



## ENHANCING KNOWLEDGE AND STRATEGIC PLANNING OF BANK CUSTOMER LOYALTY USING FUZZY COGNITIVE MAPS

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**Abstract.** Understanding customer loyalty has been a growing concern for the services industry. In a context of increasing competitive pressures, such loyalty is seen as a key element in service companies' success. Maintaining customer loyalty and identifying its underlying factors, however, are recognizably difficult to do. Grounded on the use of cognitive mapping techniques, this paper proposes a knowledge-based framework for the identification of the key determinants of customer loyalty, and the relationships among them. A step-by-step guide to the development of such a framework is presented, and illustrated through a practical application in the banking context. The resulting findings are supportive of the applicability of such methods for understanding customer loyalty, and the improvement of long-term relationships with customers. They are furthermore indicative of new ways in which knowledge can be incorporated into management activities to improve service outcomes. Some managerial implications of our contribution and avenues for future research are also reported.

**Keywords:** customer loyalty, fuzzy cognitive mapping, knowledge enhancement, problem structuring, service improvement.

**JEL Classification:** C44, G20, M10.

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## Introduction

Consistently considered “hot topics” in service industries, service quality and customer loyalty have long been recognized as critical driving forces of business performance for firms wishing to gain sustainable competitive advantages (*cf.* Amin *et al.* 2011; Lee, Chulhyun 2014; Ferreira *et al.* 2015a). And in the current context of generalized macroeconomic recessions, increased competition, and every more informed and demanding customers, these issues have arguably achieved unprecedented levels of importance.

Identifying the factors that most contribute to creating and maintaining service quality and customer loyalty, however, is notoriously difficult. These are subjective matters and depend on a variety of multi-faceted variables, which greatly complicates decision making and choices with regard to the most effective means of strengthening this loyalty (Salinas, Schinzano 2014; Jalali *et al.* 2016). Furthermore, customer loyalty is only one of many factors upon which firm profitability is likely to depend.

At the same time, the increasing volatility and competitiveness of the business environment have caused a wider shift in organizational priorities and concerns. Concerns over long term planning or top-down directives, for instance, are being replaced with preoccupations with organizational agility and employee involvement; and within this context, the issue of knowledge has risen to the forefront (Farquhar, Panther 2008; Ferreira *et al.* 2014). How can organizations, particularly those within the services industry, for which employee engagement and contact with customers is of notable concern, tap into the knowledge of their workers? And how can they provide the conditions for the continuous creation of new knowledge, and ensure its use and application for business success?

This paper aims to answer these questions and bring together these two inter-related concerns of understanding customer loyalty and creating and using knowledge; and proposes fuzzy cognitive maps (FCMs) as one way to address them.

Cognitive mapping has been widely applied to the treatment of complex decision problems (*cf.* Belton, Stewart 2002; Eden, Ackermann 2004; Ackermann 2012; Ferreira *et al.* 2014; Filipe *et al.* 2015); and FCMs in particular are considered “*a well-established artificial intelligence technique, incorporating ideas from artificial neural networks and fuzzy logic, which can be effectively applied in the domain of management science*” (Carlucci *et al.* 2013: 208).

As such, this paper aims to explore the applicability of these maps in supporting the identification of key determinants of customer loyalty and enhancing the levels of transparency in the decision making processes related to these variables. By applying this methodology to bank customer loyalty in particular, we also aim to show that the use of FCMs can give rise to conceptually coherent and empirically valid knowledge-based frameworks to dynamically analyze and understand the reciprocal influence of key determinants of customer loyalty (in this case, within banks). From a practical point of view, such a framework can be used to strengthen current approaches to customer loyalty management, providing an indication as to which best practices could be followed to boost long-term relationships with customers. To the best of our knowledge, the application of FCMs to enhance transparency and knowledge use in this context is a novel approach in the literature and, thus, this framework contributes to advance theory and empirical research on customer loyalty, service management and operational research.

The paper is structured as follows: the next section provides an overview of related work on customer loyalty, and then focuses on our application context (the banking industry) in particular. The following section presents the methodological background of our application; the ensuing section describes the steps followed for the construction of our FCM, highlighting the results obtained and presenting managerial recommendations; the final section presents concluding remarks and avenues for future research.

## 1. Related work

Customer loyalty has been a fast growing concern for companies in the service industry. It is generally accepted that “loyal customers are more likely to concentrate on long-term benefits from the relationship and are more willing [...] to develop mutual benefits than non-loyal customers are” (Martin et al. 2009: 589); and this, in turn, is expected to allow service companies to more effectively achieve their financial and business goals. Such loyalty-based market success is all the more likely when customers’ fealty stems from higher levels of satisfaction (cf. Dekker, Post 2000; Farquhar, Panther 2008; Amin et al. 2011; Ferreira et al. 2015b). According to Bayraktar et al. (2012: 99), “higher customer satisfaction and loyalty can lead to stronger competitive position resulting in larger market share and profitability”.

The importance and increasing focus on customer loyalty notwithstanding, it is also generally recognized that, due to the unique features of services (e.g. intangibility, inseparability of production and consumption, and heterogeneity), the evaluation of customer loyalty in this domain is particularly difficult and complex (Jalali et al. 2016). Finding novel ways to understand and measure customer loyalty in the services, then, is of particular interest. Academically, it would advance our understanding of customer loyalty and its determinants; and in practical terms, such advances can provide managers with more directed insights as to how to increase their customers’ attachment and loyalty to their services. Mihelis et al. (2001: 347) note the importance of identifying the factors underlying customer loyalty, since these determinants offer “an immediate, meaningful and objective feedback about clients’ preferences and expectations”, which can in turn provide firms with better decision support mechanisms and the potential for better portfolio management (see also Nadiria et al. 2009).

Understanding the determinants that most contribute to customer loyalty can allow service companies to: (1) understand and target customers; (2) anticipate customer needs and preferences; (3) define a suitable business profile for each customer; (4) adapt promotional campaigns to customer needs; (5) be aware of the profitability of each customer; and (6) increase the degree of appropriateness and intervention of client account managers (for discussion, see Salinas, Schinzano 2014; Jalali et al. 2016).

Given the importance of customer loyalty, it is not surprising that appreciable progress has taken place over the years in attempting to understand its determinants. Research has focused on variables such as: *perceived service quality*, *perceived value*, *customer expectations*, *trust*, *switching cost* and *firm image* (for an in-depth discussion, see Garland, Gendall 2004; Ehigie 2006; Manrai, L., Manrai, A. 2007; Vesel, Zabkar 2009; Yoon et al. 2010; Aghdaie et al. 2012; Bobâlcă et al. 2012; Dhebar 2013; Yoo, Bai 2013). Despite the undeniable merit of such research, it is worth noting that there is still room for more comprehensive representations of

the domain, and for frameworks able to incorporate decision makers' own beliefs and convictions. The conventional approaches typically applied to the study of customer loyalty are unable to do this, in effect leaving a large amount of knowledge in the organization untapped. Furthermore, most of the existing contributions show the end results, but do not explain why they emerge, or how they can be improved. Notable exceptions include Lee *et al.* (2010), who used a means-end chain approach to elaborate a hierarchical loyalty map; however, the result is nonetheless that there is still an array "of factors that limit a comprehensive understanding of customer loyalty and prevent the generalization of research findings" (Pan *et al.* 2012: 150).

Indeed, existing contributions do not put the discussion on the determinants of customer loyalty to rest and, as recognized by Hsieh (2004), the use of other modern approaches, such as neural networks and fuzzy logics, represents a promising avenue in this field of research. In this sense, there appears to be substantial scope to explore the use of fuzzy cognitive mapping to improve our understanding of the customer loyalty phenomenon, using the knowledge of those most directly involved with those customers in day-to-day operations.

The current paper thus aims to examine the applicability of fuzzy cognitive maps to our understanding of customer loyalty determinants, through a practical application to the banking sector. The significant challenges currently faced by the banking industry, make it a particularly pertinent context of analysis. Indeed, the most recent economic recession has greatly intensified competition among financial institutions (*cf.* Ferreira *et al.* 2012); and as a result, attracting and retaining customers, ensuring complementary margins and reducing lack of liquidity have become priority concerns for these institutions (*cf.* Hartman *et al.* 2001; Howcroft 2006; Minami, Dawson 2008; Ferreira *et al.* 2011; Kowalski, Shachmurove 2011; Amin *et al.* 2012).

Given that "bank branches are the primary place in which consumers have access to products for either building assets and/or obtaining credit" (Serna 2005: 2), this concern over customer loyalty culminates at the bank branch level, where front office employees are seen as a driving-force which can foster customer attraction and retention (*cf.* Bontis *et al.* 2007; Ferreira *et al.* 2011; Farahani 2012). As such, our implementation of fuzzy cognitive maps for the evaluation of bank customer loyalty was also centered at the bank branch level. The next section describes the theoretical foundation of the methodology used, followed by a step-by-step description of its illustrative application within banking.

## 2. Basics of fuzzy cognitive mapping

Cognitive maps have been recognized as important instruments for the structuring and clarification of complex decision situations (*cf.* Eden 2004; Ackermann *et al.* 2011; Ferreira *et al.* 2011; Carlucci *et al.* 2013). As stated by Gavrilova *et al.* (2013: 1758), "maps as visual tools facilitate the representation and communication, support the identification and the interpretation of information, facilitate consultation and codification, and stimulate mental associations". These maps are interactive, versatile, and perhaps most importantly, they foster discussion among decision makers, allowing for a better understanding of decision situations through recourse to participants' existing knowledge and their joint creation of new insights.

Cognitive mapping became an even more powerful tool with the development of fuzzy cognitive maps (Kosko 1986, 1992), which have been extensively applied to a variety of different contexts and decision problems, sharing the common trait of complexity (e.g. Kim, Lee 1998; Stylios, Groumpos 1999; Tsadiras et al. 2003; Carvalho 2013; Ferreira et al. 2015a). In this type of maps, the relationships between criteria can be represented by positive and negative causality; the intensity of which is then translated into a number which can vary from -1 to 1. Specifically, all the values in the map can be fuzzy and, therefore, each concept has a state value  $A_i$  that can be a fuzzy value in the range [0, 1] or a bivalent logic in {0, 1}. Additionally, the weights of the relationships/arcs can be a fuzzy value within [-1, 1] or a trivalent logic within {-1, 0, 1}. As pointed out by Salmeron (2012) and Carlucci et al. (2013), the resulting map then allows for dynamism, by including feedback links between the criteria, as shown in Figure 1, where  $C_i$  is criterion  $i$  and  $W_{ij}$  represents the extent to which criterion  $i$  influences criterion  $j$ . As discussed, this relationship ( $W_{ij}$ ) can be of positive, negative or null causality, depending on whether  $C_i$  causes a move in the same direction, the opposite direction or has no impact on  $C_j$ .

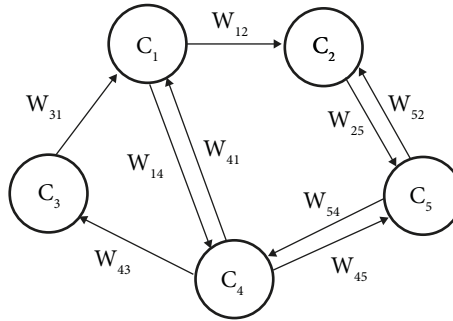


Fig. 1. Example of an FCM  
Source: Mazlack (2009: 5).

Behind this graphical representation, there is a mathematical background. As discussed by Mazlack (2009) and Carlucci et al. (2013), there is a  $1 \times n$  state vector  $A$  that includes the values of the  $n$  criteria; and a  $n \times n$  adjacency matrix  $W$  that gathers the weights  $W_{ij}$  of the interconnections between the  $n$  criteria. Kok (2009) states that non-zero values on the main diagonal might be considered, but the adjacency matrix usually presents all the entries of the main diagonal equal to zero, meaning that no criterion causes itself. The value of each criterion is influenced by the values of the interconnected criteria (with the appropriate weights) and by its previous value. The mathematics behind FCMs can be summarized in formulation (1), where  $A_i^{(t+1)}$  is the activation level of criterion  $C_i$  at time  $t+1$ ;  $A_i^{(t)}$  is the activation level of criterion  $C_i$  at time  $t$ ;  $A_j^{(t)}$  is the activation level of criterion  $C_j$  at time  $t$ ;  $W_{ji}$  is the weight of the interconnection between both criteria; and  $f$  represents a threshold activation function:

$$A_i^{(t+1)} = f \left( A_i^{(t)} + \sum_{\substack{j=1 \\ j \neq i}}^n A_j^{(t)} \cdot W_{ji} \right) \tag{1}$$

As explained by Mazlack (2009: 6), every criterion has a new value at every step of interaction, and “the new state vector  $A_{new}$  is computed by multiplying the previous state vector  $A_{old}$  by the weight matrix  $W$ ”. This means that the overall impact of a change in the value of one criterion can be given by  $A_{new}$ . According to Carlucci *et al.* (2013: 213), “the resulting transformed vector is then repeatedly multiplied by the adjacency matrix and transformed until the system converges to a fixed point. Typically it converges in less than 30 simulation time steps”. The result is that: (1) the impact of changes in the value of any single criterion can be assessed; (2) the strength of variables’ impact on each other can be determined; and (3) “what-if” questions can be formulated, to ascertain the impact on the system as whole of changes in some variables and/or the addition/removal of criteria (for developments, see Kardaras, Mentzas 1997; Tsadiras *et al.* 2003; Yaman, Polat 2009; Salmeron 2012). Based on these considerations, “they [FCMs] have powerful and far-reaching consequences as a mathematical tool for modeling complex systems” (Mazlack 2009: 5), and we propose that there is substantial scope to explore their applicability to the issue of customer loyalty in the services. In particular, we examine and illustrate the application of FCMs in the context of bank customer loyalty.

### 3. Developing the map

In constructing an FCM, “using a group of experts has the benefit of improving the reliability of the final model” (Yaman, Polat 2009: 387), allowing expert knowledge to be tapped into. Although it is difficult to establish the number of members which should compose the expert panel (Salmeron 2009), it has been indicated that “the consultant [*i.e.* researcher] will relate personally to a small number (say, three to ten persons)” (Eden, Ackermann 2001: 22). We therefore chose a number in between and constructed our FCM, during an intensive 7-hour group work session, with six experienced bank branch front office employees from the most well-known banks in Portugal. These panel members operate in the Central-West region of Portugal, and were selected based on their years of experience and willingness to participate. The session was conducted by a facilitator/researcher, accompanied by an assistant technician who was responsible for registering the results. Despite the specificity of the panel used in this study, the process followed can work well with any group of experts, from any industry. The methods used in this study, and their application to bank customer loyalty in particular, are process-oriented, and based on a constructivist and learning-based standpoint (*cf.* Ferreira *et al.* 2015a).

#### 3.1. Identifying concepts and quantifying relationships

Given the decision makers’ limited availability, the group meeting started with a presentation of the research objectives and of the basic concepts related to FCMs, in order to avoid any potential misunderstandings. Given these initial clarifications, the operational phase of the process was started with the following trigger question: “Based on your own values and pro-

*fessional experience, what are the factors/determinants that most influence customer loyalty?”*. This question provided the starting point for the debate/negotiation among the experts, and allowed the “post-its technique” to be applied.

This technique consists of writing what the expert panel members consider as important concepts/determinants on post-its (*i.e.* one concept per post-it), and sticking those post-its on a large piece of paper. Grounded on permanent discussion, this procedure is repeated until the group reveals satisfaction with the number and depth of the concepts identified (see Ackermann, Eden 2001; Ferreira *et al.* 2015b; Filipe *et al.* 2015). In a second phase of the process, the post-its are then organized by segments or areas of concern (*i.e.* clusters), allowing for additional discussion and clarification regarding the significance of each criterion. In the final stage of the technique, each area of concern is then analyzed individually and the post-its are (re)organized following a means-end-based logic.

The process typically concludes with the decision makers’ agreement on the form and content of the map, which once it is consensual, is called the “collective” or “strategic” map. In this study, the conception of the map was supported by the *Decision Explorer* software ([www.banxia.com](http://www.banxia.com)), and the final outcome is (partially) illustrated in Figure 2 (a full and editable version of the map can be obtained from the corresponding author upon request).

Although the context-dependence of the conception of a cognitive map can be seen as a methodological limitation, this is arguably more than compensated by the experts’ direct involvement in its development, and the vast amounts of information and knowledge shared, discussed and created (Ferreira *et al.* 2012). Additionally, in this case, the map provided the participating decision makers with a holistic picture of bank customer loyalty, which allowed determinants typically omitted in previous research to be identified. The framework’s openness to continuous adjustments and updates (*e.g.* inclusion of new concepts) (Xue *et al.* 2010; Filipe *et al.* 2015) was considered extremely positive by the expert panel.

Aiming to dynamically analyze the cause-and-effect relationships previously identified in the cognitive map, the map was reconstructed with the support of the *FCMapper* (<http://www.fcappers.net>) and *Pajek* software (<http://pajek.imfm.si/doku.php>). The combination of these two software packages allowed the group to move forward in the construction of the FCM, namely in terms of the intensity of the relationships. Figure 3 illustrates the new form of the agreed collective map, where the numbers, for simplification purposes, represent the previously identified determinants (a full version using concept names instead of numbers can be obtained from the corresponding author upon request).

The group members were then asked to analyze the intensity of the relationships between criteria. Figure 4 exemplifies the analysis carried out for one of the segments (or clusters), where the intensity of each relationship was quantified and, as already pointed out, ranged from -1 to 1. The analysis was repeated for all the clusters and relationships identified.

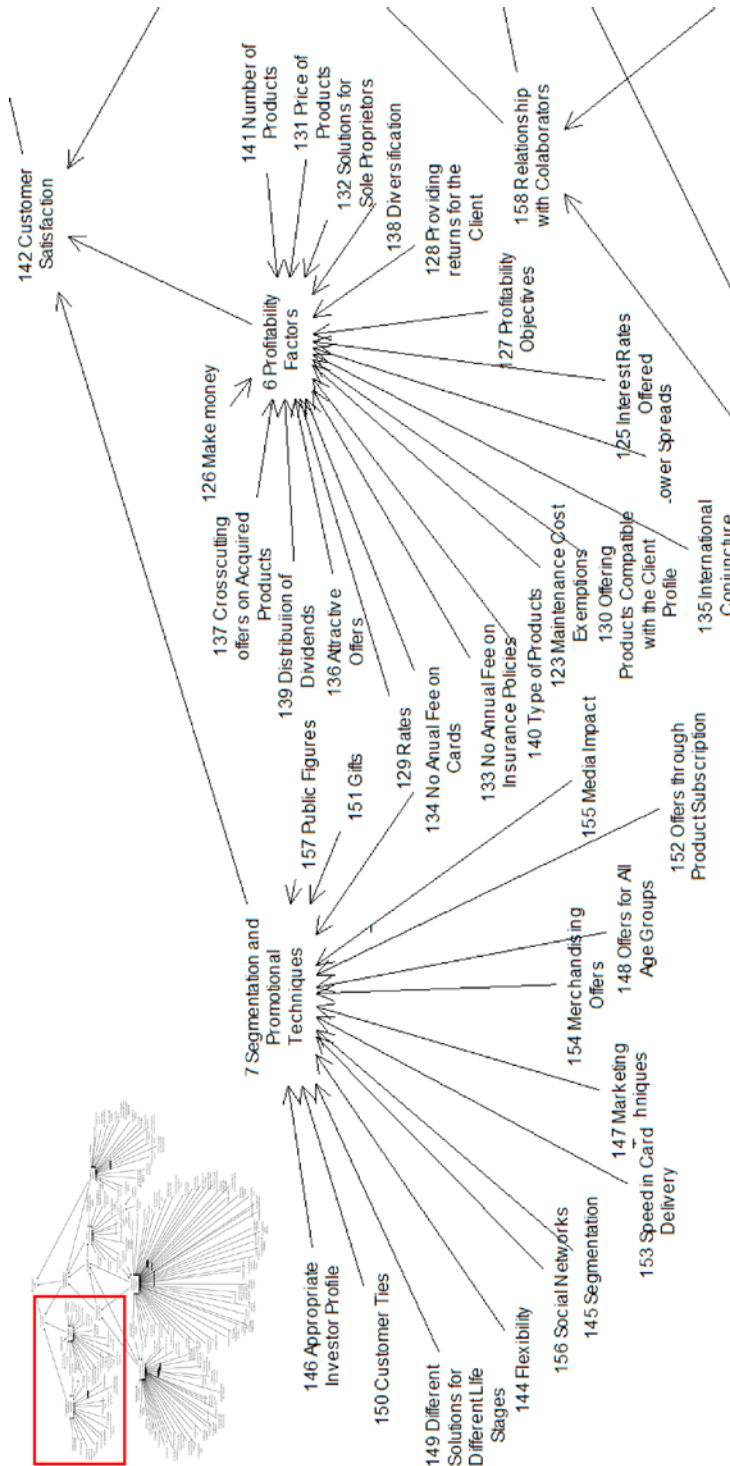


Fig. 2. Part of the collective map  
Source: Adapted from Ferreira et al. (2015b).



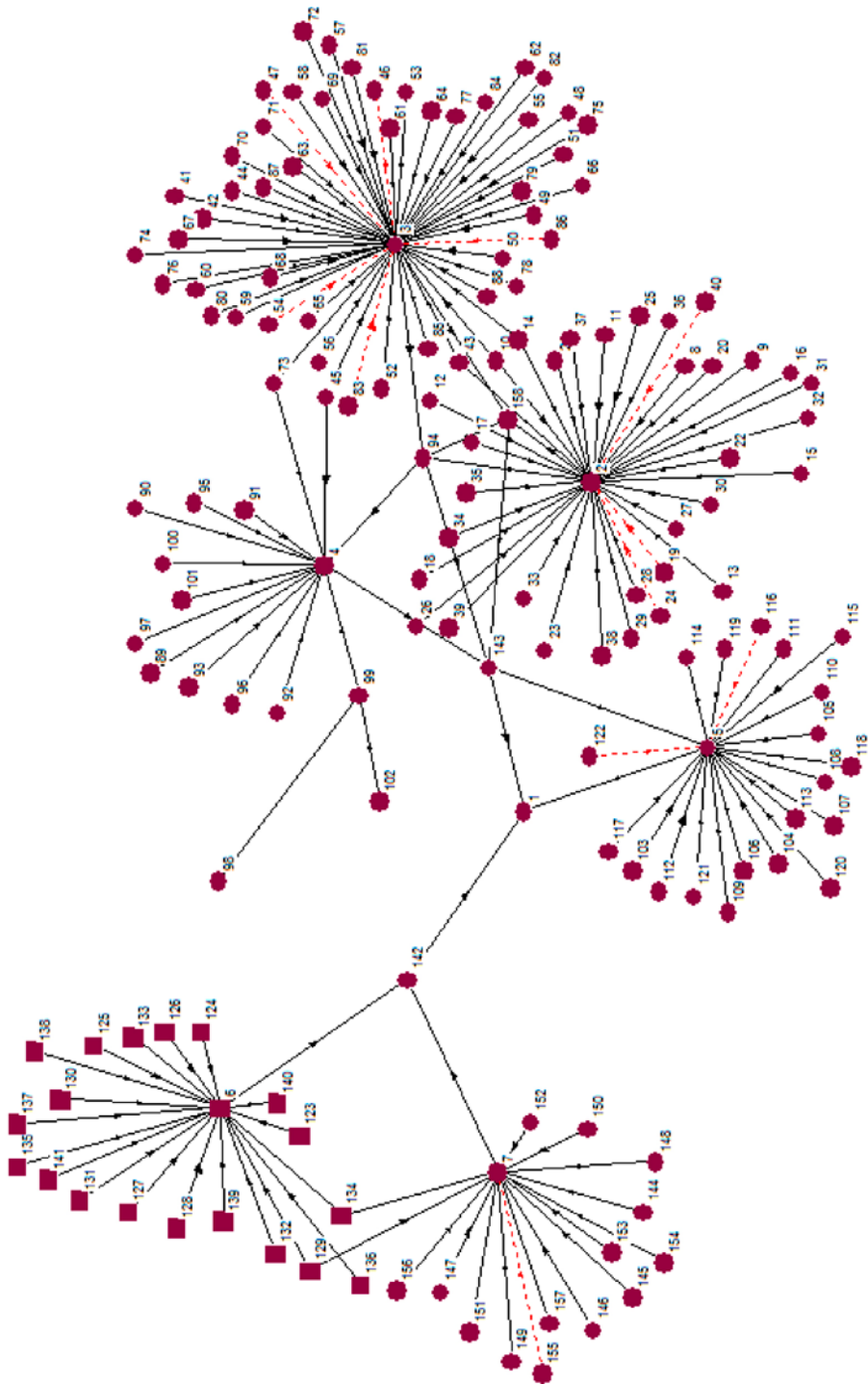


Fig. 3. [Initial] Structure of the FCM

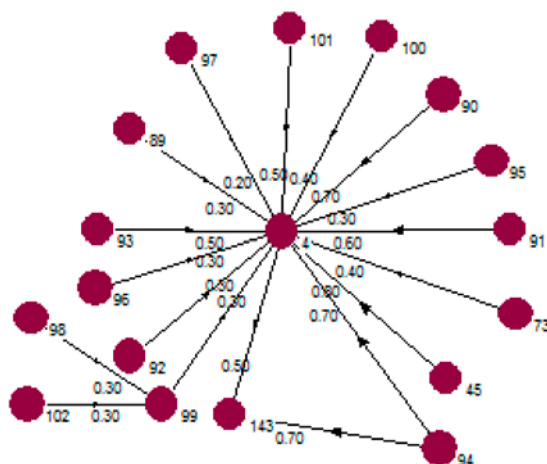


Fig. 4. Quantification of relationships

The panel members were then asked to fill in an adjacency matrix (as described in *Section 3*) containing previously identified degrees of intensity. The final version of the map contained 158 interlinked determinants, resulting in a  $158 \times 158$  weight matrix (which, naturally, cannot be displayed in this paper due to space constraints. The matrix can be obtained from the corresponding author upon request). This procedure served to promote additional discussion on the research outputs, and determined the basis for recommendations (see Salmeron 2009; Papageorgiou *et al.* 2012; Carlucci *et al.* 2013).

### 3.2. Interpreting the research outputs

The final version of our FCM was deeply discussed with and among the expert panel members, and as such represented the result of the negotiation among them, and agreement reached. Because it could have been different had the context or the experts involved been others, or had the session lasted longer, it is important to highlight that rather than a single formulaic answer, the results are aimed at encouraging discussion, while promoting knowledge development and a better understanding of the factors associated with (in this case) bank customer loyalty. As such, a battery of static and dynamic tests was carried out throughout the study; which “*through a proper neural network computational model*” allows us to get “*an idea of the ranking of the variables in relationship to each other according to how the system is perceived in the FCM*” (Carlucci *et al.* 2013: 216). From this premise, and based on the mathematical formulation presented in *Section 2*, *Table 1* reveals the major determinants of bank customer loyalty that resulted from the concept interaction presented in our FCM.

All the determinants comprised in the FCM present a centrality index. However, due to the high number of concepts identified by the participating decision makers, *Table 1* presents only those with the highest centrality indices. In particular, *Collaborators’ Professional Training* and *Collaborators’ Personal Training* appear to have a prominent role as driving forces of bank

Table 1. Major determinants of bank customer loyalty [based on centrality]

Concepts	Reference	Outdegree	Indegree	Centrality
Collaborators' Professional Training	3	1.50	30.40	31.90
Collaborators' Personal Training	2	1.30	20.10	21.40
Profitability Factors	6	0.80	11.80	12.60
Institutional Aspects	5	0.60	9.50	10.10
Segmentation and Promotional Techniques	7	0.70	7.90	8.60
Branch Characteristics	4	0.50	6.30	6.80

customer loyalty, with centrality indices of 31.90 and 21.40 respectively. Albeit grounded on a different methodological basis, our findings allow the results of Arbore and Busacca (2009), Culiberg and Rojssek (2010), Lee *et al.* (2011) and Ferreira *et al.* (2015b) to be reinforced, namely in what refers to the crucial importance of human resources' skills and relational quality in bank branch services.

It should be highlighted, however, that while most of the variables included in the map are not new, the completeness of our FCM allowed important details to be detected (*e.g. no annual fee on cards – cf. Figure 2*), which might otherwise go undetected. In this sense, and as *Table 1* illustrates, the FCM developed offers a real insight into the variables which can improve bank customer loyalty, and thus also provides further empirical evidence that “FCMs are simple, yet powerful tools for modeling and simulation of dynamic systems, based on domain-specific knowledge and experience” (Papageorgiou *et al.* 2012: 45).

The direct extrapolation of our results should be treated with reservation (as discussed in the next subsection). However, it should be noted that, “*from an Artificial Intelligence perspective, FCMs are supervised learning neural systems, where as more and more data is available to model the problem, the system becomes better at adapting itself and reaching a solution*” (Salmeron 2009: 275). In this sense, our framework holds great potential for strategic planning and bank customer loyalty management.

### 3.3. Limitations and recommendations

The development of our FCM allowed the bank branch front office employees to: (1) identify the key determinants of bank customer loyalty; (2) engage in debate throughout the decision making process, thus sharing and co-creating knowledge; and (3) provide important insights about the driving forces and the key feedback loops in the system which can improve the understanding of service provision and bank customer loyalty.

Despite the fact that this type of knowledge basis seems to be increasingly needed in domains characterized as subjective and fuzzy, as is the case of customer loyalty of banks or other services, and that the system created allowed encouraging results to be achieved, it should be noted that this proposal is not without its own limitations. Due to their context-dependence and subjective nature, “*FCM development methods are far from being complete and well-defined, mainly because of the deficiencies that are present in the underlying theoretical framework [...] the development of FCM models almost always relies on human knowledge [... and are] strongly*

depend on subjective beliefs of expert(s) from a given domain” (Stach *et al.* 2005: 372). However, as discussed before, these limitations are offset by the direct involvement of the decision makers, the amount of information discussed and the interactive nature of the procedures, which allow experiences to be shared and insights on the role of key feedbacks in the system to be identified, which might otherwise go undetected by statistical approaches alone (for further discussion, see Stach *et al.* 2010).

## Conclusions and implications

Despite the significant progress achieved over the years in customer loyalty management, current available approaches fall short of comprehensively identifying the driving forces behind this phenomenon, or allowing decision makers to express their own convictions and even knowledge. From this premise, and assuming a non-prescriptive position, this paper aimed to propose and illustrate the application of FCMs to the identification of customer loyalty – in this case, in the context of banking. This methodological option resulted from the fact that FCMs are widely known as neuro-fuzzy systems able to incorporate experts’ knowledge, and model complex decision problems (Mazlack 2009).

The conception of an FCM using a panel of experts in our study allowed key determinants of bank customer loyalty to be identified in a comprehensive manner, which greatly reduced the number of omitted variables *vis-a-vis* conventional models for the identification of such determinants. This greater transparency was further facilitated by the large amounts of information discussed, processed and negotiated in the panel’s debates throughout the development of the FCM. Finally, the resulting knowledge-based framework provided relevant insights into bank customer loyalty, the processes driving it and how they feedback into the system.

As a result, the conception of an FCM in this study also provides empirical evidence that the use of such maps can support the identification of the determinants of customer loyalty and increase the transparency of the cause-and-effect relationships between them, thus holding great potential for strategic planning in, and the management of, service institutions. Although the managerial implications of FCMs can go far beyond the specific context of this study, the application of FCMs to this context is, to the best of our knowledge, a novel approach in the literature.

Because the procedures we have followed are context-dependent, our results are encouraging but subjective in nature. This means that direct extrapolations of these results should be treated with caution. It should be recalled, however, that offsetting this drawback is the direct involvement of the participating decision makers, as well as the amount of information collected and discussed, which allowed experiences to be shared, and new knowledge to be created as determinants of customer loyalty and the relationships between them became better understood. The application of FCMs can thus be of practical consequence for managers (within banks or in other industries) in the planning process of their business activity.

Future research might want to work toward the improvement of our knowledge-based framework. Specifically, it seems important to: (1) replicate this study in other service contexts, to further illustrate the significant impact using FCMs can have in our understanding of customer loyalty; (2) design a panel study within a different country and/or other type of

participants to increase the generalizability; and (3) conduct a survey based on different panel studies to increase the reliability of the results. Improvements will strengthen the potential of our proposal.

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