TOWARDS MORE EFFECTIVE SERVICE MANAGEMENT DECISION MAKING: DESIGN AND APPLICATION OF AN OPTIMIZATION FRAMEWORK IN A FRONTLINE EMPLOYEE MANAGEMENT CONTEXT

(#05-0058)

Sandra Streukens (Corresponding Author)
Professor of Marketing
Department of Business Studies, Hasselt University
Agoralaan – Building D
BE-3590 Diepenbeek, Belgium
T: +3211268628, E: sandra.streukens@uhasselt.be

Ko de Ruyter
Professor of Interactive Marketing
Department of Marketing, Maastricht University
PO Box 616, 6200 MD Maastricht, The Netherlands
T: +31433883739, E: k.deruyter@mw.unimaas.nl

Stan van Hoesel
Professor of Operations Research
Department of Quantitative Economics, Maastricht University
PO Box 616, 6200 MD Maastricht, The Netherlands
T: +31433883727. E: s.vanhoesel@ke.unimaas.nl

Ad de Jong
Assistant Professor
Department of Organization Science and Marketing, Eindhoven University of Technology
PO Box 513, 5600 MB Eindhoven, The Netherlands
T: +31402472423, E: a.d.jong@tm.tue.nl

TOWARDS MORE EFFECTIVE SERVICE MANAGEMENT DECISION MAKING: DESIGN AND APPLICATION OF AN OPTIMIZATION FRAMEWORK IN A FRONTLINE EMPLOYEE MANAGEMENT CONTEXT

ABSTRACT

Despite the awareness that effective management of the climate in which service employees operate is a necessary condition for the development of favorable customer service evaluations and the generation of service revenues, little research exists that includes this knowledge in decision making models. By combining existing knowledge on service management with mathematical rigor, this study develops and empirically assesses a general applicable decision making approach that allows for an explicit evaluation and optimization of service profitability in an economically justified and service oriented manner.

Service management theory is summarized in a behavioral model capturing the chain of effects among employee perceptions, customer evaluations, and service revenues. Subsequently, this behavioral model is integrated in a mathematical optimization framework. The decision making value of our approach lies in the explicit assessment of the following three issues: (i) evaluation and optimization of the profitability stemming from service investment strategies, (ii) the allocation of investment efforts to optimize financial performance, (iii) the robustness of the proposed solution to assess the impact of uncertainty in decision making. Besides offering a first in-depth treatment of profit optimization in service management, an additional contribution of our work lies in the fact that our study offers one of the few attempts to model the entire chain of effects between employee perceptions, customer evaluative judgments, and financial performance.

Subject areas: Services Management, Customer Service, Management Decision Making. Hierarchical Linear Modeling, Structural Equation Modeling, Dynamic Programming .

INTRODUCTION

The key to an effective service organization starts with managing employees' perceptions regarding their own organization (Schneider & Bowen, 1993; Rogg, Schmidt, Shull, & Schmitt, 2001). This proposition is supported by ample services research providing evidence that efforts aimed at generating favorable employee perceptions with regard to their work environment result in the creation of a service climate, which in turn has a profound positive impact on customer service evaluations, that ultimately translate into revenues (de Jong, de Ruyter, & Lemmink 2004a; Schneider, White, & Paul, 1998; Kamakura, Mittal, de Rosa, & Mazzon, 2002; Schneider & Bowen 1993).

Despite this large body of research, decision making models that take explicit advantage of this service management knowledge are very scant in the existing literature. Aligned with this hiatus in service management research many researchers (e.g., Metters & Marucheck, 2007; Bretthauer, 2004; Boudreau, Hopp, McClain, & Thomas, 2003; Amundson, 1998; Melnyk & Handfield, 1998) call for the development of decision making models that unite mathematical rigor and behavioral services management premises. Also, the practical need for such models is growing as a consequence of two trends in the Western service-based economies. First, due to increased competition service firms need to be increasingly results-oriented in order to survive. Second, in today's mature and slow growing markets customers have become an increasingly scarce resource pursued by an escalating number of aggressive suppliers.

Inspired by the need for these particular decision making models, the aim of our study is to develop and demonstrate a practical and versatile decision making tool that assists managers in evaluating and optimizing service improvement initiatives in an economically justified, yet behavioral-oriented manner.

As this paper builds upon existing insights within the service research discipline, the relative contribution of our work becomes most evident when we compare and contrast our model with related service management models put forward in the literature so far (see Table 1).

INSERT TABLE 1 ABOUT HERE PLEASE

The service profit chain (SPC) and the return on quality/marketing (ROM) model serve as the main pillars of our decision-making model. Similar to the principles underlying the SPC, our model departs from the notion that service revenues are driven by customer and employee perceptions. In line with the ROM approach our decision-making model permits making service improvement initiatives financially accountable. Similar to Rust, Lemon, and Zeithaml's (2004) ROM model, our decision-making approach provides actionable and relevant guidance to decision makers as the model's behavioral component, aimed at uncovering the processes which connect service improvement initiatives to revenue generation, is directly imputed in the profit calculation. Unlike the models presented thus far in the literature, the approach put forward in this paper offers a first framework that provides a clear-cut answer to the topic of investment profit and investment effort optimization concerning service improvement initiatives. Furthermore, our approach contributes to the literature by offering explicit insight into resource allocation decisions needed to optimize service investments. Compared to the other models presented in Table 1, a further contribution of our approach is that it allows assessing the degree of risk associated with a particular investment strategy. An additional contribution of our study stems from providing one of the few integral empirical tests taking into account the entire chain of effects among employee perceptions, customer evaluative judgments, and financial data. Finally, although the empirical results presented in this paper may to some extent reflect the idiosyncrasies of the research setting, it should be noted that the format of our decision-making framework is generally applicable across service settings.

The remainder of this paper unfolds as follows. In the next section we present our service management decision-making model and provide a detailed description of its key elements and relationships. Subsequently, we estimate and calibrate the various components of our model and demonstrate how it can be used to optimize service improvement initiatives in terms of profitability, investment effort and resource allocation. Furthermore we show how the level of investment risk involved can be evaluated by examining the solution's robustness to changes in the model's parameters. We end our paper with an overview of the main conclusions that can be drawn from our work, touch upon the implications our model has for decision makers, and discuss the limitations of our approach.

MODEL DEVELOPMENT

Overview of the Decision-Making Model

To arrive at a decision-making model that allows for an economically justified analysis of service improvement initiatives both the revenues and costs of these investment schemes need to be taken into account (Zhu, Sivakumar, & Parasuraman, 2004; Rust et al, 2004). This principle is reflected in Figure 1a which summarizes the core of our decision-making model at a macro level.

INSERT FIGURE 1A ABOUT HERE PLEASE

The first link (i.e., link 1) in our conceptual model captures the positive relationship between revenues increase stemming from service improvement initiatives and the overall profitability of these investments. The processes describing the generation of revenues in our model draw heavily upon behavioral theories from the fields of organizational psychology (e.g., Schneider et al., 1998; Schmit & Allscheid, 1995) and marketing (e.g., Kamakura et al., 2002; Loveman, 1998). Links 2 and 3 capture the profitability consequences of the investment costs or efforts associated with the service improvement initiatives. The impact of these investment efforts on investment profitability is characterized by a dual effect. First, investment efforts have an indirect and positive influence on service investment profitability via the perceptions one aims to improve via the improvement strategy (i.e., link 2). Put differently, targeted investments lead to an increase in employee perceptions, which in ignite a chain of effects that eventually results in higher revenues and profits. Second, all investment costs have a direct negative impact on the investments' profitability (i.e., link 3).

Building on the macro-level conceptual model presented in Figure 1a, Figure 1b summarizes the relevant equations of our decision-making approach and provides a detailed (i.e., micro level) graphical overview of our decision-making model containing the behavioral model used to describe the revenue generating process associated with service improvements. The remainder of this section aims to explain the various elements presented in Figure 1b. First, we describe the general structure of the revenue generating part of our decision-making approach (related to link 1 in Figure 1b). Second, we explain how to capture the effects of investment effort in our model (related to links 2 and 3 in Figure 1b). Last but not least, we integrate the revenue and cost functions in a framework allowing decision makers to determine and optimize service investment profitability.

INSERT FIGURE 1B ABOUT HERE PLEASE

Modeling Service Revenues: A Behavioral Approach

As can be seen in Figure 1b, the basic tenet of our behavioral model is captured by an employee-customer-revenues chain. Modeling revenues, and ultimately profitability, as a function of employee and customer evaluative judgments warrants the design of investment initiatives that explicitly take into account two of a firm's most valuable assets: its employees and customers. In a nutshell it is conjectured that employees' perceptions of a climate of well-being at work positively influence the formation of a service climate (e.g., Schneider et al., 1998; Schmit & Allscheid, 1995). A positive service climate has been shown to be a key contributor to the development of favorable customer evaluative judgments such as perceived quality and satisfaction (e.g., Salanova, Agut, & Peiró, 2005; de Jong et al., 2004a; Schneider et al., 1998). In turn, these customer evaluative judgments are considered leading indicators of service revenues (e.g., Kamakura et al., 2002; Loveman, 1998; Rucci, Kirn, & Quinn, 1998).

To conceptualize the starting point of our model (i.e., the perceptions we directly want to influence via investments initiatives), we use the employee well-being climate dimensions suggested by Burke, Borucki, and Hurley (1992) and interdepartment service construct suggested by Schneider et al. (1998). This conceptualization covers all relevant aspects of the service employees' work environment and is generalizable across settings (Kopelman, Brief, & Guzzo, 1990). Furthermore, research by Harter, Schmidt, and Hayes (2002) shows that employees' perceptions on similar dimensions can be effectively influenced by targeted investments. This latter aspect is of importance to start the chain of effects that ultimately should result into improved revenues and profits. As all constructs and relationships included in our behavioral model are strongly rooted in existing research, a compact overview of the relationships included in our behavioral model, along with a summary of the relevant literature per relationship, and a definition of each construct is presented in Table 2 below.

INSERT TABLE 2 ABOUT HERE PLEASE

In order to integrate the revenue generating process described by behavioral model described above in our decision-making approach we proceed as follows. Based the method proposed by Streukens and de Ruyter (2004), it can be concluded that none of the relationships in the employee-customer-revenues chain is characterized by nonlinearities such as increasing or decreasing returns. Since all individual relationships in the behavioral model are linear, the revenues vary as a linear function of changes in employee well-being dimensions. This linear relationship between the variables at which our improvement efforts are aimed (i.e., the employee well-being climate perceptions) and the resulting revenues is can be compactly expressed as shown in Equation (1).

$$REV = N\left(\sum_{i \in I} \delta_i (y_i - y(0)_i)\right) \quad (1)$$

In Equation (1), y_i $(i \in I)$ denotes the level of various employee climate dimension, or input variables i. The term $y(0)_i$ reflects the current level of input variable i $(i \in I)$. The parameter δ_i $(i \in I)$ reflects the total effect of each input variable i and on revenues REV. As our model is a-cyclical, parameter δ_i equals the sum of all paths or relationships connecting input variable i to revenues REV as outlined in our behavioral model. Finally, N denotes the number of customers served by the company which are comparable to the customers used in our sample.

With regard to investment profitability, the revenues REV stemming from service improvement investments aimed at raising, in this case, employee perceptions y_i contribute positively and directly to the investment's profits (i.e., link 1 in our conceptual model).

Modeling the Effects of Service Investment Expenditures

As mentioned previously, to adequately capture the profitability consequences of service investment efforts both their indirect positive effect on profitability through the increase on employee perceptions (i.e., link 2) and their direct negative impact on profitability (i.e., link 3) need to be considered.

Modeling the indirect positive profit consequences of service improvement expenditures requires estimates of the rating shifts in employees' well-being climate perceptions caused by target improvement efforts (i.e., link 2). In line with the suggestion by Rust and Zahorik (1993) to use decision calculus methods, we employed the response curve used in Little's (1970) ADBUDG model to capture the link between investment expenditures and the resulting rating shift in the level of employees' perceptions y_i. The value of Little's (1970) ADBUDG model is two-fold. First of all, ADBUDG offers a "simple, robust, easy to control, adaptive, as complete as possible, and easy to communicate with" (Little, 1970 p.466) modeling approach. Second, as the parameters of the model are calibrated in consultation with managers, the ADBUDG model reflects Blattberg and Hoch's (1990) notion that decision quality is best when both statistical and human input is combined.

In line with the general ADBUDG structure (Little, 1970) Equation (2) presents the relationship between the level of the various input variables y_i and investment effort x_i.

$$y_i = a_i + (b_i - a_i)\frac{x_i^{c_i}}{d_i + x_i^{c_i}} \qquad (2)$$

Concerning Equation (2), parameters a_i and b_i restrict y_i to a meaningful range (i.e.,$[a_i, b_i]$). More specifically, a_i represents the level of input variable y_i when no money is spend on this variable (i.e., $x_i = 0$); b_i corresponds to the value of input variable i when an infinite amount of money would be spend on this variable (i.e., $x_i \to \infty$). Parameters c_i and d_i determine the shape of the relationship between y_i and x_i.

As x_i reflects the investment effort needed to influence the various levels of employee well-being climate dimensions y_i**,** the total investment effort associated with a particular investment strategy can be defined as:

$$\text{Total investment effort} = \sum_{i \in I} (x_i - x(0)_i) \tag{3}$$

In Equation (3) the term $x(0)_i$ in the investment level needed to maintain the $y(0)_i$ level of the input variables (please note that this relationship is implied by Equation (2)). As indicated by link 3 of our conceptual model, the level of total invest effort directly reduces the profitability of service improvement investments.

Modeling Service Investment Profitability

The profitability of service improvement initiatives equals the difference between the revenues and costs associated with a particular service improvement initiative. Consequently, the profitability function, presented in Equation (4), follows directly from the revenue and total investment effort function expressed in Equations (1) and (3) respectively.

$$profit = N\left(\sum_{i \in I} \delta_i (y_i - y(0)_i)\right) - \sum_{i \in I} (x_i - x(0)_i) \tag{4}$$

Above and beyond profit calculation, profit optimization is a crucial decision-making theme in services management (Zeithaml, 2000). To address decisions regarding profit optimization in a formal and economically justified manner, the profit function expressed in

Equation (4) will serve as an objective function in an optimization framework. Please note that including Equation (1), representing the behavioral chain of effects between employee perceptions, customer evaluations, and revenues, in the profit equation, the employee and customer focus on service improvement initiatives is warranted.

To optimize the profit function the following constraints should to be taken into account. First, as resources are scarce a budget constraint needs to be included. The budget constraint is modeled as follows (see Equation (5a)).

$$\sum_{i \in I} (x_i - x(0)_i) \leq BUDGET \tag{5a}$$

Equation (5a) implies that the total investment effort cannot exceed a pre-set budget or spending limit. Second, we impose a nonnegativity constraint for investment effort x_i, which is formally expressed in Equation (5b).

$$x_i \geq 0 \tag{5b}$$

The third constraint describes the impact of investments on the level of the input variables, as implied by the ADBUDG-model. As a reminder, this constraint is thus modeled as follows.

$$y_i = a_i + (b_i - a_i) \frac{x_i^{c_i}}{d_i + x_i^{c_i}} \tag{5c}$$

Our fourth and final constraint deals with the fact that the level of each of the input variables y_i we invest in should be at least equal to its starting value $y(0)_i$. In formal notation the fourth constraint boils down to the expression presented in Equation (5d) below.

$$y_i \geq y(0)_i \tag{5d}$$

Overall, the objective function and the accompanying constraints lead to the optimization framework presented in Exhibit 1.

Exhibit 1: Optimization framework

$$
\begin{array}{llcll}
\max & profit & = & N\left(\sum_{i\in I}\delta_i(y_i - y(0)_i)\right) - \sum_{i\in I}(x_i - x(0)_i) & \\
s.t. & \sum_{i\in I}(x_i - x(0)_i) & \leq & BUDGET & \\
 & x_i & \geq & 0 & (i \in I) \\
 & y_i & = & a_i + (b_i - a_i)\dfrac{x_i^{c_i}}{d_i + x_i^{c_i}} & (i \in I) \\
 & y_i & \geq & y(0)_i & (i \in I)
\end{array}
$$

In the next section we will demonstrate the decision-making value of our approach. First, we describe the empirical study needed to assess the relationships underlying our behavioral model. Subsequently, these empirical results are integrated in the optimization framework outlined in Exhibit 1. To complete the operationalization of the decision-making framework, the calibration of the functions regarding investment effort will be described. Finally, we demonstrate in detail how our optimization framework can be used to tackle key decision-making issues like profit maximization, determination of the optimal level of total investment effort, optimal resource allocation, return on investment, and investment risk.

ANALYZING THE BEHAVIORAL MODEL: UNDERSTANDING SERVICE REVENUES

Sampling and Surveying

Regarding the behavioral model, survey data were obtained from employees and business customers of a large internationally operating company that manufactures and sells office equipment such as copiers, printers, and faxes. The company has a dominant presence in medium and high volume segments and puts the maintenance of long-standing relationships with its customers on the basis of service excellence as a central element of the corporate mission.

The after-sales service business unit where we conducted our research employs 250 service employees, which are divided over 28 teams with an average size of 8 employees. Due to the relatively limited amount of service employees we conducted a census. Paper-and-pencil questionnaires were given to team leaders who made sure that the questionnaires were distributed among the service employees and who returned the completed questionnaires in a numbered closed envelop. The employee census resulted in an effective sample size of 169.

Although researchers agree upon the climate for employee-well being components, no single established scale is available in the literature to assess these dimensions (Parker, 1999). Consequently, we carefully scrutinized the definitions of the various climate dimensions as provided by Burke et al. (1992) and Schneider et al. (1998) and compared these definitions to similar construct that could be measured by validated scales. For interdepartment service we used a self-developed scale which assesses the employees' perceptions of the other departments' service delivery to them. Details concerning the scales used to assess the relevant employee constructs are presented in Table 3.

Each team of service engineers serves customers in a certain region (regions are based on postal code). In order to be eligible for our study, customers had to meet the following three criteria. First, the customer has to operate in a retail environment. Second, the customer should have a relationship of at least 24 months with the company. Third, the customer should have contacted the service employees at least twice during the last 12 months. From this population 1500 customers were randomly selected, evenly spread over each region. The effective sample size for the customer survey consists of 499 usable respondents (minimum number of respondents per region is 5; maximum number of respondents per region is 38).

To guarantee an assessment of perceived quality that covers all relevant aspects of the service process the customer is faced with, a scale was designed along the guidelines suggested by Rust et al. (1995). The items included in the perceived quality scale result from interviews with customers and customer service managers. Customer satisfaction and behavioral intentions are both assessed through scientifically validated scales. Details regarding the customer constructs are presented in Table 4.

Estimating the complete employee-customer-revenue chain requires financial data at the customer level. For each customer that participated in our study, we had access to internal company records containing the complete sales history (revenues) of each customer covering a period of 21 months after the customer questionnaires have been distributed.

Finally, to merge the data stemming from three different sources (i.e., employees, customers, and internal data) we covertly coded all customer questionnaire with the customers' unique client number. Through this client number we were able to determine which service team was responsible for the service delivery and to connect the data on customers' perceptions with the associated revenues.

Psychometric Properties

We used Partial Least Squares (PLS) to assess the psychometric properties of the scales used in our study. The choice for PLS was based on the following grounds. First, in order to integrally test the measurement properties of the 7 constructs measured from the employees we failed to meet the minimum 1 to 10 parameter-to-sample size ratio suggested by Raykou and Widaman (1995) and Bentler and Chou (1987). Second, our study employs both formative and reflective scales. The results concerning the psychometric properties of the scales used are summarized in Tables 3 (employee data) and 4 (customer data).

INSERT TABLE 3 ABOUT HERE PLEASE

INSERT TABLE 4 ABOUT HERE PLEASE

Concerning the interpretation of the scales' psychometric properties it is crucial to make a distinction between formative and reflective indicators (MacKenzie, Podsakoff, & Jarvis, 2005; Jarvis, MacKenzie, & Podsakoff, 2003; Bollen & Lennox, 1991). Starting with the constructs measured by reflective indicators (i.e., all constructs except perceived quality and interdepartment service), evidence for the unidimensionality of these constructs is provided by inspection of the eigenvalues of the covariance matrix of each block of variables (Tenenhaus, Esposito Vinzi, Chatelin, & Lauro, 2005). As for each block of variables only the first eigenvalue exceeds 1, evidence for unidimensionality is offered. Reliability of the constructs is confirmed by the high internal consistency measures (Nunnally & Bernstein, 1994). The magnitude and significance of all loadings provide support for within-method convergent validity of the constructs (Anderson & Gerbing, 1988). Finally, discriminant validity is evidenced by the fact that all average variance extracted values exceed the squared value of the correlation coefficient between the relevant constructs (Hulland, 1999).

Given the nature of formative indicators, the procedures outlined to assess unidimensionality, reliability, and convergent validity above do not apply (Jarvis et al., 2003; Diamantopoulos & Winklhofer, 2001). Validity of the formative constructs is ensured by covering all relevant aspects of the domain the constructs pertain to (Jarvis et al., 2003). In case of the interdepartment service construct this is achieved by measuring the perceived quality of service delivery of all departments in which a typical service employee is involved. For the perceived service quality construct this is realized by assessing the customer's perceived service quality of all relevant business processes. The factor loadings provided in Tables 3 and 4 underscore the relevance of the various formative indicators in measuring interdepartment service and perceived customer service quality respectively (Diamantopoulos & Winklhofer, 2001). Discriminant validity of the formative scales is evidenced by the fact that all relevant correlation coefficients are within two standard deviations of an absolute value of 1.

Estimation Procedure

The structure of the behavioral model's data is characterized by a large degree of complexity. Basically, we can discern three structures in the data. First of all, concerning the employee part of the model (i.e., the relationship between perceived employee climate and service climate) it needs to be taken into account that service workers are nested within the teams they work for. Second, regarding the link between perceived service climate and customers' perceived service quality it is important to realize that customers are nested with the team they are served by. Third, concerning the relationships among the customer constructs in our model (i.e., all relationships from perceived service quality until customer revenues) the data exhibits a regular between-person structure.

In order to make valid inferences from our data it is crucial to opt for analytical techniques that adequately capture the various data structure properties described above (Hofmann, 1997). Following de Jong et al. (2004a, 2004b) hierarchical linear modeling (HLM) is used to assess the relationships involving nested data. Furthermore, Seemingly Unrelated Regression (SUR) is used to model the nomological network among customer evaluations and revenues as it allows us to take possible interrelationships among the various equations into account.

HLM analyses require examining whether the relevant data is suitable for aggregation. First, we calculated interrater-agreement $r(WG)_j$ values for all employee constructs. As can be concluded from the figures in Table 5, the $r(WG)_j$ coefficients provide ample support for within-group agreement concerning the various constructs under study (James, Demaree, & Wolf, 1993). Second, based on the ICC(1) values and the accompanying F-values (see also Table 5) we can conclude that a significant part of the variance in the individual level responses that can be explained by the group-level properties of the data (Bliese & Halverson, 1998). Finally, taking into account the effect of differences in team size we also calculated the accompanying ICC(2) values as suggested by Bliese (2000). As can be seen in Table 5, all except one variables have an ICC(2) value that equals or exceeds 0.50. Thereby providing additional support for data aggregation (de Jong et al. 2004a).

INSERT TABLE 5 ABOUT HERE PLEASE

Following the empirical support for data aggregation within the various teams, the following 2-level HLM model describes the relationships among the employee constructs. Equation (6a) represents the level 1 (individual-level) submodel specifying the effects of the within-group variables and Equation (6b) expresses the level 2 (group-level) submodel specifying the effects of group-level variables. In the HLM equations below index i stands for individuals and index j indicates groups.

$$\mathrm{SERVCLIM}_{ij} = \beta_{0j} + \beta_{1j}\mathrm{ROR}_{ij} + \beta_{2j}\mathrm{MEMP}_{ij} + \beta_{3j}\mathrm{GEMP}_{ij} + \beta_{4j}\mathrm{MSUP}_{ij} + \beta_{5j}\mathrm{WGS}_{ij} + \beta_{6j}\mathrm{IDS}_{ij} + e_{ij} \quad (6a)$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01}\mathrm{ROR}_{j} + \gamma_{02}\mathrm{MEMP}_{j} + \gamma_{03}\mathrm{GEMP}_{j} + \gamma_{04}\mathrm{MSUP}_{j} + \gamma_{05}\mathrm{WGS}_{j} + \gamma_{06}\mathrm{IDS}_{j} + u_{0j} \quad (6b)$$

$$\beta_{qj} = \gamma_{q0} + u_{qj} \text{ for } q = 1,\ldots,6 \quad (6c)$$

Substituting Equations (6b) and (6c) in Equation (6a) yields the following multi-level model:

$$\mathrm{SERVCLIM}_{ij} = \gamma_{00} + \gamma_{10}\mathrm{ROR}_{ij} + \gamma_{20}\mathrm{MEMP}_{ij} + \gamma_{30}\mathrm{GEMP}_{ij} + \gamma_{40}\mathrm{MSUP}_{ij} + \gamma_{50}\mathrm{WGS}_{ij} + \gamma_{60}\mathrm{IDS}_{ij} + \gamma_{01}\mathrm{ROR}_{j} + \gamma_{02}\mathrm{MEMP}_{j} + \gamma_{03}\mathrm{GEMP}_{j} + \gamma_{04}\mathrm{MSUP}_{j} + \gamma_{05}\mathrm{WGS}_{j} + \gamma_{06}\mathrm{IDS}_{j} + u_{0j} + u_{1j} + u_{2j} + u_{3j} + u_{4j} + u_{5j} + u_{6j} + e_{ij}. \quad (6d)$$

To avoid convergence problems and unstable parameter estimates, we follow the recommendation of Bryk and Raudenbush (1992) to constrain the predictor variables β_{qj} (q =1,…,6) to be invariable across groups (i.e., no random term is included on level 2 for these coefficients).

The relationship between employee service climate perceptions and the customers' perceived quality is modeled by means of a 3-level HLM model. Here, level 1 refers to the dependent variables indexed by $h = 1,\ldots, m$, level 2 reflects the individual customers $i = 1,\ldots,n_j$, and level 3 involves the teams $j = 1,\ldots,N$. Dummy variables d_1 to d_m are used to indicate the nine outcome variables (i.e., quality01,…, quality09). The dummy d_h is 1 or 0, depending on whether the data line refers to outcome variable Y_h or to another outcome variable. This principle is expressed by Equation (7a) below.

$$d_{shij} = \begin{cases} 1 & h = s, \\ 0 & h \neq s. \end{cases} \quad (7a)$$

Using these dummy variables, the equations for the m outcome variables can be integrated into the following three-level model (equation (7b)).

$$Y_{hij} = \sum_{s=1}^{m} \gamma_{0s} d_{shij} + \sum_{k=1}^{p} \sum_{s=1}^{m} \gamma_{ks} d_{shij} x_{kij} + \sum_{s=1}^{m} u_{sj} d_{shij} + \sum_{s=1}^{m} e_{sij} d_{shij} . \quad (7b)$$

Regarding the connections among the customer evaluative judgments and the revenues the following equations apply. To clarify that Equations (8a)-(8d) describe the customer part of the behavioral model, coefficients' indexes for these equations contain the letter c .

$$QUAL = \sum_{r} \varpi qual + \varepsilon_{1c} \quad (8a)$$

$$SAT = \alpha_{1c} + \beta_{1c} QUAL + \varepsilon_{2c} \quad (8b)$$

$$INT = \alpha_{2c} + \beta_{2c} SAT + \beta_{3c} QUAL + \varepsilon_{3c} \quad (8c)$$

$$REV = \alpha_{3c} + \beta_{4c} INT + \varepsilon_{4c} \quad (8d)$$

In Equation (8a) ϖ_r is the weight vector connecting the formative perceived service quality indicators to its underlying construct and results from the PLS analysis presented in Table 4 (Tenenhaus et al. 2005). The ensuing latent variable score for the perceived service quality construct ($QUAL$) will be used as a predictor variable in the remainder of the estimation procedure.

Empirical Results Behavioral Model

Table 6 below summarizes the empirical results pertaining to the analysis of our behavioral model.

INSERT TABLE 6 ABOUT HERE PLEASE

Overall, the results point out that employee perceptions of well-being climate contribute significantly to the formation of a service climate, which in turn has a significant positive impact on the formation of customer evaluative judgments. Subsequently, customer evaluative judgments can be considered relevant drivers of customer revenues over a given time period T. Support for the existence of the employee-customer-revenues chain, justifies our intended strategy to invest in employee perceptions regarding climate of well-being with the aim of ultimately increasing the company's profitability.

As mentioned previously, we used HLM to adequately capture the fact that employees are nested in teams. Nonetheless, none of the contextual or group effects proposed in Equation (6d) turns out to be significant. A logical explanation for this fact is that the actual work that covers most of an employee's working day is performed by each employee individually. Please note that Table 6 contains all information to determine parameter δ_i $(i \in I)$ of the revenue function as expressed in Equation (2), which also makes up a substantial part of the optimization framework presented Exhibit 1. Please see Appendix A for details regarding the calculation δ_i using the empirical data.

Using the data and results from this empirical study, the next section aims to explain how the proposed decision-making framework can be applied in optimizing and evaluating service improvement initiatives.

APPLICATION DECISION-MAKING MODEL

We start with the calibration of the various elements of our decision-making framework (i.e., revenue function, cost function, and profit function), after which we demonstrate the decision-making value of our model by displaying how it can be used to assess the following three critical decision-making areas. First, we address the relationship between investment effort and profitability. More specifically, we show how our model can be used to determine the optimal investment level and the accompanying rate of return. A second theme we address is the allocation of investment effort. Based on the calculated optimal spending level, we show how our model provides insight in how to allocate investment effort over the various input variables (i.e., climate of employee well-being dimensions) in order to achieve the projected maximum level of profitability. Finally, we demonstrate how sensitivity analysis can be used to assess the robustness of our optimal solution. This robustness estimate is a proxy of the risk or uncertainty accompanying the strategy aimed to lead to the optimal solution. Please note that for a detailed overview regarding the operationalization of the decision-making approach and the assessment of the various decision-making issues the reader is referred to Appendix A.

Calibrating the Decision-Making Model

Revenue function The operationalization of the revenue function (i.e., Equation (1)) stems directly from the empirical results pertaining to the analysis of our behavioral model presented in Table 6. Given the a-cyclical nature of the revenue generating process parameter δ_i, which captures the entire set of relationships put forward in our behavioral model, equals the sum of all paths or relationships connecting input variable i to revenues REV. Taking into account that $N = 10{,}000$ a unit increase in variable y_i leads to the following increases in revenues REV : $\delta_1 = 436.74$ (rewards orientation); $\delta_2 = 246.86$ (goal emphasis); $\delta_3 = 436.74$ (management support); $\delta_4 = 189.89$ (workgroup support) and $\delta_5 = 379.78$ (interdepartment support).

Investment effort function To capture the profitability consequences of the service improvement initiatives' costs the ADBUDG based function expressed by Equation (2) needs to be calibrated. It should be noted that once we calibrated this function for each of the input variables (i.e., the well-being dimensions that significantly influence the development of a service climate) we automatically have an estimate for the total investment effort as reflected by Equation (3).

To calibrate the function between investment effort (x_i) and employees' perceptions of well-being dimensions (y_i) as captured by Equation (2), we first need to understand what actions are capable of influencing employee well-being perceptions. Second, we need to assess how various levels of these actions, reflecting different investment cost levels, relate to changes in reported employee well-being ratings (i.e., rating shifts).

Regarding the current application, parameter c_i was set to 1, thereby reflecting that the investments aimed improving employees' perceptions of well-being dimensions are subject to diminishing returns (Little, 1970). For parameter d_i different values were chosen for each dimension y_i to account for differences in the shape of the function. Finally, as the objective of parameters a_i and b_i is to restrict changes in y_i to a meaningful range, these parameters are implicitly determined by the endpoints of the scales we used to measure employees' perceptions of climate of well-being facets. Consequently, parameter a_i is set to 1 (the lowest value of the measurement scale used) and parameter b_i is set to 9 (the highest value of the measurement scale used). For further details on the calibration of the ADBUDG function please see Appendix A.

Investment Approach

One can view financial returns from service quality as arising from decreasing costs, increasing revenues by increasing customer satisfaction, or both at once (Rust, Moorman, & Dickson 2002). They conclude that, while no company can afford to ignore either revenues or costs, companies that emphasize revenues expansion more than cost reduction have better customer relationship outcomes and better financial outcomes, as measured by both self-reports and objective financial returns. This finding builds on Anderson, Fornell, and Rust's (1997) proposition that there is a trade-off between cost-cutting (standardization) and customer satisfaction (customization). Another issue faced with when planning service improvement initiatives is whether to focus on attracting new customers (offensive effect) or retaining existing customers (defensive effect). Research has shown investing in lowering customer defection rates is an economically more feasible strategy than attracting new customers (Reicheld & Sasser 1990; Fornell & Wernerfelt 1987, 1988). Based on these findings, we seek an investment strategy that aims to optimize profitability based on increasing the revenue obtained from existing customers.

Tackling Key Decision-Making Issues

In line with the proposed investment strategy, we will now explain how our decision-making framework can be used to assess the following relevant decision-making issues: profit maximization, choosing the optimal level of investment effort, evaluating the return on investment, the optimal allocation of investment effort and the judgment of robustness or risk of the projected investment performance.

Optimizing profit, total effort, and return on investment In order to obtain the optimal level of investment profitability the calibrated revenue and cost functions, as summarized in Exhibit 1, are optimized in AIMMS (Advanced Interactive Mathematical Modeling Software) using the subgradient optimization algorithm.

Crucial to the evaluation and optimization of investments is the relationship between investment effort and profitability. Figure 2 graphically presents the relationship among the total investment effort $\sum_{i \in I}(x_i - x(0)_i)$ aimed at improving employee climate perceptions, and respectively revenues $N\left(\sum_{i\in I}\delta_i(y_i - y(0)_i)\right)$ and profitability

$N\left(\sum_{i\in I}\delta_i(y_i - y(0)_i)\right) - \sum_{i\in I}(x_i - x(0)_i)$ for the situation at hand.

INSERT FIGURE 2 ABOUT HERE PLEASE

The concave shape of the relationship between investment effort and profitability implies that it is possible to spend too much on service improvement initiatives, thereby stressing the need to carefully balance costs and benefits in deciding on service investments. As can be seen from Figure 2 an optimal level of investment effort, or put differently an investment level that maximizes the service investment profitability, exists. In calculating the investment optimum (i.e., investment level that leads to the maximum profit level) it is important to note that not the level of input variable y_i determines the optimal profit level but the amount x_i invested to obtain this particular level of input variable y_i. This is clearly demonstrated by Equation (9) were we substituted the ADBUDG function in the revenue component of the profit function.

$$profit = N\left[\sum_{i\in I}\delta_i\left(\left(a_i + (b_i - a_i)\frac{x_i^{c_1}}{d_i + x_i^{c_i}}\right) - \left(a_i + (b_i - a_i)\frac{x(0)_i^{c_i}}{d_i + x(0)_i^{c_i}}\right)\right)\right] - \sum_{i\in I}(x_i - x(0)_i) \tag{9}$$

To determine the exact optimal amount of total investment effort, the derivative of the profit function with respect to investment effort x_i plays a pivotal role. Leaving out the parts related to the status quo investment level $x(0)_i$ and the number of customer N for the sake of clarity, the profit function at hand this derivative is defined below in equation (10).

$$\max_{i \in I}(\delta_i y_i(x_i) - x_i)' = \max_{i \in I}\left\{\frac{\delta_i (b_i - a_i) c_i d_i x_i^{c_i - 1}}{\left(d_i + x_i^{c_i}\right)^2} - 1\right\} \tag{10}$$

The derivate of the profit function with respect to x_i denotes the rate of return per unit change in x_i. Thus, investments remain feasible as long as $\max_{i \in I} \; (\delta_i y_i(x_i) - x_i)' > 0$, whereas the optimal profitability level is obtained when $\max_{i \in I} \; (\delta_i y_i(x_i) - x_i)' = 0$. Therefore, to find the total level of investment effort yielding a maximum profitability level the derivative of the profit function (see Equation (10)) is set equal to zero and solved for x_i.

For the current situation, when planning to improve financial performance through investments aimed at improving employees' well-being perceptions, a maximum profitability level of $2,661,480 can be obtained by directing a total investment effort $7,700,000 to actions known to positively impact these perceptions. Note that this investment level figure reflects the level of effort required over and above the effort required to maintain the status quo level of service employee perceptions (i.e., $x(0)_i$).

In order to evaluate investments in employee and/or customer evaluative judgments on an even footing with competing investment opportunities an estimate of the rate of return is necessary. In terms of our mathematical framework the rate of return, defined as the profitability-effort ratio, is expressed as follows:

$$ROI = \frac{N \sum_{i \in I} \delta_i (y_i - y(0)_i) - \sum_{i \in I} x_i - x(0)_i}{\sum_{i \in I} x_i - x(0)_i} \tag{11}$$

Using the preceding optimal solution the accompanying ROI figure would be 34.56%.

Optimal allocation of investment effort Besides determining the total level of investment effort needed to maximize profitability, deciphering the question on how to optimally allocate this total amount over the various input variables i is equally important to maximize profits (Mantrala, Sinha, & Zoltners, 1992). The solution to optimally allocate the total investment effort over the available input variables i is provided by the absolute and relative magnitudes of the partial derivatives of the profit function with respect to the effort levels needed to influence the input variables (see also Equation (10)).

Before turning to the optimal allocation for the situation at hand, it may be useful to explain in general terms how the optimal allocation procedure works. An optimal allocation starts with assigning all efforts to the process that yields the highest return on investment (i.e. process for which the partial derivative expressed in Equation (10) is highest). Since the returns on investment are subject to diminishing returns, the process with the highest partial derivative, say process p, will equal the second-highest partial derivative, say process q, at a certain stage. Upon reaching the point where $\frac{\delta_p (b_p - a_p) c_p d_p x_p^{c_p - 1}}{\left(d_p + x_p^{c_p}\right)^2} = \frac{\delta_q (b_q - a_q) c_q d_q x_q^{c_q - 1}}{\left(d_q + x_q^{c_q}\right)^2}$ investments continue in such proportion over processes p and q that the partial derivatives remain equal. The allocation over the various processes or input variables remains economically feasible until for all input variable the partial derivative of the profit function with regard to y_i equals zero. To further demonstrate the importance of both effort level and allocation of the effort level in profit optimization, Figure 3 graphically shows how the optimal allocation of resources varies as a function of the level of total investment effort.

INSERT FIGURE 3 ABOUT HERE PLEASE

When deciding on how to optimally allocate a known amount of total investment effort, say $B = \sum_{i \in I} (x_i - x(0)_i)$, the optimal allocation scheme can be obtained as follows from our optimization framework. In addition to using the same parameters as in the determination of the optimal level of investment effort, we also impose the budget constraint by setting constraining the effort level to the optimal effort level B . Solving the optimization problem then yields a set of values for x_i and y_i associated with the maximum profitability level. To obtain the actual investment effort associated with the optimal level of each input variable i , the optimal effort level x_i needs to be corrected for the level of investment effort needed to maintain the initial perception level $y(0)_i$. This so-called maintenance or status quo effort level $x(0)_i$ follows directly from the function presented in Equation (2). For the situation under study, assuming the disposal of all resources needed to maximize profitability (i.e., an investment effort level of $7,700,000 above and beyond the effort needed to maintain the status quo) the optimal allocation over the various input variables is as presented in Table 7. To translate the investment amount into actual activities, the input data used to calibrate Equation (2) should be used for interpolation.

INSERT TABLE 7 ABOUT HERE PLEASE

Risk: Assessing the robustness of the projected profitability Similar to all other investment decisions, the profitability projections associated with investment actions aimed at improving evaluative judgments are characterized by uncertainty or risk. In line with the notion that the variability in investment outcome reflects the amount of risk involved (Brealey & Myers, 2000) examining the robustness of the optimal solution to changes in the model's parameters provides an excellent way to asses the level of investment risk. Two useful approaches to assess the robustness of the investment profit projections include nominal range sensitivity analysis and the calculation of switch-over values (Frey & Patil, 2002; Morgan & Henrion, 1990; von Winterfeldt & Edwards, 1986). After briefly describing the two robustness or risk assessment methods, we will explain the application of the methods in the context of our decision-making model.

Nominal range sensitivity analysis evaluates the effects on a model's output due to changes exerted by varying individual model parameters across a range of plausible values while keeping the other parameter values at the nominal or base-case values. The robustness of the model is subsequently expressed as the positive or negative percentage change compared to the nominal solution. Switch-over analysis involves finding model parameters values that provide an output level for which a decision maker would be indifferent among various risk options (Frey & Pattil, 2002). In the context at hand a switch-over value represents the minimum value a parameter in the behavioral model may take without yielding a negative investment outcome under the suggested optimal investment effort level and allocation.

In the context of our study, nominal range sensitivity analysis is conducted to provide an estimate of how the maximal profitability level alters as a function of changes in each of the coefficients in our behavioral framework by conducting a series of numerical experiments. Note that we allow parameter estimates to vary in both positive and negative directions, to express stronger and weaker relations respectively. Subsequently, for each parameter alteration the associated profit level is determined and compared to the previously determined optimal profit level. See Table 8 below for the results of the nominal range sensitivity analysis.

Concerning the switch-over analysis, for each regression-based parameter β in our behavioral model the accompanying switch-over value is determined by setting the profit equation equal to zero and solving if for β. As explained above the effect of β on profitability is captured by the term δ_i. Furthermore, the lower bound for the switch-over values is set to zero as negative values are irreconcilable with existing theory that provides ample support for positive relationships in the behavioral model. For each parameter in our behavioral model, the switch-over value is presented in Table 8.

INSERT TABLE 8 ABOUT HERE PLEASE

Overall, the results for both the nominal range sensitivity analysis and the switch-over values indicate that the projected optimal profitability level is pretty robust to parameter changes in the behavioral model as evidenced by the relatively small percentual changes in optimal solution under varying conditions. Consequently, we can state that the proposed investment strategy aimed at improving customer revenues through improving service employees' perceptions is not characterized by a high level of risk, or put differently has a relatively high chance to be indeed profitable. Note that the risk assessment procedures outlined here can also be applied to the cost functions of the decision-making model.

DISCUSSION AND IMPLICATIONS

Motivated by the academic and practical need for decision-making models that merge existing knowledge regarding behavioral theories in services management with mathematical rigor, our aim was to develop and test a decision-making model that enables service organizations to evaluate and optimize the financial consequences of service improvement initiatives in economically sound manner whilst guarding the firm's key assets: its employees and customers. Overall, this study aims to make the following contributions to service management theory and practice. First, although profit maximization is often referred to as the key decision-making criterion in services management (Kamakura et al., 2002; Zeithaml, 2000; Rust et al. 1995), our framework offers a first attempt that allows managers to actually determine the optimal investment amount and the accompanying maximum profit level.

Second, above and beyond paying attention to the optimal spending and profitability level, our model also provides a straightforward answer to resource allocation matters. Optimal resource allocation is equally important as setting the optimal budget, as the goal of profit maximization can only be obtained when the optimal amount of investment effort is allocated accordingly. In our decision approach, the first-order partial derivatives of the profit function provide all the necessary information to achieve optimal resource allocation for any possible level of expenditures. Third, we exemplify how robustness assessment can be used to quantify the effect of changing conditions (e.g., the weakening of the link between customer satisfaction and customer loyalty due to the market entry of a new competitor) on the optimality of the projected solution. Similar to one of the basic principles of finance, this variance in profitability reflects the degree of risk associated with the planned investment strategy. This issue is especially relevant given the inherent dynamism of the service environment, thereby imposing a large degree of uncertainty for all decisions. Together with the investment's projected rate of return, which can be directly derived from our model, the figures regarding the robustness of a solution provide the required data to make a risk-return trade-off, which is considered as one of the key elements in deciding on the soundness of an investment plan. Regarding rate of return stemming from our decision-making tool, it should be noted that it places service investments on an even footing with any other investment. Put differently, the projected ROI of a service investment can be directly compared with the estimated ROI of for instance a new advertising campaign. Besides its decision-making value, another contribution of our work is that it offers one of the few integral empirical assessments of the entire chain of effects between employee well-being perceptions, service climate perceptions, customer service evaluations, and financial performance. Our empirical results emphasize the need for service managers to focus on critical employee perceptions, as these ignite a chain of effects that ultimately result increased service revenues. Overall, our findings support Schneider et al.'s (1998) notion that the creation of a service climate is a key process for service firms to influence customer evaluative judgments. Although Schneider et al. (1998) argue that a climate for employee well-being and interdepartment service are crucial foundation issues in the creation of a service climate solid empirical evidence was lacking. Hence, our study extends Schneider et al.'s (1998) proposition by providing empirical based insight into what specific dimensions lead to a service climate. Concerning this matter, the empirical results of our behavioral model suggest that in order to manage service employees effectively, a variety of interfaces in which the employee is involved are of relevance. Put differently, in order to enhance the financial performance of service firms the service-spirit should be present at all levels and functions of the organization.

One remark on our decision-making model is needed to show an even more extensive application potential than illustrated in this paper. Although the focus of this paper was on profit maximization, both in terms of investment level and allocation decision, the framework is not restricted to this objective. Our approach offers the flexibility to derive an optimal result, both in terms of profitability and allocation, for any level of investment effort. Thus, for any situation aimed at improving financial performance through investments in employee climate of well-being perceptions our model enables managers to optimize the results from their valuable and scarce resources. Furthermore, it should be underscored that although the empirical results of our behavioral model confirm the findings of previous work in other service settings, it should be noted that the generalizability of the empirical findings pertaining to our behavioral model depend on the unique context in which every service organization operates. However, given the general applicability of the employee climate dimensions as discussed by Kopelman et al. (1990), the support for existence of the employee-customer-revenue chain in a wide variety of service settings, and the context independence of our optimization framework we do feel that we offer an decision-making approach of which the structure can be practically applied to a large selection of service firms. Finally, although we chose to include the entire chain of effects between employee and customer perceptions in the revenue generating process and thus our optimization model, this does not represent a necessary condition. In situations where it is difficult or impossible to trace back the interaction between provider and customer (e.g., online business) it is possible to either use customer perceptions of the revenue generating process as starting point of the decision framework or to use a relevant substitute for the behavioral model's employee part (e.g., online transaction characteristics) in trying to predict customer evaluative judgments and the accompanying revenues.

An attractive feature of our proposed decision-making framework in terms of its practical applicability is that the data needed to operationalize the framework is often easily available as most firms keep information on customer level revenues in their systems and a growing number of companies conduct periodical employee and customer interviews. Hence, the approach put forward is this paper offers a relative cost-effective way to firmly connect the customer to a firm's strategy.

LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

This study presents one of the few empirical inquiries into the quantification and optimization of service evaluations in terms of financial consequences, a phenomenon of great managerial and academic interest. However, several limitations are warranted to qualify our findings and encourage future research efforts.

Recognizing that the relationships between employee judgments, customer evaluations, and revenues may entail lag effects and persistence, it would be desirable to test these relationships by means of a longitudinal design. Such a multi-period approach is also desirable in order to make strong causal inferences regarding the relationships in the behavioral framework. Moreover, the use of a longitudinal design would also enrich the possibilities of the optimization model and useful insight can be gained about the long-term effects of service quality investments.

Inclusion of customer characteristics may permit managers and researchers to obtain a more accurate picture of how customer service evaluations render into revenues. Several studies have underscored this importance of segmentation of the customer base in assessing antecedents and consequences of customer satisfaction (e.g., Garbarino & Johnson, 1999; Danaher 1998; Blattberg & Deighton 1991). In line with these studies, Zeithaml (2000) states that one of the key questions in research addressing the economic worth of customers is the investigation of what variables (demographic and psychographic) are most effective in characterizing profitable segments.

Finally, in evaluating the economic attractiveness of alternative service initiatives we only took defensive effects into consideration. According to Rust et al. (1995) the benefits of service improvements come in two forms: defensive and offensive effects. As the attraction of new clients is of vital importance to maintain a financially healthy customer base, effort also needs to be addressed at the offensive effects of investment strategies aimed at optimizing profitability.

REFERENCES

Amundson, S.D. (1998). Relationships between theory-driven empirical research in operations management and other disciplines. *Journal of Operations Management*, *16*(4), 341-359.

Anderson, E.W., Fornell, C., & Lehmann, D.R. (1994). Customer satisfaction, market share, and profitability: findings from Sweden. *Journal of Marketing*, *58*(3), 53-66.

Anderson, E.W., Fornell, C., & Rust, R.T. (1997). Customer satisfaction, productivity, and profitability: differences between goods and services. *Marketing Science*, *16*(2), 129-145.

Anderson, J.C., & Gerbing, D.W. (1998). Structural equation modeling in practice: a review and recommended two-step approach. *Psychological Bulletin*, *103*(3), 411-423.

Anderson, E.W., & Sullivan, M.W. (1993). Antecedents and consequences of customer satisfaction for firms. *Marketing Science*, *12*(2), 125-143.

Beehr, T.A. (1976). Perceived situational moderators of the relationship between subjective role ambiguity and role strain. *Journal of Applied Psychology*, *61*(1), 35-40.

Bentler, P.M., & Chou, C.P. (1987). Practical issues in structural modeling. *Sociological Research and Methods*, *16*(1), 78-117.

Blattberg, R.C., & Deighton, J. (1991). Interactive marketing: exploiting the age of addressability. *Sloan Management Review*, *33*(1), 5-14.

Blattberg, R.C., & Hoch, S.J. (1990). Database models and managerial intuition: 50% model + 50% manager. *Management Science*, *36*(8), 887-899.

Bliese, P.D. (2000). Within-group agreement, non-independence, and reliability : implications for data aggregation and analysis. In K.J. Klein & S.W.J. Kozlowski (Eds.), *Multilevel theory, research, and methods in organizations*. San Francisco, CA: Jossey-Bass, 236-249.

Bliese, P.D., & Halverson, R.R. (1998). Group size and measures of group-level properties: an examination of eta-squared and ICC values. *Journal of Management*, *24*(2), 157-172.

Bollen, K. & Lennox, R. (1991). Conventional wisdom in measurement: a structural equation perspective. *Psychological Bulletin*, *110*(2), 305-314.

Bolton, R.N. (1998). A dynamic model of the duration of the customer's relationship with a continuous service provider: the role of satisfaction. *Marketing Science*, *17*(1), 45-65.

Boshoff, C., & Allen, J. (2000). The influence of selected antecedents on frontline staff's perceptions of service recovery performance. *International Journal of Service Industry Management*, *11*(1), 63-90.

Boudreau, J., Hopp, W., McClain, J.O., & Thomas, L.J. (2003). On the interface between operations and human resource management. *Manufacturing & Service Operations Management*, *5*(3), 179-202.

Brady, M.K., Knight, G.A., Cronin Jr., J.J., G.T.M. Hult, & Keillor, B.D. (2005). Removing the contextual lens: a multinational, multi-setting comparison of service evaluation models. *Journal of Retailing*, *81*(3), 215-230.

Brady, M.K., & Robertson, C.J. (2001). Searching for a consensus on the antecedent role of service quality and satisfaction: an exploratory cross-national study. *Journal of Business Research*, *51*(1), 53-60.

Brealey, R.A., & Myers, S.C. (2000). *Principles of corporate finance*. New York, NY: McGraw-Hill College.

Bretthauer, K.M. (2004). Service management. *Decision Sciences*, *35*(3), 325-332.

Bryk, A.S., & Raudenbush, S.W. (1992). *Hierarchical linear models: applications and data analysis methods*. Newbury Park, CA: Sage.

Burke, M.J., Borucki, C.C., & Hurley, A.E. (1992). Reconceptualizing psychological climate in a retail service environment: a multiple-stakeholder perspective. *Journal of Applied Psychology*, *77*(5), 717-729.

Campion, M.A., Medsker, G.J., & Higgs, C.A. (1993). Relations between work group characteristics and effectiveness: implications for designing effective work teams. *Personnel Psychology*, *46*(4), 823-850.

Cronin, J.J., Jr., Brady, M.K., & Hult, G.T.M. (2000). Assessing the effects of quality, value, and customer satisfaction on consumer behavioral intentions in service environments. *Journal of Retailing*, *76*(2), 193-218.

Dabholkar, P.A., Shepherd, C.D., & Thorpe, D.I. (2000). A comprehensive framework of service quality: an investigation of critical concept and measurement issues. *Journal of Retailing*, *76*(2), 139-174.

Danaher, P.J. (1998). Customer heterogeneity in service management, *Journal of Service Research*, *1*(1), 129-139.

De Jong, A. & de Ruyter, K. (2004b). Adaptive versus proactive behavior in service recovery: the role of self-managing teams. *Decision Sciences*, *35*(3), 457-491.

De Jong, A., de Ruyter, K., & Lemmink, J. (2004a). Antecedents and consequences of the service climate in boundary spanning self-managing teams. *Journal of Marketing*, *68*(2), 18-35.

Diamantopoulos, A., & Winklhofer, H.M. (2001). Index construction with formative indicators: an alternative to scale development. *Journal of Marketing Research*, *38*(2), 269-277.

Fornell, C., & Wernerfelt, B. (1987). Defensive marketing strategy by customer complaint management: A theoretical analysis. *Journal of Marketing Research*, *24*(4), 337-346.

Fornell, C., & Wernerfelt, B. (1988). A model for customer complaint management. *Marketing Science*, *7*(3), 287-298.

Frey, H.C., & Patil, S.R. (2002). Identification and review of sensitivity analysis methods. *Risk Analysis: An International Journal*, 22(3), 533-578.

Garbarino, E., & Johnson, M.S. (1999). The different roles of satisfaction, trust, and commitment in customer relationships. *Journal of Marketing*, *63*(2), 70-87.

Hallowell, R. (1996). The relationships of customer satisfaction, customer loyalty, and profitability: an empirical study. *International Journal of Service Industry Management*, *7*(4), 27-42.

Harter, J.K., Schmidt, F.L., & Hayes, T.L. (2002). Business-unit-level relationships between employee satisfaction, employee engagement, and business outcomes: a meta-analysis. *Journal of Applied Psychology*, *87*(2), 268-279.

Hofmann, D.A. (1997). An overview of the logic and rationale of hierarchical linear models. *Journal of Management*, *23*(6), 723-744.

House, R.J., & Dessler, G. (1974). The path-goal theory of leadership: some post hoc and a priori tests. In. J.G. Hunt & L.T. Larson (Eds.), *Contingency approaches to leadership*, Carbondale (IL): Southern Illinois University Press, 29-55.

Hulland, J. (1999). Use of partial least squares (PLS) in strategic management research: a review of four recent studies. *Strategic Management Journal*, *20*(2), 195-204.

Iverson, R.D. (1992). Employee intent to stay : an empirical test of a revision of the Price-Mueller model. *Unpublished Doctoral Dissertation*, University of Iowa, Iowa City, IA.

James, L.R., Demaree, R.G., & Wolf, G. (1993). r_{wg} : an assessment of within-group interrater agreement. *Journal of Applied Psychology*, *78*(2), 306-309.

Jarvis, C.B., MacKenzie, S.B., & Podsakoff, P.M. (2003). A critical review of construct indicators and measurement model misspecification in marketing and consumer research, *Journal of Consumer Research*, *30*(2), 199-218.

Johnson, J.W. (1996). Linking employee perceptions of service climate to customer satisfaction. *Personnel Psychology*, *49*(4), 831-851.

Kamakura, W.A., Mittal, V., de Rosa, F., & Mazzon, J. (2002). Asesssing the service profit chain. *Marketing Science*, *21*(3), 294-317.

Kopelman, R.E., Brief, A.P., & Guzzo, R.A. (1990). The role of climate and culture in productivity. In B. Schneider (Ed.),*Organizational climate and culture*. San Francisco, CA: Jossey-Bass, 282-313.

Little, J.D.C. (1970). Models and managers: the concept of a decision calculus. *Management Science*, *16*(8), 466-485.

Loveman, G. (1998). Employee satisfaction, customer loyalty, and financial performance: an empirical examination of the service profit chain in retail banking. *Journal of Service Research*, *1*(1), 18-31.

MacKenzie, S.B., Podsakoff, P.M., & Jarvis, C.B. (2005). The problem of measurement model misspecification in behavioral and organizational research and some recommended solutions. *Journal of Applied Psychology*, *90*(4), 710-730.

Mantrala, M.K., Sinha, P., & Zoltners, A.A., (1992). Impact of resource allocation rules on marketing investment-level decisions and profitability. *Journal of Marketing Research,* *29*(2), 162-175.

Melnyk, S.A., & Handfield, R.B. (1998). May you live in interesting times….the emergence of theory-driven empirical research. *Journal of Operations Management*, *16*(4), 311-319.

Metters, R., & Marucheck, A. (2007). Service management – Academic issues and scholarly reflections from operations management researchers. *Decision Sciences, 38*(2), 195-214.

Morgan, M.G., & Henrion, M. (1990). *Uncertainty: a guide to dealing with uncertainty in quantitative risk and policy analysis*. Cambridge, NY: Cambridge University Press.

Nunnally, J.C., & Bernstein, I.H. (1994). *Psychometric theory*, New York, NY: McGraw-Hill.

Parker, C.P. (1999). A test of alternative hierarchical models of psychological climate: PC_g, satisfaction, or common method variance?. *Organizational Research Methods*, *2*(3), 257-273.

Rauyruen, P., & Miller, K.E. (2007). Relationship quality as a predictor of B2B customer loyalty. *Journal of Business Research*, *60*(1), 21-31.

Rasbash, J., Browne, W., Goldstein, H., Yang, M., Plewis, I., Healy, M., Woodhouse, G., Draper, D., Langford, I., & Lewis, T. (2000). *A user's guide to MlwiN*. Multilevel Models Project Institute of Education, University of London.

Raykou, T., & Widaman, K.F. (1995). Issues in applied structural equation modeling research. *Structural Equation Modeling*, *2*(4), 289-318.

Reichheld, F.F., & Sasser, W.E., Jr. (1990). Zero defections: quality comes to services. *Harvard Business Review*, *68*(5), 105-111.

Rogg, K.L., Schmidt, D.B., Shull, C., & Schmitt, N. (2001). Human resource practices, organizational climate, and customer satisfaction. *Journal of Management*, *27*(4), 431-449.

Rucci, A.J., Kirn, S.P., & Quinn, R.T. (1998). The employee-customer-profit chain at Sears. *Harvard Business Review*, *76*(1), 83-97.

Rust, R.T., Keiningham, T.L., Clemens, S., & Zahorik, A.J. (1999). Return on quality at Chase Manhattan Bank. *Interfaces*, *29*(2), 62-72.

Rust, R.T., Lemon, K.N., & Zeithaml, V.A. (2004). Return on marketing: using customer equity to focus marketing strategy. *Journal of Marketing*, *68*(1), 109-127.

Rust, R.T., Moorman, C., & Dickson, P.R. (2002). Getting returns on quality: revenue expansion, cost reduction, or both?. *Journal of Marketing*, *66*(4), 7-24.

Rust, R.T., & Zahorik, A.J. (1993). Customer satisfaction, customer retention, and market share. *Journal of Retailing*, *69*(2), 193-215.

Rust, R.T., Zahorik, A.J., & Keiningham, T.L. (1995). Return on quality (ROQ): making service quality financially accountable. *Journal of Marketing*, *59*(2), 58-70.

Salanova, M., Agut, S., & Peiró, J.M. (2005). Linking organizational resources and work engagement to employee performance and customer loyalty: the mediation of service climate. *Journal of Applied Psychology*, 90(6), 1217-1227.

Sawyer, J.E. (1992). Goal and process clarity: specification of multiple constructs of role ambiguity and a structural equation model of their antecedents and consequences. *Journal of Applied Psychology*, *77*(2), 130-142.

Seashore, S.E. (1954). *Group cohesion in the industrial workgroup*, Ann Arbor, MI: Institute for Social Research.

Schmit, M.J., & Allscheid, S.P. (1995). Employee attitudes and customer satisfaction: making theoretical and empirical connections. *Personnel Psychology*, *48*(3), 521-536.

Schneider, B., & Bowen, D.E. (1993). The service organization: human resources management is crucial. *Organizational Dynamics*, *21*(4), 39-52.

Schneider, B., Wheeler, J.K., & Cox, J.F. (1992). A passion for service: using content analysis to explicate service climate themes. *Journal of Applied Psychology*, *77*(5), 705-716.

Schneider, B., White, S.S., & Paul, M.C. (1998). Linking service climate and customer perceptions of service quality: test of a causal model. *Journal of Applied Psychology*, *83*(2), 150-163.

Streukens, S., & de Ruyter, K. (2004). Reconsidering nonlinearity and asymmetry in customer satisfaction and loyalty models: an empirical study in three retail service settings. *Marketing Letters*, *15*(2/3), 99-111.

Tenenhaus, M., Esposito Vinzi, V., Chatelin, Y.M., & Lauro, C. (2005). PLS path modeling, *Computational Statistics & Data Analysis*, *48*(1), 159-205.

von Winterfelt, D., & Edwards, W. (1986). *Decision analysis and behavioral research*. Cambridge, NY: Cambridge University Press.

Zeithaml, V.A. (1988). Consumer perceptions of price, quality, and value: a means-end model and synthesis of evidence. *Journal of Marketing*, *52*(3), 2-21.

Zeithaml, V.A. (2000). Service quality, profitability and the economic worth of customers: what we know and what we need to learn. *Journal of the Academy of Marketing Science*, *28*(1) 67-85.

Zeithaml, V.A., Berry, L.L., & Parasuraman, A. (1996). The behavioral consequences of service quality. *Journal of Marketing*, *60*(2), 31-46.

Zhu, Z., Sivakumar, K., & Parasuraman, A. (2004). A mathematical model of service failure and recovery strategy. *Decision Sciences*, *35*(3), 493-525.

APPENDIX A: GUIDE TO IMPLEMENTING THE DECISION-MAKING MODEL

In order to make the practical implementation of our suggested decision-making model more accessible, this Appendix provides a detailed overview of the estimation and calibration of the various components of the model.

Revenues and behavioral model

One of the main features of our model is that it incorporates employee and / or customer perceptions directly into the profitability calculation, by modeling investment revenues as a function of these evaluative judgments. The connection between revenues and the perceptions one wants to influence or more formally the input variables $i \quad (i \in I)$ is expressed by equation (A1):

$$REV = N\left(\sum_{i \in I} \delta_i (y_i - y(0)_i)\right) \tag{A1}$$

Where

y_i	=	Level of input variable i when investing amount x_i
$y(0)_i$	=	Level of input variable i before investing amount x_i or status quo level
δ_i	=	Influence of input variable i on revenues
N	=	Number of customers

The data needed to operationalize equation (A1) is usually obtained as follows. The relevant employee and / or customer data is captured by means of surveys. The mean scores of the perceptions representing the input variables, are a direct estimate of $y(0)_i$. Data on service revenues is usually present in company databases, just as an estimate of N. After linking the perceptual and financial data in a single data matrix, the entire chain of effects is estimated using a regression-based approach. Based on the regression results Parameter δ_i in equation (A1) can be determined from these regression results as follows.

Assume the set of equations displayed in Exhibit A1 connecting input variables y_1 and y_2 to revenues REV, via constructs q_1 and q_2. Parameters β_i represent the relevant unstandardized regression coefficients.

Exhibit A1: Example system of equations

$$q_1 = \alpha_1 + \beta_1 y_1 + \varepsilon_1$$

$$q_2 = \alpha_2 + \beta_2 y_1 + \beta_3 y_2 + \beta_4 q_1 + \varepsilon_2$$

$$REV = \alpha_3 + \beta_5 q_1 + \beta_6 q_2 + \varepsilon_3$$

The total impact of each input variable i on revenues REV, represented in Equation (A1) by parameter δ_i, is determined by calculating the product of the coefficients relevant to each path connecting input variable i and revenues REV and subsequently summing these products. In terms of the Exhibit A1, the total impact of one unit change in y_1 on REV (i.e., δ_1) equals $(\beta_1\beta_5) + (\beta_1\beta_4\beta_6) + (\beta_2\beta_6)$. In a similar vein, the total impact of one unit change in y_2 on REV (i.e., δ_2) equals $\beta_3\beta_6$.

Costs

The relationship between investment effort and the level of the input variables is modeled using decision calculus. Opting for Little's (1970) ADBUDG model, offers a simple and flexible tool to calibrate a variety of S-shaped or concave response functions. The general form of the ADBUDG-function describing the relationship between effort (x_i) and response y_i is defined in Equation (A2).

$$y_i = a_i + (b_i - a_i)\frac{x_i^{c_i}}{d_i + x_i^{c_i}} \qquad \text{(A2)}$$

Where:

y_i	=	Response variable, target at which effort is directed (e.g., management support)
x_i	=	Effort in \$
a_i	=	Minimum value of y_i when $x_i = 0$
b_i	=	Upper asymptote of scale assessing y_i (corresponds with $x_i \to \infty$)
c_i	=	Parameter determining shape of response function. Function is concave when $0 < c_i < 1$ and S-shaped when $c_i > 1$
d_i	=	Parameter determining shape of response function in terms of elevation and steepness

The four parameters in Equation (A2) are usually determined by interviews with the decision-makers and/or the people at whom the efforts are directed (in our application service employees). Typically, these interviews focus on the following four questions:

1) If effort x_i is reduced to 0 what will than be the evaluation regarding i (that is y_i)? This provides the value for parameter a_i. The value of a_i is typically the lowest value of the scale used to assess the perceptions regarding y_i.

2) If effort x_i approaches infinity when will than be the value of y_i? This answer provides the value for parameter b_i. The value of b_i is typically the highest value of the scale used to assess the perceptions regarding y_i.
3) Regarding i what is the current level of effort (x_i) and to what evaluation does that lead (y_i)?
4) If compared to the current situation effort x_i is doubled to what level of y_i would that lead?

The answers to questions 3 and 4 provide information regarding the shape of the ADBUDG-function. Thereby providing helpful hints on the values for c_i (S-shaped or concave function) and d_i (elevation and steepness of function), which are chosen in such a manner that the ADBUDG curve matches the qualitative data obtained in the calibration phase as closely as possible.

Profit optimization

All optimization analyses were conducted in AIMMS (Advanced Interactive Mathematical Modeling Software). For more information on this software package see www.aimms.com.

The relationships between total investment effort, profitability, and revenues as depicted in Figure 2 are obtained by solving the optimization framework for various levels of investment effort. Subsequently, we plotted the various data points in a graph. It should be noted that the AIMMS output reflects the total investment revenues, that is the revenues obtained under the status quo investment level ($\sum_{i \in I} x(0)_i$) and the revenues that are obtained by investing more than the status quo investment level. Hence, to obtain the results stemming from investments to improve the status quo level the revenues yielded when investing $\sum_{i \in I} x(0)_i$ need to be subtracted from the total revenues.

To determine the level of total investment effort that leads to a maximum level of profitability, one needs to solve the Equation (A3) in AIMMS.

$$\max_{i \in I} \quad (\delta_i y_i(x_i) - x_i)' = 0 \qquad \text{(A3)}$$

It should be noted that the AIMMS output automatically provides all the information needed to determine the return on investment rate.

Effort allocation

With regard to allocation decisions given a certain investment effort, the derivative of the profit function (see Equation (A4)) plays a crucial role.

$$\max_{i \in I}(\delta_i y_i(x_i) - x_i)' = \max_{i \in I}\left\{\frac{\delta_i(b_i - a_i)c_i d_i x_i^{c_i - 1}}{\left(d_i + x_i^{c_i}\right)^2} - 1\right\} \tag{A4}$$

Running the optimization framework for a series of effort levels as is done to obtain Figure 3 provides sufficient information to obtain a global impression on how the efforts are allocated over the various input variables. When running the optimization framework, AIMMS automatically provides the optimal allocation of the effort level stated in the budget constraint. Similar to situation described in the paragraph above, the solution contains the levels of y_i and x_i stemming from both the level of investment needed to maintain the status quo and all investments above and beyond this maintenance effort level. As such, the investment effort pertaining to the improvement initiative aimed at variable i equals $x_i - x(0)_i$. The value for $x(0)_i$ follows from Equation (A2) when solving for the known status quo level $y(0)_i$ of input variable i.

Risk

The optimal investment strategy, both in terms of investment level and effort allocation, is a function of β_i and changes in the magnitude of these coefficients have consequences for the financial results stemming from our investment efforts. In line with the notion that the variability in investment outcomes reflects the amount of risk involved, examining the robustness of the optimal solution to changes in the model's parameters provides a means to asses the level of investment risk.

The robustness of the optimal solution is determined by means of nominal range sensitivity analysis and the calculation of switch-over values. The essence of both approaches lies in altering the designated parameters in the optimization framework, re-running the optimization framework with the altered parameters and comparing the change in solution between the original model and the alternative model. To demonstrate the use of nominal range sensitivity analysis to assess the robustness of the projected optimal solution in greater detail, we take the system of equations presented in Exhibit (A1). Suppose in reality a coefficient in our behavioral model would deviate φ_1 from its empirical coefficient β_1. For this new situation the original parameter δ_1, now becomes $\delta_1' = ((\beta_1 + \varphi_1) \cdot \beta_5) + ((\beta_1 + \varphi_1) \cdot \beta_4 \cdot \beta_6) + (\beta_2 \cdot \beta_6)$. The robustness or sensitivity of the outcome to change in parameter β_1 is determined as follows:

1. Run optimization framework with value δ_i and determine the level of profitability $profit(\delta_i)$.
2. Run optimization framework with value δ_i', ceteris paribus, and determine the level of profitability $profit(\delta_i')$.

3. The level of sensitivity of the profit level to changes in parameter β_i is equal to

$$profit(\delta_i) - profit(\delta_i^{'}) \text{ or } ((profit(\delta_i) - profit(\delta_i^{'})) / profit(\delta_i)) \times 100\%$$

Alternatively, the robustness of the optimal solution can be assessed by calculating the switch-over values for each coefficient β_i. The switch-over value is the value a parameter (say β_i) may take to make the investment profitability equal to zero. In line with this definition, the switching value is obtained by setting the profitability equation equal to zero and solving it for parameter β_i, which is captured in the term δ_i.

AIMMS output file used for the optimization analysis presented in this paper.

```
DEFINITION OF PARAMETERS
SETS:
        Processes := {ROR, GEMP, MSUP, WGS, IDS, REV, PROF},

        Investments subset Processes :={ROR, GEMP, MSUP, WGS, IDS},

        Relations   subset   (Processes,Processes)   :=   {(ROR,REV),   (GEMP,REV),   (MSUP,REV),
(WGS,REV), (IDS,REV)                                                  }
;
INDICES:
        p, p1, p2 in Processes,
        i in Investments
;
PARAMETERS:
        Budget  := 37730000,
        MaintenanceValuesX(i) :=   {ROR: 7425000, GEMP: 5830000, MSUP: 5775000, WGS: 7755000,
IDS: 3245000},
        Delta(p1,p2)  :=  {(ROR,REV):  436.7442,  (GEMP,REV):  246.8554,  (MSUP,REV):  436.7442,
(WGS,REV): 189.8888, (IDS,REV): 379.7776                                                  }
;
VARIABLES:
        x(i)    -> [0,inf),
        y(p)    -> [0,9]
;
x.l(i)        := MaintenancevaluesX(i);

DEFINITION OF MODEL
CONSTRAINTS:
        BudgetRestriction ..
                SUM[(i), x(i)] <= Budget,

InvestmentRestrictionROR ..
Y('ROR') = 8*x('ROR') / ( 1 + x('ROR') ),
InvestmentRestrictionGEMP ..
Y('GEMP') = 8*x('GEMP') / ( 1 + x('GEMP') ),
InvestmentRestrictionMSUP ..
Y('MSUP') = 8*x('MSUP') / ( 1 + x('MSUP') ),
InvestmentRestrictionWGS ..
Y('WGS') = 8*x('WGS') / ( 1 + x('WGS') ),
InvestmentRestrictionIDS ..
Y('IDS') = 8*x('IDS') / ( 1 + x('IDS') ),
RestrictionREV ..
Y('REV')     =     beta('ROR','REV')*y('ROR')     +     delta('GEMP','REV')*y('GEMP')     +
delta('MSUP','REV')*y('MSUP') + delta('WGS','REV')*y('WGS') + delta('IDS','REV')*y('IDS')
;
RestrictionPROF..
Y('PROF') = y('REV')-(x('ROR') + x('GEMP') + x('MSUP') + x('WGS') + x('IDS'))

OPTIMIZATION COMMANDS
MODEL:
        ProfitModel
        MAXIMIZE:     Y('PROF')
        METHOD:         NLP
;
SOLVE ProfitModel;

OUTPUT SPECIFICATION
DISPLAY ProfitModel.objval, x.l, y.l;

OUTPUT SPECIFICATION OF PROFITLEVELS FOR VARIOUS EFFORT LEVELS
ORDERED SETS:
        Solutions := {1 .. 41}
;
INDICES:
        s in Solutions
;
PARAMETERS:
        ObjVal(s),
        Effort(s),
        Increments := 5500000
;
        Effort :=0;
        SOLVE ProfitModel;
        FOR (S|ProfitModel.modelstat = 1 OR ProfitModel.modelstat = 2 OR ProfitModel.modelstat
= 7) DO
                ObjVal(s) := ProfitModel.objval;
                Effort(s):= Effort;
                DISPLAY ObjVal, Efforts;
                DISPLAY Budgets;
                DISPLAY x.l, y.l;
                EffortTot := Effort + Increments;
                SOLVE ProfitModel;
        ENDFOR
```

Table 1: Comparing our decision making model to the existing literature

Model	Example	Strategic trade-offs of any service investment?	ROI modeled and calculated?	Can be applied to most service industries	Optimization of service investments?	Optimal allocation of service investments?	Assessment robustness of service investments?	Statistical details?
Service profit chain	Loveman (1998) Rucci et al. (1998) Kamakura et al. (2002)	No	No	Yes, adapt to context if necessary	No	No	No	Yes
Return on quality	Rust et al. (1995) Rust et al. (1999)	No	Yes	Yes	No	No	No	Yes
Return on marketing[a]	Rust et al. (2004)	Yes	Yes	Yes	No	No	No	Yes
Our decision making approach		Yes	Yes	Yes	Yes	Yes	Yes	Yes

[a] Features like explicitly modeling of competition and the modeling of brand switching at the customer level as proposed in Rust et al.'s (2004) Return on Marketing model can be easily incorporated in our model by defining the relevant variables as Markov switching matrices.

Table 2: Literature review behavioral model

Relationships	Definition predictor variable	Empirical support
Reward orientation → Service climate	Extent to which rewards are perceived to be linked to outstanding performance in customer service (Burke et al. 1992)	Schmit and Allscheid (1995) Johnson (1996)
Means emphasis → Service climate	Extent to which employees perceive their organization provides the appropriate training and information necessary for personnel to effectively perform their job (Burke et al. 1992)	Schneider et al. (1992)
Goal emphasis → Service climate	Extent to which employees perceive their immediate manager as setting clear-cut performance standards (Burke et al. 1992)	Schneider et al. (1992) Schneider et al. (1998)
Manager support → Service climate	Extent to which employees perceive their immediate manager as assisting in performing their jobs and showing concern and respect for employees (Burke et al. 1992)	Schmit and Allscheid (1995)
Work group support → Service climate	Extent to which employees perceive other employees as cooperative and friendly (Burke et al. 1992)	De Jong et al. (2004a) Campion et al. (1993)
Interdepartment service → Service climate	Extent to how well units in a firm serve each other (Schneider et al. 1998)	Schneider et al. (1998) Johnson (1996) de Jong et al. (2004a, 2004b)
Service climate → Perceived service quality	Employee perceptions of the practices and procedures, and behaviors that get rewarded, supported, and expected with regard to providing quality customer service (Schneider et al. 1998)	Schneider et al. (1998) de Jong et al. (2004a)
Perceived service quality → Customer satisfaction	Customer' appraisal of a service's overall excellence or superiority (Zeithaml 1988)	Cronin et al. (2000) Dabholkar et al. (2000) Brady et al. (2005)
Customer satisfaction → Customer loyalty	A consumer's cumulative evaluation based on all experiences with the supplier's service offering over time (Anderson et al. 1994)	Anderson and Sullivan (1993) Bolton (1998) Loveman (1998)
Perceived service quality → Customer loyalty	Customer' appraisal of a service's overall excellence or superiority (Zeithaml 1988)	Cronin et al. (2000) Brady and Robertson (2001) Rauyruen and Miller (2007)
Customer loyalty → Revenues	A consumer's intention to stay with a service provider (Zeithaml et al. 1996).	Kamakura et al. (2002) Loveman (1998), Hallowell (1996)

Table 3: Psychometric properties employee constructs

	Mean	SD	Loading	t-value
Rewards (Boshoff and Allen, 2000)				
$\lambda_1 = 2.78$; $\lambda_2 = 0.56$; $\alpha = 0.94$; ave =0.80				
1 Improvements in customer service are rewarded	5.89	0.99	0.85	34.65
2 Customer service evaluations have an impact on rewards	5.80	0.94	0.86	36.24
3 Serving customers well is rewarded	5.36	1.02	0.85	36.57
4 Dealing effectively with customer problems is rewarded	5.33	1.05	0.76	15.37
Means emphasis (Iverson, 1992)				
$\lambda_1 = 2.48$; $\lambda_2 = 0.71$; $\alpha = 0.92$; ave =0.74				
1 Difficulty getting the equipment I need to do my job	5.50	1.16	0.77	19.64
2 Difficulty getting the information I need to do my job	4.98	1.25	0.82	22.87
3 The equipment I have to perform my job is not the best (-)	4.68	1.18	0.72	16.53
4 Received sufficient training to do my job	5.17	1.26	0.83	27.29
Goal emphasis (Sawyer, 1992)				
$\lambda_1 = 2.28$; $\lambda_2 = 0.74$; $\alpha = 0.90$; ave =0.69				
1 Duties and responsibilities are clear	5.17	1.04	0.71	14.94
2 Goals and objectives for my job are clear	5.10	1.20	0.74	16.25
3 Expected results of my work are clear	4.85	1.17	0.75	17.81
4 Aspects of work that lead to positive evaluations are clear	5.32	1.03	0.79	22.21
Management support (House and Dessler, 1974)				
$\lambda_1 = 4.22$; $\lambda_2 = 0.71$; $\alpha = 0.95$; ave =0.73				
1 Direct manager is polite and friendly	4.45	1.36	0.74	18.42
2 Direct manager puts suggestions of team into operation	4.82	1.24	0.76	19.46
3 Direct manager treats all team members as his equals	5.37	1.28	0.76	19.18
4 Direct manager gives advance notice of changes	5.31	1.35	0.79	27.36
5 Direct manager looks out for personal welfare of team members	4.94	1.38	0.82	21.93
6 Direct manager is willing to make changes	5.50	1.11	0.77	16.93
7 Direct manager helps overcome problems that inhibit work	5.24	1.11	0.79	20.32
Work group support (Beehr, 1976 / Seashore, 1954)				
$\lambda_1 = 4.01$; $\lambda_2 = 0.94$; $\alpha = 0.94$; ave =0.69				
1 Really feel that I am part of my team	5.62	1.28	0.76	18.80
2 If opportunity comes to do same work in other team, I would go there	6.00	0.91	0.84	34.43
3 Will always defend members of my team against outsiders' criticism	5.57	1.18	0.84	37.80
4 Always prepared to help my colleagues on the job	5.33	1.24	0.74	11.89
5 In team people get along very well	5.51	1.16	0.85	33.05
6 In team people really stick together	5.39	1.15	0.60	10.81
7 There is a sense of trust among team members	6.33	0.67	0.60	9.19
Interdepartment service (adapted from Schneider et al. 1998)				
Formative scale λ_1 , λ_2, α and ave do not apply				
1 Being informed about new product developments	4.77	1.43	0.66	16.79
2 Being informed about new service developments	4.03	1.43	0.71	18.04
3 Information exchange with sales department regarding clients	3.59	1.58	0.72	17.86
4 Information exchange with sales department regarding products	3.59	1.49	0.77	27.70
5 Information exchange with the supplies unit	3.84	1.50	0.69	16.75
Service climate (Schneider et al., 1998)				
$\lambda_1 = 3.58$, $\lambda_2 = 0.592$; $\alpha = 0.93$; ave =0.65				
1 Job knowledge and skills in your team to deliver superior service	5.70	0.79	0.79	22.46
2 Efforts to measure and track the quality of the delivered service	5.73	0.79	0.68	13.89
3 Recognition and rewards received for delivering quality service	5.43	1.14	0.68	12.24
4 Overall quality of service provided by your team	5.03	1.00	0.81	25.22
5 Leadership supporting the delivery of superior service	4.92	1.10	0.82	24.38
6 Effectiveness of communications efforts to employees	3.27	1.50	0.50	6.49
7 Resources to delivery superior service	3.72	1.52	0.62	9.94

Table 4: Psychometric properties customer constructs

	Mean	SD	Loading	t-value
Quality (self designed scale cf. Rust et al. 1995)				
Formative scale λ_1 , λ_2, α and ave do not apply				
1 Time between call and actual visit of service employee	5.65	1.473	0.76	32.35
2 Taking customer wishes into account when planning visit	5.82	1.394	0.76	33.44
3 Information regarding arrival of service employee	5.35	1.553	0.74	34.54
4 Time taken for repair by service employee	6.15	1.285	0.86	58.32
5 Solving problem in one visit	5.99	1.288	0.79	41.90
6 Feedback on progress visit	6.63	1.266	0.84	57.47
7 Cleaning up work space at customers' site	6.68	1.236	0.86	62.40
8 Taking needs of customer into account	6.67	1.263	0.83	59.32
9 Competence of service worker	6.07	1.464	0.64	20.69
Satisfaction (Anderson et al. 1997)				
Single item scale λ_1 , λ_2, α and ave do not apply				
1 Overall, how satisfied are you with XXX services?	6.98	1.128	---	---
Behavioral intent (Zeithaml et al. 1996)				
$\lambda_1 = 1.56$; $\lambda_2 = 0.44$; $\alpha = 0.79$; ave =0.66				
1 XXX is my first choice	5.53	1.892	0.62	15.61
2 Do more business with XXX in the coming years	6.32	1.802	0.83	46.58

Table 5: Justification for aggregation

	Minimum $r_{WG(J)}$	Maximum $r_{WG(J)}$	Mean $r_{WG(J)}$	Median $r_{WG(J)}$	ICC(1)	ICC(2)	$F_{(27,141)}$	p-value
ROR	0.81	0.99	0.93	0.94	0.14	0.50	2.003	< 0.01
MEMP	0.78	0.96	0.90	0.92	0.15	0.52	2.072	< 0.01
GEMP	0.81	0.96	0.91	0.93	0.18	0.57	2.327	< 0.01
MSUP	0.87	0.99	0.94	0.94	0.43	0.82	5.486	< 0.01
WGS	0.85	0.98	0.94	0.95	0.10	0.40	1.666	< 0.05
IDS	0.78	0.96	0.88	0.89	0.27	0.69	3.265	< 0.01
SERVCLIM	0.88	0.99	0.94	0.95	0.17	0.55	2.207	< 0.01

Table 6: Empirical results behavioral model

Eq.	Link	b (unst.)	p-value	Eq.	Link	b (unst.)	p-value	Eq.	Link	b (unst.)	p-value
(6d)	ROR → SERVCLIM (I)[1]	0.23^{*}	0.001	**(7c)**	SERVCLIM → QUAL01	0.90^{*}	<0.0001	**(8b)**	QUAL → SAT	0.73^{*}	<0.0001
(6d)	MEMP → SERVCLIM (I)	-0.05^{ns}	0.488	**(7c)**	SERVCLIM → QUAL02	0.74^{*}	<0.0001	**(8c)**	QUAL → INT	0.19^{*}	0.015
(6d)	GEMP → SERVCLIM (I)	0.13^{**}	0.058	**(7c)**	SERVCLIM → QUAL03	0.76^{*}	<0.0001	**(8c)**	SAT → INT	0.51^{*}	<0.0001
(6d)	MSUP → SERVCLIM (I)	0.23^{*}	0.001	**(7c)**	SERVCLIM → QUAL04	0.57^{*}	<0.0001	**(8d)**	INT → REV_T	1092.80^{*}	<0.0001
(6d)	WGS → SERVCLIM (I)	0.10^{ns}	0.152	**(7c)**	SERVCLIM → QUAL05	0.39^{*}	0.005				
(6d)	IDS → SERVCLIM (I)	0.20^{*}	<0.0001	**(7c)**	SERVCLIM → QUAL06	0.36^{*}	0.007				
(6d)	ROR → SERVCLIM (G)[2]	0.09^{ns}	0.596	**(7c)**	SERVCLIM → QUAL07	0.40^{*}	0.002				
(6d)	MEMP → SERVCLIM (G)	-0.08^{ns}	0.544	**(7c)**	SERVCLIM → QUAL08	0.42^{*}	0.002				
(6d)	GEMP → SERVCLIM (G)	-0.03^{ns}	0.849	**(7c)**	SERVCLIM → QUAL09	0.50^{*}	0.005				
(6d)	MSUP → SERVCLIM (G)	-0.03^{ns}	0.834								
(6d)	WGS → SERVCLIM (G)	0.10^{ns}	0.573								
(6d)	IDS → SERVCLIM (G)	0.02^{ns}	0.815								
(6d)	R^2 LEVEL 1	0.586		**(7c)**	R^2 LEVEL 1			**(8b)**	R^2 ADJ	0.295	
(6d)	R^2 LEVEL 2	0.674		**(7c)**	R^2 LEVEL 2			**(8c)**	R^2 ADJ	0.229	
								(8d)	R^2 ADJ	0.640	

[1] (I) refers to antecedents at the individual level; [2] (G) refers to antecedents at the team level

Table 7: Optimal allocation of resources

Input variable	Optimal level input variable	Initial level input variable	Optimal effort level	Maintenance effort level	Optimal investment level	Proportional optimal investment level
	y_i	$y(0)_i$	x_i	$x(0)_i$	$x_i - x(0)_i$	$(x_i - x(0)_i) / \sum_{i \in I} (x_i - x(0)_i)$
$ROR(i=1)$	5.83	5.60	$ 8,360,000	$ 7,425,000	$ 935,000	12.14 %
$GEMP(i=2)$	5.12	5.12	$ 5,830,000	$ 5,830,000	$ 0	0 %
$MSUP(i=3)$	5.83	5.10	$ 8,360,000	$ 5,775,000	$ 2,585,000	33.57 %
$WGS(i=4)$	5.68	5.68	$ 7,755,000	$ 7,755,000	$ 0	0 %
$IDS(i=5)$	5.60	3.97	$ 7,425,000	$ 3,245,000	$ 4,180,000	54.29 %

Table 8: Results sensitivity analysis

Relationship	β	Switch value	Financial consequences β - 10% (Total profit ; investment profit ; change compared to opt. solution)	Financial consequences β - 5% (Total profit ; investment profit ; change compared to opt. solution)	Financial consequences β + 5% (Total profit ; investment profit ; % change in total profit)	Financial consequences β + 10% (Total profit ; investment profit ; change compared to opt. solution)
ROR → SCLIM	0.23	0.00	$38,814,041 ; $2,561,182 ; -5.15%	$39,867,773 ; $2,611,332 ; -2,58%	$42,041,240 ; $2,771,627 ; +2.73%	$43,095,977 ; $2,822,726 ; +5.31%
GEMP → SCLIM	0.13	0.00	$39,905,324 ; $2,661,481 ; -2.49 %	$40,413,415 ; $2,661,481 ; -1.24%	$41,495,025 ; $2,720,898 ; +1.40%	$42,003,547 ; $2,721,268 ; +2.64%
MSUP → SCLIM	0.23	0.05	$38,814,041 ; $2,343,603 ; -5.15%	$39,867,773 ; $2,502,542 ; -2.58%	$42,041,240 ; $2,880,379 ; +2.73%	$43,095,977 ; $2,822,726 ; +5,31.%
WGS → SCLIM	0.10	0.00	$40,032,826 ; $2,661,481 ; -2,17%	$40,477,166 ; $2,661,481 ; -1.09%	$41,430,842 ; $2,720,528 ; +1.24%	$41,875,182 ; $2,720,528 ; +2.33%
IDS → SCLIM	0.20	0.12	$39,176,145 ; $2,043,511 ; -4 .27%	$40,048,825 ; $2,352,496 ; -2.13%	$41,859,991 ; $3,030,236 ; +2.29%	$42,773,479 ; $3,339,945 ; +4.43%
SCLIM → Q01	0.90	0.00	$40,235,679 ; $2,571,131 ; -1.68%	$40,235,679 ; $2,571,131 ; -1.68%	$41,672,896 ; $2,811,393 ; +1.83%	$41,672,896 ; $2,811,393 ; +1.83%
SCLIM → Q02	0.74	0.00	$39,793,701 ; $2,512,905 ; -2.76%	$40,357,604 ; $2,587,193 ; -1.38%	$41,550,871 ; $2,795,239 ; +1.54%	$42,115,239 ; $2,869,950 ; +2.91%
SCLIM → Q03	0.76	0.00	$40,068,032 ; $2,549,045 ; -2.09%	$40,357,604 ; $2,587,193 ; -1.38%	$41,550,871 ; $2,795,239 ; +1.54%	$42,450,809 ; $2,914,373 ; +3.73%
SCLIM → Q04	0.57	0.00	$39,938,487 ; $2,531,979 ; -2.40%	$40,429,996 ; $2,596,730 ; -1.20%	$41,478,418 ; $2,785,648 ; +1.36%	$41,970,333 ; $2,850,768 ; +2.56%
SCLIM → Q05	0.39	0.00	$40,303,660 ; $2,580,087 ; -1.51%	$40,612,583 ; $2,620,784 ; -0.76%	$41,295,681 ; $2,761,457 ; +0.91%	$41,604,859 ; $2,802,386 ; +1.67%
SCLIM → Q06	0.36	0.00	$40,315,090 ; $2,518,593 ; -1.48%	$40,618,298 ; $2,621,537 ; -0.74%	$41,289,961 ; $2,760,700 ; +0.90%	$41,593,419 ; $2,800,871 ; +1.64%
SCLIM → Q07	0.40	0.00	$40,231,668 ; $2,570,603 ; -1.69%	$40,576,587 ; $2,616,042 ; -0.85%	$41,331,706 ; $2,766,226 ; +1.00%	$41,676,910 ; $2,811,924 ; +1.84%
SCLIM → Q08	0.42	0.00	$40,222,443 ; $2,569,388 ; -1.71%	$40,571,975 ; $2,615,434 ; -0.86%	$41,336,322 ; $2,766,837; +1.01%	$41,686,142 ; $2,813,146 ; +1.87%
SCLIM → Q09	0.50	0.00	$40,279,796 ; $2,576,943 ; -1,57%	$40,600,651 ; $2,619,212 ; -0.79%	$41,307,622 ; $2,763,038 ; +0.94%	$41,628,742 ; $2,805,548 ; +1.73%
Q01→ QUAL	0.76	0.00	$39,549,852 ; $2,480,781 ; -3.35%	$40,235,679 ; $2,571,131 ; -1.68%	$41,672,896 ; $2,811,393 ; +1.83%	$42,359,290 ; $2,902,258 ; +3.51%
Q02→ QUAL	0.76	0.00	$39,793,701 ; $2,512,905 ; -2.76%	$40,357,604 ; $2,587,193 ; -1.38%	$41,550,871 ; $2,795,239 ; +1.54%	$42,115,239 ; $2,869,950 ; +2.91%
Q03→ QUAL	0.74	0.00	$39,793,701 ; $2,512,905 ; -2,76.%	$40,357,604 ; $2,587,193 ; -1.38%	$41,550,871 ; $2,795,239 ; +1.54%	$42,115,239 ; $2,869,950 ; +2.91%
Q04→ QUAL	0.86	0.00	$39,938,487 ; $2,531,979 ; -2.40%	$40,429,996 ; $2,596,730 ; -1.20%	$41,478,418 ; $2,785,648 ; +1.36%	$41,970,333 ; $2,850,768 ; +2.56%
Q05→ QUAL	0.79	0.00	$40,303,660 ; $2,580,087 ; -1.51%	$40,612,583 ; $2,620,784 ; -0.76%	$41,295,681 ; $2,761,457 ; +0.91%	$41,604,859 ; $2,802,386 ; +0.87%
Q06→ QUAL	0.84	0.00	$40,315,090 ; $2,581,593 ; -1.48%	$40,618,298 ; $2,621,537 ; -0.74%	$41,289,961 ; $2,760,700 ; +0.90%	$41,593,419 ; $2,800,871 ; +1.64%
Q07→ QUAL	0.86	0.00	$40,231,668 ; $2,570,603 ; -1.69%	$40,576,587 ; $2,616,042 ; -0.85%	$41,331,706 ; $2,766,226 ; +1.00%	$41,676,910 ; $2,811,924 ; +1.84%
Q08→ QUAL	0.83	0.00	$40,222,443 ; $2,569,388 ; -1.71%	$40,571,975 ; $2,615,434 ; -0.86%	$41,336,322 ; $2,766,837 ; +1.01%	$41,686,142; $2,813,146 ; +1.87%
Q09→ QUAL	0.64	0.00	$40,279,796 ; $2,567,943 ; -1.57%	$40,600,651 ; $2,619,212 ; -0.79%	$41,307,622 ; $2,763,038 ; +0.94%	$41,628,742 ; $2,805,548 ; +1.73%
QUAL → SAT	0.73	0.55	$33,056,355 ; $1,625,333 ; -19.22%	$36,988,930 ; $2,143,407 ; -9.61%	$44,922,328 ; $3,241,554 ; +9.77%	$48,858,153 ; $3,762,580 ; +19.39%
QUAL → INT	0.19	0.00	$39,665,725 ; $2,496,046 ; -3.07%	$40,293,615 ; $2,578,764 ; -1.54%	$41,614,912 ; $2,803,717 ; +1.69%	$42,243,321 ; $2,886,096; +3.23%
SAT → INT	0.51	0.19	$33,056,355 ; $1,625,333 ; -19.22%	$36,988,930 ; $2,143,407 ; -9.61%	$44,922,328 ; $3,241,554 ; +9.77%	$48,858,153 ; $3,762,580 ; +19.39%
INT → REV	1092.80	812.50	$33,056,355 ; $1,625,333 ; -19.22%	$36,988,930 ; $2,143,407 ; -9.61%	$44,922,328 ; $3,241,554 ; +9.77%	$48,858,153 ; $3,762,580 ; +19.39%

Figure 1a: Macro-level graphical overview decision-making approach

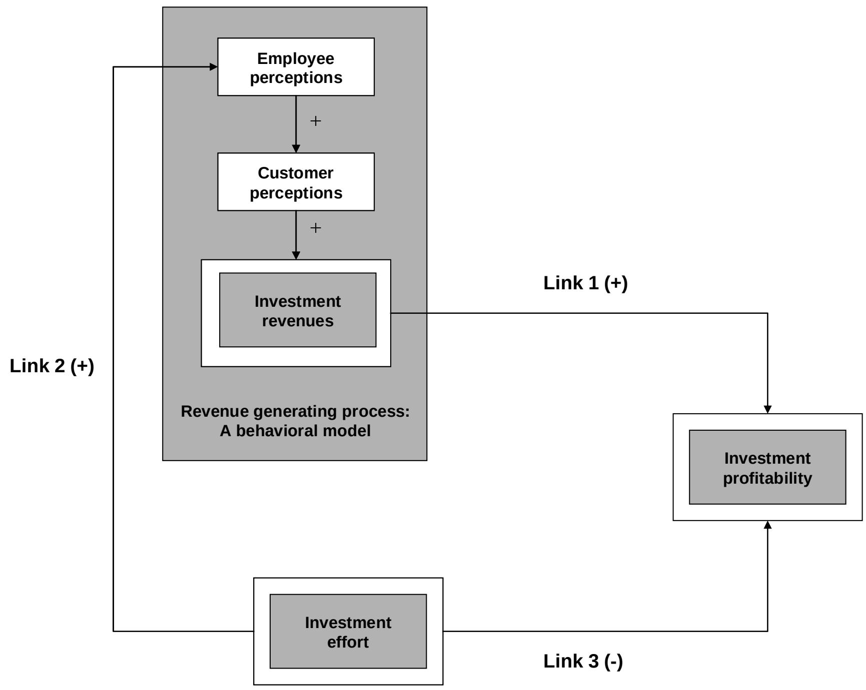

Figure 1b: Micro-level graphical overview decision-making approach

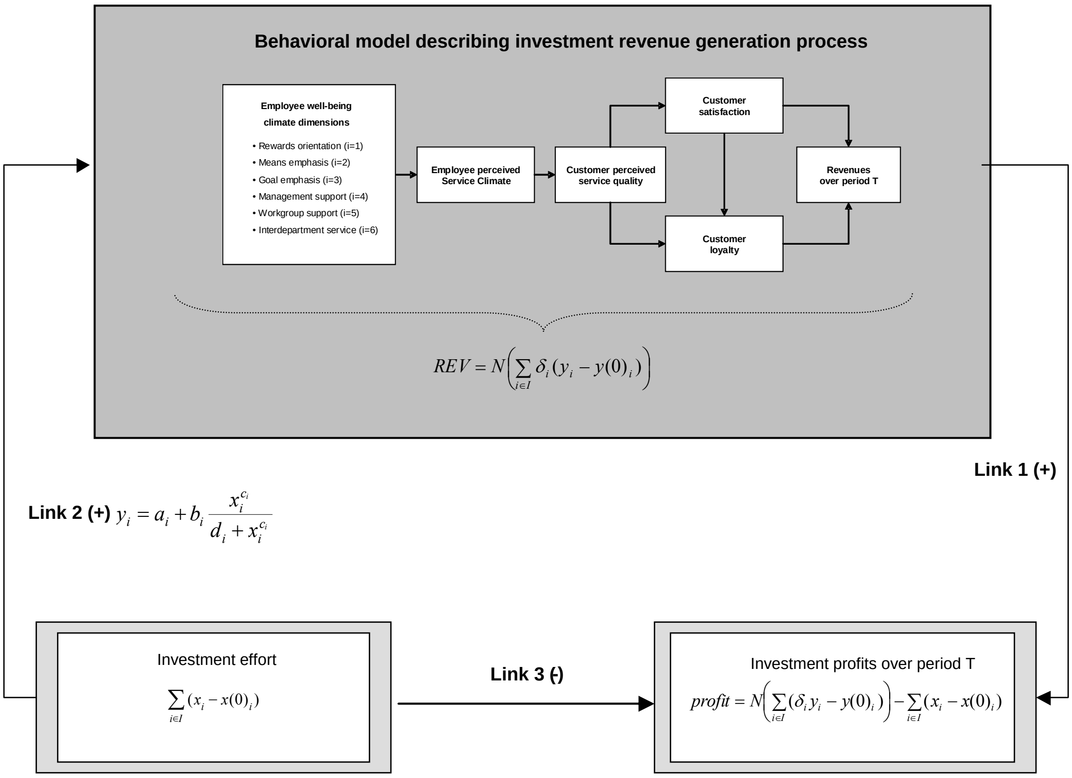

Figure 2: Investment effort, profitability, and revenues

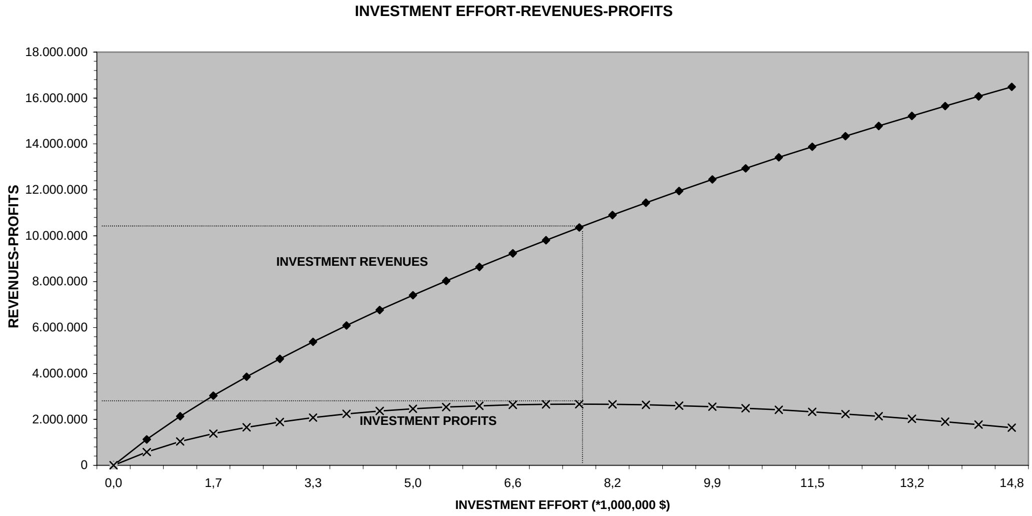

Figure 3: Allocation of investment effort