Interactive Modelling and Decision Calculus on the World Wide Web

Application to assessing the impact of Quality and Switching Costs on Satisfaction, Loyalty and Return in a segmented market

by Francis Salerno and Mihai Calciu

The paper suggests and illustrates a framework for interactive marketing model building on the Internet. It integrates the "decision calculus" model building philosophy. Graphical instruments to capture judgmental market response estimations from managers written in Java and Javascript language are introduced. The model that is being built deals with assessing return on customer investment for defensive marketing mix strategies and their intermediate effects on satisfaction, switching costs and market share.

Introduction

Decision calculus, now a classical concept introduced by Little in the seventies for including managerial judgement in calibrating marketing models, can acquire a world-wide use on the Internet. The World Wide Web and its new programming facilities, the Java and Javascript language, allow not only frontier-less managerial judgement collection but also instantaneous model response and scenario illustration.
The managers can completely interact with a model, without spatial constraints, they can test point estimates for market size, sales, coefficients of sensibility (elasticity) to marketing effort. They can choose among possible sales-response functions or merely describe the shape of the response function. They can also estimate uncertainty levels for parameters and outcomes or set weights to variables.
The interaction with the model can help managers correct their initial estimations. Additional corrective effect may be obtained by allowing access to estimations given by other managers, or interaction with some pooled estimations.
In the paper we show the new dimensions given by technological advances to model building and decision support systems construction. Simplicity, flexibility and robustness criteria suggested by Little (1970) for marketing models are substantially enhanced by the introduction of the object oriented paradigm and world wide communicating software and computer languages.

The model we suggest and whose sensitivity we test in this paper deals with the relations between quality, satisfaction and customer returns and is based upon recent research literature treating quality as an investment, aiming to respond to present managerial needs. The core of the model is built upon the "Return on Quality" (Rust, Zahorik & Keiningham, 1995) approach, and in its simplest form tends to make this approach operational.

Simulation of various scenarios and sensitivity analysis have shown the usefulness of the enhancements we brought to the "Return on Quality Investment" approach. Further enhancements are still necessary, but the focus should constantly remain on "the Return on Customer Investment".
Our model has been implemented as a Decision Support System on IBM-PC and compatible computers. The programme has also been ported as a collection of Java Applets and Javascript functions and embedded into a series of HTML documents and can be accessed by WWW-clients from all over the world. The recorded judgements and actions can contribute to improve model calibration and model philosophy.

Internet as a media for participative model building

Internet is a place, "everywhere" in the world, were managers and management scientists (or marketing scientists) can meet. Both have the same kind of problems to solve but they use different problem solving approaches.
The manager, who is a man of action, analyses a situation in terms of difference and changes in order to improve the competitive position of the company or product he is responsible for.

The management scientist is a man of thought, he seeks generalisation in order to build models that solve many problems of the same kind.
Although a huge communication gap between them still exists both parties need each other.
Managers need formal tools like models to support their decisions.
The management scientist needs the managers' experience, intuition and knowledge of the "difference" in order to make his model more realistic and adapt it to the different situations to which it could be applied.

Internet’s World Wide Web transports not only text, images, sounds and all the staff around the concept of multimedia, but also programming integrated as Java Applets, or as Javascripts. This offers tremendous interaction and response capabilities, with huge benefits to the model building approach in marketing and other branches of science.

As with the advent and diffusion of many technologies, computer science has evolved from a "fetish" towards banalisation. First human minds had to adapt and serve the "technological marvel" and concentrate on algorithmic machine thinking. The more the information technology was mastered the more it lost its "aura" and the more it had to adapt to human mind adopting the cognitive approach of "object orientation". Historically decision calculus was probably the first "cry" for user friendliness coming from management science oriented towards both model building and computer implementation. For model building in marketing, it probably marked a turning point while for model computer implementation, it served as a vision which was largely completed by the object oriented paradigm.
In our view the concept of decision calculus as a philosophy of model building and implementation has two main points that can take huge profit from modern Internet technology:

a) Subjective judgement incorporation through world-wide communication;
b) Simplicity, robustness, control, adaptiveness through object orientation

The programming capabilities which become now standard on the Internet, the Java and Javascript language integrate the object oriented paradigm, which is the natural evolution in main stream programming from the procedures (algorithmic) oriented approach.
This evolution could not have been foreseen in the model building approaches that have dominated marketing for the last decades and it needs some theorisation.

1. The concept of decision calculus

"Decision calculus" has been defined by Little (1970) as a series of guidelines for building and using model based decision support systems. It indicates criteria that should be satisfied by models in order to be used by managers and tells managers what criteria to use and how to judge models.

This approach was stimulated by the lack of communication and understanding between managers and model building researchers, and by observations showing that managers seemed reluctant to use models, that good models were rare and often hard to parameterize and were *not understood* by managers.

Although managers are typically willing to use models that predict future, while using them they find some assumptions questionable, terminology used confusing and some important qualitative issues ignored and give up or postpone using them.
By misunderstanding the true reasons for this, model builders, respond assuming that model is not complete and tend to work on it and make it more complicated and hard to understand. Science "fraternity" requirements also push the model builders towards complexity.
The reason why models seem often *incomplete* to managers is also the lack of proper communication and mutual understanding. When managers must solve a problem they almost always have a model of their one in mind and when needed information is lacking they use intuition and experience to complete it. Why would they not have the same goodwill with a model build by others? In order to bring such a model "to the manager and make it more a part of him", Little (1970) suggested the concept of a decision calculus.
He defines it as "a model-based set of procedures for processing data and judgements to assist a manager in his decision making";

Decision calculus considers that managers need to interactively communicate with the model, to intuitively accept or reject the results, to perform sensitivity analyses, and even to change the problem formulation or their subjective estimates. Models and their implementations should help "update the manager's intuition".

In order to be used by managers a model must be "simple, robust, easy to control, adaptive, as complete as possible and easy to communicate with" (Little, 1970, p.466)
The model must start simple and easy to control in order to be understood and to attract the managers interests. This does not mean that the model should be simplistic, it still has to be a good abstraction for the real problem and it must be able to evolve and grow in complexity.
He illustrates these ideas with a very simple S-shaped advertising budgeting model (ADBUDG) for which he provides a structure that allows robust and easy control of sales response to marketing mix efforts. He uses a conversational computer implementation of the model to capture judgmental estimations from managers concerning sales response.
The lack of interactive graphical capabilities of those times' computers, limits the number of point estimates asked to four essential response levels as shown in Figure 1.

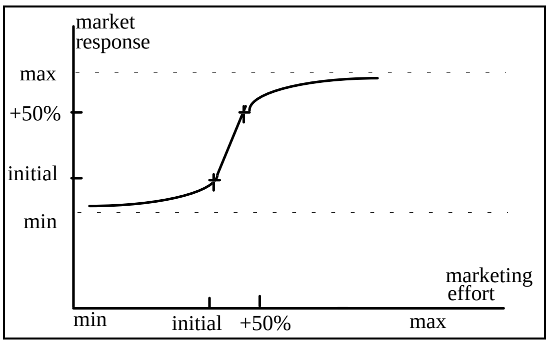


Figure 1. A S-curve of marketing response versus marketing effort specified by four estimates

The author was aware of the technical limitations linked to collecting numeric estimations by typing numbers, as he puts it "it is doubtful that, as today, we could specify a sales response curve in any greater detail than represented by a smooth curve through four appropriately chosen points".

We have overcome this limitation by creating a measurement tool, presented later in this paper, which can capture subjective (or objective) response estimations, graphically.

Calibrating models by decision calculus helps structure the manager's experience in a formal model which can be then used in decision making.

To illustrate the decision calculus approach, its initiator presents a computer implementation of his prototypical model and shows the printed traces of computer inputs and outputs using data for a brand called "Groovy" (Little, 1970, pp. 476-479).

We give here an abridged version, which is to be compared to the illustration of the Internet interactive model building framework shown later in this paper.

"Groovy" is a brand in the treacle market.
Market specific inputs:
Product class sales rate at start of period (unit/period):290000000
Average price for product class ($/sales unit): 1.88
Index of product class sales for several periods (reference case=1): 1.93; 1.012; 1.065; 0.959

Brand specific inputs:
Advertising that will maintain share (Dollars/Period): 486900, (reference case)
Advertising (Dollars/Period) planned for several periods: 486000; 606000; 876000; 414000
Index of non-adv. effects for several periods (reference case=1): 1.0; 1.05; 0.98; 1.0

Response functions (captured on a four point basis):
Market share at start period (% of units): 1.86
Market share at end of period if Adv. reduced to zero: 1.77
Market share at end of period if Adv. increased to saturation: 2.55
Market share at end of period if Adv. increased 50% over maintenance : 2.55
.....
Contribution or profit (before adv. expense) expressed in dollars/sales unit: 0.68

*Outputs (*for several periods)
Market share per period: 1.868; 1.999; 2.002; 2.009
Product class sales in units and dollars per period: ...
Brand sales in units and dollars per period: ...
Contribution (or profit): 3.46M; 3.99M; 3.33M; 3.39M
...

The decision calculus concepts of ADBUDG have been extended in the BRANDAID model (Little, 1975), to include the main marketing variables.

A great number of models based on decision calculus have been suggested ever since (for many of the earlier once see Chakravarti, Mitchel and Staelin 1979).

Fidelisator, the model we suggest in this paper has a different problem to solve but as in the ADBUDG implementation in the Groovy case and in BRANDAID, it heavily relies on the pattern of market response to marketing mix elements. This time it is mainly defensive mix elements we are interested in and their impact on market shares and profitability.

2. Decision calculus framework for model formulation

"Decision calculus is not any specific model or type of model, but rather a philosophy of model building . Although many academically interesting models can and have been built, experience in the last ten years suggests that the general decision calculus criteria must be met by models in the decision information system if decision implementation is desired" (Urban and Hauser, 1980, pp. 500)

From the original definitions we separate a model building and a model implementation dimension.

The model building dimension insists on simplicity, robustness, controllability, modularity of the mathematical formulations used while the implementation dimension applies similar principles to the computer implementation of the model as a decision support system. For the letter dimension, recent evolution in programming philosophy, the object oriented approach ensures a larger and better defined framework than initially expected for decision calculus principles. In the following paragraphs some essential mechanics of the decision calculus model formulation framework are summarised and some relevant formulations from Little's (1975) prototypical BRANDAID model are given.

In a simplified top down model formulation one would start with the profit which is the ultimate goal of marketing activity, it depends on sales and sales depend on marketing efforts (marketing mix strategies).

The profit function has the highest level of aggregation. Profit is modelled here as difference between the gross marketing contribution applied to sales and the cost of marketing mix efforts. Profit is represented by the following formula:

$$\pi_t = g_t s_t - \sum_{i=0}^{M} c_t(i)$$

where:

π_t = the profit in period t

g_t = net marketing contribution by sales monetary unit

s_t = value of sales, period t

$c_t(i)$ = cost of the i-th marketing mix element, where $c_t(0)$ are fixed costs

Until here there is nothing spectacular, besides the simplicity of the formulation. The next element to be modelled is sales:

$$s_t = s_o \prod_{i=1}^{M} f_{it}$$

where:

s_t = current sales

s_o = reference sales

f_{it} = response function to the i-th marketing mix element.

This formulation illustrates decision calculus principles. Marketing mix response functions are multiplicatively combined as an index.

Each response function f_{it} represents percentage increases or decreases in sales response. It equals 1.0 for reference level efforts. This is a simple and modular way to model marketing mix interactions. It is also very flexible because one can easily add or eliminate marketing mix elements. Additional response patterns as highs and lows after each promotion campaign or lagged time effects can also be attached.

Each mix response function equals 1.0 for reference level efforts (expenses), because f_{it}=f(x_{it}) where

$$x_{it} = \frac{effort_{it}}{effort_{io}}$$

and by convention when marketing effort at time t equals the reference effort the market response to that particular mix element equals the reference value. This is particularly useful when collecting separate judgmental estimations of response to each mix element, because each response function can be calibrated individually and multiplicatively combined in a response index.

Start simple and flexible is an highly advisable guideline in building marketing models for managerial use. Even when increasing complexity the simple and flexible structure should be kept.

For example the marketing effort in a mix element like advertising is a complex quantity that consists of several components. In BRANDAID these components are h_{it} media efficiency (exposures/$), k_{it} copy effectiveness and a_{it} spending rate and they are articulated keeping the same simple and flexible structure:

$$x_{it} = \frac{h_{it} k_{it}\, a_{it}}{h_{io}\, k_{io}\, a_{io}}$$

This hierarchically decomposable construction of model formulas suits well an object oriented approach to model implementation.

3. The object oriented paradigm and decision calculus

Object oriented conception is a way of analysing and building complex systems and decomposing them into logical models (classes and objects) and physical ones(processes and module architecture) with their static and dynamic interactions. It has been largely developed in computer science and it is standard on the World Wide Web. As a system analysis method and a programming method it marked an important evolution compared to the procedures oriented approach. Model based marketing decision support systems are complex systems and can largely benefit from this evolution.

Curtois (1985) has suggested five attributes of a complex system that justify a object oriented approach:

1. Complexity takes often the form of hierarchy within which a complex system is decomposed in subsystems linked to each other, having their own subsystems. This decomposition continues till elementary components are attained. A model decomposes the marketing system into marketing environment, the competing firms acting in this market and the market segments that respond to the actions of the firms. Each firm has its marketing mix decision subsystem. Each segment has its response subsystem to marketing mix stimuli and so on.

2) The choice of primary components is relatively arbitrary and depends on the observer's judgement.

3) The links within the components are generally stronger than the ones between the components. This allows a separation between high frequency dynamics concerning the internal structure of components from low frequency dynamics concerning interactions between components (Simon, 1982).

4) Hierarchical systems are usually formed of a small number kinds (categories) of subsystems appearing in various arrangements and combinations (Simon 1982).

5) A complex system that is working has always evolved form a simple system that worked. A complex system built ex-nihilo never works, it must be derived from simple ones that work (Gall, 1986).

The object oriented model is defined by four major elements (abstraction, encapsulation, modularity and hierarchy) and by three minor ones (typecasting, simultaneity and persistence).

Abstraction is a simplified description or specification of a system, highlighting only some details or characteristics of the system and suppressing the others (Booch, 1992, p.41). An abstraction emphasises essential characteristics of an object, that distinguish it from other kinds of objects and gives rigorously defined conceptual boundaries from the point of view of the observer. A model itself is an abstraction. In a decreasing order of utility we distinguish the following four kinds of abstractions: entity, action, virtual machine and coincidence abstraction.

Entity abstractions define objects representing the model of an entity from the domain of the problem. In a marketing model market, firms and segments as objects are entity abstractions.

Action abstraction defines an object implementing a generalised group of operations having the same kind of functions. In a marketing model the "response" object can be such an abstraction because it has the same functions for the market and segments seen as objects.

Decision calculus uses simplicity as an equivalent for abstraction. *Simplicity* promotes ease of understanding and is obtained by selecting important phenomena and leaving unimportant ones out.

Encapsulation is the "occultation of information" it is a procedure by which all details of an object are hidden, that are not part of its essential characteristic.

For a manager the essential characteristics of a model are the inputs and outputs. They should be visible and adapted to the manager's understanding and language while the internal parametrisation of the model should be hidden. Encapsulation makes a model *easy to communicate with*.

Modularity is a feature of a system which allows it to be decomposed into coherent modules weakly linked.

Hierarchy is an arrangement or ordering of abstractions. Heritage is a special kind of hierarchy in which a subclass inherits from one (simple heritage) or several (multiple heritage) super-classes.

Typecasting is imposing the class to an object, in such a way that objects belonging to different classes could not be inverted. Polymorphism is a linked concept, meaning that a unique name, like a method declaration could denominate several kinds of objects (classes) which are connected by a common super-class.

Simultaneity is concentrating on processes and their synchronisation. Each object (abstraction of the real world) can have a separate control task (process abstraction), such objects are called active. Thus simultaneity is a property distinguishing between active objects and those that are not. Interactiveness in model based marketing decision support systems relies a lot on simultaneity.

Persistence is a characteristic that is marking the existence of the object in space and time.

4. World Wide Web interactiveness and participative model building

Internet's World Wide Web will help reduce the communication gap between managers and management scientist. It makes communication much easier, less formal and highly illustrative. Many of the advantages of communicating models through Internet will be extensively demonstrated later in this paper. Here we would simply point out some of the essential web characteristics and concepts that facilitate interactiveness and participative model building.

The form is the main mechanism by which information from the web page reader can be collected. Forms are processed on the servers on which the web page was published by CGI programmes. By CGI web page readers can execute programmes on the server. But most of the time CGI programmes are used to record information from filled in forms in databases. That is how information can be directly collected from all over the world.

The FORM tag defines the information exchange dialogue between the web page readers and the server who collects the information. This interface is graphical and uses most of the common dialogue objects existing in today's system as drop down lists, radio buttons, check boxes, press buttons etc.

With forms and CGI the most sophisticated computer assisted interviewing systems can be easily implemented on the World Wide Web (WWW).

The Javascript language which is the inbuilt language of the best known web browsers, with its multiple event handling facilities and object based handling of web windows, frames, pages and forms makes the most complicated information exchange and interviewing procedures possible.

With the Java language, that is used to build Applets, as full scale programmes living in web pages, any imaginable application can be implemented and viewed world wide. Models of any kind can be implemented on the net using both Javascript and Java language as powerful object based and object oriented programming tools.

Marketing models if implemented and published on the web can be seen at work, world wide. Managers and marketing scientists can try them out, perform sensitivity analysis and contribute building and improving them. If a graphic is worth a thousand words, then a working model is worth many thousands.

The model whose implementation on the Internet will be illustrated in this paper, has been integrated as an applet in a web page collection together with other graphical model helper applets and with Javascript applications that control some forms. The demonstration takes full advantage of programming features, information exchange facilities in forms but also of the more recently available communication possibilities between Javascript and Java applets in order to create an interactive environment for world wide participative model building.

The "Fidelisator" Model - a dual retention satisfaction Model

1. A Problem in need of modelling and decision calculus

Traditionally in marketing, the offensive side, new customer attraction, has been the main force to be developed within the company. New marketing brought another look to the retention of existing customers as a marketing success tool.

As Rust, Zahorik and Keiningham (1995) put it "when customers are more satisfied with the products they buy, they become repeat customers". Several authors (Dawkings and Reichheld 1990; Fornell and Wernerfelt 1987, 1988; Payne and Rickard 1993; Reichfeld and Sasser 1990) show that small increases in retention rates can have a dramatic effect on the profits of a company.

This issue that has concerned both marketing managers and marketing scientists in an era of relationship marketing, bringing quality, customer service and communication using databases and direct media together. *The problem is to evaluate the impact on market share and profitability of satisfaction through quality and of customer retention and loyalty oriented policies.*

For marketing managers this is a challenge because they have realised recently that "quality" for the sake of "quality" was not always successful and that quality for the sake of customer satisfaction seems to be the right thing to do. They have found that in growing, highly competitive markets customers must be satisfied by their purchases or they will go elsewhere (Rice, 1990). But there are also other means to retain customers like loyalty programmes (e.g. fidelity cards) and relational communications. In their competitive markets managers launch "defensive marketing" programmes in order to acquire competitive advantage or to respond to programmes initiated by competitors.

They naturally have some idea and probably a model of their own based on experience and intuition which helps them take quick decisions but they would like to have some more formal models that enjoy a certain validity and acceptance, models they could understand and use to evaluate the impact of their decisions.

For the marketing scientist such a problem is challenging because of its novelty and its great interest for the marketing management community. He tries to build a model and formally define the problem. He will use professional and scientific literature to get an idea about the problem, if the problem is new he will try to find analogies with similar problems for which solutions have been given and he will build a diagrammatic model that logically represents an essential, simplified representation of the problem. Probably he will also seek some privileged contact with a manager or practitioner in order to get some data or information, but this information tends to be biased and give him only a narrow view of the market reality.

The marketing scientist wants to develop and improve his model and to make it useful for the manager. He needs judgmental information from managers about customer response that depends on experience and intuition within a market and he also needs confirmation or criticism to the main simplifications used in the model.

2. The model

The model, whose main aspects (dimensions) are presented in Figure 2, tries to suggest a simple framework for approaching customer management problems from the relationship marketing point of view.

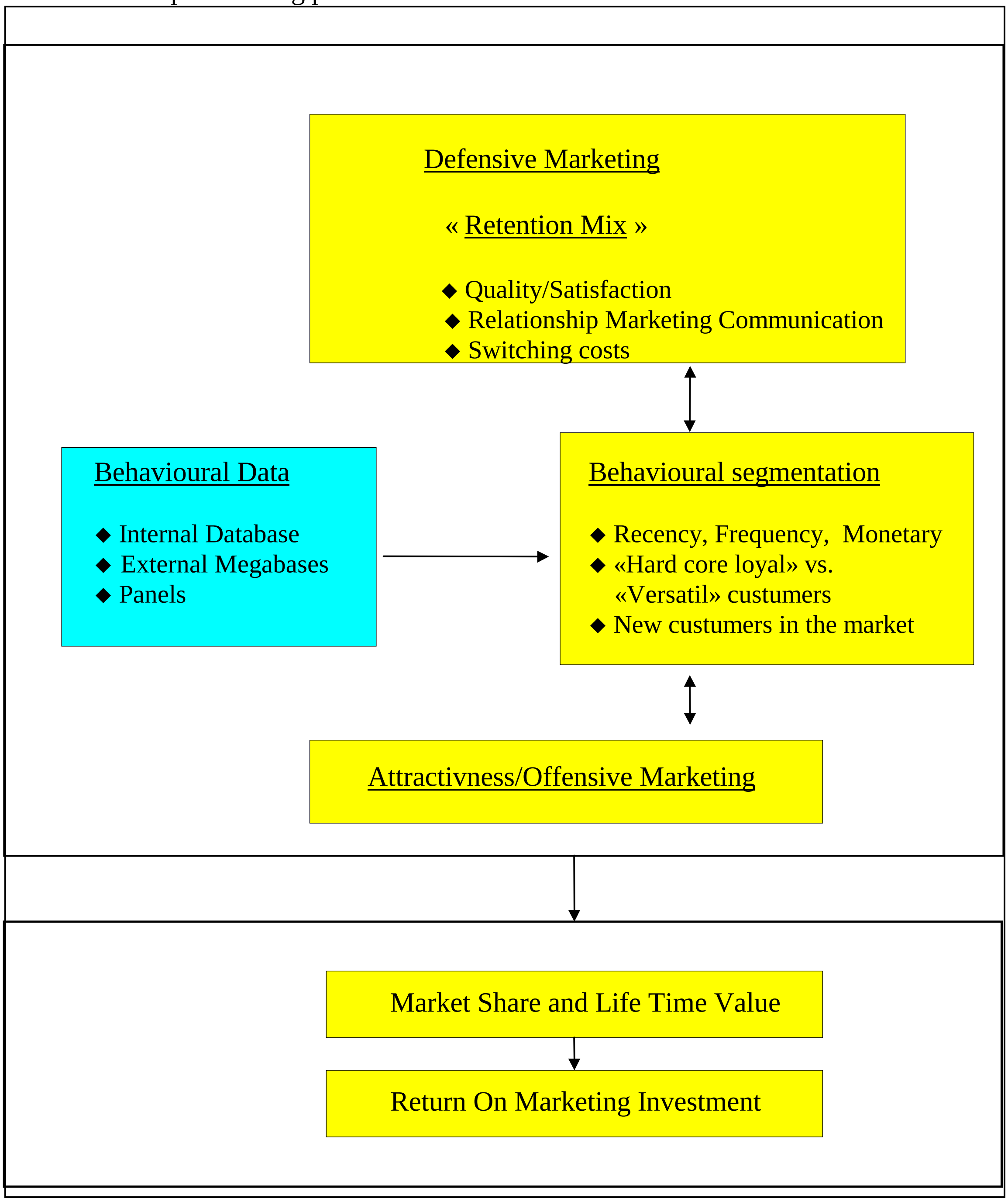


Figure 2. Diagram of the Fidelisator model

It sees the market as a place were firms exert two kinds of forces upon segments. These forces are retention and attractiveness.

Segments are defined by behavioural segmentation methods that are appealing to relational and direct marketing practitioners (like RFM). To accommodate the impact of retention and attractiveness we consider separability between loyalty and attractiveness recently advocated by Colombo and Morrison (1989) and Bultez (1996 and 1997).

Each firm's segments consists of "hard core loyal customers" and "potential switchors" as Colombo and Morrison (1989) would have called them. Bultez (1996) names potential switchors "versatiles".
"Hard core loyal" customers are sensitive uniquely to their firm's retention mix stimuli, while "versatile" ones are sensitive to the attraction exerted by all the firms.

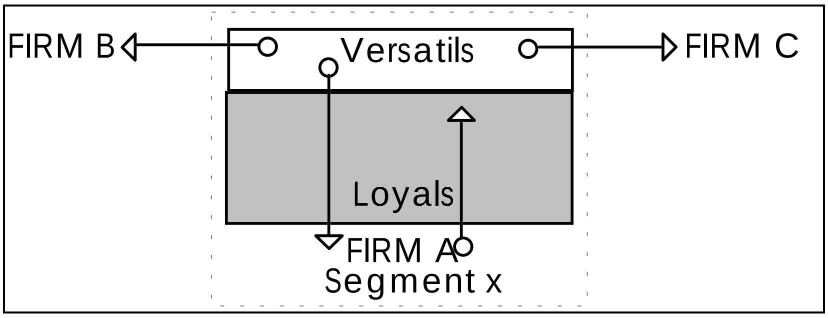


Figure 3 - push and pull forces affecting loyal and versatile customers

In modelling the impact of "retention mix" we have adapted ideas from literature modelling the relationship between quality, customer satisfaction and retention (the ROQ approach Rust, Zahorik and Keiningham, 1995). This approach regards quality as an investment but not as the ultimate goal of a company. The ultimate goal remains profit and it is achieved by customer retention and attraction. Quality can improve satisfaction which can increase retention. But quality based satisfaction is not the only element of "retention mix".
We think that retention mix strategy should include besides investments in quality, loyalty programmes aiming to increase customers' switching costs, relationship marketing communications.

Each segment has its own *response function* to marketing mix efforts and a varying reactivity to quality improvements affecting satisfaction, to switching costs variations and to other defensive marketing inputs. The reactivity to "retention mix" is modelled to be stronger than the reactivity to offensive marketing. It uses the generally accepted assumption that it is less costly to keep existing customers than to attract new ones.
For simplicity reasons (and not only) response parameters and functions vary by segment and mix element but not by firm. Simple S-shaped models (Adbudg, Logistic and Gompertz) are used to represent them. The response models can be calibrated from empirical data (panels) or by judgmental estimation using decision calculus.
In a first version of the "Fidelisator" model response shapes were calibrated by a meta-analytic reproduction of data from recent articles focusing on the return on quality (Rust, Zahorik and Keiningham, 1995 and Rust and Zahorik 1993).
The main scenarios in which the models are tested were taken from two different contexts: banking and tourism.
The approaches and measures used in customer management differ widely between the two contexts, particularly the ones used in evaluating the current customer value (or mean value) and the cumulated value during the whole duration of the exchange relation (Life Time Value). The importance of the up front investment to initiate retention programmes varies also a lot between the two contexts. These switching costs are usually higher in "banking" than in "tourism". The use of the model is not restricted to the two marketing contexts selected here, nor is it limited to the field of

services. In most other industries, growth of non-product differentiation means and opportunities offered by information technology foster the use of such models and the building of new ones.

During each analysed period the competing firms oppose their offensive and defensive marketing mix simultaneously to all segments (a simplification, no targeting) and obtain market shares on each segment proportional to the reactions triggered by their marketing efforts as shown in Figure 4.

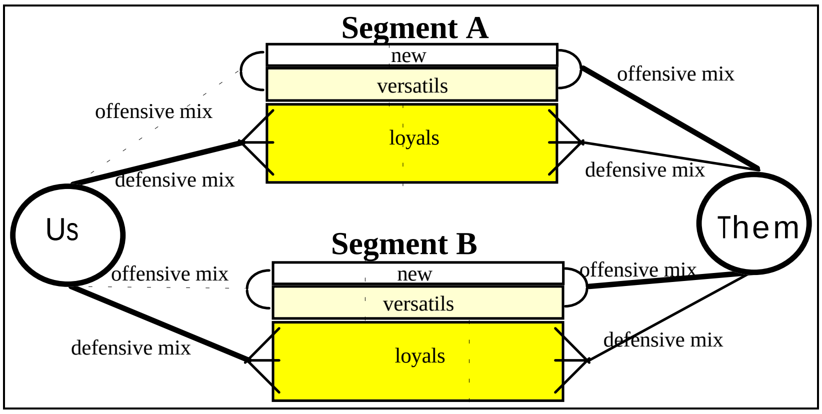


Figure 4. Impact of competing firms' offensive and defensive mix on different segments

The proportion of "hard core loyal" customers a firm has in each segment depends on the defensive mix it opposes. Retention (seen as the part of loyal customers) is totally under the firm's control while attraction is not.
The relative attractiveness of the competing firms on each segment (at market level) determines the share of versatile and new customers it obtains.

The variations in market share and in customer structure from one period to the other affect the return on investment of the quality improvement and retention effort and determine overall gains.

Retention rate driven by customer satisfaction, switching costs, and other defensive marketing inputs is seen as the most important component of market share. That is true for many markets or industries relying heavily on relationship marketing (direct marketing, data base marketing but also business to business marketing).

3. Decision calculus and object orientation in this model

The decision calculus model formulation principles, that have already been presented above, have guided our model. In an earlier version of this model which was implemented as a Visual Basic application on a spreadsheet (Excel), we adopted the following s-shaped formulation for the retention response function:

$$f_t = \frac{1}{1+e^{(-(ao+\sum ai\ xit))}}$$

where f_t is the response or output at period t and x_{it} are the i-th marketing mix inputs.

This model formulation as a multidimensional logistic function is useful when series of empirical data are available, but it is not suitable to integrate judgmental estimations.
One cannot ask a manager to estimate the simultaneous effects of several marketing mix changes, because there is an infinity of combinations of input values ginving not easily imaginable results.
In order to give an "accurate" impact evaluation of a change in an input variable a model formulation is needed that isolates the effect of that input variable. Therefore in our last implementation of the model we ask for reference values for the input variables and adopt a multiplicative model, like in Little's BRANDAID, that explains the output variable as a product or individual s-shaped functions. Using this model formulation managers can isolate and imagine the impact of a change in the analysed input variable when the other input values remain unchanged. The model's formulation helps its flexible implementation using object orientation.
Object orientation is the standard in the Internet. Advantages of object orientation are more striking when a model is very complex. That is not yet the case for this introductive model.
The object oriented analysis we apply here can apply to any marketing strategy models. Four main classes have been defined: markets, segments, firms and response functions. Each class has a state and a behaviour. The state is defined by a set of variables and the behaviour is implemented by methods as shown her for the market and firm class.

The market class:
- defines:
  - the market's environment and common market response characteristics
  - the competitive environment consisting of firm and segment objects
- computes (for each firm at segment level):
  - attraction probabilities adjusting relative attraction indexes with market share per segment
  - attracted versatile and new customers' share
  - current market share by totalling loyal, versatile and new customers share
  - mean sales value (by segment)
- records:
  - numeric and value market share
  - return on investment and net present value

The firm class:
- instantiates its:
  - reference values:
    - numeric market share total and by segments,
    - satisfaction , loyalty and attraction by segments,
    - mix values (budget and mix structure),
  - planed values
    - mix values (budget and mix structure)
- computes for each period its segments':
  - retained share (hard core loyal customers) as response to defensive mix
  - unadjusted response indexes to offensive marketing efforts used at market level (but recorded at firm level) to compute attraction probabilities (excerted on versatile and new customers) in confrontation with the other competing firms

The response class is defined by the type and parameters of model and it computes the given model.

The segment class is here a simple structure that only defines response objects for each mix element. In future implementations we could use *hierarchical inheritance* and exploit the fact that at segment level many of the market features are present. The segment class could be a super class for the market that implements response mechanisms to mix stimuli, equilibrium mechanisms for competition between firms within a segment. The market would then inherit state variables and methods from the segment class and add market specific variables and behaviour.
These classes are *abstractions* of the real world categories they represent. They *encapsulate* in their methods many operations and mathematical formulas the managers do not need to see and only show the information that makes sense to the user. This approach gives structure to the model and facilitates further more complex developments.

4. Sensitivity analysis

A series of scenarios have been created in order to test the model's sensitivity and to evaluate the impact on market share, customer composition and profits of various retention mix strategies.
There are five scenarios for the Hotel Industry and five for the Banking Industry. In both industries the first three scenarios are mono-segment (non key customers only) and the last two are multi-segment. In the first three scenarios we wanted to evaluate the effect of different marketing budgets on profitability during five periods of time. The results have proved that for each market situation their is an optimal budget, in the analysed cases the second scenario was near the optimum while in the first scenario the budget was not high enough, and in the third it was excessive. In the first three scenarios both competitors invest mainly in quality in order to achieve customer retention through satisfaction. In the scenarios four and five the market is heterogeneous (multi-segment) and each competitor uses all marketing mix components both defensive and offensive.

Industry			Hotel1	Hotel2	Hotel3	Hotel4	Hotel5
Market Size (numeric)			10000000	10000000	10000000	10000000	10000000
% Quitting the market			10%	10%	10%	10%	10%
Growth rate			0	0	0	0	0
Actualisation rate			15%	15%	15%	15%	15%
Defensive vs. offensive ratio			1,61	1,61	1,61	1,61	1,61
Mean customer value		Non key	470	470	470	470	470
		Middle	1000	1000	1000	1000	1000
		Key	4000	4000	4000	4000	4000
Market share	Us		2,48%	2,48%	2,48%	2,48%	2,48%
	Them		97,52%	97,52%	97,52%	97,52%	97,52%
Segment structure	Us	Non key	1	1	1	0,89	0,89
		Middle	0	0	0	0,08	0,08
		Key	0	0	0	0,03	0,03
	Them	Non key	1	1	1	0,9	0,9
		Middle	0	0	0	0,09	0,09
		Key	0	0	0	0,01	0,01
Marketing effort ($)	Us		1000000	1400000	2400000	1400000	1400000
	Them		30000000	30000000	30000000	30000000	30000000
Mix structure	Us	Offensive	0	0	0	0,2	0,1
		Satisfaction	1	1	1	0,5	0,5
		Switching costs	0	0	0	0,3	0,4
		Communication	0	0	0	0	0
	Them	Offensive	0	0	0	0,3	0,3
		Satisfaction	1	1	1	0,3	0,3
		Switching costs	0	0	0	0,4	0,4
		Communication	0	0	0	0	0

Table 1. Hotel chain scenario: market environment, share, segment composition and marketing mix

SCENARIOS			Bank1	Bank2	Bank3	Bank4	Bank5
Market Size (numeric)			200000	200000	200000	200000	200000
% Quitting the market			10%	10%	10%	10%	10%
Growth rate			0	0	0	0	0
Actualisation rate			15%	15%	15%	15%	15%
Defensive vs. offensive ratio			1,61	1,61	1,61	1,61	1,61
Mean customer value		Non key	158	158	158	158	158
		Middle	300	300	300	300	300
		Key	1500	1500	1500	1500	1500
Market share	Us		21,00%	21,00%	21,00%	21,00%	21,00%
	Them		79,00%	79,00%	79,00%	79,00%	79,00%
Segment structure	Us	Non key	1	1	1	0,89	0,89
		Middle	0	0	0	0,08	0,08
		Key	0	0	0	0,03	0,03
	Them	Non key	1	1	1	0,9	0,9
		Middle	0	0	0	0,09	0,09
		Key	0	0	0	0,01	0,01
Marketing effort ($)	Us		50000	78000	100000	78000	78000
	Them		118300	118300	118300	118300	118300
Mix structure	Us	Offensive	0	0	0	0,2	0,2
		Satisfaction	1	1	1	0,6	0,4
		Switching costs	0	0	0	0,2	0,4
		Communication	0	0	0	0	0
	Them	Offensive	0	0	0	0,4	0,4
		Satisfaction	1	1	1	0,2	0,2
		Switching costs	0	0	0	0,4	0,4
		Communication	0	0	0	0	0

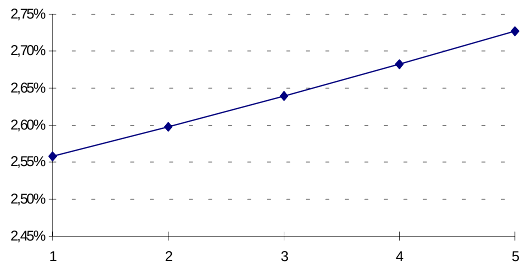
Table 2. Bank scenario: market environment, share, segment composition and marketing mix

The main results given are the market share, the market composition by segments and the returns after five periods. In the case of the scenario Hotel4 the following tables and graphics illustrate the results.

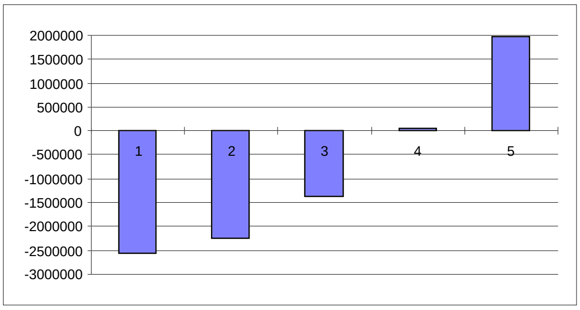
	Us	Them
Market share	0,0272807	0,9727193
Structure by segment:		
Not key customers	0,8683784	0,874736
Middle customers	0,1190915	0,1239443
Key customers	0,01253	0,0013197

Table 3 - Market share and segment composition after five periods (scenario Hotel4)

As the marketing effort remains the same during several periods, market shares for the first firm evolve constantly, as in Figure 5. As many elements of defensive marketing mix like quality improvement efforts are regarded as investments a return on investment schedule is also computed



(a)



(b)

Figure 5. Market share (a) and return on customer investment (b) in five periods

The loss of key customers due to smaller switching costs explains why the progression in market shares is not accompanied by enough overall gains. In scenario five the first firm is aware that key customers are very sensitive to switching costs and adopts an

appropriate retention mix strategy. This strategy will bring substantial gains. In both industries scenario one, three and four give negative results while scenarios two and five return gains.
The resemblance between the two industries is only superficial and comes from the way sensitivity analysis was scheduled in order to facilitate comparison between results. There are important differences that are encapsulated in the market response models. Notions like "departure / retention" or "repurchase / non repurchase" may define transitions depending on the industry and on the continuity of the customers relationships. The same distinction should be made between "lost for good" versus "always a share".

4. Dual segmentation sub models

Our model is *dual*, because what can be called the "primal" approach would normally first evaluate the impact of offensive marketing strategies measured by the number of customers each company attracted while retention and customer loyalty will result as a remaining difference. Here we use a reverse (dual) approach. We evaluate first the impact of defensive marketing ("defensive mix") to evaluate loyal customers and attraction results as a remaining difference. We think that relationship marketing is somehow a dual marketing when seen from this point of view.
The approach is dual because it uses also a double segmentation: "loyal versus versatile" and "key versus non key customers". In our opinion these are the two main segmentation criteria for a defensive marketing approach.

The *distinction between "hard core loyals" and "potential switchors"* helps distinguish the customers who respond to "defensive marketing" from those who respond to "offensive marketing". This segmentation was first used in marketing by Alfred Kuehn (1961). The initial econometric solutions to his ideas (see also Kuehn, McGuire and Weiss, 1966; Wormer and Weiss, 1970) resulted in intractably non-linear equations considered by many too difficult to calibrate and operationalise (see Bultez 1996), and were therefore somehow forgotten.
In 1989, Colombo and Morrison, took these concepts up again, inspired not directly by Kuehn but by parallel research in statistical modelling of work force migration (Goodman, 1961). The last developments on the subject and the most appealing to our approach are the two latest papers by Alain Bultez (1996 and 1997) who builtd upon the works of Kuehn and Colombo and Morrison and give easy operational solutions to both estimate and separate among customers the "hard core loyals" from "switchors" (Bultez, 1996) and to evaluate econometrically, the effects of "offensive marketing" on attractiveness (Bultez, 1997).

The "key versus non key customers" segmentation with one or several intermediate states between key and non-key customers given by some combination of "Recency, Frequency and Monetary Amount" is a traditional approach in relationship marketing and direct marketing. It is largely used in the industry.
We suggest here some improvements of the approach which are inspired from the works of Morrison, Chen, Karpis and Britney (1982).
Internal purchase history data are used:
- to determine several customer profiles;
- to infer customers' probability of becoming key given their profiles;

 - to qualify the heterogeneity of this probability's distribution among individual customers
 - to forecast future customer profiles.

Both behavioural segmentation methods have been implemented as separate modules in a decision support system. They serve as a front-end to identify the customer structure needed by the model presented in this paper.

Interactive model building. A Word Wide Web illustration

1. Introducing the model to managers world wide

As we have already shown Internet can help the marketing scientist and managers in many ways. First the marketing scientist must build a web page, make it available on the net and diffuse his web page's address (e.g. http://eudil.univ-lille1.fr/enseignants/calciu) through professional associations, or professional e-mail discussion lists or by other more traditional means. With the diffusion of the web address he includes a message inviting managers to visit the page, try the model out and contribute to the model by filling in the questions and required estimations and by sending suggestions for further developments.

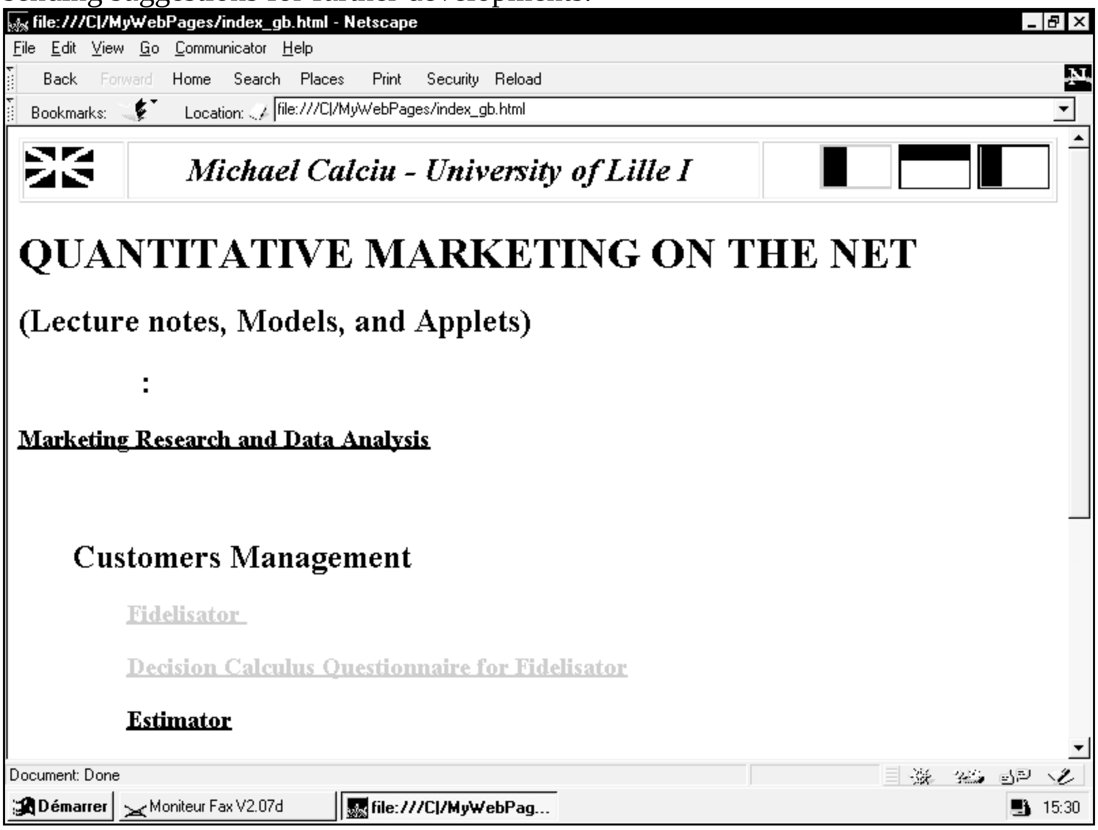


Figure 6. A possible management scientists web-site presenting the model being developed

The managers who are informed about the research that is going on around this model, if linked to the Internet with a WWW browser with Java capabilities can fully participate in this experiment.
The manager can choose to try the model out first and then fill in the questionnaire or do the other way round.

2. Scenario and model testing

If he chooses to try the model out first he will get the following web page collection:

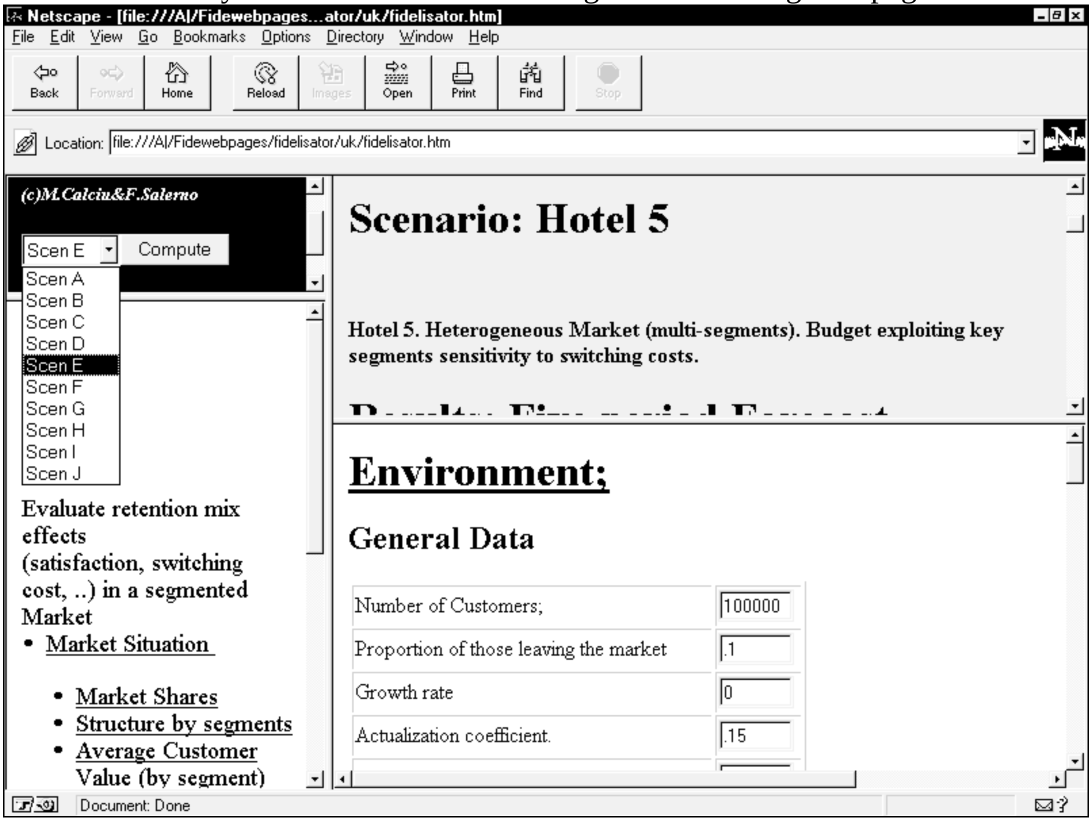


Figure 7. Fidelisator Model - Multiple frames demonstration window

Before trying the model out the user can read about the model directly by browsing the appropriate web page or print the page or download a document with information about it.

To facilitate quick contact with the model several scenarios from the Banking and Hotel industries are given. They were derived by a meta-analytic reproduction of data from recent articles focusing on the return on quality (Rust, Zahorik and Keiningham, 1995 and Rust and Zahorik 1993).

The basic model window, shown in Figure 7, consists of four frames the control frame (north-west), the contents frame (south-west), the data input frame (south-east) and the output frame (north-east).

The control frame controls Scenario selection and model computation. When a new scenario is selected, its data fill the form in the input frame and display a short scenario description in the output frame. When the compute button is pressed the output frame gets the forecast results for the requested number of periods. The results include market shares global and by market segments and financial results.

The content frame facilitates navigating in both the input and the output frame, each content item is linked to an input or output table and brings that specific table on display when selected.

The input data are grouped at market, firm and segment level. Some market environment elements are shown in Figure 7. For segments mean customer value and response behaviour to defensive and offensive mix is recorded. For firms data about the market situation (market share, total and by segment) and marketing mix inputs

are stored. Marketing mix is expressed as total money effort and the proportion of "retention mix" components (satisfaction, switching costs and communication) and of offensive marketing are given separately (as in Figure 8).
Results appear in the output frame either in text form or as graphics. Java programmes integrated to the web page called "Applets" are used to represent output data graphically as shown in Figure 8.

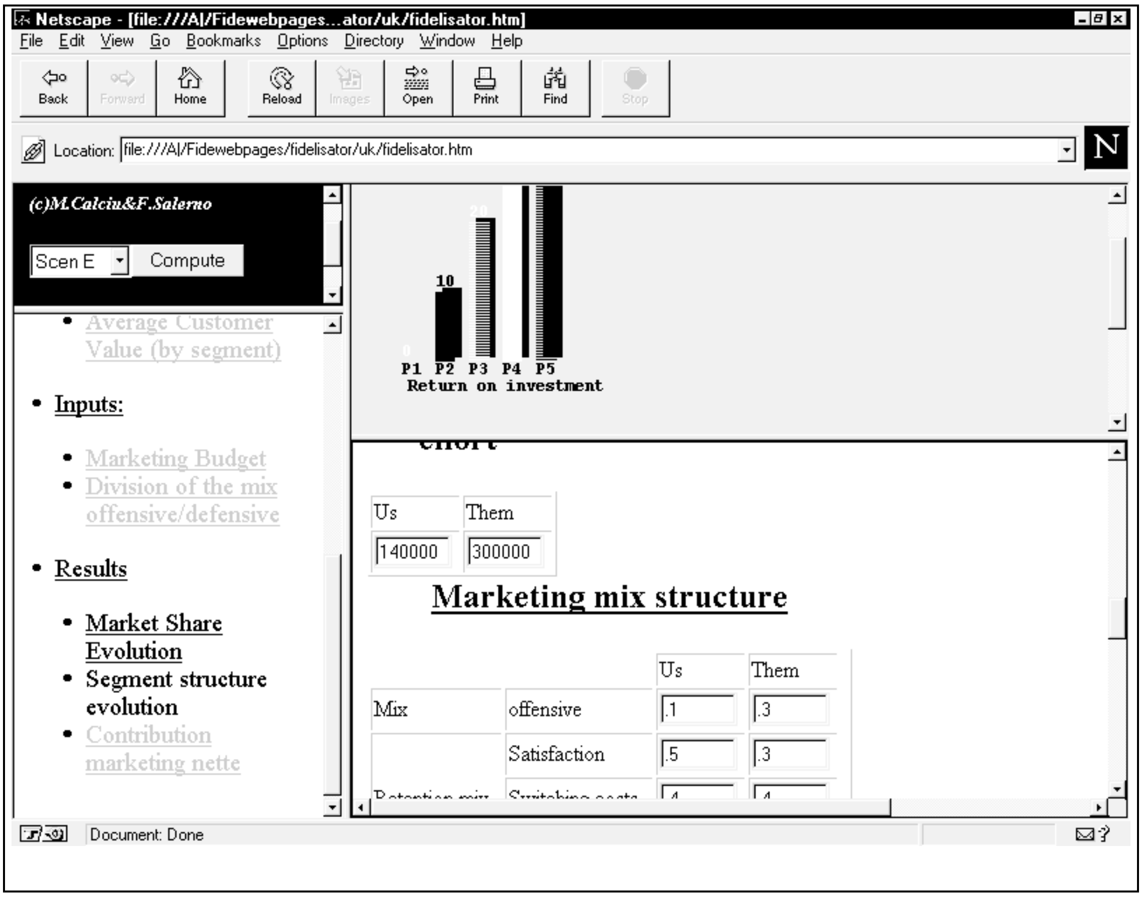


Figure 8 - Fidelisator model

More detail about the model itself will be given later in this paper. In this section we simply wanted to show how anybody with an Internet connection can access the model and try several scenarios or input his own data and compute results. In fact anyone can perform full scale sensitivity analysis and get a good knowledge of the model.
Consequently the manager can appreciate if the model seems to him a good simplification to start with and he can have some ideas of the way the model can be adapted to meet his own needs.

3. Getting judgmental market response estimates graphically

Visiting or trying out the model is an introductory and optional step. It prepares a central issue that is getting estimates of customer response to marketing mix stimuli using the managers' experience and intuition. The model deals with the impact of defensive marketing versus offensive marketing. A U.S. Department of Consumer Affairs study (Peters, 1988) has shown that it is five times more efficient (less costly) to keep old customers than to gain new ones. This means that customers react proportionally better to retention mix efforts than to offensive mix. We think that this reactivity varies among segments and is different for each marketing mix element. To assess this and to capture market specific estimations we question managers on the Internet using the layout shown in Figure 9.

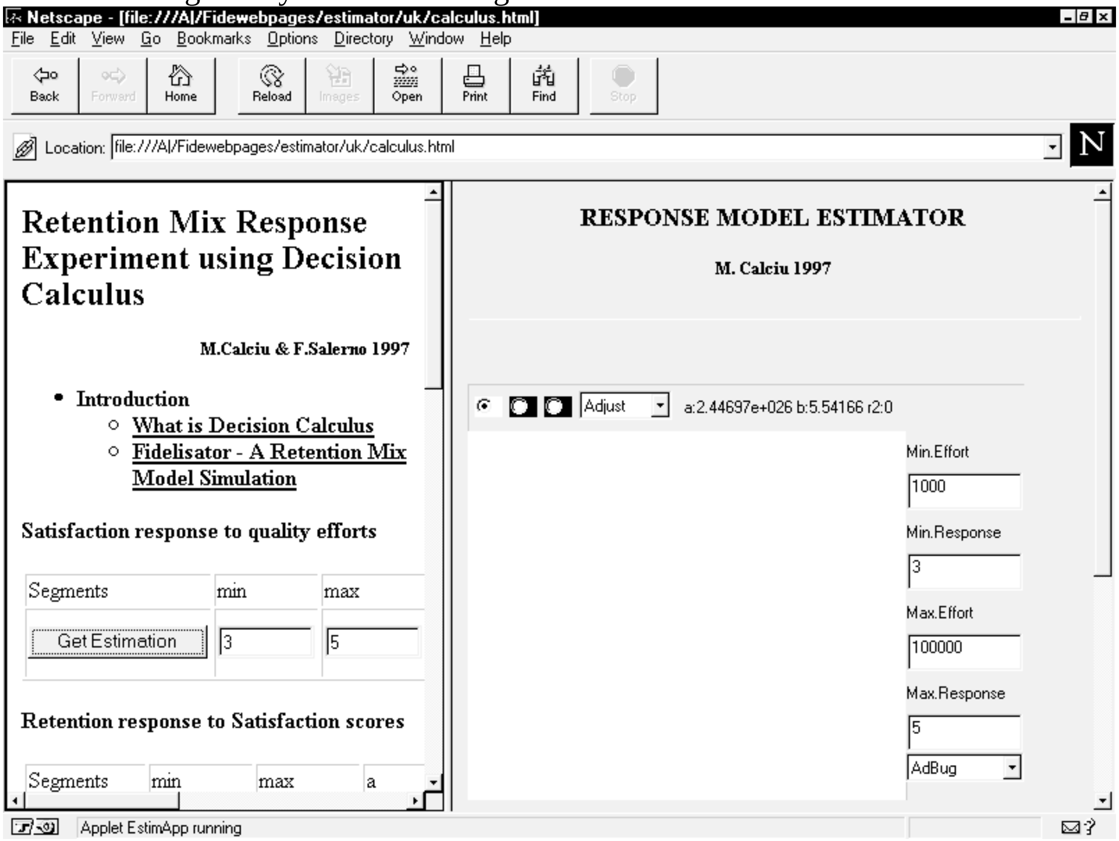


Figure 9. S-curve estimation tool to capture judgmental estimation about market response from managers world wide

Judgmental estimation of consumer response to marketing mix has been advocated by Little (1970) and included in his concept of a "decision calculus" upon which our model building framework heavily relies.

The Internet browser window's layout shown in Figure 9. contains the survey (questionnaire) form in the left frame. The right frame displays our graphical tool for getting the manager's estimation of customer response functions. The survey form buttons when pressed, transfer the parameters of the latest estimated model from the graphical tool to the survey form in the line of that button.

More information concerning the model or the "decision calculus" method for judgmental response function estimation can be obtained by activating a hypertext link to the desired subject.

If decision calculus is selected the respondent gets some useful information about the estimation method and about the main points he should indicate while using the graphical tool as illustrated in Figure 10.

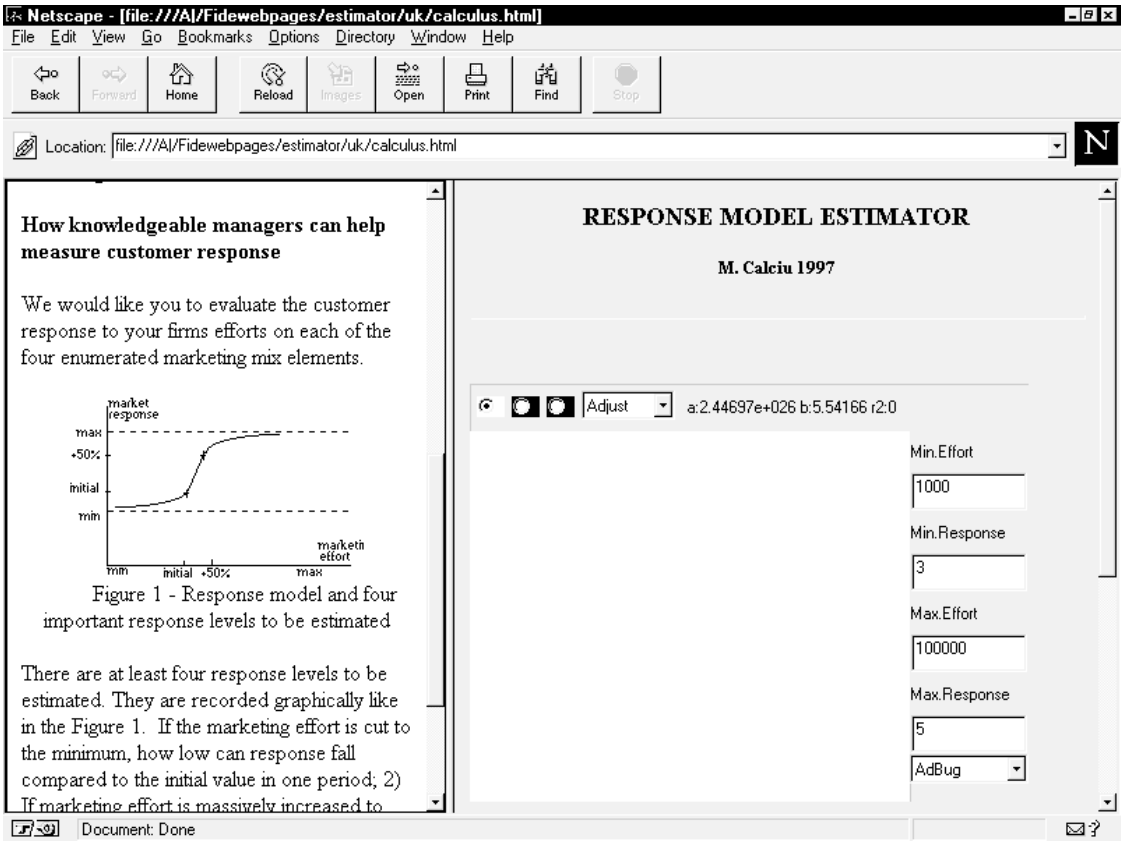


Figure 10. Initiation to judgmental estimation by decision calculus

The customer response function is often supposed to be S-shaped. There are four numbers which are considered by Little (1970) to have a particular operational meaning to the managers and that can help them calibrate and specify the response curve. They are highlighted in Figure 10. and respond to the following questions:

1) If the marketing effort is cut to the minimum, how low can response fall compared to the initial value in one period ?

2) If marketing effort is massively increased to reach saturation, what would be the ceiling or maximum response level that can be obtained in one period ?

3) What is the effort rate that maintains initial response ?

4) What is the response to a 50% increase in effort over the maintenance rate ?

With the graphical tool the manager can draw the response curve in the drawing panel. The abscissa represents the marketing effort and the ordinate represents the market response. The minimum and maximum effort and response must be given by the respondent. There is no upper limit for the number of estimation points. The lower limit is four points (if possible those suggested by Little). The drawing mode is enabled when the one colour is selected and the "Suggest" option is set in the upper panel. The "Adjust" option fits the theoretical model specified in the right panel (Adbudg, Logistic or Gompertz) to the points drawn by the respondent, displays the results in the upper panel and draws the smooth theoretical curve as in Figure 10.
The tool was created using object oriented Java programming language and was implemented as an Applet in a series of Internet World Wide Web pages.

In this implementation of the model we have three segments (key, middle and non key customers) characterised by the mean value of purchase and by distinct response reaction to the four direct marketing mix stimuli and to one indirect mix element which is quality.

4. Estimating the effect of Quality programmes on Satisfaction

Satisfaction response to quality effort is the same for all segments. Many big companies measure customer satisfaction and quality on a regular basis. This is particularly true for services companies like bank and hotel chains on which we based our first scenarios.

Many managers may have some idea about the impact of the quality improvement effort on a given five points customer satisfaction scale. If they have some other satisfaction estimates in mind like the proportion of dissatisfied customers they could by simple calculations give a five point score. Lets build on the hotel chain example from Rust, Zahorik and Keiningham (1995). Limited testing at a handful of hotels revealed a relationship between time spent cleaning each bathroom and satisfaction. The time spent converted easily to cost using average wage rates. Managers estimated that they were currently spending $1 million on cleaning. They could evaluate the impact on the percent of disappointed customers of several quality expenditure levels:

Quality effort (thousands $)	600	1200	1800	2400	3600
Percent disappointed	10	7	5	3.8	2.5
Satisfaction score(1 to 5)	3,3	3,36	3,4	3,424	3,45

Table 4. Converting percent of disappointed customers to a five point satisfaction score

Suppose they consider an average score of 1.5 for dissatisfied customers (between 1 and 2) and the average score of 3.5 for satisfied customers (between 3 and 5). If they would engage the maximum realistic expenditure $3.6 million they would be near to the maximum possible satisfaction score (3.5 means no disappointed customers at all), the less they spend the lower the satisfaction score.

These managers can easily communicate with the web survey using the graphical response model estimator in order to help the marketing scientist develop his model. An illustration can be seen in Figure 9.

5. Estimating the impact of defensive marketing on customer retention

Figure 11 shows the estimation instrument integrated in an Internet questionnaire collecting market response estimations to different offensive and defensive marketing mix stimuli.

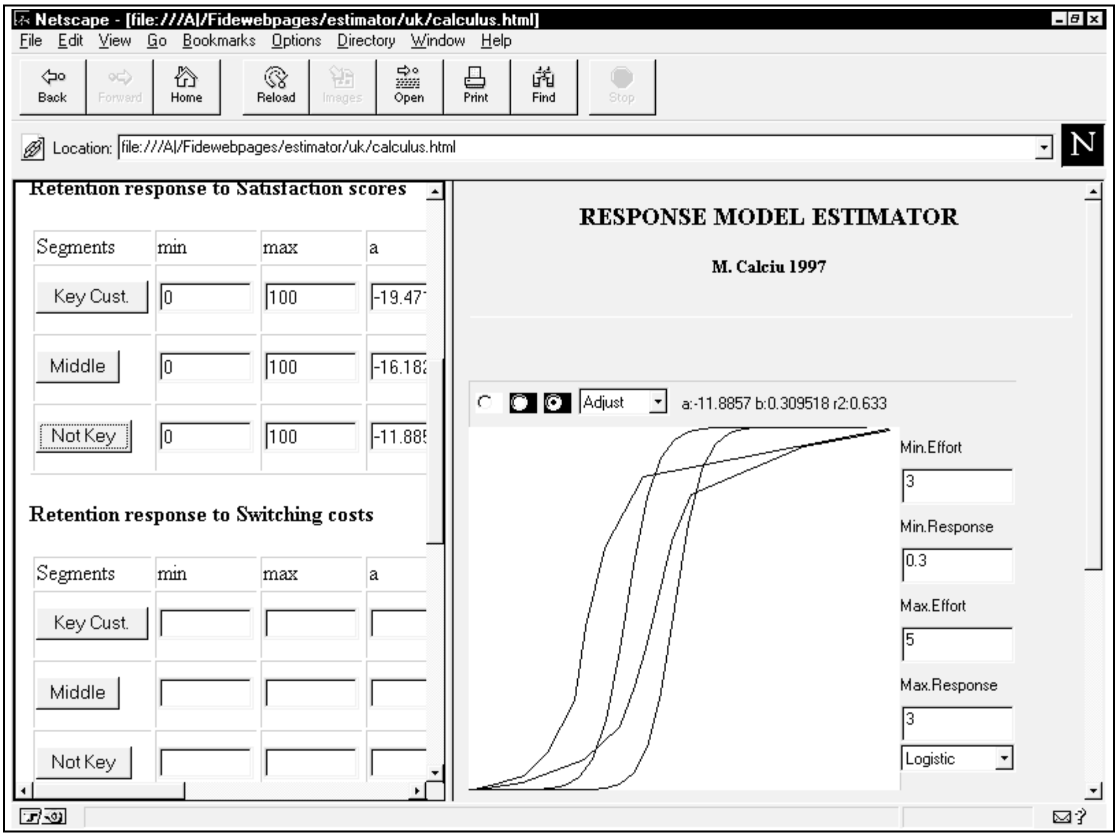


Figure 11. Collecting judgmental response estimations by decision calculus

Defensive marketing has been divided into three retention mix components: satisfaction, switching costs and communications.

As shown above, satisfaction scores are determined by the company's quality improvement efforts.

Switching costs are the results of loyalty programmes as fidelity cards or other measures trying to hinder or prevent customers from leaving the company. In this demonstration switching costs stand for the part of the marketing budget allocated to this purpose.

By Communication we mean personalised relational communications aimed to increase customer retention.

Segment sensitivity of each of the three retention mix components varies. Therefore managerial estimation of their impact on customer retention are recorded on a segment basis. The buttons placed before each segments response function's parameters, when pressed, collect the parameters of the latest estimated model from the graphical tool. Figure 11 shows that the graphical model estimator tool allows three different estimations to be visualised at the same time. The latest estimation is indicated in the upper panel by the selected radio button. If adjusted the parameters of that model estimation are displayed in the upper panel.

6. Estimating the impact of offensive marketing on attraction

Offensive marketing effort includes traditional mix elements (product, price, promotion, and distribution) and is not detailed in our simple model

The managers are simply asked to evaluate the overall impact of offensive mix on attraction. Attraction could be indicated as a relative index compared to a given reference value.

Managers should keep in mind that for similar budgets retention mix elements have a bigger impact on existing customers than the offensive mix has on new customers.

7. Communicating suggestions for further developments of the model

Managers or other marketing scientists can send their suggestions about the model and its implementation to the authors. These suggestions can refer to the model as a whole or to particular aspects of the model that appear in different web pages. This is easily done due to a standard tag in the Hypertext Mark-up Language (HTML) that allows to insert a reference that brings electronic mail facilities into a web page. It has become common practice to include a "mailto" reference with the author's electronic mail address in every web page of a presentation. In this way anyone reading that page can easily send messages to the owner of the page. The "mailto" resource is one of the several resources (file, http, news, gopher, telnet, wais) that can be referenced using the Universal Resource Locator (URL) concept and that make possible access from a web page to all the services that made the fame of Internet.

Conclusions

Following the principles of decision calculus, the model presented in this paper tries to give a framework for evaluating the impact of defensive mix vs. offensive mix in a segmented market where customer management, retention policies and overall relationship marketing are important. It also wants to show using various scenarios and simulations that variations in marketing mix and segment compositions can have a crucial impact on profitably or return on quality and retention efforts.

The model itself is an oversimplification of the real world, it is ment to capture mechanics that are essential for managers. In this way managers are confronted to a certain reasoning, can communicate wether they agree with it and induce their intuition and judgement into the matter.

A framework for participative model building on the World Wide Web, using decision calculus and object orientation concepts is presented. The framework can itegrate most of the classical interviewing techniques for participative model building and estimation.

Estimations given by managers could be added as anonymous scenarios and accessed by all managers interested in the model. They can compare their estimations to the ones of other managers. In a discussion group around the model, created using an electronic mail discussion list or web browsers' "chat" facilities, a lively exchange of opinions can take place. On that occasion missunderstandings are uncovered. Considerations introduced by some people can lead others to change their estimations. Useful ideas about the model and the problem it tries to solve come out. Some of them will be integrated in new versions of the model and published on the web.

The "fatal flaw" of econometric decision support models is that they are based on data from the past (Simon,1994). It is a way of looking to the future through the "looking glass" as some would put it (a statement due to R. Schlaiffer from Harvard). Although this is a biased point of view the problem exists and it encourages participative modelling techniques in the inspired by decision calculus. This approach has been found very useful by Simon (1992) although "not very scientific in a Popperian sense but a simple way to extract and systematically structure expert knowledge". He considers that too little research has been done on how to successfully carry out this task. The present approach tries to contribute to this research by suggesting a way in which modern internet communication technology can be used to investigate an important source of marketing knoledge, the managers.

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