The Optimal Level of CRM IT Investments

An Economic Model and its Application at a Financial Services Provider

Abstract:

In light of the growing relevance of customer-oriented business strategies IT investments in the field of Customer Relationship Management have increased considerably. However, firms often could not realize sufficient returns on these IT investments. One major reason for this failure seems to be the lack of appropriate approaches to determine the economic impact of such investments ex ante. Therefore, we develop an economic model to determine the optimal level of Customer Relationship Management IT investments. Using this approach, firms can evaluate, to what extent investments in Customer Relationship Management IT are reasonable. One major result is that in most cases the “all or nothing strategy” pursued by many firms does not lead to the optimal level of investments. To illustrate the practical utility and applicability of the approach, we provide a real world example of a German financial services provider.

Introduction

In recent years, we observe a change from product-oriented to customer-oriented business strategies, where customers are considered as a firm's major assets (Gupta and Lehmann 2003) and resources of value to be managed across a lifecycle (Romano and Fjermestad 2009). Due to the growing relevance of profitable customer relationships, Customer Relationship Management (CRM) and CRM systems have become essential for companies seeking growth and profit in today's competitive global markets. With the emergence of Internet-based technology, electronic CRM (eCRM) expands the traditional CRM techniques by integrating aspects of new electronic channels into the overall enterprise CRM strategy (Pan and Lee 2003; Kim et al. 2002). In this context, also electronic commerce CRM (ECCRM) for companies interacting with their customers predominantly via Internet becomes more and more important (Schoder and Madeja 2004; Romano and Fjermestad 2001a). To this end, many firms are investing in CRM IT in order to improve the knowledge about their customers (Xu et al. 2002), to support activities improving sales and/or customer service (Ang and Buttle 2006), and to identify the most valuable customers (Rigby et al. 2002). At the same time, in the Information Age more and more companies cooperate with partner companies in business networks where CRM plays an important role when coordinating the actors. As a consequence, it is not surprising that Gartner (2009) observed a considerable raise in CRM IT investments over the last years.

Despite enormous amounts spent, many firms are disappointed by the returns on their CRM IT investments (Rigby and Ledingham 2004, Bohling et al. 2006): According to estimations at least 50% of the installed CRM IT systems do not fulfill their promises (Fox 2001). One major reason for this failure is the lack of appropriate approaches to determine the economic impact of such investments ex ante (Heidemann et al. 2009). Especially in the field of ECCRM little work exists regarding the examination if and how these investments contribute to corporate success (Schoder and Madeja 2004; Tan et al. 2002). The quantification of costs and benefits of IT investments constitutes the basis for both reasonable ex ante justification and ex post review (Clermont 2002). However, a survey with 101 firms found that only 40% of all CRM IT investment decisions are based on well-defined business cases and return on investment (ROI) calculations (Bohling et al. 2006). In addition, because of the popularity of CRM and marketing efforts of CRM software vendors, firms are likely to assume that implementing and using more CRM IT is better (Rigby et al. 2002) and therefore overinvest in CRM IT ending up with low returns (Kim and Mukhopadhyay 2006). Consequently, many CRM applications, features, and functionalities are never used after implementation (Lee 2001). To determine the optimal level of CRM IT investments, a well-founded analysis regarding the value of each feature and functionality considered for implementation is necessary. This is especially true against the backdrop that more and more service-oriented architectures (SOA) are implemented within companies (e.g. Heffner 2008; TechTarget and Forrester Research 2010) where each functionality is encapsulated in a web service. Consequently, major vendors in the CRM market (e.g. Oracle, SAP, Microsoft) have already approached SOA (Beal 2007).

According to the paradigm of aligning IT to customer-oriented business strategies, the value of investments in CRM IT has to be determined based on financial customer metrics like the firm's customer equity (CE). However, to the best of our knowledge neither CRM nor IS literature provides an approach for an economic, customer-oriented evaluation of such investments. Against this background, this paper aims at two contributions: (1) it provides an economic model to determine the optimal level of CRM IT investments considering a firm's CE; (2) it demonstrates the applicability and the practical utility of the approach by means of a real world example of a major German financial services provider (FSP).

The paper is based on the seven guidelines for conducting Design Science Research by Hevner et al. (2004). To organize the paper, we follow Peffers et al. (2008): after the discussion of the general relevance of the problem and the motivation ("problem identification and motivation"), we briefly review existing literature and identify the research gap ("define the objectives for a solution"). Then we develop our artifact as a quantitative decision model ("design and development"). The practical applicability ("demonstration") of the artifact as well as its practical utility ("evaluation") is illustrated by a real world example of a German FSP. After a discussion of critical issues and limitations the last section summarizes the results and suggests areas for further research ("communication").

Related Literature

CRM aims at building valuable long-term relationships with customers and can be defined as a customer-oriented enterprise approach (Swift 2001). In the context of electronic markets, ECCRM refers to the application of CRM when companies interact with their customers mainly via the Internet (Schoder and Madeja 2004; Romano and Fjermestad 2001a; for an overview of existing ECCRM research cf. Romano and Fjermestad 2001b). Like CRM in general, ECCRM has also been identified as critical success factor, especially for the B2C sector (Schoder and Madeja 2004). Within CRM the customer process is in the center of consideration. Thereby, in the prevailing Information Age the only opportunity to serve the customer process in all its aspects is to cooperate with partner companies in business networks ([blinded for review]), the latter meaning that companies cooperate with a set of connected partners to produce added value (Anderson et al. 1994; Alt and Smits 2007). Hence, in the context of CRM and its variants, a good cooperation of all business network's participants constitutes the basis for understanding the customer process and identifying customer needs in order to establish customer orientation and realize the full potential of CRM in business networks ([blinded for review]). At the same time, customer orientation through CRM is indispensable in business networks to coordinate the network actors and to survive in saturated markets.

Although CRM and its variants are generally possible without sophisticated technology, IT is necessary for successful CRM at any firm of a significant size (Kim and Mukhopadhyay 2006). Especially for large firms CRM IT is indispensible for a coherent view of relevant information about the customers and their behavior (Ryals and Payne 2001). Therefore, for many firms, the adoption of a CRM strategy takes into account the implementation of an IS (Hadaya and Cassivi 2009). On this basis, firms can increase customer profitability, loyalty, and satisfaction, for example by offering a higher level of service quality (Liu et al. 2011). However, the use of CRM IT might not always deliver the expected return. In literature, first articles focus on identifying the factors leading to success or failure during CRM implementation. Kim et al. (2002), for example, analyzed critical success factors for CRM and eCRM systems by means of an exploratory multi-case study. They identified organizational (e.g. championship, management support), process (e.g. CRM strategy and process), technological (e.g. compatibility, channel integration), and project (e.g. user participation and project team skills) success factors which influence user satisfaction via system quality and information quality (Kim et al. 2002). Furthermore, Rigby et al. (2002) discovered four perils of CRM which should be avoided: 1) implementing CRM before creating a customer strategy, 2) rolling out CRM before changing the organization to match, 3) assuming that more CRM Technology is better, 4) stalking, not wooing, customers. Another main success factor for CRM IT projects and especially their ex ante evaluation is to link them to financial metrics (Boulding et al. 2005, Ryals 2005), which is in the focus of our paper. As "CRM is a long-term investment, not a short-term one" (Xu et al. 2002), corresponding financial customer metrics like the customer lifetime value (CLV) or the CE are discussed in literature (e.g. Gupta and Lehmann 2003). The CLV is defined as the present value of all existing and future cash flows of a certain customer (Berger and Nasr-Bechwati 1998). On this basis, Rust et al. (2004)

define the CE as “the total of the discounted customer lifetime values summed over all of the firm’s current and potential customers”. Marketing CRM literature provides several approaches to determine the optimal level of investments in customer relationships based on financial customer metrics. Ho et al. (2006) for example propose a CLV model to analyze the optimal investment in customer satisfaction. Furthermore, Blattberg and Deighton (1996) present an approach for the optimal level of acquisition and retention spending to maximize CE. Besides that, there also exist first contributions regarding the operationalization and calculation of the CE in practice. Wiesel and Skiera (2007) for example illustrate in detail how to get the data to calculate the CE of two firms (“T-Online” and “Freenet”) by means of an economic model. Furthermore, Wiesel et al. (2008) show how to determine the CE of Netflix based on quarterly data and Pfeifer (2011) demonstrates how to use company reported summary data to estimate a firm’s CE as well. As most customer-oriented firms invest in CRM IT in order to get higher cash flows from their customers, the impact on CE seems to be an adequate measure for the evaluation of such IT investments. However, the approaches in marketing CRM literature do not consider the specifics of IT investments up to now.

Regarding the evaluation of IT investments, several papers exist in IS literature. Empirical studies in the field of economics in IS (e.g. Brynjolfsson and Hitt 1996; Cheng and Nault 2006) analyze the impact of IT investments on the profitability of firms. Thatcher and Pingry (2004) also study the impact of firms’ IT investments on economic performance but propose an economic model to formalize this relationship. However, these approaches do not differentiate among different IT projects but consider only the total IT spending of a firm and the impact on the economic performance. In contrast, several publications exist which study the business value of IT with respect to single IT projects. For example Taudes et al. (2000) as well as Benaroch and Kauffman (1999) evaluate single IT infrastructure investments using real option approaches. Santhanam and Kyparisis (1996) and Verhoef (2002) present quantitative approaches how to aggregate single IT investments to evaluate a firm’s IT portfolio. Thereby, Verhoef (2002) just like Boehm et al. (2000) address the impact of different project sizes or investment levels on the project’s business value. Furthermore, some publications exist which study the business value of components and web services wherein single functionalities of IT applications are encapsulated. For instance, Jung and Choi (1999) evaluate commercial of the shelf (COTS) components for modular software systems. Tansey and Stroulia (2007) develop a procedure for an economic evaluation of a set of web services composed to a business process and Braunwarth and Heinrich (2008) establish a portfolio optimization model balancing costs and risks. The latter model allows the decision maker to evaluate a set of internally developed or externally obtained web services. However, all these approaches from IS literature do not use a financial customer metric to measure the impact on the firm's output and consequently do not support a customer-oriented business strategy.

Finally we can summarize: (1) In marketing CRM literature exist several approaches to determine the impact of CRM activities on the CE. But to the best of our knowledge, there is no approach to determine the impact of different levels of IT investments on this financial customer metric. (2) IS literature provides several approaches to evaluate IT investments. However, financial customer metrics like CE to support IT investment decisions in the field of CRM are not considered at all. Therefore, in this paper we bring together the mentioned literature streams and contribute to both of them by developing an economic model to determine the optimal level of CRM IT investments considering a firm's CE.

Optimization Model

It is often not reasonable to implement all functionalities imaginable or favored by the business units within an IT investment project (in the following denoted as project). Thus, for a well-founded ex ante analysis of projects, the project size (extent of functionality realized within the project representing the level of CRM IT investments) has to be planned considering economic aspects. Therefore, the benefit of each possible functionality, which is often encapsulated in modules or IT-services, must be compared to the costs for its realization. The optimization model to determine the optimal project size considering the impact of CRM IT investments on the firm's CE bases on the following assumptions and definitions:

A.1: The project size p is normalized to the interval [0; 1] and infinitely divisible.

A.2: The present value of the project size dependent investment costs $C(p)$ which cannot be assigned directly to the customer base as well as the related change in CE $\Delta CE(p)$ can be estimated ex ante.

Thereby, the CRM optimization model developed in this section focuses primarily on consumer markets. Based on these assumptions, the optimal level of CRM IT investments can be determined. A project size of $p=0$ means that no functionality is realized – i.e. the project is not conducted at all. In contrast, $p=1$ represents the realization of all possible functionalities. To determine the optimal project size p^{opt}, the change in CE $\Delta CE(p)$ induced by the project must be compared to the present value of the investment costs $C(p)$. Thus, the corresponding objective function $OF(p)$ of the optimization model can be denoted as follows:

(1) $OF(p) = \Delta CE(p) - C(p) = \max!$

To concretize the optimization model, the functions $\Delta CE(p)$ and $C(p)$ have to be examined. We argue that $\Delta CE(p)$ is an increasing function depending on p (i.e. $\partial(\Delta CE(p)) / \partial p > 0$). This is due to the fact that by means of CRM IT, information about customers can be integrated faster and better. Furthermore, the selection of information as well as its processing can be improved. Hence, salespeople are able to get a better picture of their customers enabling an individual customer service (Xu et al. 2002). Moreover, salespeople's ability to evaluate and exploit the potential of customers is improved. As a consequence, on the one hand, the quality of salespeople's decisions rises (e.g. selection of profitable customers). On the other hand, the quality of advice and service offered to the customers increases as well (Ahearne et al. 2008). According to empirical studies, this results in a higher level of customer satisfaction and loyalty, as well as in more intensive customer relationships (Anderson and Sullivan 1993; Xu et al. 2002). Besides a lower price sensitivity of customers and a better exhaustion of cross selling potential (Ang and Taylor 2005), these effects normally also increase the cash flows of a firm's customers. Consequently, the CE of the firm as well as $\Delta CE(p)$ rise accordingly. Furthermore, we argue that an increasing project size is characterized by a diminishing marginal utility regarding $\Delta CE(p)$ (i.e. $\partial^2(\Delta CE(p)) / \partial p^2 < 0$): Initial investments in CRM IT usually serve the salespeople in a more perceivable way than the intensification of already high investments. Furthermore, these initial improvements are mostly better recognized and honored by the customers.

To sum it up: $\Delta CE(p)$ can be described by a strictly monotonically increasing ($\partial(\Delta CE(p)) / \partial p > 0$), concave ($\partial^2(\Delta CE(p)) / \partial p^2 < 0$) function. Furthermore, $\Delta CE(0) = 0$ must hold, because not conducting the project (i.e. $p = 0$) does not result in any project-induced change of CE. To formalize $\Delta CE(p)$, we have to choose a function fulfilling these characteristics. A possible formalization can be described as follows[1]:

(2) $\Delta CE(p)=p^{\eta}\cdot A$ with $\eta\in]0; 1[$ and $A\in \mathrm{IR}^+$

The factor A denotes the maximal increase in CE, which can be realized by choosing the maximal project size (i.e. $p = 1$). The parameter $\eta\in]0; 1[$ represents the diminishing marginal utility depending on an increasing project size. A value of η close to 0 is appropriate, if most of the maximal increase in CE (cf. A) can already be realized with a relatively small project size. In this case, a further intensification of the initial IT investments primarily means realizing "nice to have"-functionalities, which affect the CE only marginally. In contrast, a

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[1] Other functions fulfilling the characteristics lead to similar findings.

value of η close to 1 implies that $\Delta CE(p)$ increases nearly constantly when the project size is enlarged. This denotes that functionalities which are prioritized higher and should therefore be realized preferentially within the project are characterized by an only slightly higher marginal utility than subordinate functionalities. Fig. 1 illustrates the project-induced change in CE $\Delta CE(p)$ for three different parameterizations of η.

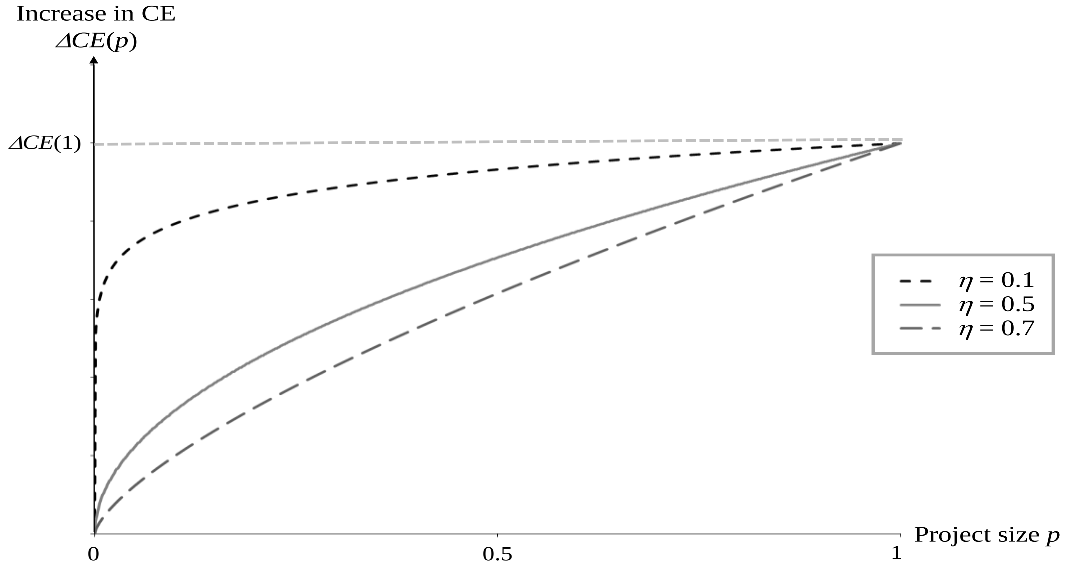

Fig. 1. Project-induced change in CE $\Delta CE(p)$ for different values of η.

The second component of the objective function represents the present value of the investment costs $C(p)$ including organizational costs (e.g. for trainings and internal marketing) depending on the project size p. Thereby, fixed and variable components can be distinguished. On the one hand, IT-projects induce payments which are independent from the project size chosen (e.g. costs for arranging a project team). This part of the investment costs C^{fix} arises if the project is started (i.e. $p > 0$). On the other hand, variable investment costs have to be considered. Their total amount depends on the chosen project size p (e.g. costs for the implementation of different functionalities). As a larger project size usually results in higher project-immanent complexity (e.g. due to more interfaces between different modules), it is obvious that the variable costs do not only increase with more functionalities to be implemented (i.e. $\partial(C(p)) / \partial p > 0$). In fact, they grow over-proportionately depending on the project size p (i.e. $\partial^2(C(p)) / \partial p^2 > 0$). Such curves for the project effort depending on the size of IT projects are often described in cost estimation models. In the Constructive Cost Model (CoCoMo), for instance, the required person months to conduct a project are forecasted based on the lines of code to be implemented (Boehm 2000). Thereby, the investment costs depending on the number of lines of code are generally assumed to grow over-proportionately.

To sum it up: $C(p)$ can be described by a strictly monotonically increasing ($\partial(\Delta CE(p)) / \partial p > 0$), convex ($\partial^2(\Delta CE(p)) / \partial p^2 > 0$) function. Furthermore, the fixed costs have to be taken into account in such a function. A possible formalization which fulfills these characteristics can be described as follows[2]:

$$(3) \qquad C(p)=1_{]0;\,1]}(p)\cdot C^{fix}+p^{\beta}\cdot C^{var} \text{ with } \beta\in]1;\,\infty[,\ C^{fix}\in \mathrm{IR}^{+} \text{ and } C^{var}\in \mathrm{IR}^{+}$$

The first summand represents the fixed costs. The fact that C^{fix} accrues if and only if the project is conducted (i.e. $p > 0$), is considered by the characteristic function $1_{]0;\,1]}(p)$. The second summand reflects the variable component of $C(p)$. Thereby, the exponent $\beta\in]1;\,\infty[$ takes into account the fact that $C(p)$ grows over-proportionately when the project size p increases. If due to the characteristics of the project the effects resulting from complexity do not arise perceptibly until the project size is relatively large, ceteris paribus a higher value of β is appropriate et vice versa. The factor C^{var} represents the maximal present value of the variable project costs. It corresponds to the costs incurred when the maximal functionality within the project is realized ($p = 1$). Fig. 2 illustrates the net present value of the investment costs $C(p)$ for three different values of β.

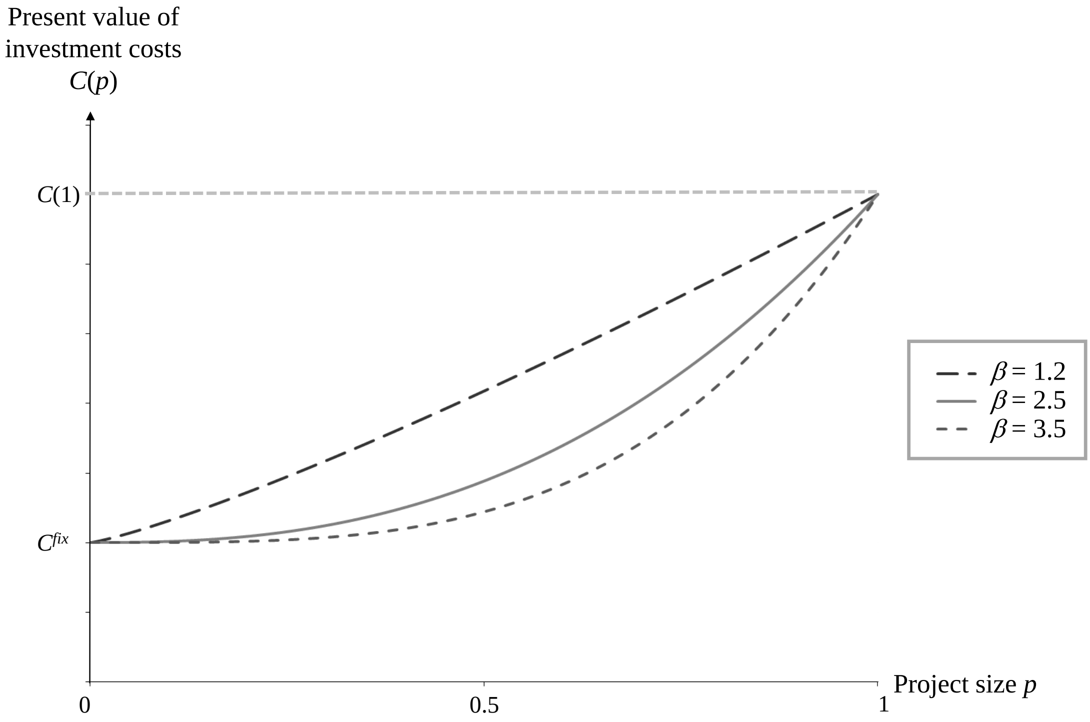

Fig. 2. Net present value of the investment costs $C(p)$ for different values of β.

Finally, based on formulas (1) to (3), the optimization model can be expressed as follows:

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[2] Other functions which fulfill the characteristics lead to similar findings.

(4) maximize $OF(p)=\Delta CE(p) - C(p)=p^{\eta}\cdot A - (1_{]0;\,1]}(p)\cdot C^{fix}+p^{\beta}\cdot C^{var})$ with $p\in[0;\,1]$

A mathematical analysis shows that, if the project is conducted (i.e. $p > 0$), the objective function strictly increases until the project size equals $p^{*} := \min\{[(\eta\cdot A) / (\beta\cdot C^{var})]^{1 / (\beta-\eta)};\, 1\}$. This means that up to this point, an intensification of the CRM IT investments results in a higher increase of $\Delta CE(p)$ compared to the related $C(p)$. Beyond a project size of p^*, the increase of $C(p)$ due to a larger project size cannot be compensated by the increase of $\Delta CE(p)$ any more. In fact, the objective function is strictly decreasing henceforward (i.e. for $p > p^*$). So, it is reasonable to expand the project within the interval $]0;\, p^*[$ in order to improve its value proposition. However, from an economic point of view, a project should only be realized at all (i.e. $p^{opt} > 0$), if the costs can be compensated in p^*. This holds for $OF(p^{*}) \geq 0$. Otherwise, the project should not be conducted (i.e. $p^{opt} = 0$). Due to the fact that the objective function is concave, a corner solution ($p^{opt} = 0$ or $p^{opt} = 1$) is only optimal in exceptional cases. Otherwise, $p^{opt} = p^*$ holds. Consequently, an “all or nothing”-strategy often leads to suboptimal results and should not be adopted. One must rather differentiate: CRM IT investments have to be planned modularly and only value creating functionalities should be realized.

Application of the Optimization Model

In this section, we demonstrate the applicability of our model and evaluate its practical utility. In cooperation with a German FSP, the approach was applied to determine the optimal size of a large-scale CRM project: a new customer-oriented application system had to be implemented by means of several web services to enable an integration in the existing SOA. For reasons of confidentiality, the figures and data used have been changed slightly and made anonymous. Nevertheless, the procedure and the basic results remain the same. In case of the FSP, the project size could only take a small limited number of different values according to the sizes of the web services. Therefore, we did not use the continuous model described in the previous section, but discretized it accordingly. If – in contrast to the situation illustrated here – there exists a multiplicity of possible project sizes, only a manageable amount of project sizes has to be evaluated. Out of this, the described functions $C(p)$ and $\Delta CE(p)$ can be deduced easily (e.g. by using a least square estimation). On this basis, the optimal level of CRM IT investments can be determined as described in the previous section.

Because of changes in fiscal and social security laws regarding retirement provisions (RP) in Germany, the complexity of financial advisory services has increased. Thus, it was the FSP’s objective to change the approach of the RP-advisory service from a product-centric to a customer-centric one. The FSP did not only focus on the legally obligatory adaptations (change in treatment of existing RP-products regarding fiscal and social security aspects and introduction of new RP-products). The FSP rather wanted to offer a unique, individualized advisory service generating competitive advantages. To this end, we designed a new customer-oriented advisory process. Its starting point is the collection of all advisory relevant data about the customer and the products in his or her existing portfolio. Based on these data the gap in coverage has to be calculated. Therefore, the individually desired net retirement payment of the customer has to be compared to the expected net retirement payment resulting from the RP-products of the customer's existing portfolio. In a third step, an individual recommendation based on the existing portfolio for closing the gap in coverage with different RP-products must be generated considering the customer's desired respectively realizable savings performance. Finally, the process ends with the contract conclusion.

Due to the multiplicity of relevant customer and product data and the high complexity of generating individual RP-solutions, an innovative, customer-oriented application system to support the advisory process was needed. To assure that the advisory system (AS) fulfills the quality standards and the requirements of the marketing division, we defined possible functionalities which can be encapsulated in a web services together with the operating department and a representative group of salespeople (financial advisors). At the same time, the IT department forecasted the lines of code LOC_i needed for the implementation of each web service S_i (i = 1, …, 5). The following web services were defined:

S_1: *Customer data* (LOC_1 = 13.000): Coverage of all customer data relevant for RP-advisory (e.g. financial and fiscal data, social security data, existing RP-products, customer attitudes and desires).

S_2: *Fiscal logic* (LOC_2 = 17.000): Implementation of the new fiscal and social security logic to calculate the net retirement payment for each RP-product and the customers' gap in coverage.

S_3: *Optimization* (LOC_3 = 12.000): Calculation of a customized optimal solution. This requires a complex optimization algorithm (cf. [*blinded for review*]), which generates for each customer the RP-product combination resulting in the maximal expected retirement payment after taxes and social contributions for a given savings performance.

S_4: *Occupation disability* (OD) (LOC_4 = 9.000): Consideration of the OD-insurance in the optimization. Due to new legal regulations, it is possible to link the OD-insurance to another RP-product named "Basisrente". In this case, the savings payments can be offset against tax.

S_5: *Riester* (LOC_5 = 5.000): Graphical representation of the tax effects of a fiscally promoted German RP-product called “Riester” to illustrate the specific payment structure involved and to support the financial advisors when explaining this product (cf. [*blinded for review*]).

To decide which web services to implement from an economic point of view, we applied our economic model. Thereby, the increase in CE induced by the implementation of each web service had to be estimated. Such a determination of the benefits from IT module by module has already been postulated by Barua et al. (1995). The implementation of the CLV and the CE is very hard in practice. However, there exist first contributions providing examples how to operationalize the CE and how to gain the relevant data (cf. e.g. Wiesel and Skiera 2007; Wiesel et al. 2008, and Pfeifer 2011). Our estimation was based on a former project which had been conducted to analyze the CLVs of the FSP’s customers (for details cf. [*blinded for review*]). In this context, we assumed that every customer passes through different phases of life and defined a corresponding typical customer life cycle. Based on that, we determined a customer’s (typical) needs for different domains (e.g. for the domain RP) in each of the phases. This way, it was possible to estimate the firm’s potential cash flows resulting from selling products and services in different domains for each phase which can be realized if a customer covers all his needs with financial products of the FSP. Based on these potential cash flows we calculated the potential CLVs and the potential CE. To estimate the change in CE induced by the CRM project, in a first step we compared the potential CE of the current customer base related to the domain RP (including OD) with the one actually realized. This led to a CE related to this domain of about €4 million, which was not yet exhausted. An evaluation by the operating department of the FSP showed that approximately 75% of this amount could be realized in the long run if the project size is maximal. Hence, the maximal increase in CE $\Delta CE_{1,\ldots,5}$ which can be realized in the project[3] is set to €3 million.

Furthermore, we analyzed each of the possible web services separately regarding its effect on the CE. Thereby, S_1 and S_2 constituted an exception: as they only address the legally obligatory changes for RP advisory their implementation was obligatory to maintain the quality of the advisory service for the customers after the legal changes and to preserve the status quo regarding the firm’s CE ($\Delta CE_{1,2} = 0$). Hence, the implementation of S_1 and S_2 was declared to be a so-called “must-investment”. To find out which of the optional functionalities (S_3 to

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[3] The fact that the new AS also positively affects the acquisition of new customers and the exhaustion of their potential is not taken into account here as the management wished for a conservative forecast.

S_5) to realize from an economical point of view and how to prioritize them, we forecasted the effects of each functionality on the CE. Afterwards, we generated a ranking of the web services regarding their marginal effects on CE related to the lines of code needed. Starting with the web service with the highest marginal effect, the results are as follows (cf. also Table 1):

S_3: *Optimization*: Due to the complex logic of fiscal and social security aspects, the implementation of S_3 is required to optimally allocate a client's savings payments on different RP-products. Thus, S_3 enables the recommendation of optimal, customer-specific RP-solutions. This would constitute a unique selling proposition. At the same time, customers would get the impression of a substantiated, reliable advisory service. So, according to forecasts, about 80% of $\Delta CE_{1,\, \dots,\, 5}$ could be realized due to the implementation of S_3. Consequently, ΔCE_3 was assessed to be €2.5 million resulting in a marginal effect of €2.5 million / 12.000 lines of code = €208 / line of code.

S_4: *OD*: The OD-insurance constitutes a basic coverage for customers and can be combined with RP-products. Thus, a substantiated, customer-centric OD-advisory service requires its integration into the RP-advisory process. Although the analysis of CE showed that OD holds less potential compared to other products, the implementation of this functionality would entail the realization of €250.000 of the not yet exhausted potential CE. As the customers generally consider OD to be highly relevant, it implies considerable cross-selling potential. So, further 5% of $\Delta CE_{1,\, \dots,\, 5}$ can be attributed to S_4. In summary, ΔCE_4 amounts to €400.000 involving a marginal effect of €44 / line of code.

S_5: *Riester*: In the optimization, the RP-product "Riester" is already taken into account (cf. S_3). Thus, in the advisory process an optimal customized recommendation can be determined without the implementation of S_5. However, the financial advisors wished for a module assisting the illustration of the characteristics of this quite complicated product. As S_5 can be considered as add-on functionality, an analysis ascribed only about 3% of $\Delta CE_{1,\, \dots,\, 5}$ to S_5. This is equivalent to ΔCE_5 = €100.000 and a marginal effect of €20 / line of code.

In a next step, the present value of the investment costs depending on the project size had to be quantified. Due to the short time horizon for the implementation of about one year, the FSP assumed that all project costs had to be paid at once.

To forecast the costs, the FSP used the cost estimation model CoCoMo. Based on the characteristics of the project, the general function (cf. Boehm et al. 2000) was parameterized as follows: $PM = 2.8 \cdot 0.7 \cdot LOC^{1.1}$. By applying $LOC_{1, \ldots, i}$[4] (for the CoCoMo-variable LOC which is measured in thousand lines of code) to this formula, we calculated the corresponding project effort in person months ($PM_{1, \ldots, i}$) resulting from design, implementation, and test. To calculate the investment costs $C_{1, \ldots, i}$, we multiplied $PM_{1, \ldots, i}$ with the average daily rate of €600 per person and 20 working days per month. The resulting investment costs depending on the project size are provided in Table 1. The costs for S_1 and S_2 ("must-investment") can be interpreted as fixed costs. With this interpretation, the CoCoMo-formula can easily be transformed to the expression of formula (3) so that it is consistent with the previous section.

Finally, to determine the optimal project size the forecasted increase in CE had to be compared to the forecasted project costs. The value proposition depending on the project size is depicted in Table 1 (cf. formula (1)).

Table 1 Increase in CE, investment costs, and value proposition depending on the project size.

Functionalities $S_{1,\ldots,i}$	$S_{1,2}$	$S_{1,\ldots,3}$	$S_{1,\ldots,4}$	$S_{1,\ldots,5}$
Size $LOC_{1,\ldots,i}$ (in thousand lines of code)	30	42	51	56
Project size $p_{1,\ldots,i}$ ($LOC_{1,\ldots,i}/ LOC_{1,\ldots,5}$)	53.6%	75.0%	91.0%	100.0%
Increase in CE $\Delta CE(p_{1,\ldots,i})$ [€]	0	2,500,000	2,900,000	3,000,000
Investment costs $C(p_{1,\ldots,i})$ [€]	991,000	1,436,000	1,777,000	1,970,000
Value proposition $OF(p_{1,\ldots,i})$ [€]	-991,000	1,064,000	1,123,000	1,030,000

The highest value proposition (€1.123 million) is achieved for the implementation of $S_{1, \ldots, 4}$. The additional integration of S_5 would reduce the forecasted value proposition of the project. Thus, the FSP decided to realize $S_{1, \ldots, 4}$ and chose the optimal project size of 0.91%[5]. Fig. 3 illustrates the results and shows that the previously discussed characteristics of formulas (2) and (3) could actually be observed.

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[4] The index *1, …, i* represents the cumulated functionalities 1 to *i*.

[5] When applying the continuous model the optimal project size has to be determined as shown in the previous section. Afterwards, a realizable project size "near" this optimal solution should be adopted.

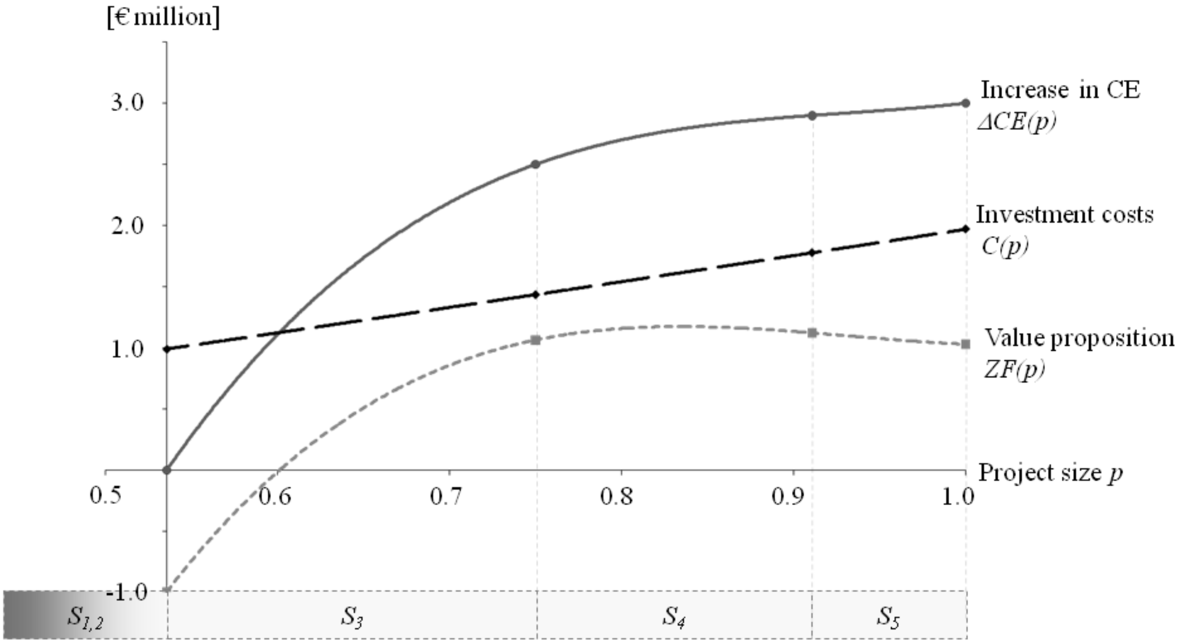

Fig. 3 Results of the project-specific calculations.

Discussion

We have illustrated the practical applicability of our approach by means of a real world example. However, we also have to point out some limitations which have implications for management and research. Moreover, the practical utility of applying the approach has to be discussed:

- **Parameterization:** We presented how the input parameters of our approach may be estimated. However, to a certain extent the estimation of these values is based on historical data, experiences, and subjective estimations. Consequently, errors can occur. Therefore, decision makers should use a sensitivity analysis to analyze the robustness of the optimal decision depending on the input parameters of the model. For our real world example we conducted such a sensitivity analysis. The results are reported in Table 2. In the first column the initial values of the input parameters are listed. Each row consists of two sub-rows. The upper (lower) sub-row contains the results when the parameter value is increased (decreased) by 10% relative to the initial value[6].

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[6] S_1 and S_2 are seen as must investments which induce $\Delta CE_1 = \Delta CE_2 = 0$ and are therefore not subject to a variation.

Table 2 Sensitivity Analysis.

Input parameter: Original value	Modified values (+/-10%)	Optimal project size p^{opt}	Investment costs $C(p^{opt})$	Increase in CE $\Delta CE(p^{opt})$	Value proposition $OF(p^{opt})$	Change in value proposition
LOC_1: 13,000	11,700	$S_{1, \ldots, 4}$	1,728,000	2,900,000	1,172,000	+4%
	14,300	$S_{1, \ldots, 4}$	1,827,000	2,900,000	1,073,000	-4%
LOC_2: 17,000	15,300	$S_{1, \ldots, 4}$	1,712,000	2,900,000	1,188,000	+6%
	18,700	$S_{1, \ldots, 4}$	1,843,000	2,900,000	1,057,000	-6%
LOC_3: 12,000	10,800	$S_{1, \ldots, 4}$	1,731,000	2,900,000	1,169,000	+4%
	13,200	$S_{1, \ldots, 4}$	1,823,000	2,900,000	1,077,000	-4%
LOC_4: 9,000	8,100	$S_{1, \ldots, 4}$	1,743,000	2,900,000	1,157,000	+3%
	9,900	$S_{1, \ldots, 4}$	1,812,000	2,900,000	1,088,000	-3%
LOC_5: 5,000	4,500	$S_{1, \ldots, 4}$	1,777,000	2,900,000	1,123,000	0%
	5,500	$S_{1, \ldots, 4}$	1,777,000	2,900,000	1,123,000	0%
ΔCE_3: 2,500,000	2,750,000	$S_{1, \ldots, 4}$	1,777,000	3,150,000	1,373,000	+22%
	2,250,000	$S_{1, \ldots, 4}$	1,777,000	2,650,000	873,000	-22%
ΔCE_4: 400,000	440,000	$S_{1, \ldots, 4}$	1,777,000	2,940,000	1,163,000	+4%
	360,000	$S_{1, \ldots, 4}$	1,777,000	2,860,000	1,083,000	-4%
ΔCE_5: 100,000	110,000	$S_{1, \ldots, 4}$	1,777,000	2,900,000	1,123,000	0%
	90,000	$S_{1, \ldots, 4}$	1,777,000	2,900,000	1,123,000	0%

The investment costs $C(p^{opt})$ (cf. column 4), the increase in CE $\Delta CE(p^{opt})$ (cf. column 5) and thus the value proposition $OF(p^{opt})$ (cf. column 6 and 7) change according to the variations of the input parameters. Nevertheless, the optimal solution (cf. column 3) to implement $S_{1, \ldots, 4}$ remains the same[7]. Consequently, for our real world example the result of our economic model is quite robust. To identify critical input parameters in other real use situations practitioners should use such a sensitivity analysis as well to find out for which input parameters a change in the optimal solution could already occur in case of a slight estimation error. However, at the same time it is the task of research to further improve the available estimation techniques.

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[7] This holds for a variation of LOC_i in a symmetric interval from -16% to +16% and of ΔCE_i in a symmetric interval from -14% to +14% around the respective initial values.

To illustrate that in our case the input parameters were estimated with sufficient accuracy, we carried out a comparison with the values actually realized after conducting the project. Regarding the project costs, definitive numbers are available. With €1.72 million, the costs were about 3% lower than estimated. For the project-induced increase in CE such a comparison is considerably more difficult. This is due to the fact that the CE is a future-oriented key figure. Nevertheless, there are several signs that the estimated increase in CE will actually be realized. A survey showed that the number of financial advisors using the new IT-support in the advisory process has increased by 13% since the introduction of the AS. Furthermore, the number of IT-supported advisory services per month has almost doubled. Apart from this, the number of successfully sold RP-products shows the success of the project. For instance, the Financial Times Deutschland reported that thanks to the new AS the FSP (with a customer base of only about 670,000) reached an absolute market share of 38% for the product "Basisrente" (cf. S_4) in Germany (Fromme 2005). This success is especially based on the optimization algorithm (cf. S_3) taking into account the OD-insurance (cf. S_4). Thereby, combining OD-insurances with the RP-product "Basisrente" generates considerable utility for the customers. At the same time, the FSP is enabled to sell a lot of these products and exhaust high cross selling potential. In summary, these figures indicate that the estimated increase in CE due to the introduction of the new AS seems realistic.

- **Modeling:** The proposed economic model is based on the assumption that CRM IT investments are infinitely divisible (cf. assumption A.1). This assumption holds true if a project can be divided in a theoretically infinite number of functionalities. In practice, however, this is usually not the case. In the context of our real world example the number of possible functionalities is rather small. Therefore, when applying the model we relaxed assumption A.1 and discretized the model accordingly. When applying the model possible interdependencies between the different functionalities have to be taken into account. This is no problem if functionalities with a higher marginal effect on CE related to the required lines of code are the basis (basic functionalities) for follow-up functionalities (dependent functionalities) with a lower marginal effect. In our real world example this is the case for S_3 and S_4: The consideration of the OD-insurance in the optimization (S_4) and thus the realization of the respective increase in CE ΔCE_4 is only possible if the optimization logic (S_3) is also part of the project. Due to the fact that the marginal effect of the basic functionality S_3 (€208 / line of code) is higher than the marginal effect of the dependent functionality S_4 (€44 / line of code) this interdependency is implicitly considered within the economic model. In other real use situations, however, the marginal effect of the dependent functionality may be higher than that of the basic functionality or more functionalities may dependent on each other. These situations can be resolved by means of scenario analyses with respect to the dependent functionalities and the respective increases in CE (cf. Laux et al. 2012). In this context, the increase in CE of a dependent functionality can only be realized if the corresponding basic functionalities are also part of the project (scenario 1). Otherwise, the increase in CE of a dependent functionality amounts to zero (scenario 2). Practitioners have to be aware of such interdependencies when applying the economic model and build scenarios if necessary.

- **Practical utility:** To evaluate the practical utility of using the proposed model in our real world example we compare the "all or nothing strategy" with the optimal solution ($S_{1,\ldots,4}$) determined by means of the model. Implementing all web services ($S_{1,\ldots,5}$) would decrease the value proposition by €93,000 compared to the optimal solution. A much higher decrease of €2,114,000 would result from implementing only the "must investments" ($S_{1,2}$). One of these two alternatives the FSP would have chosen without using our model. The better value proposition when using the model has to outweigh the effort for applying the model which mainly results from retrieving the input data. In our real world example, this effort was negligible because the input data were already available. However, managers should be aware of this effort before applying our model. Considering the increasing importance of SOA and the emerging web service market (cf. Legner 2009; Nüttgens and Dirik 2008) where companies can purchase web services from software companies like Fraudlabs, StrikeIron, or ServiceObjects or from web service brokers like Seekda!, Soa Trader, or ProgrammableWeb, this effort will decrease in the near future as the relevant input data like the costs to purchase web services can be observed on the market and do not have to be estimated internally.

Finally, we conclude the discussion with a more general perspective on the generalizability and the breadth of the applicability of our approach. We have demonstrated that the model is appropriate for the evaluation of CRM IT investments in terms of the development of web services of a financial services provider. Due to the fact that the proposed model does not require any context specific characteristics, it seems to be applicable to further companies of different branches which have a customer centric management philosophy. Furthermore, we expect that the approach is also transferable to the evaluation of standard CRM solutions of software vendors like Oracle, Microsoft, and Salesforce which offer different CRM modules. In this case, the estimation of the investment costs seems to be easier because they are fixed by the vendor to a significant extent. Hence, only the costs for the adaptation to the existing IT infrastructure of the company and the organizational costs (e.g., costs for necessary trainings, etc.) have to be estimated. Thus, we expect that the general approach is also transferable to such kind of CRM IT investments. However, to concretize this transfer is an issue for further research.

Conclusion

Related to the seven guidelines for conducting Design Science Research by Hevner et al. (2004) we summarize as follows: Our *artifact* (cf. Guideline 1) is an optimization model to determine the optimal level of CRM IT investments. Statements in literature support, that planning CRM IT investments (including ECCRM and eCRM investments) is a *relevant problem* (cf. Guideline 2): on the one hand, in the Information Age IT investments in this field have been increasing substantially due to the growing relevance of profitable customer relationships in electronic markets, for example; on the other hand firms could often not realize sufficient returns on these investments. A major reason for this fact seems to be the lack of appropriate approaches to determine the value proposition of CRM IT investments based on financial customer metrics ex ante. Our artifact constitutes a first, but essential step to solve this important business problem. We *evaluated* (cf. Guideline 3) our model regarding applicability using the real world example of a major German FSP. In this context, the model was analyzed “in depth in business” (Hevner et al. 2004). Furthermore, we studied and discussed the practical utility of the model as well as the effort necessary for applying it. Nevertheless, further work is needed to analyze if the application of the model also succeeds for other fields of application. Our *research contribution* (cf. Guideline 4) includes the following aspects: We provide a first artifact that makes it possible to determine the optimal level of CRM IT investments considering the impact on a firm’s CE. We illustrated that applying this artifact – in terms of the optimization model – may result in considerable practical utility (e.g. in comparison with alternative strategies). In addition, it could be shown that in many cases the “all or nothing strategy” commonly applied in practice leads to suboptimal results and should not be adopted. Summing up, our research provides new insights with respect to planning CRM IT investments and proposes a new artifact that addresses an important gap in science and practice. To assure a *rigorous* construction of our artifact (cf. Guideline 5) we based our work on prior marketing CRM literature, which contains several approaches to determine the impact of CRM activities on the CE, and prior IS literature, which provides established approaches to evaluate IT investments. Moreover, we denoted our model formally and applied mathematical optimization methods to derive the optimal solution. Thereby, we drew on Hevner et al. (2004) who state that the “artifact itself must be rigorously defined, formally represented, coherent, and internally consistent (Guideline 5)” and that “in an attempt to be mathematically rigorous, important parts of the problem may be abstracted”. Nevertheless, a number of design choices were made resulting in limitations which we discussed in the previous section. For instance, the assumption that the project size is infinitely divisible may be critical. In many cases, however, it is at least approximately fulfilled (e.g. by the encapsulation of functionalities in granular services in service-oriented architectures). Otherwise, the model has to be discretized accordingly. Regarding the *search process* (cf. Guideline 6), present and future steps can be distinguished. In this paper, we presented the initial design of an economic model for planning CRM IT investments as a starting point to solve the described problem. The design process was guided by existing literature and the identified main factors of influence of such investments. Certainly, we abstracted quite strongly when initially designing the model. Therefore, in future iterations the assumptions of the model have to be relaxed and the artifact has to be particularized and enhanced accordingly. Moreover, we are currently working on an extension of the model taking into account risk aspects. Finally, by means of this paper we aim at *communicating* (cf. Guideline 7) our research. We also try to attract a managerial audience and included extensive explanations of the formulas as well as a discussion of the managerial implications resulting from the limitations of the model.

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