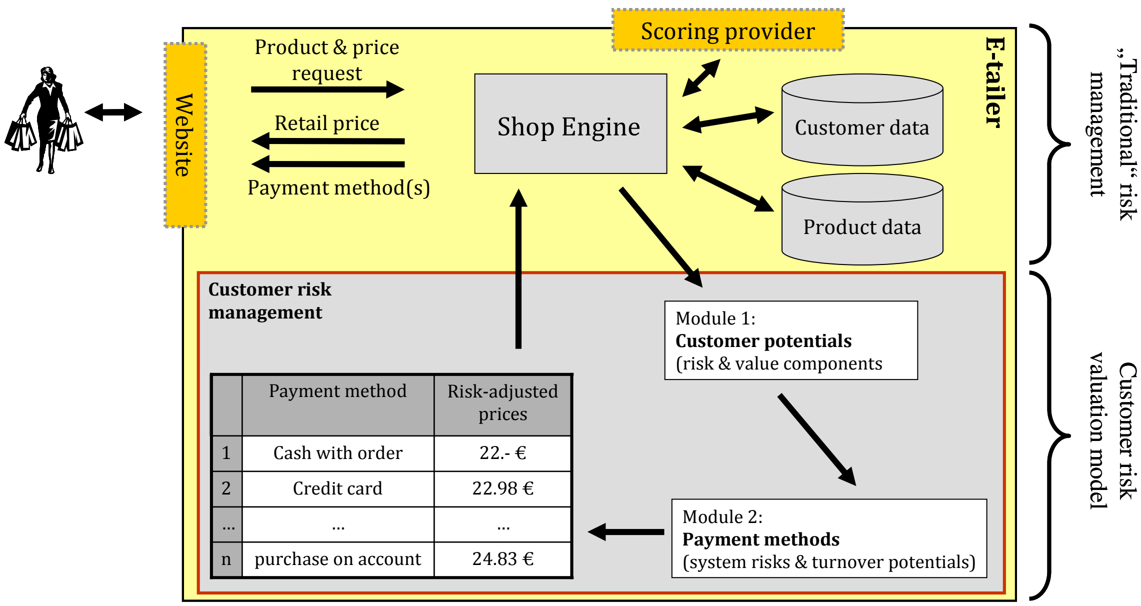
The economic impact of e-commerce has been growing since it was established as a new distribution channel, shown by consistently increasing turnovers in latter years (Eng, 2008). For example, in 2006 the transaction volume in German business-to-consumer e-commerce reached 46 billion euros and 145 billion euros are forecasted for 2010 (BITKOM, 2009). Unfortunately, these increasing turnovers come with – from an e-tailers point of view – a simultaneous increase in risk (BDV, 2008). Companies following an integrated value-oriented management approach have to manage such risk explicitly. Since customers in e-commerce are the most important driver of sustainable increases in company values and risk, special focus should be directed to the identification, quantification and management of the risks resulting from customer behavior and customer transactions.

A recent survey of 292 companies (Sackmann, Kundisch and Ruch, 2007) summarized payment fraud and customer migration as being significant and hugely damaging economic risks (Stahl, Breitschaft, Krabichlerm and Wittmann, 2007). Current customer relationship management (CRM) systems partially support a quantification of these risks and the derivation of management measures. However, in e-commerce, it becomes necessary to make automated ad hoc decisions, e.g. which price or payment conditions should be offered to a customer in the online shop. To meet to this real-time requirement, current approaches take customer risks into consideration either by increasing retail prices by an overall factor to compensate for risk losses (risk precaution) (Romeike and Finke, 2004) or by focusing only on the risk of payment fraud. To reduce or avoid payment fraud, a restriction of accepted payment methods according to an (external) customer score value is generally used (Siegl and Sackmann, 2008). However, such restrictions can lead to cancelled transactions (Stahl, Breitschaft, Krabichlerm and Wittmann, 2008) and also inherently reduce potential turnover. Thus, exclusively focusing on payment fraud risks will not lead to optimal results if other target variables exist, such as turnover, profit or market share. Since the resulting interdependencies lead to a trade-off between risk reduction and reachable turnover (Stahl et al., 2008), the effects of risk management measures should be considered on both the risk side and the turnover side. There are no previous approaches which systematically detect customer-specific risk and turnover potential, simultaneously evaluate these and enable real-time risk management decisions for e-tailers.

In this contribution we present an innovative valuation model for bridging this gap. The model brings together customer values, customer risks, and risks of specific payment methods. Based on this information, e-tailers can calculate risk-turnover combinations per customer and transaction, which in turn provides an objective and comparable foundation for integrated risk-turnover management decisions. The model consists of two modules: The first module evaluates risk-adjusted customer potentials and the second module integrates payment-specific potentials according to turnover and risk. Before introducing the model, we define a business scenario in the next chapter. Subsequently, current approaches for customer valuation and risk assessment are analyzed and brought together, providing a risk-turnover combination that is payment method specific. Finally, the results are summarized and an outlook on further developments and evaluation of the model is given.

BUSINESS SCENARIO: AN E-TAILER WITH RISK MANAGEMENT

A non-market dominating e-tailer is our exemplary e-commerce scenario. The e-tailer aligns his pricing decision with existing market prices. It is further assumed that the e-tailer manages customer risk by increased average retail prices, compensating for risk losses through an overall risk premium. Customers visit the online shop via the e-tailer's website and then request product information (see Figure 1). The shop engine fetches product-specific data from the product database, and also queries the customer database for previously collected customer data. If the customer is unknown, a new customer account is created. Payment fraud risk is managed by retrieving scores from external scoring providers. These scores are interpreted as payment fraud probabilities for each specific transaction (Siegl et al., 2008). Subsequently, the customer is provided with the actual price, and, based on the score, the e-tailer offers specific payment methods. Such a "traditional" approach to manage the risk of payment fraud (see upper half of Figure 1) is widely used. However, negative effects on customers and on the reachable turnover are completely neglected, although these are relevant factors (Stahl et al., 2008).



	Payment method	Risk-adjusted prices
1	Cash with order	22.- €
2	Credit card	22.98 €
...	...	...
n	purchase on account	24.83 €

Figure 1. E-tailer with „traditional" risk management plus an innovative customer risk valuation model

In order to achieve an integrated management of risk and turnover, we propose an extension of this "traditional" approach through an additional "customer risk management" tool (see the box at the bottom of Figure 1). The new tool asks the shop engine for the customer data and the internal base price of the requested product, and then calculates risk adjusted prices for each payment method. The tool is divided into two modules: the first module calculates customer-specific potentials by incorporating customer values, e.g. the Customer Lifetime Value (CLV). Furthermore, it calculates the identified mitigation and payment fraud risk of the customer. The second module essentially assesses the general system risks and risk of transaction cancellations. The result of the second module is a combination of expected risk and turnover for each customer and offered payment method. Based on these results, comparable risk-turnover combinations and risk adjusted prices for every single transaction can be derived, enabling risk management decisions without jeopardizing turnover potentials.

CUSTOMER VALUATION AND RISK ASPECTS

Module 1: Evaluating Customer Potentials

Existing methods for a comprehensive evaluation of customer potentials claim to account for customer-specific value as well as risk aspects. However, these methods are limited in their ability to quantify the effect of risk management measures, such as restricting payment methods, on value and risk simultaneously (Kundisch, Sackmann and Ruch, 2008). Therefore, established methods for customer value and risk estimation are analyzed in this section, with the aim of identifying feasible and compatible approaches which can be used to simultaneously calculate values and risks in our model.

Measuring Customer Values

The concept of *customer value* is used in both theory and practice to evaluate customer-specific shares that support a company's economic objectives such as turnover or profit (Rudolf-Sipötz, 2001). An overview and a categorization of the manifold estimation methods can be found in, e.g., (Krafft, 2007) and (Schroeder, 2006). For an integrated and comprehensive estimation of customer value, the evaluation approach should fulfill the following criteria:

1. *Prospectivity*: Since management decisions should be optimal in the long run, the decision-making process should take a customer's future potentials into consideration. Therefore, evaluation approaches directed exclusively towards the past, e.g. ABC analyses, are deemed unsuitable for an integrated estimation of customer value.
2. *Analytical approach*: The approach should be built on an analytical method, i.e. it should provide systematical and comprehensible results. This is required for achieving a consistent scaling, weighting, and, in consequence, an objective comparability of customer values and risks.
3. *Monetary value*: The approach should have monetary values as result. In order to summarize all resultant value components of a customer relationship in one figure, all value components such as market potential (e.g. turnover and cross-selling potential) or resource potential (e.g. reference and information potential) have to be measured in the same unit of measurement. This allows different value components to be compared with costs, and the resultant values can also be used by other company units such as the controlling or marketing department and for strategic decisions at the management level.
4. *Customer-specific evaluation*: With the aim of efficient investment and management decisions, the approach should provide values for each single customer and not only offer an overall estimation of a customer segment or portfolio value and risk. The valuation of each customer is a requirement to (automatically) derive customer-specific management decisions if needed.

Analyzing established customer valuation methods shows that the customer lifetime value (CLV) method and its extensions best fit these criteria, even if the method imposes heavy requirements on the underlying IT and the necessary customer data. Nevertheless, since CLV is increasingly used in companies (Sackmann et al., 2007), and e-tailers in particular have extensive possibilities for collecting and processing the required customer data under cost-efficient conditions, CLV is proposed in our model as method for customer evaluation. The CLV as analytical, one-dimensional, and monetary method, forecasts for a customer i future cash flows R which are discounted by an interest rate d to a net present value less the acquisition costs I:

$$CLV_i = -I_i + \sum_{t=0}^{n} R_{it} \cdot (1+d)^{-t} \ .$$

Measuring Customer Risks

Similar to the customer value estimation, various methods for quantifying customer risks exist, and some of them also address risk integration in CLV (e.g., (Hogan, Lehmann, Merino, Srivastava, Thomas and Verhoef, 2002; Schroeder, 2006; Borle, Singh and Jain, 2008)). One category of these methods quantifies customer risks in the form of an overall risk variable – widely used in practice – for reducing the expected cash flows in order to build up risk reserves (e.g., (Jain and Singh, 2002; Gupta and Lehmann, 2003)). However, this does not allow risk to be quantified and managed at the customer-specific level. The same shortcoming can be observed in the suggestion of increasing the discount rate used in CLV to compensate the uncertainty of predicting distant future cash flows (Eberling, 2002). Other approaches use the Weighted Average Cost of Capital (WACC) as the theoretical, capital market consolidated discounting rate (Dhar and Glazer, 2003; Gupta, Lehmann and Stuart, 2004; Hogan et al., 2002). This approach is based on the Capital Asset Pricing Model and divides the total risk into a systematic risk and a completely diversifiable, unsystematic risk. The discount rate is thereby determined by the expected return from the interest rate of a secure investment, plus a segment-specific risk premium (Hopkinson and Lum, 2002). However, the usage of WACC also brings some shortcomings. Relations between enterprises and customers can vary strongly (e.g. individual costs of the relationship setup and maintenance, future cash flows varying from customer to customer). Hence, a planned segment-specific risk premium can – if at all – only be calculated under restrictive assumptions (Hogan et al., 2002). In addition, perfectly diversified customer portfolios cannot be assumed (Kundisch et al., 2008), and therefore it is disputable whether the unsystematic risk is actually entirely diversifiable.

In contrast to these overall risk approaches, another category of quantification methods follows a risk segmentation approach, where the total risk is divided into relevant, uncorrelated single customer risks. To realize such an approach, various methods for quantifying single customer risks are already established (Schmittlein, Morrison and Colombo, 1987; Berger and Nasr, 1998; Dwyer, 1997; Gupta et al., 2003). In the context of customer risk, *migration risk* and *payment fraud risks* have been identified as relevant for e-tailers, since competitors are only "one click" away, and financial losses caused by fraud have been permanently increasing for many years (Sackmann et al., 2007; Stahl et al., 2008). Evaluating risk on an individual customer level is seen as a promising way forward for e-tailers, since it allows for the characterization of risks in a customer- and transaction-specific way. Our model follows this approach and integrates both migration risk and payment fraud risks.

To integrate different *migration risk* quantification methods (Calciu and Salerno, 2002) into the CLV, so-called migration and retention models are available (Berger et al., 1998; Dwyer, 1997; Gupta et al., 2003). Both models assume specific market conditions whereas retention models presume a lost-for-good situation, in which consumers fulfill their needs only via one single supplier, while migration models presume an always-a-share situation in which several supplies fulfill consumer needs (Schroeder, 2006). Because of these restrictive market and behavior assumptions, both models are seen as ill-suited for adequately evaluating customer risk in the dynamic e-commerce environment. An alternative with less restrictive assumptions for quantifying migration risk is the NBD/Pareto model (Schmittlein etal., 1987), its extension (Schmittlein and Peterson, 1994), and further developments built hereupon (Jerath, Fader and Hardie, 2008). The basic model generates a probability *P(alive)* for non-contractual relationships which can be interpreted as a customer-specific repurchase probability (Krafft, 2007). Although the NBD/Pareto model has some minor weaknesses for market segments with long-lasting products, it is used in our model for estimating the migration risk of single customers since e-tailers are seen as capable of collecting and processing the required data regarding a customer's transaction history (Kundisch et al., 2008; Schmittlein etal., 1987).

Besides migration risks, the so-called *payment fraud risk* has been identified as relevant customer risk, i. e. the risk of a customer being unable or unwilling to pay for obtained services or products. Currently, several e-tailers are already evaluating this payment fraud risk for individual customers, e.g. by various scoring methods which have emerged as best practice approaches (Ryals, 2003). For calculating such scores, economically relevant monetary and non-monetary impact factors need to be identified. In most cases, the score value is generated by a simplistic weighted aggregation of these factors (Krafft, 2007). In our valuation model, such a scoring model is also proposed for estimating the payment fraud risk, since numerous external providers specialize in such scoring services. In principle, this enables e-tailers to estimate a customer-specific payment fraud probability for each individual transaction.

Module 2: Evaluating Risks of Payment Methods

The second module of our customer risk valuation model aims to assess the general *system risks* and *risk of transaction cancellations* for different payment methods. These risks are seen as independent of the customer-specific payment fraud risk but can likewise result in massive losses. Therefore these risks should also be taken into consideration for integrated risk-turnover management. Knowing the effects of specific payment methods on risk as well as on turnover is especially relevant for e-tailers, since the selection of accepted payment methods is an interesting "tool" for risk management. This selection can be adjusted to each individual customer and transaction, e.g., by offering more or less restrictive payment methods based on customer-specific characteristics. However, the concrete use of payment method selection for risk management varies according to cultural background: While payment via credit card is the prevalent method in many countries, in several countries other methods are equally important, for example in Germany where over 40 different payment methods are in daily use (Stahl et al., 2008). This means that for each e-tailer an individual adaptation of our valuation model is required according to the payment methods in use. In the following, we focus on five prevalent payment methods in e-commerce: cash with order, credit card, cash on delivery, direct debit and purchase on account. This selection does not limit the generality of our approach, since further payment methods, e.g. e-payment methods such as "paypal", can be easily integrated. From an e-tailer's point of view, with exception of the risk-free payment method cash with order, all methods hold specific system risks as Table 1 shows.

PAYMENT SYSTEM	SYSTEM RISKS
1. cash with order	– no risks for e-tailers
2. credit card	– inaccurate credit card data – exceeded card limit – chargeback (payment revocation)
3. cash on delivery	– incorrect delivery address – undeliverable mailing, customer not available – hoax orders
4. direct debit	– incorrect banking accounts – exceeded account limit – revocation of a debit entry
5. purchase on account	– missed term/maturity of payment – incorrect billing address

Table 1. Exemplary system risks of prevalent e-commerce payment methods

Since each payment method has specific risk characteristics, quantifying these risks is a nontrivial problem. Although there are established evaluation schemes for some of these system risks (Degennaro, 2006; Bezuidenhout and Gloeck, 2003; Bezuidenhout and Gloeck, 2004), for the sake of simplification we renounce with single risk evaluations and rely on first intersector empirical results to estimate overall system risks per single payment method (Stahl et al., 2008). Table 2 shows these results, assuming a risk neutral decision-maker:

PAYMENT SYSTEM	SYSTEM RISKS
1. cash with order	0.0 %
2. credit card	0.9 %
3. cash on delivery	1.2 %
4. direct debit	1.7 %
5. purchase on account	3.7 %

Table 2. System risks values of prevalent e-commerce payment methods (in extension of (Stahl et al., 2008))

Besides the payment method system risks, e-tailers should also consider negative effects of limiting payment methods, since these limitations increase the probability that customers cancel their transactions (See-To, 2007; Siegl et al., 2008). Empirical evidence shows that by offering less restrictive payment methods, the annual turnover of e-tailers can be increased. For example, an e-tailer raised its annual turnover by about 12.5 % by also offering "credit card" and "purchase on account" in addition to the restrictive payment method "cash with order" (Stahl et al., 2008). Since there is no further empirical data available yet, we set the method "cash with order" as maximally restrictive and "purchase on account" as minimally restrictive payment methods for customers. Values for expected turnover potentials are interpolated as follows: credit card 4 %, cash on delivery 7 % and direct debit 9 % (see also Table 3). If better empirical data becomes available, the results of our model may improve.

PAYMENT SYSTEM	TURNOVER POTENTIALS
1. cash with order	0.0 %
2. credit card	4.0 % *
3. cash on delivery	7.0 % *
4. direct debit	9.0 % *
5. purchase on account	12.5 %

Table 3. Turnover potentials of prevalent e-commerce payment methods (in extension of (Stahl et al., 2008), * interpolated values)

Model for a Risk-Adjusted Customer Valuation

Efficient and integrated risk-turnover management requires the simultaneous assessment of risk and value potentials of customers and payment methods. All methods for evaluating customer value, customer risks, system risks, and turnover potentials of payment methods presented in the previous sections fulfill the criteria of monetary value, a single aggregated turnover and risk value can be calculated for every transaction. To calculate risk-adjusted prices in a competitive market environment, two additional factors are included in our model: the product base price, i.e. the lowest price an e-tailer demands for its product, and the average market price, i.e., the highest price an e-tailer would be able to realize. Thus, the product base price and the market price spread the manageable price range for the e-tailer. In total, our valuation model contains three variables for measuring values and four variables for measuring risk as shown in Table 4:

VALUE VARIABLES		RISIK VARIABLES	
P	product base price	PFP_k	payment fraud risk of customer k, calculated by an external scoring provider
CLV_k	customer value of customer k	PFE_k	payment fraud risk of customer k, calculated by the e-tailer
TP_b	turnover potentials of payment method b	MR_k	migration risk of customer k
		SRP_b	system risk of payment method b

Table 4. Input variables for detecting customer-specific risk-turnover combinations per transaction

Consequently, the aggregated turnover variable u for a customer k and a payment method b is a function of the three value variables representing the effectively reachable turnover for a specific transaction, incorporating future customer potentials:

$$u_{kb} = f\left(P, CLV_k, TP_b\right).$$

Accordingly, the aggregated risk variable r for a specific transaction is a function of the four risk variables:

$$r_{kb} = f\left(PFP_k, PFE_k, MR_k, SRP_b\right).$$

Applying our model requires an identification of the formal interdependencies between the value and risk variables. Since there is no empirical experience currently available, we intend to aggregate P and the (weighted) variables CLV and TP by addition. Furthermore, as a starting point, we propose a multiplicative aggregation for the probability values of the risk variables. The application of our approach requires a concrete specification of the model. This is the current focus of our research, and we investigate the adaptation of methods from the financial and insurance sector. However, the results presented in the following are independent of the concrete specification of the model, and are discussed on a more abstract level by using exemplified business scenarios. Based on the above selected five exemplary payment methods, five risk-turnover combinations can be calculated for each transaction, one for each payment method. These risk-turnover combinations can be visualized by a risk-turnover diagram, so that all accessible risk-turnover combinations for a single customer can be directly compared as shown in Figure 2.

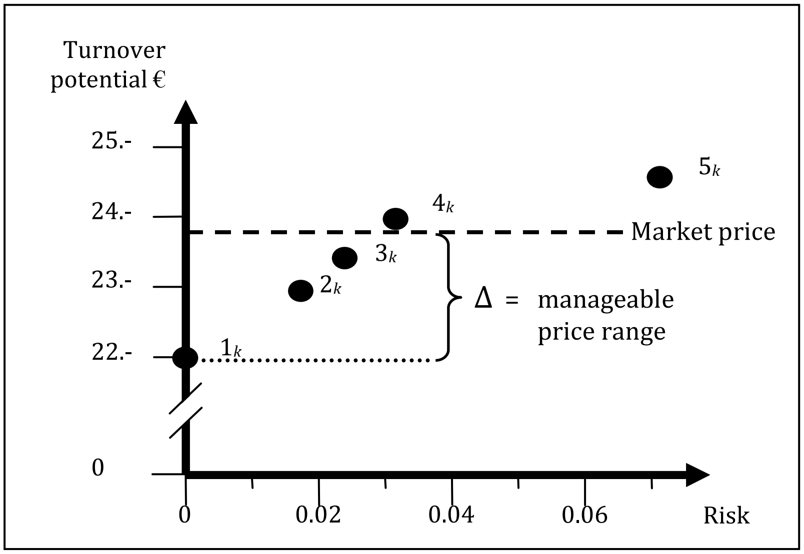


Figure 2. Risk-turnover combinations for a customer *k* and five payment methods

The second module allows to determine the additional turnover reachable under a certain level of risk. Thus, an e-tailer is provided with risk-adjusted prices and an objective decision base for customer-specific risk management, taking turnover potentials into consideration. The company's risk preferences determine which of the payment methods (see points 1_k to 5_k in Figure 2) should be provided to the customer, and how the risk-adjusted price range (see Δ in Figure 2) should be used. Even if the calculated risk-adjusted price for a customer is higher than the market price (see points 4_k and 5_k in Figure 2), e-tailers can manage risks by automatically offering more restrictive and ceteris paribus less risky payment methods such as "cash with order", "credit card" or "cash on delivery".

The way in which the risk-adjusted prices are finally operated depends on further factors, such as a general pricing (Schwind, Hinz, Stockheim and Bernhardt, 2008), sales, or market share strategies. Nevertheless, if a risk-adjusted price lies under the market price, an e-tailer can manage this price range. For instance, the e-tailer can see this as additional margin, or can decide to pass this "premium" on to the customer in the form of a discount. Since the model defines the market price as the maximum price and only risk-adjusted discounts down to the minimal base price are addressed, there should be no negative reaction on the customer side to such marketing measures, and a general acceptance of risk based pricing should be acheived. However, marketing measures based on risk-adjusted pricing are not limited to discounts.

The model presented in this contribution is flexible and open to further, perhaps branch-specific value and risk variables that can potentially raise the forecast accuracy. Furthermore, the modular architecture of our valuation model also enables – to a certain extent – the evaluation of customers on which little or no data is available, as it is typically the case with new customers. Here, average branch or company experiences can be used to calculate risk and value data. Should this be impossible, single variables can be omitted from the model, allowing each customer to be evaluated with less accuracy but still allowing an automated management for e-tailers.

CONCLUSION AND OUTLOOK

A growing turnover potential in e-commerce inevitably goes hand in hand with an increase in risks (e.g. payment fraud and migration risk), which should be managed. Existing applicable approaches for e-tailers either increase average prices by an overall risk premium or manage risks by only offering low-risk payment methods. However, following a value-oriented strategy, these approaches prevent optimal risk-turnover management, since customer-specific value and risk factors as well as turnover potentials are neglected. Integrating these factors into a valuation model is proposed in this contribution. The new valuation model includes two modules for customer and payment method evaluation, which generate an objective decision base for a customer-specific risk management which integrates turnover potentials. To this end, the first module combines the customer lifetime value, migration risk (evaluated by the NBD/Pareto model), and payment fraud risk (evaluated by scoring methods) to estimate customer potential. The second module integrates payment system risks from offering different payment methods and the risk of transaction cancellations on the basis of first empirical data. As a result, customer specific risk-turnover combinations for every payment method and transaction are generated, enabling e-tailers to make objective risk management decisions. Since the model requires a variety of inputs, and since optimal risk management decisions can only be made in conjunction with other customer management measures, our model should be seen as a possible extension of current CRM systems and not as a stand-alone approach.

Our next step is an extension of the valuation model by a third module which aims at automating the – currently manual – decision process of a risk-optimal selection of payment methods. To do so, currently company-specific risk preferences will be integrated into the model. Furthermore, we will analyze how the results can be used to support other company goals, e.g. for identifying valuable customers or for optimizing the whole customer portfolio under risk criteria as proposed in (Kundisch et al., 2008). Last but not least, a necessary applicability check (Rosemann and Vessey, 2008) is planned to test the results and performance within the shop engine of a German e-tailer. For this purpose, we will weight the used value variables at the e-tailer-specific level. A prototypical implemention as business process and pretests based on real customer data will then provide first results on practical quality and performance. The final evaluation of the model is part of a research project supported by the German Federal Ministry of Education and Research, and the findings will be used for an iterative improvement of the model concept presented in this contribution.

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