6

Measuring the Return of Quality Investments on Mobile Telecommunications Network

Manuel J. Vilares[1,2] and Pedro S. Coelho[1,3]
[1]*ISEGI, Universidade Nova de Lisboa*
[2]*Banco de Portugal*
[3]*Faculty of Economics, Ljubljana University*
[1,2]*Portugal*
[3]*Slovenia*

1. Introduction

Until recently, methodologies that identified the extent to which various improvements in quality caused financial returns were unavailable (Aaker & Jacobson, 1994; Zeithaml, 2000). Therefore, the benefits of the investment in improving the quality of mobile telecommunications networks have been questioned by many operators. Others have accepted investments in quality as unquestioned generators of returns, with the result that some firms have run into financial difficulties after having incurred heavy investments in quality (Rust, Zahorik & Keiningham, 1995). For instance, some firms faced serious difficulties after winning the Malcom Baldrige National Quality Award in 1990. Also, several surveys conducted during the 90's have indicated a failure of quality implementation approaches (such as Total Quality Management) to increase the economic returns of firms (Ittner & Larcker, 1996; Keiningham, Zahorik &Rust, 1994). In addition, it has been difficult or impossible to choose objectively between different types or levels of quality investment. These negative experiences, plus concerns over cost reductions in many telecommunications operators, caused a real interest in the benefits of quality investments. The identification of perceived quality as a driver of customer satisfaction and loyalty is a well researched field, but firms began to feel the need for methodologies to connect quality investments to the bottom line. In fact, for many quality investments there must be a point above which further investment is unprofitable.

Rust et al. (1995), following the previous work of Rust & Zahorik (1993) presented a very promising approach to this problem named ROQ (Return on Quality). The authors consider a causal chain between quality improvement and profitability, through customer retention and cost reduction in a duopoly context. Danaher & Rust (1996) empirically show that service quality impacts customer attraction and customer usage rates. Bolton & Drew (1991) found a relationship between service change and customer attitudes in the fixed phone industry. Aaker & Jacobson (1994), Anderson, Fornell & Lehmann (1994), Anderson, Fornell & Rust (1997) and Ittner & Larcker (1996, 1998) found significant associations between customer satisfaction (or other related variables) and financial performance data such as Return on Investment (ROI) and accounting returns. Zeithaml (2000) presents a survey of the research for evaluating quality investments. A similar approach is adopted by Rust et al. (2004) in a later survey concerning the measuring of the return of the investments in marketing. Also, Allen & Wilburn (2002) present the state of the art regarding the linkage between customer and employee satisfaction and the financial performance of the firms. More recently Anderson, Fornell & Mazvancheryl (2004) propose the first extensive theoretical and empirical examination of the association between customer satisfaction and shareholder value. Rust, Lemon & Zeithaml (2004) outline a broad approach to estimate return on marketing, focusing on customer equity that enlarges the return on quality approach to different marketing dimensions and Coelho & Vilares (2010) propose an extension of Return on Quality approach to a realistic competitive context applied to the mobile telecommunications industry. In fact, among these works, only Bolton & Drew and Coelho & Vilares work has been developed or applied in the framework of telecommunications (fixed phone and mobile phone industries, respectively).

Notwithstanding the appearance of some literature in recent years, the number of applications of this approach is not only very limited, but some have also adopted unrealistic simplifications that very significantly reduce their operational value. Many of them link quality investments (or quality perceived by customers) to customer's attitudes (and sometimes behavioural intentions), but do not establish a complete connection between the investments and their financial returns. Others find significant associations between customer satisfaction and financial performance, but do not identify the role and importance of the mediating variables. An exception to this is the Kamakura et al. (2002) paper which presents an application encapsulating both the Service-Profit Chain (SPC) framework (Heskett et al., 1994) and the Data-Envelopment Analysis (DEA) framework (Charnes et al., 1994). The authors offer an integrated framework to understand how firms' operational investments are related to customer's perceptions and behaviours and translated into profits.

Building on previous work on the Return on Quality (ROQ) from Coelho & Vilares (2010), Rust et al. (1995), Rust & Zahorik (1993), the present work aims to develop an integrated methodology for estimating the return on quality investments with application in mobile telecommunications industry. More precisely, the aim of this work is to propose a methodology that will enable the identification of profitable quality investments. This includes identifying the profitability of different levels of investments and prioritizing alternative investments, taking into account their return or profitability. The approach uses a chain of causality that assumes that quality investments in the mobile network potentially affect technical quality indicators. This in turn affects customer perceptions and customer satisfaction, thus influencing customer behaviours generators of financial returns to the operator. This methodology will also provide a cost-benefit analysis of the investments on network quality, allowing to estimate several effects in the value chain: 1) the relationship between the quality investments and the improvement of customer perceptions of network quality; 2) the relationship between improvement in the customer perceived quality and improvements in customer satisfaction and loyalty; 3) the relationship between improvement of customer satisfaction and loyalty and improvement of the financial results of the firm. We assume that this relationship is mediated by customer behaviours.

In contrast to the previous work of the same authors where the focus was on the relationship between customer satisfaction and customer behaviours potentially generator of financial returns, this work will focus on the whole causal chain ranging from quality investments, technical network quality indicators and customer perceptions to operator's results originated by changed customer behaviours. We can also be distinguished from some previous approaches to this problem whose aim is to link customer's perceptions and behavioural intentions to profitably. In our approach we explicitly model additional revenues and expenditures generated by quality investments and obtain Return on Investment (ROI) as a result of the predicted future cash-flow.

The remainder of this chapter is divided into three sections. The next section of this chapter describes the methodological approach and identifies the channels through which investments on network quality may improve the financial results of the firm. This section also presents some comments about modelling and data challenges. The third section presents an application of this approach to the mobile telecommunications industry. The final section discusses the main conclusions.

2. Methodological approach

2.1 Structure of the approach

Our modelling chain is shown in Figure 1. First it is assumed that investments in quality improve technical quality of the network. We implicitly assume that technical quality indicators that adequately express the relevant results of quality improvements are available.

The second step represents the relationship between technical quality and perceived quality. An improvement in a technical quality indicator should be at least partially perceived by the customers, resulting in an improvement in perceived quality (Bolton & Drew, 1991; Simester et al., 2000). This perception in turn positively affects customer satisfaction and loyalty. In fact, the existence of a relationship between perceived quality and customer satisfaction is well known and researched (Anderson et al. 1994; Keiningham et al., 1994; Fornell et al., 1996). Note that contrarily to previous proposals (eg. Burton et al., 2003) who assume that this technical quality or actual performance may be a significant direct predictor of customer satisfaction, we propose to consider this effect of technical quality on customer satisfaction as indirect, i.e. mediated by perceived quality.

Next, we consider that perceived quality and customer satisfaction will have a potential positive impact on customer loyalty. The existence of a relationship between customer satisfaction and loyalty is generally accepted and is extensively supported both by theory and empirical results (Anderson et al., 1994; Oliver, 1997a, Oliver, 1997b; Fornell, 1992; Fornell et al. 1996; Hallowell, 1996; Strauss & Neuhaus, 1997).

Furthermore, this improvement in customer satisfaction and loyalty has effects on the financial results of the firm through customer behaviours. In this context we have considered three main channels of customer behaviour: 1) **revenue per customer**. As a result of improved perceived quality and customer satisfaction, it is expected that customers will increase their consumption of the operator services (e.g. usage of the network) and increase the likelihood of buying new products and services from the same operator (Bolton, 1998, Reichheld & Sasser, 1990; Reichheld, 1996; Anderson et al., 1994, Danaher & Rust, 1996; Ittner & Larcker, 1998). In addition, the improvement in satisfaction may render customers more willing to pay higher prices (Zeithaml, Berry & Parasuraman, 1996). Both behaviours contribute to an increase in the average revenue per customer. In our model a possible direct effect from technical quality on customer behaviours and particularly on customer revenue is also considered. In fact, a failure resulting from a low product or service quality (eg. lack of network coverage, call drop) may render the consumption of the product or service impossible during the failure period (impossibility to use the operator network, to maintain a call, etc), and therefore reduce the customer revenue; 2) **customer retention**. The improvement of customer satisfaction and loyalty resulting from the increase in perceived quality is expected to generate a higher probability of staying with the operator, and thus higher customer retention (Reichheld & Sasser, 1990; Rust & Zahorik, 1993; Anderson et al. 1994, Bolton, 1998, Ittner & Larcker, 1998). Customer retention improves market share and may also influence the revenue per customer, which in both cases has a positive impact on the revenues and profits of the firm (Rust & Zahorik, 1993; Rust et al., 1995; Reichheld, 1996); 3) **acquisition of new customers**. More satisfied and loyal customers will recommend the company, potentially increasing the acquisition of new customers (Anderson et al., 1994, Anderson, 1998, Danaher & Rust, 1996). Also, a higher quality of products and services can be advertised, constituting another mechanism through which customer attraction can be obtained. According to Kordupleski, Rust and Zahorik (1993), advertising not accompanied by an effective increase in quality is unlikely to increase market share. Finally, increases in the number of customers through customer acquisition will generally cause an improvement in the returns of the firm.

Finally, additional revenues resulting from the quality investment should be compared to the expenditures in quality improvement in order to obtain the profitability of the investment.

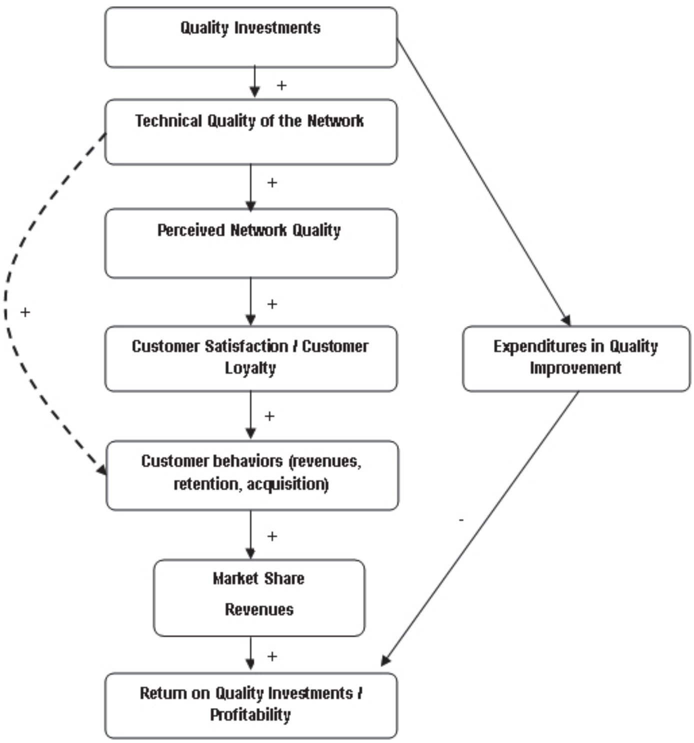


Fig. 1. Modelling chain

In this context, the development of an approach of return on quality from an operational point of view requires an explanation of the relationships between the variables adopted to represent the different stages that mediate between the investment on the quality and the financial performance of the firms.

2.2 Evaluation of the return on network quality investments

In this section, we formalize the relationships implicit to the chain represented in Figure 1, resulting in the calculation of the return on network quality investments.
Assuming that a network quality investment can be expressed through a set of technical quality indicators, *TQ*, then

$$PQ = f_1(TQ) + \varepsilon_1 \tag{1}$$

where *PQ* represents perceived quality and ε a stochastic error term.
The effect of perceived quality on customer satisfaction and loyalty may be modelled as

$$\begin{aligned} S &= f_2(PQ, DS) + \varepsilon_2 \\ L &= f_3(PQ, S, DL) + \varepsilon_3 \end{aligned} \tag{2}$$

where *S* and *L* represent customer satisfaction and loyalty, respectively. *DS* and *DL* represent the other drivers of customer satisfaction and loyalty that are included in the modelling process. These include factors such as company image, customer expectations and perceived price.
Let:
$a_{jt}^{(1)}$: Acquisition rate of firm *j* for competition churners in period *t* (i.e. the probability that a customer leaving one of the competitors moves to firm *j*);
$a_{jt}^{(2)}$: Acquisition rate of firm *j* near new customers in period *t* (i.e., the probability of a new entrant to choose firm *j*);
r_{jt}: Retention rate of firm *j* in period *t* (i.e., the proportion of firm *j* customers that remained in the company)
1- r_{jt} : Proportion of the customers of firm *j* that switched to competition or left the service in period *t*;
v_{jt}: Average revenue per customer of firm *j* in period *t*;
The retention and acquisition rates and the revenue per customer can now be expressed as (for simplicity of notation the indexes representing the firm are omitted):

$$\begin{aligned} r_t &= f_4(S_{t-1}, L_{t-1}, M_{t-1}) + \varepsilon_4 \\ a_t^{(i)} &= f_5(S_{t-1}, L_{t-1}, M_{t-1}) + \varepsilon_5 \\ v_t &= f_6(S_{t-1}, L_{t-1}, M_{t-1}, TQ_t) + \varepsilon_6 \end{aligned} \tag{3}$$

where *M* represents other determinants potentially influencing the levels of customer retention, acquisition and revenue per customer as market characteristics (e.g. market shares) or characteristics of the customer (e.g. socio-demographics, customer profile)[1]. As

[1] By including the lagged market share as an explanatory variable, the number of retained customers in each period plays an accelerating effect. An increase in the retention or acquisition rates will potentially increase the market share that in turn will influence retention and acquisition rates in the next period.

explained previously in equation (3) we also consider a possible direct path from technical quality to revenue per customer.
Let also:
MS_{jt}: Market share of firm *j* in period *t*;
N_t: Market size in period *t* (total number of customers of all competing firms);
N_{jt} : Total number of customers of firm j in period t ($N_{jt} = MS_{jt}.N_t$)
n_t: Market growth rate (measured by the number of customers) in period *t*;
d_t: Discount rate in period *t*;
If we assume that customers switch between operators at most once during a period, then the number of customers of any firm *j* in period *t* comes from three sources.

1. Number of retained customers, i.e. customers that remain as customers from the previous period. The number of retained customers obviously depends on the customer retention rate of firm *j*. If we call the number of retained customers *N1*, we will have:

$$N1_{jt} = r_{jt}\ N_{jt-1} \tag{4}$$

2. Number of customers switching from competitors to firm *j*. This contribution, represented by *N2*, depends on the attraction rate of firm *j* and the retention rate of the competitors:

$$N2_{jt} = a_{jt}^{(1)} \sum_{i \neq j} N_{it-1}(1 - r_{it}) \tag{5}$$

3. Number of new customers entering the market and attracted by firm *j*. This contribution depends on the growth of the market in each period and on the attraction rate of new customers for firm *j*:

$$N3_{jt} = a_{jt}^{(2)}\ n_t\ N_{t-1} \tag{6}$$

If we combine the three sources, then the number of customers of firm *j* in period *t* is:

$$\begin{aligned} N_{jt} &= r_{jt}N_{jt-1} + a_{jt}^{(1)} \sum_{i \neq j} N_{it-1}(1 - r_{it}) + a_{jt}^{(2)} n_t N_{t-1} \\ &= \left[r_{jt}MS_{jt-1} + a_{jt}^{(1)} \sum_{i \neq j} MS_{it-1}(1 - r_{it}) + a_{jt}^{(2)} n_t \right] N_{t-1} \quad = r_{jt}\ N_{jt-1} \end{aligned} \tag{7}$$

and the market share of firm *j* at moment *t* is given by:

$$MS_{jt} = \left[r_{jt}MS_{jt-1} + a_{jt}^{(1)} \sum_{i \neq j} MS_{it-1}(1 - r_{it}) + a_{jt}^{(2)} n_t \right] \Big/ (1 + n_t) \tag{8}$$

Assuming that the investments in network quality influence the rates r_{jt} , $a_{jt}^{(1)}$, $a_{jt}^{(2)}$, as well as the average revenue per customer v_{jt} , and let us also suppose that the discount rate is equal to *d* during *p* periods. Then, the net present value of the incremental returns generated by an investment in quality, *NPVR*, is given by:

$$NPVR = \sum_{k=1}^{p} (1+d)^{-k} \left(v_{jt+k} \Delta N_{jt+k} + \Delta v_{jt+k} N_{jt+k} + \Delta v_{jt+k} \Delta N_{jt+k} \right), \tag{9}$$

with the change on the number of customers given by:

$$\Delta N_{jt} = [\Delta r_{jt} \ MS_{jt-1} + \Delta c_{jt}^{(1)} \sum_{i \neq j} MS_{it-1}(1 - r_{it}) + \Delta c_{jt}^{(2)} \ n_t] \ N_{t-1} \tag{10}$$

where the symbol Δ represents the change of the associated variable following an investment in quality by firm *j*.

In order to obtain the return on a quality investment, let us assume an initial investment of I_0, a level of ongoing expenditure I_1, and a level of expenditure after the investment I (including the cost of maintenance of the new investment), net of any eventual reductions on costs that can be interpreted as negative expenditures.

The present value of the additional expenditure during *p* periods, *NPVAE* is given by:

$$NPVAE = I_0 + (I - I_1) \sum_{k=1}^{p} (1+d)^{-k} \tag{11}$$

So, the return on the investment on quality is given by:

$$ROQ = NPVR / NPVAE \tag{12}$$

The value of *NPVR* for firm *j* depends on: the market share MS_j in each time period for firm *j*, the size of the market , i.e. the number of customers in each period N_t, the market growth rates n_t, the average revenue per customer v_j, the retention and acquisition rates r_{jt}, $a_{jt}^{(1)}$, $a_{jt}^{(2)}$, the discount rate d (assumed to be constant over periods), and the number of periods, p.

Among the whole set of variables that influence the return on quality investments, the average revenue per customer and the customer retention and attraction rates are those variables that firms can influence through quality investments. These variables are at least partially influenced by customer satisfaction and loyalty. In turn, these attitudes are influenced by customer perceptions of the quality of products and services delivered by the firm, which in turn are influenced by the investments in quality.

2.3 Modelling and data challenges

Note that data used in the proposed modelling chain typically result from different sources. Data referring to quality investments and technical quality indicators usually come from technical or quality departments within the operator. Usually it is organized with an aggregation level that doesn't enable the linkage towards individual customers. In fact, it is usually impossible to know the level of network quality (eg. network coverage, quality of the communication, existence of call drops) experienced by each individual customer.

Data relative to customer perceptions and attitudes would be typically obtained from a satisfaction survey. In this framework is extremely important to organize the questionnaire around quality dimensions that can comprehend quality investments. Each quality dimension should be implemented using a set of perceived quality manifests that can be directly associated to technical quality indicators.

Data relative to customer effective behaviours (customer retention, customer acquisition and revenue) may be obtained from marketing files, accounting files or other company sources. It can also be complemented through a longitudinal satisfaction survey where each customer is observed in more than one wave. This allows the collection of customer perceptions and attitudes as well as actual and reported behaviours in the same survey. Also, market sizes and market shares can, in some situations, be obtained from published data regarding the mobile telecommunications industries. In several countries this information is published by telecommunications regulators. In other situations it has to be obtained through customer satisfaction surveys or other specific surveys, including customers not only from the focal operator, but from all relevant operators in the market.

Among the relationships shown in Figure 1, the most difficult to model are the ones that link data of a different type or from a different sources, i.e. the linkage between technical quality and perceived quality (equation 1) and the linkage between customer perceptions and attitudes and effective behaviours (equation 3). These difficulties arise from the fact that these sources frequently use different aggregation levels.

Due to these difficulties, most of the studies published so far have only just used behaviour intentions as a proxy for the effective behaviours. Our experience confirms the results of other authors (see, for instance, Johnson & Gustafsson, 2000, p.7) that state this can generate totally unrealistic results, since repurchase or recommendation intentions are in many situations very far from the true observed behaviours.

3. Application to the mobile telecommunications industry

3.1 Introduction

The following application uses the mobile telecommunications industry in an EU state, which is composed of three operators. The main goal of the application is to evaluate the return of investments in the quality of the telecommunications network. The potential quality investments carried out on the focal firm's network regard the installation of new cell towers and aim to improve three technical quality indicators: the *call drop rate*; the *congestion rate*; and the *coverage rate*. These indicators are those that are most widely used to measure technical quality in mobile telecom and for which there is available data. They are defined as

Call drop rate = number of dropped calls (due to loss of radio frequency or handover failure) / total number of initiated calls

Congestion rate = number of failures in channel attribution / number of attempts of channel attribution

Coverage rate = coverage area / total area

The steps in the process of converting quality investments into financial outcomes are the same as were defined previously. In our application the relationships between technical quality and perceived quality were established using linear regression linking levels of technical quality experienced by customers and their perception regarding the quality of the network measured in a satisfaction survey. The relationships linking perceived quality to customer satisfaction and loyalty were established using structural equation modelling (SEM). Sequentially the modelling of customer retention, acquisition and revenues were based in logistic and linear regression. Finally, the changes in market share and the effects on the financial results following investments in the improvement of the quality of the network will be estimated in the framework of a simulation. In what follows we briefly address each one of these steps.

3.2 Perceived network quality

Data referring to perceived network quality were obtained through the administration of a perceived quality and customer satisfaction survey comprising users of the three mobile phone operators in the market. There were three waves of the survey administered every six months during a period of one and a half years (July 2001, January 2002 and July 2002). The survey is based on a probability sample drawn through random digit dialing of mobile phone numbers from the three operators. The sample size was 1448.

The questionnaire used in the survey queries the overall experience of the respondent with the operator. It includes questions regarding a set of multidimensional constructs: image, expectations, several dimensions of perceived quality (including perceived network quality), customer satisfaction and customer loyalty. To measure perceived network quality we used 4 manifests: perceived network coverage, perceived network availability, perceived network uniformity and perceived communication quality. The first three manifests are the perceptive contra parts of the quality indicators influenced by the planned investments (call drop rate, the congestion rate and the coverage rate). Manifests are measured in an 11 point interval scale (0 to 10) ranging from very negative appreciation to very positive.

Several explanatory models were tested to explain the three target variables (perceived network coverage, perceived network availability, perceived network uniformity), having as potential explanatory variables the three technical indicators (call drop rate, the congestion rate and the coverage rate). As the level of technical indicators experienced by individual customers was not available, we tested the regression models at different regional aggregation levels (municipalities, NUTSIII and NUTSII). Also different time lags were tested in order to account possible lags between changes in the level of network quality and customer perceptions. It was not possible in any case to find relationships with statistical significance between these two sets of variables. This result was not surprising as the estimates for customer perceptions are only representative at NUTSII level. The aggregation of technical indicators at this high regional level hides disparities within each region, making it impossible to relate individual customer perceptions with the actual level of network quality experienced by each customer. The overcome this limitation we have included a new set of questions in customer satisfaction questionnaires querying the customer about his/her perception regarding the experienced level of technical indicators (using the questionnaire applied in the third available wave of the survey). This made it possible to model data at individual level. To measure the experienced level of call drop rate each customer was asked to state the approximate proportion of times that s/he has experienced a call drop during conversation within a 6 month period. To obtain a proxy of congestion rate the customer was asked about the proportion of times that s/he was not able to initiate a call due to network unavailability. Finally, experienced coverage rate was approximated asking the proportion of places where s/he was not able to initiate a call due to lack of coverage within the same time frame.

Three regression models were adjusted (one for each indicator). Using F tests for the significance of the three regressions, the null hypothesis that all model coefficients are zero was always rejected ($p<.001$), showing the relevance of the three models. The effects of perceived call drop rate, congestion rate and coverage rate on perceived network coverage, perceived network availability, perceived network uniformity are presented in Figure 2 and were always found significant using *t* tests ($p<.001$). For each percentage point of reduction in the call drop rate perceived network uniformity will grow .25 points (in the 11 point scale), for each percentage point drop in the congestion rate perceived network availability will grow .26 points and for each percentage point of increase in coverage rate the perceived network coverage grows .19 points.

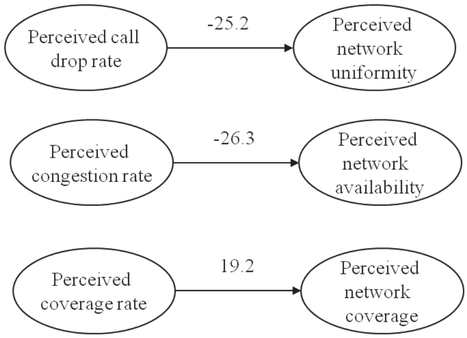


Fig. 2. Modelling of network perceived quality

3.3 Customer satisfaction and loyalty

Customer satisfaction and loyalty are modelled using data from the customer satisfaction survey also used to model perceived network quality. Structural equation modelling (SEM) was used to model customer satisfaction and loyalty. Construct indexes were produced in a 0 to 100 scale. The model is constituted by 12 multi-item constructs and is summarized in Figure 3. The model was estimated using partial least squares (PLS) and the parameters significance was accessed using bootstrapping with 1000 replicates. Final results shown good explanatory power both for customer satisfaction (R^2=0.72) and loyalty (R^2=0.64). The

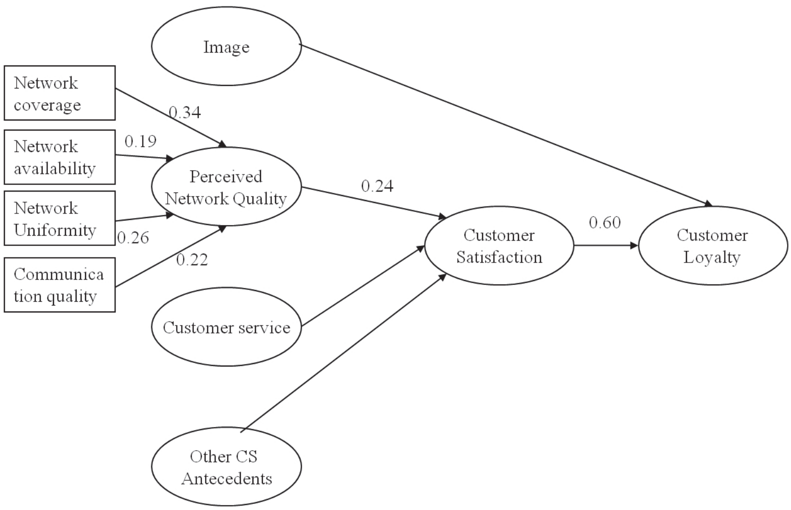


Fig. 3. Customer satisfaction model

perceived network quality construct had significant impact of 0.24 (p<.001) on customer satisfaction. The impact of this construct on customer loyalty is indirect (mediated by customer satisfaction) and equal to 0.14. The weights of perceived network quality manifests are all significant (p<.001) and the respective estimates are shown in Figure 3.

3.4 Customer retention

Customer retention is modelled using panel data from the same customer satisfaction survey used to estimate the relationship between perceived network quality and customer loyalty.

The determinants of customer retention that have been examined as potentially relevant were the variables intervening in the customer satisfaction/loyalty models with particular emphasis on customer satisfaction and loyalty indexes. We also considered other possible explanatory variables related to the customer profile (such as type of contract, time as a customer, etc), socio-demographic variables, as well as the market share of each operator. In fact, empirical evidence from previous studies performed by the authors showed that a key variable in the process of leaving or choosing a future operator is whether or not an operator is used by the persons we regularly contact (due to the pricing policies for calls within and between networks). A way of including this effect is through the market shares that reflects the different sizes of the customer bases of the mobile phone operators and that appears as an explanation of customer retention.

A weighted logistic regression was used to model the retention of each customer. The weights of the logistic regression were chosen in order to reproduce the actual retention rates known for each operator obtained from a market size survey. This is a parallel survey whose main goal is to estimate market size, market shares and churn and acquisition rates for each operator.

After testing different specifications, a logistic regression was retained, having as explanatory variables customer loyalty and market share lagged one period (cg Figure 4).

The Chi-squared test for the model significance always rejected the null hypothesis that all model coefficients are zero (p<.001). The estimate of loyalty impact on the logit of retention probability is 0.014 (p<.005) and the impact of market share 1.67 (p<.005). Results confirm that in addition to customer loyalty, the relative size of operators strongly influences churning decisions. As an example, a ten point increase in customer loyalty index for a medium operator with a 30% market share and an average loyalty of 70 (on a 100 point scale) is associated with a 1.2 percentage point increase in retention rate in the period of one semester.

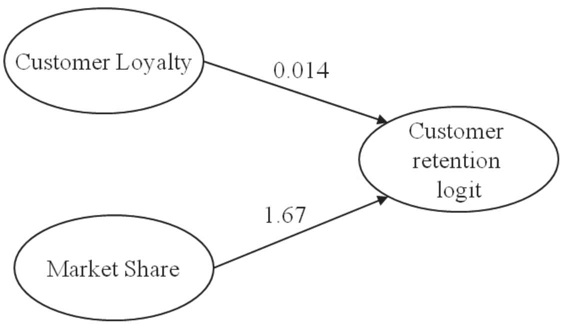


Fig. 4. Modelling of customer retention

3.5 Customer acquisition

Customer acquisition is modelled using data from two waves of a quarterly market size survey referring to January and July 2002. The survey is also based on a probability sample drawn through random digit dialing of fixed phone and mobile phone numbers. The questionnaire queries if the respondent is a mobile phone user, who the operator is and other characteristics of the service usage. In each wave, market size, market share, and the number of customers entering and leaving each operator is obtained. As customer acquisition could not be modeled at the individual level, we have used regionally aggregated data (seven regions). Using these data we modelled both customer acquisition rates: the acquisition rate of new customers ($a^{(1)}$) and the acquisition of customers leaving the competition, ($a^{(2)}$).

The determinants of customer acquisition that were examined as potentially relevant were the intervening variables in the customer satisfaction/loyalty model, as well as the market share of each operator. Linear regression was used to model the regional acquisition rates. After testing different specifications, the selected models explain customer acquisition in both cases through the regional market share of the firms. In fact, the parameter estimates for customer satisfaction and loyalty did not show statistical significance whenever the market share was present in the model. The underlying reason for the importance of market share as an explanatory variable for acquisition rates was already presented in the context of modelling customer retention. It may be possible that the relative size of the operator is so important in the choice of another operator that it completely cancels out the recommendation effect on acquisition. Nevertheless, this result may also be an artefact of the data used for modelling as only two data points were available. However, this does not mean that in the estimated models loyalty does not influence acquisition rates, but only that this relationship may be indirect and lagged. In fact, higher customer loyalty will, in our model, cause higher customer retention, which in turn will cause a higher market share and acquisition rates in the future. When simulating the market for several periods, this chain of events may be explicitly included. In our final model both acquisition rates are explained by market share lagged one period (cf. Figure 5).

Using F tests for the significance of both regressions, the null hypothesis that all model coefficients are zero is rejected in both cases showing the relevance of the model. The regional market share of each operator has positive and significant effects on both customer acquisition rates being equal to 0.82 (p<001) and 0.71 (p<0.001), respectively. The determination coefficients are 0.68 when explaining the acquisition of new customers and 0.29 for the acquisition rate from competitors.

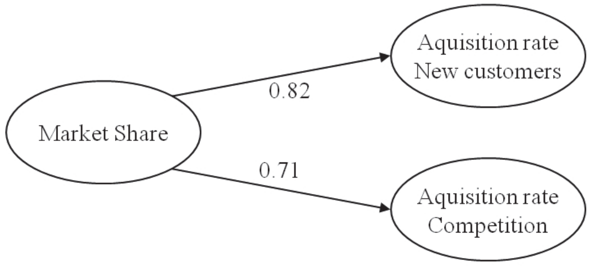


Fig. 5. Modelling of customer acquisition

3.6 Average revenue per customer

The average revenue per customer is modelled using data from the most recent wave of a customer satisfaction survey (also used to model customer retention). The determinants of customer acquisition that have been examined as potentially relevant to explaining revenues per customer were the variables intervening in the customer satisfaction/loyalty models, variables related with customer profile (such as the type of contract), socio-demographic, the market share of each operator and the three technical quality indicators (call drop rate, congestion rate and coverage rate). The reason for testing the possible direct effects from the technical quality indicators is related to the fact that a better performance of the network (and consequently fewer call drops, congestion rates and/or higher coverage rates) may result in an increase in usage/traffic and a consequent increase in the revenue per customer. Modeling on individual data was abandoned due to the difficulty to identify the levels of technical indicators effectively experienced by each customer. Therefore, we have used regionally aggregated data (seven regions). Models were estimated with a sample size of 20 observations (one observation was missed since the samples size for one operator in one of the seven regions was too small to estimate the average revenue per customer). Linear regression was used to model the regional revenue per customer. After testing different specifications, the selected model explains customer average expenditure with the type of customer contract and the coverage rate (Figure 6). Note that among the three technical indicators that have been tested (call drop rate, coverage rate and congestion of the network) only the coverage rate appeared to have a direct influence on the average revenue. A possible justification for this finding is that the calls not initiated (due to network congestion) or not concluded (due to call drop) tend to be successfully completed afterwards (by a new call). But, calls that are not completed (or initiated) due to a lack of coverage are not (at least partially) substituted and customer revenue drops. Also, among customer profile variables, only the type of contract contributes significantly to explaining average expenditure. This result was to be expected since it was already well known that customers with post-paid contracts have higher expenditures then the ones with pre-paid plans. Finally, it should be stressed that it was not possible to obtain evidence to support the idea that customer satisfaction/loyalty influences the level of use of the service and therefore the average expenditure per customer.

The F test for the significance of the regression rejected the null hypothesis that all model coefficients are zero ($p<.01$) showing the relevance of the model. The determination coefficient is 0.41. Both coverage rate (72.8; $p<.07$) and type of contract (52.8; $p<.01$) were found to have positive and significant impacts on average customer expenditure.

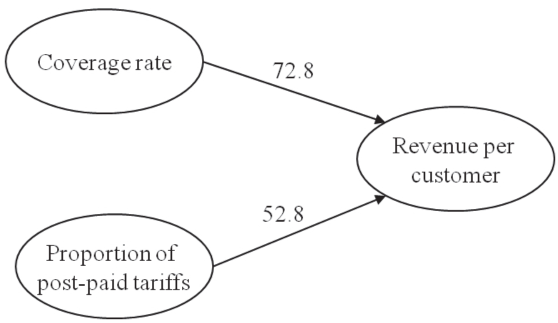


Fig. 6. Modelling of revenue per customer

3.7 Simulation

Equations (7) to (12) may be used to obtain the net present value of additional revenues resulting from the planned investment in the quality of the network. The application of the general framework proposed for evaluating the return of quality investments for these mobile telecommunications market is represented in Figure 7. The simulation starts by considering two alternative investments in network cells as planned by the focal operator (Investment A and Investment B). The level of investment A is 22 million Euros and for investment B 29 million Euros, allowing the focal company to reduce congestion rate and call drop rate in a specific area. The investment will also contribute to an improvement in the coverage rate. The improvement in technical quality indicators experienced by the customers will improve perceived network quality and customer loyalty. Initially the improvement in customer loyalty and coverage rate will improve customer retention and revenues per customers. In each period the market share will be improved through the gains in customer retention and acquisition rates obtained in previous periods, which in turn will promote in the new period, customer retention and acquisition. The increase in the number of customers along with the increase in revenues per customer will give rise to additional revenues that can be accounted for. Running the model within a time frame, it is possible to obtain the increase in revenues for each period and its present value using an appropriate discount rate. The period considered for the simulation is 10 half-years (the period for which the focal firm evaluates the return of other type of investments) and we have considered a discount rate of 5% typically used by the focal company.

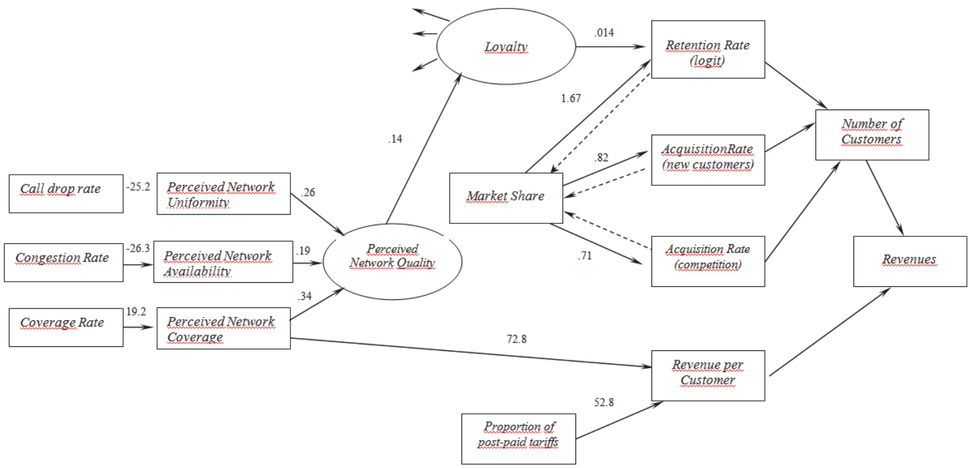


Fig. 7. Complete model used for simulation

Table 7 presents the net present values of additional revenues at each of the 10 periods included in the simulation. The planned investment A will originate additional present revenue of about 23.2 million Euros. The alternative investment B originates present revenue of about 26.6 million Euros.

The profitability of the investment may be evaluated by comparing the additional revenues with the value of additional expenditures associated with the investment. The return on investment (ROI) is 5.3% for investment A and -8.4% for investment B. Note that the ROI

depends on the considered discount rate. The internal rate of return (IRR) is 5.8% for alternative A and 3.7% for B. The result is that the latter alternative is not profitable for the level of discount rate used by the company.
These results show that the present methodology can be used to simulate the results of different types of investment in network quality, allowing the configuration of investments most adequate for a certain purpose to be determined (to maximize profitability, to maximize net profit, etc).

	Investment A		Investment B	
Period	*Aditional profits*	*NPV for aditional profits*	*Aditional profits*	*NPV for aditional profits*
1	487.975 €	464.738 €	559.024 €	532.403 €
2	1.011.413 €	917.381 €	1.158.703 €	1.050.977 €
3	1.570.409 €	1.356.578 €	1.799.143 €	1.554.168 €
4	2.164.879 €	1.781.051 €	2.480.247 €	2.040.505 €
5	2.794.680 €	2.189.705 €	3.201.846 €	2.508.730 €
6	3.459.596 €	2.581.604 €	3.963.690 €	2.957.767 €
7	4.159.324 €	2.955.954 €	4.765.425 €	3.386.699 €
8	4.893.453 €	3.312.082 €	5.606.575 €	3.794.751 €
9	5.661.451 €	3.649.422 €	6.486.523 €	4.181.270 €
10	6.462.642 €	3.967.502 €	7.404.486 €	4.545.712 €
NPV		**23.176.017 €**		**26.552.982 €**
NPVAE		**22.000.000 €**		**29.000.000 €**
ROI		**5,3%**		**-8,4%**
IRR		**5,8%**		**3,7%**

Table 1. Simulation results

4. Conclusions

This work proposes and applies a methodology that enables a cost-benefit analysis of quality investments in the context of mobile telecommunications industry.
The adopted approach aims to estimate additional revenues generated by an investment in a certain time frame along with the additional expenditures associated with the investment. Combining the estimates of additional revenues with the values of additional expenditure one may calculate the profit and profitability associated with the investments. Therefore, these results may be used to choose between alternative investments by comparing their potential profitability, allowing a rational allocation of available resources, and allowing mobile telecommunications managers to approach the investment in quality as any other investment in a competitive environment. In our application it was clear that one of the two competing investments in network cells was not profitable for the used discount rate.
Moreover it becomes possible to simulate the results of different levels and configurations in quality investments, allowing the establishment of priorities for resource allocation in order to maximize profits or profitability. Also, with this approach it is clear that the increase in expenditure on quality alone does not induce an increase in the profits of the firm. Where to spend and how much to spend needs to be identified. Moreover, it becomes clear that the benefits of quality investment are not all immediate and should be evaluated in the long term.
The development of the proposed approach from an operational point of view requires the estimation of the relationships between variables that describe the different stages of the causal chain that mediates between quality investments and the financial outcomes that result from such investments.

We have shown that it is possible to estimate financial returns from each type of quality investment, given sufficient knowledge and measurement of the critical paths in the value chain. These paths involved in the chain will include (1) variables that measure technical quality indicators, (2) constructs such as customer perceptions of quality, customer satisfaction, and customer loyalty, (3) variables that represent customer behaviours as retention, acquisition and level of expenditure and (4) financial results. In addition, there will be predictive variables unique to particular industries including market and customer characteristics. For example, in our application to the mobile telecommunications industry, market share, geographical network coverage of the network and proportion of customers using each type of billing/charging plan appeared as relevant predictors of customer behaviours.

Some limitations of this work should be stressed. Firstly, we consider that the improved level of quality perceptions resulting from an investment in quality will maintain constant over the simulation time frame. We do not take into account that the competitive advantages earned by an operator through the investments in improving service quality may be cancelled out if consumers' expectations rise or if other competitors follow suit. Nevertheless, this does not mean that the model does not consider a competitive framework, since it is possible to explicitly consider the actions of competition.

The different steps in the model chain involve different populations, different levels of aggregations (geographic and temporal) and different sources of data. Consequently, in many cases, estimation was done at a high level of aggregation and with a limited number of observations. More work should be done in order to try to establish relationships at individual level or at least at lower levels of aggregation.

Also, most of the models involved in our chain were estimated using data from one to three periods of observation. The application presented should be revisited using a longer series of observations in order to investigate non detected lags in the relationships established.

Some results, such as not having found a direct effect from customer loyalty on customer acquisition rates or on average expenditure per customer, may be an artefact of this specific market or company. This approach should be tested in other countries and with companies with different market shares. Also, the links between customer loyalty and behavioural variables as revenue per customer may be mediated by other factors as consumption rate, products and services consumed and price sensitivity. Further research explicitly considering these mediating factors may yield a greater insight on these processes.

Finally, the specifications that have been adopted in the models were in general linear. Yet the research in quality and customer satisfaction and loyalty has emphasized the potential for nonlinear relationships (see, in particular, Kano et al., 1996 and Jones & Sasser, 1995). We have tested some non-linear specifications and the quality of the results was not significantly improved. Nevertheless, with more observation periods or within the application in other countries, non-linear specifications may become relevant.

5. References

Aaker, D., Jacobson, R. (1994). The financial information content of perceived quality. *Journal of Marketing*, *58*, 191-202.

Allen, D.R., Wilburn, M. (2002) *Linking Customer and Employee Satisfaction to the Bottom Line*, ASQ Quality Press.

Anderson, E. (1998). Customer Satisfaction and the Word-of-Mouth, *Journal of Service Research*, *1*(1), 1-14.
Anderson, E., Fornell, C. & Lehmann, D. (1994). Customer Satisfaction, Market Share and Profitability. *Journal of Marketing*, *58*, 53-66.
Anderson, E., Fornell, C. & Mazvancheryl, S. (2004). Customer Satisfaction, and Shareholder Value. *Journal of Marketing*, *68*, 172-185.
Anderson, E., Fornell, C. & Rust, R. (1997). Customer Satisfaction, Productivity and Profitability: Differences between Goods and Services. *Marketing Science*, *16*(2), 129-145.
Bolton, R. (1998). A Dynamic Model of the Duration of the Customer's Relationship with Continuous Service Provider: The Role of Satisfaction. *Marketing Science*, *17*(1), 45-65.
Bolton, R., Drew, J. (1991). A Longitudinal Analysis of the Impact of Service Changes on Customer Attitudes. *Journal of Marketing*, *55*, 1-9.
Burton, S., Sheather, S. & Roberts, J. (2003). Reality or Perception? The Effects of Actual and Perceived Performance on Satisfaction and Behaviour Intention. *Journal of Service Research*, *5*(4), 292-302.
Coelho, P.S., Vilares, M. (2010). Measuring the return on quality investments. *Total Quality Management and Business Excellence*, *21*(1), 21-42.
Charnes, A., Cooper, W., Lewin, A. & Seiford, L. (1994). *Data Envelopment Analysis: Theory, Methodology and Applications*, Kluwer Academic Publishers, Norwell, MA.
Danaher, P., Rust, R. (1996). Indirect Financial Benefits from Service Quality, *Quality Management Journal*, *3*(2), 63-75.
Fornell, C. (1992). A National Customer Satisfaction Barometer: The Swedish Experience. *Journal of Marketing*, *56*, 6-21.
Fornell, C. (2003). Boost Stock Performance, Nation's Economy. *Quality Progress*, *36*(2), 25-31.
Fornell, C, Johnson, M., Anderson, E., Cha, J. & Bryant, B. (1996). The American Customer satisfaction Index: Nature, Purpose and Findings. *Journal of Marketing*, *60*, 7-18.
Hallowell, R. (1996), "The Relationship of Customer Satisfaction, Customer Loyalty, and Profitability: An Empirical Study", *International Journal of Services Industry Management*, *7*(4), 27-42.
Hart, C., Johnson, M. (1999), "Growing the trust relationship", *Journal of Marketing Management, 8*(1), 8-19.
Heskett, J., Jones, T., Loveman, G., Sasser, W. and Schlesinger, L. (1994). Putting the Service Profit Chain to Work. *Harvard Business Review*, *72*(2), 164-174.
Hromi, J. (ed.) *The Best on Quality*, *International Academy for Quality*, Vol *7*. Milwaukee, WI: The quality press.
Ittner, C., Larcker, D. (1996). Measuring the Impact of Quality Iniciatives on Firm Finantial Performance. In Soumeh Ghosh and Donald Fedor (Eds.) *Advances in the Management of Organizational Quality*, Vol. *1* (pp. 1-37). JAI.
Ittner, C., Larcker, D. (1998). Are Non-financial Measures Leading Indicators of Financial Performance? An analysis of Customer Satisfaction. *Journal of Accounting Research*, *36*(3), 1-35.
Jacobs, F., Latham, C. & Lee, C. (1998). The Relationship of Customer Satisfaction to Strategic Decisions. *Journal of Managerial Issues*, *10*(2), 165-182.

Johnson, M. D., Gustafsson, A. (2000). *Improving Customer Satisfaction, Loyalty and Profit*, San Francisco: Jossey-Bass.

Jones, T. O., Sasser JR, E. (1995). Why Satisfied Customers defect. *Harvard Business Review*, *73*, Nov-Dec.

Kamakura, W.A., Mittal, V., Rosa, F., Mazon, J. (2002). Assessing the Service-Profit Chain. *Marketing Science*, *21*(3), 294-317.

Kano, N., Seraku, N., Takahashi, F., Tsuji, S. (1996). Attractive Quality and Must Be Quality, In Hromi, J.D. (Ed.), *The Best of Quality*, Vol. *7*, Milwaukee, WI: ASQC Quality Press.

Keiningham, T., Zahorik, A. & Rust, R. (1994). Getting Return on Quality. *Journal of Retail Banking Services*, *16*(40), 7-12.

Kordupleski, R. E., Rust, R. & Zahorik, A. J. (1993). Why Improving Quality Doesn't Improve Quality (Or Whatever Happened to Marketing?). *California Management Review*, *35*(3), 82-95.

Oliver, R. (1997a), *Satisfaction: A Behavioural Perspective on the Consumer*. Boston: Irwin/McGraw-Hill.

Oliver, R. (1997b). New directions in the study of the consumer satisfaction response: anticipated evaluation, intend cognitive-affective process and trust influences on loyalty. In J.W. (Ed.), *Advances in Consumer Research*, ACR, Provo, UT.

Oliver, R. (1999). Whence Consumer Loyalty?. *Journal of Marketing*, *63* (special issue), 33-44.

Reichheld, F. (1996). *The Loyalty Effect*. Boston: Harvard Bussiness School Press.

Reichheld, F. & Sasser, L. (1990). Zero Defections: Quality Comes to Services. *Harvard Business Review*, *68*, 105-111.

Rust , R. T.; Ambler, T.; Carpenter, G. S, Kumar, V. and Srivastava, S. (2004). Measuring Marketing Productivity: Current Knowledge and Future Direction. *Journal of Marketing*, *68*, 76-89.

Rust, R.T.; Lemon, K. & Zeithaml, V. (2004). Return on Marketing: Using Customer Equity to Focus Marketing Strategy. *Journal of Marketing*, *68*, 109-127.

Rust ,R.T., Zahorik, A.J. (1993). Customer Satisfaction, Customer Retention and Market Share. *Journal of Retailing*, *69*, 193-215.

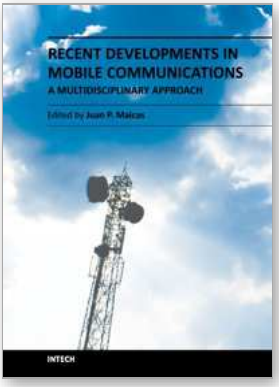
Rust, R.T., Zahorik, A.J. & Keiningham, T.L. (1995). Return on Quality (ROQ): Making Service Quality Financially Accountable. *Journal of Marketing*, *59*, 58-70.

Simester, D., Hauser, J., Wernerfelt, B. & Rust, R. (2000). Implementing Quality Improvement Programs Design to Enhance Customer Satisfaction: Quasi-Experiments in the United States and Spain, *Journal of Marketing Research*, *XXXVII*, 102-112.

Strauss, B., Neuhaus P. (1997). The Qualitative Satisfaction Model. *International Journal of Services Industry Management*, *9*(2), 69-88.

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), 68-75.

Zeithaml, V.A, Berry, L.L. & Parasuraman, B.A. (1996). The Behavioral Consequences of Service Quality. *Journal of Marketing*, *60* (April), 31-46.



Recent Developments in Mobile Communications - A Multidisciplinary Approach

Edited by Dr Juan P. Maícas

ISBN 978-953-307-910-3
Hard cover, 272 pages
Publisher InTech
Published online 16, December, 2011
Published in print edition December, 2011

Recent Developments in Mobile Communications - A Multidisciplinary Approach offers a multidisciplinary perspective on the mobile telecommunications industry. The aim of the chapters is to offer both comprehensive and up-to-date surveys of recent developments and the state-of-the-art of various economical and technical aspects of mobile telecommunications markets. The economy-oriented section offers a variety of chapters dealing with different topics within the field. An overview is given on the effects of privatization on mobile service providers' performance; application of the LAM model to market segmentation; the details of WAC; the current state of the telecommunication market; a potential framework for the analysis of the composition of both ecosystems and value networks using tussles and control points; the return of quality investments applied to the mobile telecommunications industry; the current state in the networks effects literature. The other section of the book approaches the field from the technical side. Some of the topics dealt with are antenna parameters for mobile communication systems; emerging wireless technologies that can be employed in RVC communication; ad hoc networks in mobile communications; DoA-based Switching (DoAS); Coordinated MultiPoint transmission and reception (CoMP); conventional and unconventional CACs; and water quality dynamic monitoring systems based on web-server-embedded technology.