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Information technology as a catalyst of relationship marketing within a global context

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Marketing has evolved since the beginning of the 20th century, thanks largely to information and communication technology (ICT). The transformation can be seen in changes to the economy and to technology and in the shifting preferences and needs of clients. With ICT, companies can deal directly with their clients, simulating real-life situations. This allows them to understand the necessities of the market in adopting their products and services thereby achieving a closer relationship and a competitive advantage by offering better value to their clients. At the same time, mathematics and fuzzy logic have facilitated the creation of the business models that are optimally adapted to the everyday situations that confront businesses in making their decisions in the present climate of uncertainty. This article presents the evolution of relationship marketing supported by ICT and the use of fuzzy models to simulate real situations in marketing. This work has two purposes: 1) to encourage scholars to continue researching on mathematical models applicable to relationship marketing; and 2) to invite marketing managers and ICT professionals, to develop systems to improve every day relationships with customers.

Key words: Relationship marketing, evolution of information and communication technology, fuzzy models, FuzzyLog©.

INTRODUCTION

The evolution of markets in the recent past has been possible, for the most part, due to technology (Wright, 1989). Technology is responsible for the return to individuals as it focuses on clients, by using marketing strategies that collect, store, and analyze information (Rust and Espinoza, 2006).

Technological advances have helped to rapidly cut down the cost of working with data, which in turn has made it much easier to compile, store and analyze data, and to adapt to the profiles and behaviour of clients, all of

which are now more accessible. Information-storage technology and data-mining techniques are both efficient and profitable. They have permitted researchers to analyze data in ever-greater detail and to develop ideas that allow them to build relationships with clients. The costs of collecting information and generating high-value databases continue to decrease (Rust and Espinoza, 2006).

One of the important contributions of technology is developing software that allows the simulation of actual

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cases and the speed and accuracy in calculations. The use of fuzzy models in marketing is one of those cases. This paper presents the software *FuzzyLog*[®], developed to emulate the fuzzy forgotten effects model (Kaufman and Gil-Aluja, 1988). *FuzzyLog*[®] simulated the conditions of a service company that wanted to see the attributes valued by customers when they receive a service. The programme allowed the company to analyze data from customer surveys through the matrices of the model. These calculations were extremely complex to do manually.

With the results of the model, the company was able to understand aspects not taken into account in their service strategies. The use of this software is an example of how technology provides tools for the improvement of relationship marketing in business.

In this paper, we describe the aspects outlined earlier. We introduce the reader to the objective and structure of the paper. Then show the method and procedure of the research. Next, we present a chronological summary of the development of relationship marketing from the 1960's to date. It highlights the software and hardware tools that have massively enabled relation strategies to reach more and more customers. It also shows a graphic with the chronology of the evolution of relationship marketing and ICT. Thereafter, we show the use of mathematical models, known as fuzzy models, for the study of relational strategies in contexts of uncertainty. These models, combined with the technology for the calculation of complex situations, adapted well to disciplines such as marketing since better understood expressions of everyday language. Here, we describe the software *FuzzyLog*[®], to solve the calculations of a fuzzy model applied to a relational marketing strategy. We use the forgotten effects model, applied to a company that offers a number of services to their clients. Also, we use the SERVQUAL model developed by Parasuraman et al. (1985). The article concludes with the contribution of the research to academia and business.

METHOD AND PROCEDURE

The historical analysis, on the evolution of relationship marketing and technology, started in 1960. We used historical data from major software and hardware companies such as IBM, Apple, DEC, SAP, SPSS and others. For the theoretical foundations, we consulted the authors Olsen (1983), Parise and Guinan (2008), and Ryals and Knox (2001). We built the timeline in the order of the data accessed.

For the presentation of fuzzy models, we investigated the work of the authors Gil-Aluja (1999), Gil-Lafuente (1997, 2001), Zadeh (1965), Lukasiewicz (1920), Kaufman and Gil-Aluja (1988). The model was used as an example of the forgotten effects model developed by Gil-Aluja (1999). The forgotten effects model was used in conjunction with the dimensions of quality presented by Parasuraman et al. (1985) in their SERVQUAL model. With this model, we analyze the services offered by the company to its customers.

We developed the list of services and ways of communicating with customers, consulting with managers of 10 transnational companies including those in: consumer products, the financial sector, technology and telecommunications. The values of the incidence matrices are of a pilot survey to a group of 20 customers of service companies.

For the calculations, we use the *FuzzyLog*[®] software. This software allowed the company to find aspects not taken into account in its service strategy. Figure 1 shows an outline of the methodology used.

TECHNOLOGICAL ELEMENTS AS SUPPORT FOR RELATIONSHIP STRATEGY

Marketing has entered a new age, and commercialization is now centred on offering services that can be adapted to the client and on using information to build relationships with clients. Research has developed advances in ICT that have impacted marketing. Technologies, such as the Internet, mobile phones, and fibre optic networks, have created a platform that allows for multiple ways of communicating, changing the way of doing business. Now that communication is almost instantaneous, businesses and clients have the opportunity to know much more about each other, so that the services they offer are easier to provide and less costly, and they can establish deeper client-business relationships. Technology has also changed research, and provided researchers with better tools to study market data.

Throughout the years, technology has supported the process of relationship marketing with both hardware and software tools. Figure 2 illustrates the technological media of software and hardware that relationship marketing has used throughout its evolution; and the focal points for business that have been applied according to the current strategy.

In the 1960s and 1970s, relationship marketing followed a financial focus-of-business strategy, in which the instruments of evaluation came from analysis of the primary accounts of the financial estate, valuation of financial reasons, and diagnosis of the critical factors of financial evolution. In the 1960s, the information infrastructure was made up of central computers, known as mainframes, led by IBM¹. The invention of the transistor allowed for a new generation of computers that were faster and smaller, with less need for ventilation. However, the cost of computers was still a significant portion of a company's budget. The institutions that had mainframe computers were large corporations, universities, and government entities. The U.S. Marines used the second generation of computers to create the first flight simulator; *Whirlwind I*. Airlines began to use computers for flights, air-traffic control, and general-use simulation. Businesses began to use them to store records and as a way to manage inventories, salaries, and accounting. In the area of business, administrative software became the first tool used for relationship marketing, carrying out the process of segmentation, with the information stored in accounting and financial reports. The main criterion of segmentation was turnover, and businesses began to classify their clients with levels of jargon according to the amount of turnover.

In the 1970s, the financial focus remained the fundamental objective of business strategy (Feldstein, 2002). With the development of integrated circuits (silicon chips), computers became smaller, faster, more efficient, and more accessible. The 360 model from IBM captured 70% of the market, competing with Digital Equipment Corporation (DEC) (Olsen, 1983). Minicomputer users reached a peak during these years, and commercial companies began to incorporate minicomputers into their models of

¹ Source: www.ibm.com

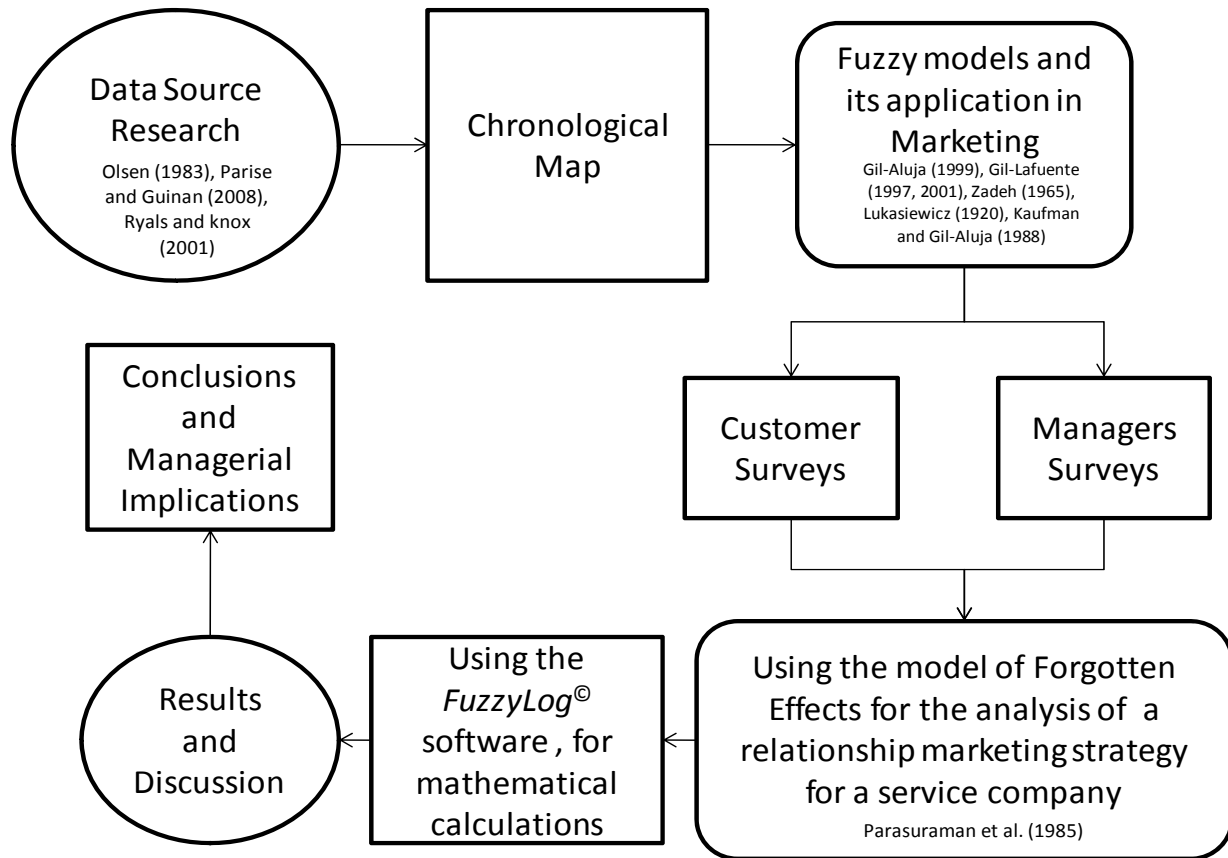


Figure 1. Methodology used in this work.

automated business, especially in administrative processes. In 1968, the software, Statistical Package for the Social Sciences, appeared on the market. Popularly known as SPSS², this is an analytical programme used in the social sciences and for research procedures, such as health, government, education, mass media communication, sociological and market analysis. This software represented a milestone in relationship marketing, using statistical methods such as tests of correlation, frequency counts, and data ordering, as well as reorganizing information and generating reports and graphics. The ease of grouping facts and conducting subsequent analysis went along with detecting niches in the market, initiating strategies of differentiation and direct communication with certain market segments.

In the 1980s, the arrival of microprocessors radically changed the business model. In 1981, IBM unveiled its personal computer, and, in 1984, Apple debuted its Macintosh². To the extent that these machines became more powerful, they could connect via networks and strengthen electronic messaging that was born in 1971 with the ARPANET network³. The strategic focus of the companies concentrated on productive efficiency, quality, and time saving.

These developments formed the foundation of relationship data that permitted businesses to conduct analysis of activities in their

own systems. Relationship marketing tapped into these databases, using them as tools to develop strategies to get closer to clients, for example, working with the post office to generate personal campaigns. As they grew in popularity, fax machines became another tool used by relationship marketing for direct communication with clients.

In the early 1980s, electronic data interchange (EDI⁴) standardized communication between businesses to directly extract information from applications and transmit documents in formats that were easily understood by computers, using telephone lines and other telecommunications devices without having to use paper. EDI allows businesses to develop relationships among themselves to speed up the exchange of products along the supply chains. The B2B⁵ strategies of relationship marketing make this standard easier.

In the 1990s, relationship marketing strategies began to be developed, but with a commercial focus that was concentrated on the product. From a technological point of view, the 1990s were a decade of great advances and innovations that encouraged the spread and personalization of technology, with mobile phones, electronic agendas, portable computers, and the immediate access of information, as well as the increasing popularity of electronic messaging and the arrival of the Internet. From a business point of

² Source: www.apple.com

³ The computer network Advanced Research Projects Agency Network (ARPANET) was created on behalf of the Department of Defense of the United States and reached up to 15 nodes in the early 1970s.

⁴ Source: www.aecoc.es

⁵ B2B: Business to Business. It is related to business transactions between two companies.

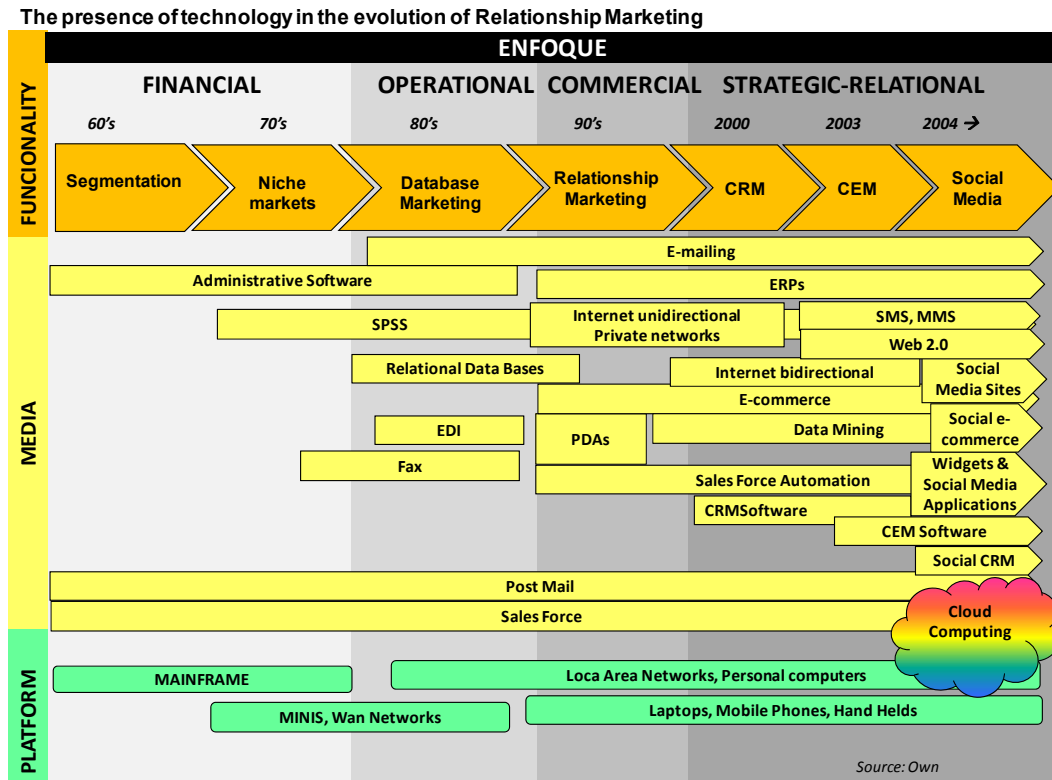


Figure 2. The presence of technology in the evolution of relationship marketing. Source: Own.

view, enterprise resource planning (ERP⁶) began to appear, that is planning systems of business resources and managerial information that integrate and direct the production operations and distribution aspects of companies that produce goods or services. The electronics business became the model of exchange between companies, consolidating B2B and allowing consumers to begin buying goods and services on the Internet (B2C⁷). At the same time, automated sale systems were born, precursors of software for managing relationships with Customer Relationship Management (CRM⁸) clients. Relationship marketing began to evolve into a business strategy for managing current internal and external information and to become able to define concrete actions of differentiation to attain competitive advantage. The most prevailing influence on CRM acceptance comes from CRM perceived usefulness, followed by the setting of accurate expectations regarding system usage, the salesperson innovativeness towards new technological tools (Avlonitis and Panagopoulos, 2004).

The beginning of the 21st century witnessed the beginning of a focus on strategic relationships, so called because companies incorporate strategic aspects into all of their business units, producing functional plans directed from a corporate business plan, and called “relationships” because companies began to centre all of their activities around clients, modifying and supporting the management tools that integrate all of the processes around the client. CRM systems integrate ERPs and automated sale systems,

and they add analytic functionalities as tools of data mining. This whole environment favours and strengthens a relationship marketing strategy, creating a new paradigm for doing business.

The rapid evolution of technology platforms has accelerated the influence of relationship marketing even more, as companies’ processes have enabled the immediate access to information from any location, using mobile phones, portable devices, and handheld computers. This was the case as much for companies as it was for consumers. The use of the Internet for whichever aspects of daily life had become routine intensified the leading role of consumers in business transactions, giving rise to the term *prosumer* (a fusion of the words *producer* and *consumer*) because of the influence of consumers in the creation and production of goods and services. Commercial strategies began to define this active participation on the part of consumers under the term *experience*, culminating in the creation of the term *customer experience management* (CEM), which was attributed to Schmitt (2003), defined it as “the process of strategically managing the total experience of the client with a product of a company). While CRM seeks to encourage certain behaviours in clients (sales/loyalty), it also tries to understand the spontaneous behaviour of clients.

Since 2004, the term Web 2.0⁹ has come into vogue to describe the interaction that takes place between different applications on the Web and that facilitates the sharing of information, as well as interoperability, design centred on users, and collaboration using the World Wide Web. The most revolutionary part of Web 2.0 has been its ability to transform the previously passive visualization of

⁶ ERP: Enterprise Resource Planning

⁷ B2C: Business to consumer. This is related to business transactions between companies and consumers.

⁸ CRM: Customer Relationship Management

⁹ Source: www.wikipedia.org

the Internet into an active process that includes the ability to modify content on web sites. Web 2.0 has radically changed the way in which consumers use the Web, with components such as blogs, wikis, social networks, and virtual worlds. Users can generate and share their own content, often with respect to company and product brands, providing potential value and posing a challenge to marketing professionals. Parise and Guinan (2008) have found that there are four principles that guide the actions of marketing directors in using Web 2.0: 1) to encourage users to generate content; 2) to focus on the creation of a community; 3) to ensure the authenticity of a message; and 4) to look for opportunities for commercialization by way of experimentation.

With the appearance of Web 2.0, ways of doing business have changed radically. Companies know that opinions and comments concerning their brands can instantly change the image of their company. Examples abound, such as to what happened to Toyota in 2009 and came to be known as "Pedal-Gate",¹⁰ or how the intervention of social networks, blogs, and immediate news can cause a brand to see its image and its share of the market change dramatically in a year and half. With these examples, relationship marketing is quickly incorporating social networks that complement the traditional paradigms by which products become successful in creating themselves, setting prices, selling on the market, and promoting themselves (the four Ps of the marketing mix¹¹). These four Ps have begun to be replaced by the four Cs, which are content, context, connection, and community (Merodio, 2010). The traditional structures of marketing and relationships socially incorporate all of the digital aspects to achieve applications such as social e-commerce, social CRM, and social media applications.

Current tendencies have confirmed the strength of using the components of Web 2.0 in relationship marketing and have created the term *cloud computing*, which is a new model for presenting business and technology services that permit users to become eligible for a catalogue of standardized services and to respond to the needs of their businesses in a way that is flexible and adaptable in the cases of unforeseen demands and challenges, having them only pay for what they actually consume¹². The benefits of cloud computing create personal campaigns that are immediate and of a global reach.

New concepts such as u-commerce (ubiquitous) extend the facilities available through e-commerce (electronic) and m-commerce (mobile) towards a fully integrated system of communication access and transaction processing (Jones and Ranchhod, 2007).

Ryals and Knox (2001) claim that technology has the potential to transform relationship marketing by knowing the market, supporting decision-making and facilitating client transactions. Some industries, such as financial services, have taken the initiative in implementing CRM strategies because their transactions are essentially based on ICT, and these companies have a great deal of information about their clients. However, the use of technology alone is not sufficient. Although the majority of financial-services companies have at least some kind of database on their clients, they are not able to develop relationships with the clients. The evolution of technology should be combined with a relationship marketing philosophy that requires the reorganization of the business around the needs of clients.

Conversely, because new information technologies came about to deal with situations that are characterized by quick changes, bringing the economic situations into a context of doubt opens considerable possibilities for the treatment of these problems. At

the centre of these techniques, a new philosophy has emerged from the multivalent reasoning that had created a theory of fuzzy subsets, so that there have been fruitful results in other fields of knowledge (Gil-Lafuente, 1997).

Subsequently, we will present the application of fuzzy models for the treatment of relationship strategies in the context of uncertainty, using the support of technology to calculate complex situations.

APPLICATION OF FUZZY MODELS SUPPORTED BY TECHNOLOGY FOR RELATIONSHIP STRATEGIES

Fuzzy models are models based on "fuzzy" or diffuse mathematics and logic. These are mathematical models that contemplate the properties of fuzzy numbers (Gil-Aluja, 1999); fuzzy models are better adapted to the real world in which we live because they allow us to better understand expressions such as "it is very hot," "he is not very tall," and "I like it a little bit". The key to this adaptation to language is based on understanding the quantifiers of our language ("very" and "a little bit," in the above examples). The rules that require an engine of inference in a fuzzy system can be formulated by experts turned on by its own system, using, in this case, the networks of neurons to strengthen future decision-making (Gil-Lafuente, 1997). It is difficult to represent all the systems that encompass human action, such as people who make decisions in companies, by using classical mathematical analysis and quantitative modelling, given that they have characteristics that complicate their quantitative treatment because: (a) the reasoning and decision-making of the people who use natural language, which plays a fundamental role as a mechanism of expression and definition within the social sciences, thus this provides a vagueness or doubt in natural language that mathematical models cannot express to the fullest extent; and (b) the complexity of the systems in question resists the formulation of an exact mathematical calculation.

In these cases, fuzzy models are presented as ideal tools for the formulation and simulation of these systems. These models try to capture human reasoning by using the relationship of cause and effect that is expressed in terms that are linguistic or vague. The theory of fuzzy combinations (Zadeh, 1965) subsequently contributed to the concept of variable linguistics, introducing a kind of word for the treatment of these quantitative models in which the diffuse, vague, and imprecise terms are fundamental. In recent decades, the use of these models has peaked because of the incredible results that have been achieved in different fields of science.

The underlying idea of all of these techniques consists of extracting the knowledge of an expert to identify a concrete situation in the state of the system and to establish the adequate action that is conducted. Owing to the complexity of the systems, these situations or states are expressed in terms that are vague and linguistic. For this reason, the use of fuzzy connections, linguistics that are variable, and, in general, the relationship mechanisms that are used in multivalent logic (Lukasiewicz, 1920) are shown to be adequate for their modelling.

In general, the creation of these fuzzy models expresses linguistic rules in the form of deductive knowledge that uses experts. This creation process can turn into complicated mathematical techniques that, thanks to technology using computers that can rapidly calculate and store enormous sets of data, can simulate real conditions and can model complex systems for decision-making.

Fuzzy models have, until now, been used mainly in the fields of finance and economic sciences, but we believe that these models apply perfectly to relationship marketing. With marketing in general, as with relationship marketing in particular, fuzzy models present ideal conditions with which to simulate real-life situations in the

¹⁰ Source: BBC News <http://news.bbc.co.uk/2/hi/business/8556865.stm> , <http://www.motorpasion.com/tag/caso-pedalgate>

¹¹ Source: Kotler and Armstrong, 2002

¹² Gartner Newsroom: <http://www.gartner.com/it/page.jsp?id=707508>

relationships between companies and their clients. Such issues help companies to understand the different grades of satisfaction from clients and to interpret and incorporate emotional aspects of the client-company relationship in their marketing strategies; the level of dissatisfaction that clients feel when they file complaints can be conveniently represented through fuzzy models thanks to the representation of variable linguistics.

To work with fuzzy models, we should know ahead of time the concept of valuation. Valuation is a numerical expression in an adequate scale of values that we associate with a phenomenon that is perceived by our senses or by our experience (Gil-Lafuente, 2001).

Valuations can be expressed through integers, relatives, and superlatives and also through values that are subjectively associated with language words. It is frequently the case that such values use numbers between 0 and 1. In this case, we should not confuse valuation with probability. A valuation is a subjective piece of data supplied by a person or by various people. Probability is an objective piece of data that is theoretically accepted in a general character. The notion of probability is connected to chance, whereas valuation is connected to uncertainty (Gil-Lafuente, 2001).

We can consider that valuation expresses a level of truth by means of a number, interval, or the like between 0 (false) and 1 (true). If one considers the valuation by using a number, one can choose an infinite number of semantic correspondences from falsehood to truth. A scale of 10 (11 values between 0 and 1, with both included) is the most commonly used, and its semantic correspondence can be expressed according to Table 1.

To continue with this example, we will demonstrate the application of the fuzzy model known as the forgotten effects model, developed as a tool of information applied to the strategy of Precisely in all the processes of a sequential nature, in which the incidences are transmitted as a chain, it is usual to omit a stage relationship marketing.

Application of the forgotten effects model using the information programme FuzzyLog® in a relationship marketing strategy

As an example of a fuzzy model applied to relationship marketing, we chose the forgotten effects model developed by Kaufman and Gil-Aluja (1988). This model is appropriate to identify aspects that were not taken into account when making a decision.

The model assumes that all events, phenomena, and facts that surround us are being subjected to some kind of cause-and-effect incidence. Despite a good control system, there is always the possibility of not taking into consideration or forgetting the voluntary form of some casual relationships that do not always turn out to be explicit, evident, or visible and normally are not directly perceived. Habitually, these incidental relationships are obscured by some effects, existing as accumulations of causes that provoke them. The concept of incidence can be associated with the idea of function and turns out to be present in the actions of every human being voluntarily or involuntarily. Every part that is forgotten has secondary consequences that have repercussions across the whole network of incidence relationships in ways that build on themselves.

Incidence is an eminently subjective concept that is usually difficult to measure, but its analysis allows the improvement of logical action and decision-making (Gil-Lafuente and Barcellos de Paula, 2010).

Gil-Lafuente and Luis-Bassa (2011) used the forgotten effects model to find the incidences between the services of support and attention that companies offer to their clients and the expectations that the clients have of companies, that is, the attributes that they

Table 1. Valuation scale of 10.

0	No incidence
0.1	Practically no incidence
0.2	Almost no incidence
0.3	Very weak chance of incidence
0.4	Weak incidence
0.5	Medium incidence
0.6	Considerable incidence
0.7	Good incidence
0.8	Strong incidence
0.9	Very strong incidence
1	Highest incidence

Source: Adapted from Kauffman and Gil Aluja, 1989.

believe will be available when they receive a service.

In order to establish the answers that companies offer to meet the requirements of their clients, we contacted the management of 10 transnational companies of mass consumption in the financial, technology, and telecommunications sectors, who are considered to be experts in the tools of communication with clients. From these surveys, we obtained a list of services and ways of communicating with clients, which is shown in Table 2, identified as the causes.

Regarding the attributes contemplated by clients when they receive services, we used 12 dimensions of quality that are listed and conformed to the work that comes from Parasuraman et al. (1985), as well as from the contribution of the authors as a product of their research. These dimensions were identified as the effects and are shown in Table 3.

With these two tables, and using the valuation scale of 10, we estimated the impact that the offered services have on the businesses to attend to their clients' expectations. According to the mathematical model of the research into forgotten effects, for the estimation of the influence of a service that the companies offer on the expectations of the clients, the impact of the offered service is quantitatively valued according to the expected attributes, applying the relationship of the direct fuzzy implication indicating into which grade of action the offer of service fell under the attributes in column j. This is how the semantic value scale was applied in Table 1.

With the values coming from a pilot survey of a group of 20 clients from service companies, we elaborated the matrices of incidence that show the continuation. These clients were asked to make semantic value judgments for each element of the matrices using the scale presented in Table 1. For this exercise of valuation, we considered the clients of service companies as a group of "experts" who know firsthand the effects of the services offered by the companies (Table 2), using their perceptions (Table 3).

The values submitted by the clients in each intersection of the three matrices (cause-effect, cause-cause, and effect-effect) were in the range defined in Table 1. The results from the first matrix, cause-effect, are expressed in the matrix of Figure 3, identified with matrix $[M]$:

The content of the matrix $[M]$ represents the weight that customers gave to each of the dimensions to suit the instrument of service provided by the company. For example, for the service offered by the company through a sales executive, the communication dimension has a very strong incidence, while the

Table 2. Causes, services offered.

a1: Sales executives
 a2: Product brochures
 a3: Informative e-mails
 a4: Internet sites
 a5: Satisfaction surveys
 a6: Mail or sites to receive feedback from clients
 a7: Automatic shopping orders
 a8: VIP services
 a9: Self-management on the Internet
 a10: Various methods of payment
 a11: Client-satisfaction executives
 a12: Complaint lines
 a13: Suggestion/complaint boxes
 a14: Answering machines (ADLs)
 a15: Centralized call centers

Table 3. Effects, expected attributes.

b1: Reliability
 b2: Sensitivity
 b3: Ability
 b4: Accessibility
 b5: Courtesy
 b6: Communication
 b7: Credibility
 b8: Sense of security
 b9: Understanding the client
 b10: Tangible elements
 b11: Recognition
 b12: Flexibility

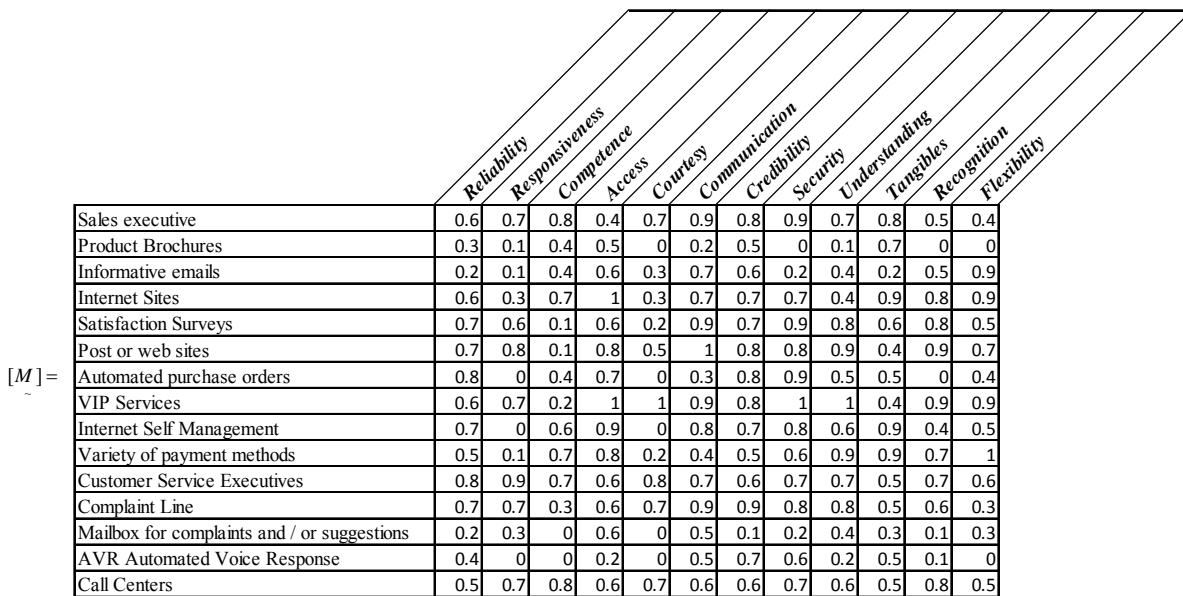


Figure 3. Matrix [M]: cause-effect.

flexibility dimension has a weak incidence.

To establish the incidental relationship that can be given between the elements of services offered by companies, the incidence relationship was determined using the matrix of fuzzy implications indicating to what degree the action of the offer of service from column i have influenced the valued attribute of column j (applying the semantic value scale indicated in Table 1). Figure 4 shows the results of the achieved evaluation.

The content of the matrix [A] represents the weight that customers gave to each of the instrument services provided by the company to suit with itself. For example, for the service offered by the company through a sales executive, the product brochures instrument has a very weak chance of incidence, while the VIP services has a very

strong incidence.

To establish the incidence relationships that can be given between the elements of the attributes that are valued by clients, we determined the incidence relationship in the fuzzy implication matrix indicating to what degree the valued attribute in row i has influenced the valued attribute in column j (applying the semantic value scale indicated in Table 1). In Figure 5, the results of the achieved evaluation are represented.

The content of the matrix [B] represents the weight that customers gave to each of dimension of quality to suit with itself. For example, for the dimension reliability, the competence dimension has almost no incidence, while the security dimension has a very strong incidence.

[A] =

	Sales executive	Product Brochure	Informative email	Internet Sites	Satisfaction Surveys	Post or web sites	Automated purchase orders	VIP Services	Internet Self Management	Variety of payment methods	Customer Service Executives	Complaint Line	Mailbox for complaints and / or suggestions	AVR Automated Voice Response	Call Centers
Sales executive	1	0.3	0.7	0.6	0.7	0.5	0.4	0.9	0	0	0.2	0	0	0	0.1
Product Brochures	0.8	1	0.3	0.6	0.4	0.2	0.9	0.7	1	0.6	0.7	0.5	0	0.1	0.6
Informative emails	0.4	0.3	1	0.6	0.8	0.9	0.8	1	0.8	0.9	0.8	0.6	0.2	0.1	0.5
Internet Sites	0.6	0.7	0.9	1	1	1	1	1	1	0.8	0.7	0.1	0.2	0	0.3
Satisfaction Surveys	0.8	0.7	0.8	0.8	1	0.9	0.2	0.9	0.2	0.7	0.9	0.9	0.2	0.8	0.7
Post or web sites	0.9	0.3	0.8	0.8	0.7	1	0.2	0.7	0.6	0.4	0.8	0.8	0.5	0.2	0.8
Automated purchase orders	0	0.6	0.7	0.8	0.5	0.7	1	0.3	1	1	0.6	0.4	0.2	0.1	0.7
VIP Services	1	0.6	0.9	0.8	1	0.9	0.3	1	0.2	0.9	0.8	0.8	0.7	0.2	0.1
Internet Self Management	0.1	0.8	0.9	1	0.8	0.9	1	1	1	0.9	0.8	0.3	0.2	0.7	0.9
Variety of payment methods	0.1	0.2	0.5	0.8	0.4	0.3	0.9	1	1	1	0.6	0.2	0.1	0	0.3
Customer Service Executives	0.8	0.8	0.9	0.7	1	0.8	0.2	0.8	0.2	0.1	1	0.9	0.3	0.4	1
Complaint Line	0.6	0	0	0.1	0.8	0.8	0.2	0.6	0.6	0.4	1	1	0.8	0.9	1
Mailbox for complaints and / or suggestions	0.3	0.2	0.3	0.3	0.9	0.8	0.1	0.9	0.5	0.3	0.8	1	1	0.1	0.6
AVR Automated Voice Response	0	0.1	0.2	0.2	0.5	0.4	0.6	0	0.2	0.2	0.3	0.2	0.1	1	0.8
Call Centers	0.3	0.7	0.8	0.8	0.9	0.8	0.5	0.7	0.9	0.4	1	1	0.2	0.5	1

Figure 4. Matrix [A]: cause-cause.

[B] =

	Reliability	Responsiveness	Competence	Access	Courtesy	Communication	Credibility	Security	Understanding	Tangibles	Recognition	Flexibility
Reliability	1	0.6	0.2	0.3	0.5	0.7	0.7	0.9	0.8	0.2	0.6	0.5
Responsiveness	0.4	1	0	0	0.8	0.7	0.4	0.4	0.5	0.2	0.2	0.9
Competence	1	0.2	1	0.3	0.2	0.5	0.8	0.7	0.8	0.5	0.5	0.7
Access	0.5	0.6	0.3	1	0.7	0.7	0.5	0.4	0.5	0.3	0.3	0.4
Courtesy	0.4	1	0.3	0.4	1	0.8	0.6	0.7	0.8	0	0.3	0.3
Communication	1	1	0.2	0.5	0.8	1	0.8	0.7	0.7	0.4	0.9	0.5
Credibility	1	0.8	0.6	0.6	0.6	0.8	1	0.9	0.7	0.6	0.6	0.3
Security	1	0.8	0.2	0.6	0.5	0.6	0.7	1	0.7	0.9	0.4	0.4
Understanding	0.8	1	0.3	0.7	0.8	1	0.9	0.9	1	0.3	0.9	0.5
Tangibles	0.9	0.8	0.7	0.4	0.3	0.3	0.8	0.9	0.7	1	0.4	0.3
Recognition	0.8	0.8	0.7	0.4	0.5	0.7	0.9	0.8	1	0.4	1	0.6
Flexibility	0.7	0.9	0.9	0.7	0.5	0.4	0.4	0.5	0.8	0.3	0.3	1

Figure 5: Matrix [B]: effect-effect.

		Reliability	Responsiveness	Competence	Access	Courtesy	Communication	Security	Understanding	Tangibles	Recognition	Flexibility	
a_1	Sales executive	0.3	0.2	0.1	0.5	0.2	0	0.1	0	0.2	0.1	0.4	0.5
a_2	Product Brochures	0.6	0.7	0.4	0.4	0.8	0.6	0.3	0.9	0.7	0.2	0.8	0.7
a_3	Informative emails	0.8	0	0.5	0.4	0.7	0.3	0.3	0.8	0.6	0.7	0.4	0
a_4	Internet Sites	0.4	0.7	0.2	0	0.7	0.3	0.2	0.3	0.6	0	0.1	0
a_5	Satisfaction Surveys	0.2	0.3	0.8	0.3	0.7	0	0.2	0	0.1	0.3	0.1	0.4
a_6	Post or sites to receive customer feedback	0.3	0.2	0.7	0	0.3	0	0.1	0.1	0	0.5	0	0.1
a_7	Automated purchase orders	0.1	0.9	0.5	0.2	0.8	0.6	0.1	0	0.4	0.4	0.9	0.6
a_8	VIP Services	0.4	0.3	0.7	0	0	0.1	0.1	0	0	0.5	0	0
a_9	Internet Self Management	0.3	1	0.3	0.1	1	0.2	0.2	0.2	0.4	0	0.5	0.4
a_{10}	Variety of payment methods	0.5	0	0.2	0.2	0.8	0.6	0.4	0.4	0.1	0	0.2	0
a_{11}	Customer Service Executives	0.1	0	0.2	0.2	0	0.2	0.3	0.2	0.1	0.4	0.2	0.3
a_{12}	Complaint Line	0.2	0.2	0.5	0.2	0.1	0	0	0.1	0	0.3	0.3	0.6
a_{13}	Mailbox for complaints and / or suggestions	0.7	0.6	0.9	0.3	0.2	0	0	0.1	0.1	0.4	0.3	0.6
a_{14}	AVR Automated Voice Response	0.4	0.8	0.8	0.4	0.7	0.2	0.1	0.2	0.6	0.2	0.7	0.7
a_{15}	Call Centers	0.4	0.2	0	0.3	0.1	0.3	0.3	0.2	0.2	0.4	0.1	0.4
		b_1	b_2	b_3	b_4	b_5	b_6	b_7	b_8	b_9	b_{10}	b_{11}	b_{12}

Figure 6: Matrix [O] of forgotten effects

Once the information regarding the three matrices was obtained, we began the calculations that allowed us, first, to obtain the second-order incident matrix, that is, the relationship of accumulated causality.

For this purpose, we proceeded with the max-min composition¹³ of the three matrices:

$$[A] \circ [M] \circ [B] = [M^*]$$

The *FuzzyLog*® software was used to conclude the calculations that permitted us to obtain the matrix of forgotten effects that is shown in Figure 6. One detail of the use of the programme *FuzzyLog*® can be found in the Appendix of this work.

RESULTS

This matrix of forgotten effects provides the degree to which the incidental relationships were initially avoided.

They constitute the verification that there are elements that effectively interact between different effects. The outstanding cells show the forgotten effect of a cause over an effect. For example, consider Figures 7 and 8, in which the cause product brochures is illustrated over the effect sense of security.

Consider the two directions in which the obscured elements strain the causality relationship. First, the element that intercedes is the self-management by Internet that, at the same time, affects tangible elements.

In the second case, the cause-and-effect relationship is made possible by automatic shopping orders. In this case, there was an estimation of 0 (no incidence) established between the incidence of product brochures from the company and the sense of security of the client. This relationship ultimately resulted in two interesting cases. In case 1, there is an incidental relationship that tells us that, although there was initially an estimation of 0 (no incidence) in the incidence of product brochures and the sense of security, in reality, this relationship increased to 0.9 (very strong incidence), given that there are two

¹³ The mix-max composition is explained in detail in the book of Kaufman, Gil Aluja J (1988), "Models for investigation of effects forgotten", pages 22-32

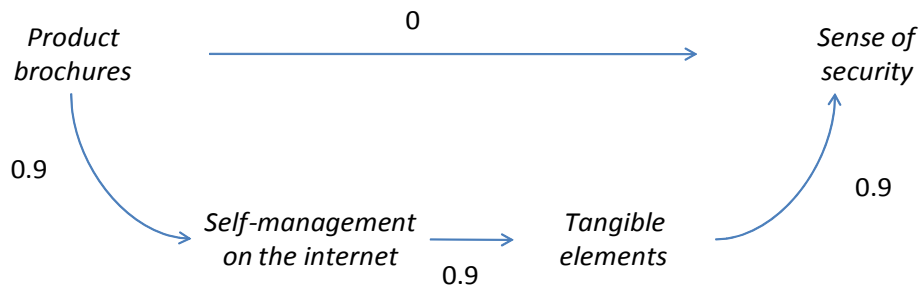


Figure 7. Case 1.

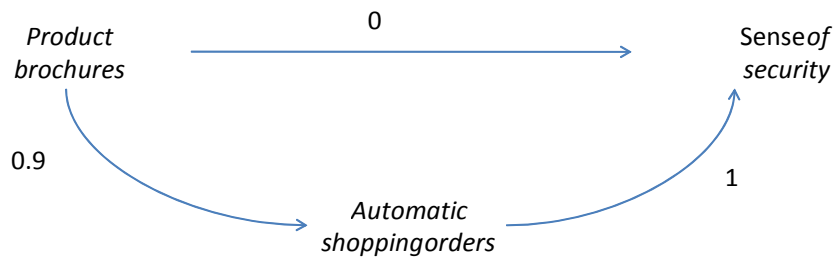


Figure 8. Case 2.

interposed elements. In case 2, again before the initial incidence that was originally established as 0 (no incidence) in the incidence of product brochures and the sense of security, in reality, this relationship increased to 1 (highest incidence) because of the presence of the element automatic shopping orders. This case can be interpreted as follows: having a brochure, means people feel more confident and closer to the products, and they can work more comfortably with automated shopping orders. These results show that firms may not have considered relevant factors in communicating with customers. This omission may result in claims and customer dissatisfaction that companies could avoid. Using this model in relationship marketing can facilitate the understanding of subjective aspects such as customer preferences to contact with the company.

CONCLUSIONS

Information technology has been a key element in the development and application of relationship marketing strategies over the past five decades. The ease with which one can manage and store data, and the immediacy of communication, are two of the aspects that have permitted companies to achieve competitive advantages through self-management of relationships with their clients.

We have also been able to prove how new

technologies, together with the application of a new mathematical model based on the more recent developments in research into the context of fuzziness, have allowed companies to adapt to the evolution of markets. In earlier work, other authors such as Gil-Lafuente (1997) have applied diverse fuzzy models to cases of marketing.

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Implications

This paper presents the possibility, through the use of fuzzy models, to increase both the compatibility of trading quantifiable data and subjective estimations, which are both present in market studies. This gives managers the tools to facilitate data collection using everyday items (like language) without losing the accuracy of mathematical models.

This study combines relational marketing, fuzzy models and ICT, showing the usefulness this combination brings to the business. For scholars, specialists in fuzzy

mathematics are an opportunity to further develop models that facilitate the incorporation of subjective aspects. For information technology professionals, this confirms the growing use of software to facilitate analysis and calculations. Finally, for managers, there is a broad set of tools that allow the adaptation of models to the realities of business organizations. This will save costs on many levels such as data storage, generation of efficient databases, simulation of real situations, and much more.

Limitations

The limitations of these models consist mainly in the correct interpretation of the answers of respondents. The interviewer should choose the appropriate option in the valuation scale of 10 to translate the respondent answer.

Another limitation is the proper selection of the variables used in the model. Selecting the appropriate variables, the surveys will be useful for research. For future research, we intend to apply this model to aspects such as complaints handling.

Conflict of Interests

The authors have not declared any conflict of interests.

REFERENCES

- Avlonitis GJ, Panagopoulou NG (2005). Antecedents and consequences of CRM technology acceptance in the sales force. *Ind. Market. Manage.*, 34(4):355-368.
- Feldstein M (2002). The transformation of public economics research: 1970–2000. *J. Public Econ.* 86:319– 326.
- Gil-Aluja J (1999). *Elements for a Theory of Decision in Uncertainty*. Spain, Milladoiro.
- Gil-Lafuente A (2001). *New strategies for financial analysis of enterprises*. Spain, Ariel Económica.1
- Gil-Lafuente A (2010). FuzzyLog®. www.fuzzyeconomics.com/fuzzylog
- Gil-Lafuente A, Barcellos de Paula L (2010). *An application of the methodology Forgotten Effects: Factors Contributing to Sustainable Growth Company*. Buenos Aires. CIMBAGE.
- Gil-Lafuente A, Luis-Bassa C, (2011). *Identifying the attributes covered by the Clients in a CRM strategy using the Forgotten Effect Model*. Buenos Aires. CIMBAGE.
- Gil-Lafuente J (1997). *Marketing for the New Millennium*. Spain. Pirámide.
- Jones S, Ranchhod A (2007). Marketing strategies through customer attention: beyond technology-enabled customer relationship management. *Int. J. Electron. Customer Relat. Manage.* 1(3):279-286.
- Kaufman A, Gil Aluja J (1988). *Models for investigation of effects Forgotten*. Spain. Milladoiro.
- Lukasiewicz J (1920). On three-valued logic. *Ruch Filozoficzny* 5:170-171.
- Merodio J (2010). *Social Media Marketing*. e-book Creative Commons.
- Olsen K (1983). *Digital Equipment Corporation: The First Twenty-Five Years*. New York. The Newcomen Society in North America.
- Parasuraman A, Zeithaml V, Berry L (1985). A Conceptual-Model of Service Quality and Its Implications for Future-Research. *J. Mark.*, 49(4):41-50.
- Parise S, Guinan P, (2008). *Marketing using Web 2.0*. 41st Annual Hawaii International Conference on System Sciences pp.2254-2260.
- Rust R, Espinoza F (2006). How technology advances influence business research and marketing strategy. *J. Bus. Res.* 59:107-1078.
- Ryals L, Knox S (2001). Cross-Functional Issues in the Implementation of Relationship Marketing Through Customer Relationship Management (CRM). *Eur. Manage. J.*, 19(5):534-42.
- Schmitt B (2003). *Customer Experience Management: A Revolutionary Approach to Connecting with Your Customers*. New York. John Wiley.
- Wright D (1989). *Technology and Performance: The evolution of Market Mechanisms*. *Business Horizons*. November-December: 65-70
- Zadeh L (1965). Fuzzy Sets. *Inform. Control* 8(3):338-353.

APPENDIX

Results of applying the model of relationship between the strategies of serving businesses and attributes valued by customers for calculation of forgotten effects, using the computer program *FuzzyLog*®.

The use of *FuzzyLog*® software made the calculations possible. This program allows managing matrices of enormous dimensions and obtains the results more quickly and more clearly, allowing the data to be interpreted so that they could be used in decision-making. Figure 9 shows the initial screen for the uploading of cause and effect. Figure 10 shows an example of the uploading screen values of the matrices. Figure 11 shows an example of the results screen. Figure 12 shows an example of a resulting graph.



Figure 9. Upload of causes and effects.

FuzzyLog

Acceso usuarios

E-Mail

Password

He olvidado mi Password

Nuevo Cálculo | Listado Modelos |

Relación entre las estrategias de servicio de las empresas y los atributos valorados por los clientes

Estimaciones

Estimar valores entre 0 y 1 (0 / 0,1 / 0,2 / 0,3 /.../ 1)

← Causas y efectos
Resultados →

Estimación de incidencias directas entre causas y efectos

Incidencia de la causa 1 Ejecutivo de ventas	sobre el efecto 1 Confiabilidad	<input style="width: 40px;" type="text" value="0,6"/>
Incidencia de la causa 1 Ejecutivo de ventas	sobre el efecto 2 Sensibilidad	<input style="width: 40px;" type="text" value="0,7"/>
Incidencia de la causa 1 Ejecutivo de ventas	sobre el efecto 3 Capacidad	<input style="width: 40px;" type="text" value="0,8"/>
Incidencia de la causa 1 Ejecutivo de ventas	sobre el efecto 4 Accesibilidad	<input style="width: 40px;" type="text" value="0,4"/>
Incidencia de la causa 1 Ejecutivo de ventas	sobre el efecto 5 Cortesía	<input style="width: 40px;" type="text" value="0,7"/>
Incidencia de la causa 1 Ejecutivo de ventas	sobre el efecto 6 Comunicación	<input style="width: 40px;" type="text" value="0,9"/>
Incidencia de la causa 1 Ejecutivo de ventas	sobre el efecto 7 Credibilidad	<input style="width: 40px;" type="text" value="0,8"/>
Incidencia de la causa 1 Ejecutivo de ventas	sobre el efecto 8 Sensación de seguridad	<input style="width: 40px;" type="text" value="0,9"/>
Incidencia de la causa 1 Ejecutivo de ventas	sobre el efecto 9 Entendimiento del cliente	<input style="width: 40px;" type="text" value="0,7"/>
Incidencia de la causa 1 Ejecutivo de ventas	sobre el efecto 10 Elementos tangibles	<input style="width: 40px;" type="text" value="0,8"/>
Incidencia de la causa 1 Ejecutivo de ventas	sobre el efecto 11 Reconocimiento	<input style="width: 40px;" type="text" value="0,5"/>
Incidencia de la causa 1 Ejecutivo de ventas	sobre el efecto 12 Flexibilidad	<input style="width: 40px;" type="text" value="0,4"/>

Figure 10. Uploading matrix values.

FuzzyLog

Acceso usuarios

E-Mail

Password

Entrar

He olvidado mi Password.

Nuevo Cálculo | Listado Modelos

Relación entre las estrategias de servicio de las empresas y los atributos valorados por los clientes

Resultados

← Estimaciones Causas y efectos →

Resultados del estudio teniendo en cuenta los efectos olvidados

Servicios ofrecidos por las empresas	Atributos valorados por los clientes	Incidencia Estimada	Efecto Olvidado	Incidencia Total	Ver Gráfico
1 Ejecutivo de ventas	1 Confiabilidad	0,6	0,3	0,9	→
1 Ejecutivo de ventas	2 Sensibilidad	0,7	0,2	0,9	→
1 Ejecutivo de ventas	3 Capacidad	0,8	0,1	0,9	→
1 Ejecutivo de ventas	4 Accesibilidad	0,4	0,5	0,9	→
1 Ejecutivo de ventas	5 Cortesía	0,7	0,2	0,9	→
1 Ejecutivo de ventas	6 Comunicación	0,9	0	0,9	→
1 Ejecutivo de ventas	7 Credibilidad	0,8	0,1	0,9	→
1 Ejecutivo de ventas	8 Sensación de seguridad	0,9	0	0,9	→
1 Ejecutivo de ventas	9 Entendimiento del cliente	0,7	0,2	0,9	→
1 Ejecutivo de ventas	10 Elementos tangibles	0,8	0,1	0,9	→
1 Ejecutivo de ventas	11 Reconocimiento	0,5	0,4	0,9	→
1 Ejecutivo de ventas	12 Flexibilidad	0,4	0,5	0,9	→
2 Folletos de productos	1 Confiabilidad	0,3	0,6	0,9	→
2 Folletos de productos	2 Sensibilidad	0,1	0,7	0,8	→
2 Folletos de productos	3 Capacidad	0,4	0,4	0,8	→
2 Folletos de productos	4 Accesibilidad	0,5	0,4	0,9	→
2 Folletos de productos	5 Cortesía	0	0,8	0,8	→

Figure 11. Results screen.

Relación entre las estrategias de servicio de las empresas y los atributos valorados por los clientes

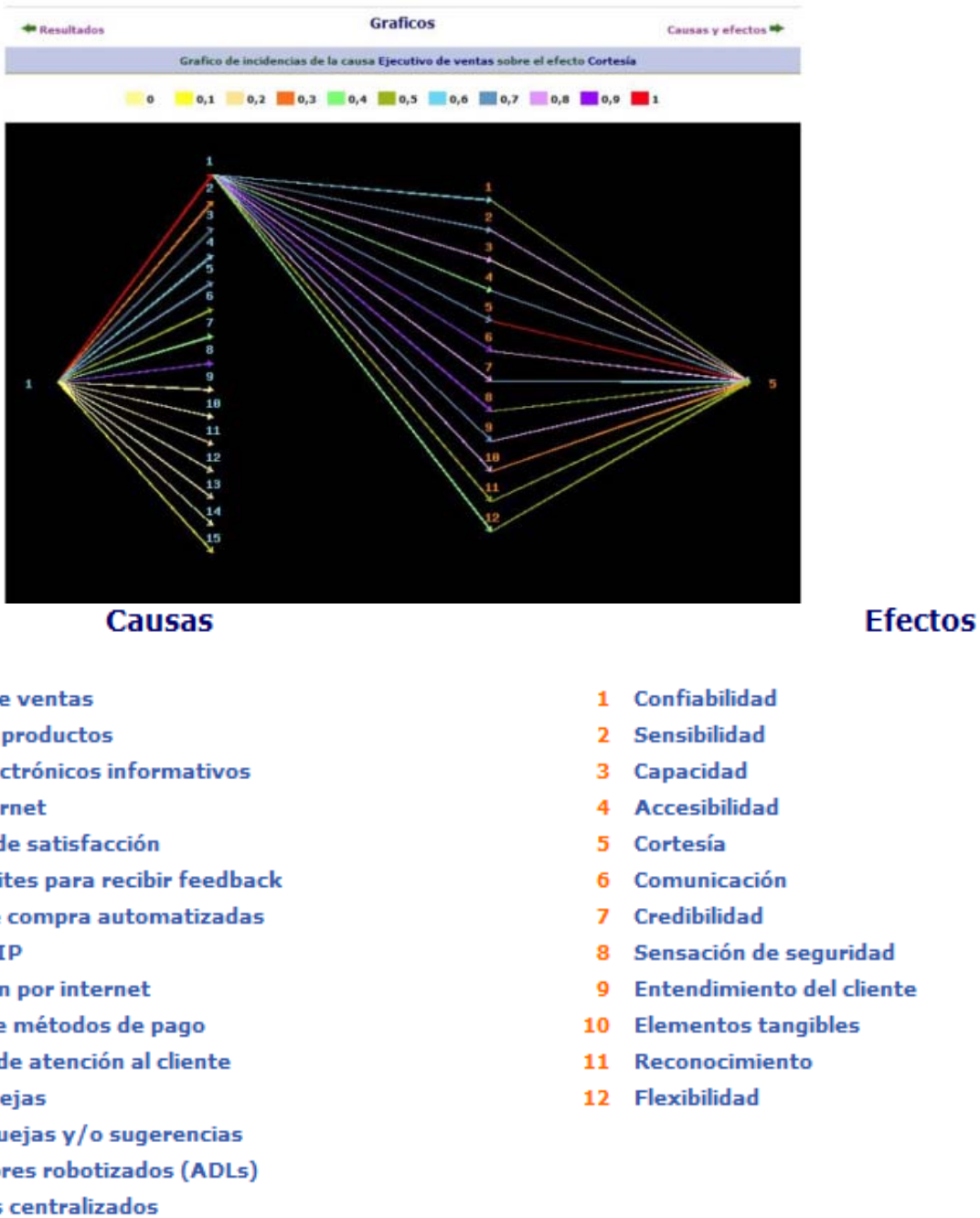


Figure 12. Graph of causes and effects.