A RULE-BASED DECISION SUPPORT SYSTEM FOR REAL ESTATE BROKERAGE SERVICE EVALUATION

Fernando A. F. Ferreira[*],
ISCTE Business School, BRU-IUL, University Institute of Lisbon,
Avenida das Forças Armadas, 1649-026 Lisbon, Portugal
&
Fogelman College of Business and Economics, University of Memphis,
Memphis, TN 38152-3120, USA
fernando.alberto.ferreira@iscte.pt or fernando.ferreira@memphis.edu

Ronald W. Spahr,
Department of Finance, Insurance and Real Estate,
Fogelman College of Business and Economics, University of Memphis,
Memphis, TN 38152-3120, USA
rspahr@memphis.edu

Mark A. Sunderman,
Department of Finance, Insurance and Real Estate,
Fogelman College of Business and Economics, University of Memphis,
Memphis, TN 38152-3120, USA
msndrman@memphis.edu

Audrius Banaitis,
Faculty of Civil Engineering, Vilnius Gediminas Technical University,
Saulėtekio al. 11, LT-10223 Vilnius, Lithuania
audrius.banaitis@vgtu.lt

João J. M. Ferreira,
Department of Business and Economics, University of Beira Interior,
Estrada do Sineiro, 6200-209 Covilhã, Portugal
&
NECE Research Unit, Portugal
jjmf@ubi.pt

Unpublished Manuscript

[*] Corresponding author.

ABSTRACT

Real estate brokers or realtors are expected to possess superior knowledge of their local markets, and typically require commissions in return for their services. The evaluation of their performance is an important issue in justifying their commissions. We develop a learning-oriented decision-making process for evaluating real estate brokerage services, which concentrates on understanding the nature, the role and the interaction of the evaluation aspects of real estate brokerage service quality by integrating cognitive maps and the Decision EXpert (DEX) approach. Results suggest that this framework permits new rudiments to be considered in the realtor decision-making and sales process, facilitating transparency and understanding of realtor functions that may lead to recommendations to improve the performance and quality of these functions. Avenues for future research are also presented.

Keywords: Brokerage Service, Real Estate, Measurement and Improvement, Cognitive Mapping, Decision Expert (DEX).

INTRODUCTION

It is essential that individual real estate agents (realtors) provide quality/efficient services not only to attain personal/financial success, but also to support the ability of their real estate firm to thrive in a competitive environment. It is generally believed that high levels of service quality generate greater customer satisfaction, fewer customer complaints, and thus improved customer retention rates and greater customer willingness to recommend the service to third parties (*cf.* Raposo *et al.*, 2009; Culiberg and Rojsek, 2010; Zalatar, 2012; Yu, 2013; Ferreira *et al.*, 2015b). Due to the recent economic downturn and subsequent recovery in real estate markets, however, the importance of service quality may be even more important in today's environment (Karatepe *et al.*, 2005; Cepeda-Carrión *et al.*, 2015; Ferreira *et al.*, 2015a).

In each unique local real estate market, sellers face imperfect information regarding property market values and identifying and marketing property to potential buyers. Aggravated by the recent world-wide economic crisis and now a recovering real estate market, imperfect information creates opportunities for realtors who possess superior knowledge of individual markets in suggesting client optimal asking prices and identifying prospective buyers. According to Rutherford *et al.* (2005), the importance of the role played by real estate agents (*e.g.* appraisers and brokers) is apparent, and in return for their services, they typically require a commission that is a percentage of the transaction price. This idea seems to be supported by Nwogugu (2007: 1054), who additionally informs that, *"in the US, the residential real estate brokerage industry alone has annual revenues of more than $60 billion"*.

Given the development and importance of real estate brokerage, substantial changes and reforms are continuing to occur, where *"the industry is regulated, is consolidating, and commissions are declining in some markets"* (Nwogugu, 2007: 1054). With the development of real estate law and regulation, real estate agents (realtors and appraisers) have fiduciary responsibilities to represent the interest of sellers. However, Rutherford *et al.* (2005) question whether or not brokers would advance their principals' interests at their own expense. This is further exacerbated by the fact that different types of brokerage exist in the real estate industry (Jung and Jo, 2000).

Issues including declining commissions and moral hazard reinforce the need for real estate brokerage service evaluation; and recent advances are discussed by Love *et al.* (2011); Agboola *et al.* (2012); Farzanegan and Fereidouni (2014) and Momparler *et al.* (2015). Still, controversy persists regarding the methodology for evaluating service

quality due to the intangible/subjective nature of the previously mentioned moral hazards associated with realtor evaluation – *i.e.* the difficulty of observing the broker's level of effort (Rudolph, 1998). As discussed by Rutherford *et al.* (2005: 628), *"the standard agency models in general, and the models of real estate brokerage in particular, argue that the percentage commission system creates an agency problem between an agent and his client because it induces the agent to expend too little effort"*. In this context, and because every methodological approach has limitations, progress is needed to identify evaluation criteria and determine their respective trade-offs. Although it needs to be stressed that this is a complex field, which a simple paper cannot hope to give full justice to, it is worth noting that *"there is a continuing need for senior managers to develop coherent, well articulated cognitive structures, or mental models, which adequately map the key aspects of their business and its environment"* (Grinyer, 2000: 51). Given this need, we develop a learning-oriented decision-making process (*i.e.* constructivist in nature, which should be regarded essentially as a learning mechanism) for real estate brokerage service evaluation, concentrating on the nature, role and interaction of evaluating real estate brokerage service quality.

Cognitive maps *"have been widely used in problem-structuring interventions,* [... they] *permit a rich representation of ideas, through the modelling of complex chains of argument, and are suitable for several types of analysis"* (Montibeller and Belton, 2006: 57). Because they reduce cognitive load (Gavrilova and Leshcheva, 2015), while allowing the number of hidden criteria to be reduced (Eden and Ackermann, 2000; Ferreira and Jalali, 2015; Ferreira *et al.*, 2015c; Filipe *et al.*, 2015), cognitive maps hold great potential for analyzing the cause-and-effect relationships among determinants of real estate brokerage service evaluation.

Conceived in the 1980s, DEX (Decision EXpert) is a qualitative multi-attribute decision making approach that represents a pioneering approach of combining MCDA with rule-based expert systems. As pointed out by Bohanec *et al.* (2013: 51), *"from MCDA* […], *DEX borrows the idea of evaluation and analysis of decision alternatives using a* […] *structured model. DEX departs from using numerical variables and weight-based utility functions by introducing concepts from expert systems: qualitative (symbolic, linguistic) variables, if-then rules, dealing with uncertainty, high emphasis on transparency of models and explanation of evaluation results"*. The original idea was extended in the early 2000s, with the development of a stripped-down and user-friendly computer software called DEXi (*cf.* Jereb *et al.*, 2003). Due to its intrinsic simplicity, the DEX approach has been actively used to address a wide range of decision situations, and DEXi turned out extremely useful even for most complex decision-making processes.

We develop a decision-making process that is learning-oriented with an internal accountability purpose, meaning that the outcomes result from brokers' perspectives. The process is developed using the knowledge and experience of current real estate brokers, who operate in the Central-West region of Portugal. Although the client (seller or buyer) point-of-view is obviously important and taken into account in different stages of the decision-making process, the construction of a cognitive map from the client perspective would imply informed sellers and buyers, when it is acknowledged that most of them are only concerned with a few aspects of service quality (*cf.* Vega-Vazquez *et al.*, 2013; Ferreira *et al.*, 2014b and 2015a). To the best of our knowledge, the combination of cognitive mapping with the DEXi approach has yet to be applied in real estate brokerage service evaluation.

The paper is organized as follows. Section two provides an overview of related previous work, section three introduces the methodology, section four describes the

evaluation/decision-making process, and section five concludes with discussion and avenues for future research.

RELATED WORK

Unlike with goods, where quality can be measured with relative ease, the evaluation of service quality is generally a very difficult endeavor. A significant part of this difficulty is justified by the unique features of services, such as: intangibility, inseparability of production and consumption, and heterogeneity (Karatepe *et al.*, 2005). In this vein, the evaluation of service quality often results from the clients' perceptions, which assume informed and concerned clients. It has been acknowledged, however, that most clients are not very much informed and, as individuals, are only concerned with a few aspects of service quality (*cf.* Ferreira *et al.*, 2014b and 2015a). *"This makes the development of psychometrically sound and managerially useful instruments to measure service quality imperative"* (Karatepe *et al.*, 2005: 373).

Karatepe *et al.* (2005), Zalatar (2012) and Lee and Chulhyun (2014) highlight the existence of an extensive body of knowledge on service quality evaluation, which includes Grönroos's (1984) two-dimensional model (*i.e.* focused on the *technical* and *functional* dimensions of the service), and Parasuraman *et al.*'s (1988) five-dimensional SERVQUAL model (*i.e. tangibles*, *reliability*, *responsiveness*, *assurance* and *empathy*). However, despite their wide application, these models and respective *"dimensions have been the subject of some criticism"* (Johnston, 1995: 54) (for further discussion, see Armistead, 1990; Seth *et al.*, 2005; Ferreira *et al.*, 2015a), leading to the conclusion that although remarkable progress has been achieved in the field, the discussion is yet to be put to rest.

As far as the real estate industry in concerned, different attributes to measure service quality have been presented over the years. For instance, O'Donnell and Geurts (1995) refer that *commissions* and *opportunity costs* have a strong impact on the client perceived service quality and sequent broker selection. *Licensing* and *certification* also provide credible information concerning service provision and quality (Rudolph, 1998). Nwogugu (2007) indicates these as *social capital*, *reputation* and *perceived sincerity of the broker*. Love *et al.* (2011) highlight *lack of sense of coherence* and *burnout* – a multidimensional syndrome revealed by professionals who are subjected to stress associated with direct interpersonal contact with clients –, which can adversely influence productivity and service quality. Although not all totally controlled by the broker, other factors can be found in the literature, namely: *broker supply of information*, *time considerations*, *intuition about prices*, *number of houses in the broker's listing pool*, *time-on-the-market effects*, *buyer's perception/cognition*, *level of education of the buyer*, *buyer's income*, *buyer's temperament*, *value of buyer's time*, *number of clients visited*, *ethical values*, *quality of information available*, *ownership type*, *continuing professional development*, *qualifications*, etc. (for further discussion, see O'Donnell and Geurts, 1995; Schroeter, 1995; Rudolph, 1998; Jung and Jo, 2000; Rutherford *et al.*, 2005; Nwogugu, 2007; Love *et al.*, 2011; Agboola *et al.*, 2012; Farzanegan and Fereidouni, 2014).

While significant progress has occurred over the past few decades, there still is, however, considerable scope for the development of comprehensive (*i.e.* transparent and comprehensible to the user) evaluation systems, based on methodologically sound procedures, which might help surpass the limitations of the current approaches in terms of criteria selection and trade-offs calculation (*cf.* Karatepe *et al.*, 2005; Zalatar, 2012; Lee and Chulhyun, 2014; Fülöp *et al.*, 2014; Ferreira *et al.*, 2015a). In light of this reasoning, there is both a theoretical and a practical interest for a better understanding of the determinants of real estate brokerage service quality and, thus, to integrate cognitive

mapping and DEXi to support the selection of appropriate criteria for real estate brokerage service quality evaluation; and, additionally, to provide guidance to what extent service quality should be improved. As defended by Bohanec *et al.* (2013: 57), *"practical experience indicates that DEX is particularly suitable for solving complex decision problems that require judgment and qualitative knowledge-based reasoning, dealing with inaccurate and/or missing data, as well as the analysis and justification of evaluation results"*.

BRIEF METHODOLOGICAL BACKGROUND

Cognitive Maps

The added value of cognitive mapping in assisting decision makers to structure complex decision problems has been addressed in detail in the literature (*cf.* Eden and Ackermann, 2001; Bell and Morse, 2013; Ferreira *et al.*, 2015b). Although subjective in nature, these maps' major advantage is clearly established and stems from the fact that they provide decision makers with a deeper understanding of the cause-and-effect relationships among criteria. In addition, cognitive maps contribute to reduce the rate of hidden variables, and allow decision makers to express and record preferences and value judgments that are not evidently detected but can be consciously identified upon group discussion (Ferreira *et al.*, 2014b; Ferreira and Jalali, 2015; Jalali *et al.*, 2015). Indeed, as pointed out by Ormerod (2013: 64), *"subjective choice is an essential element of managerial decision-making and cannot be ignored or assumed away"*.

Building on this, cognitive mapping presents a set of specific advantages, including the ability to: i) integrate objective and subjective evaluation criteria; ii) structure complex and difficult-to-analyze decision situations; iii) underpin group work, allowing for further development in a constructivist way; and iv) be useful in the definition of strategic guidelines. Following this, and due to its constructivist and recursive nature, this approach holds great potential for the structuring of performance evaluation mechanisms (*cf.* Howick and Eden, 2011; Ferreira *et al.*, 2014b).

Basics of the DEXi Methodology

Inspired on the fuzzy set theory-based work of Efstathiou and Rajkovič (1979), who proposed a tabular representation of utility relations – one of the key concepts of the DEX approach – DEXi is a DEX-based interactive decision support computer program developed by Jereb *et al.* (2003), in the early 2000s, as part of a research project entitled *Expert Systems in Education*. As with other MCDA techniques, DEX – and its extension DEXi – aims to support the development of multi-attribute models and apply those models for the evaluation and analysis of choice alternatives. As pointed out by Bohanec *et al.* (2001) and (2013), the DEXi models are grounded on attributes/criteria, and developed by defining trees of attributes, scales and utility functions. Because they use qualitative evaluation attributes instead of quantitative ones, however, DEX and DEXi differ from the most conventional multi-attribute approaches. Indeed, as reinforced by Bohanec (2014: 6), *"aggregation (utility) functions in DEXi are defined by if-then decision rules rather than numerically by weights or some other kind of formula"*. This seems to be particularly useful in dealing with situations characterized as subjective and fuzzy, which require, above all, qualitative reasoning (*cf.* Žnidaršič *et al.*, 2008). This approach has long been validated and extensively applied in complex real-life decision situations (for discussion and practical examples, see Zupan *et al.*, 1999; Jereb *et al.*, 2003; Žnidaršič *et al.*, 2008; Bohanec, 2014). Technically, multi-attribute models are grounded on utility functions, which are the basis for partial evaluation aggregations. As

explained by Bohanec (2014), for each aggregate evaluation criterion *Y*, whose descendants are X_1, X_2, … X_n, the corresponding utility function is given by formulation (1):

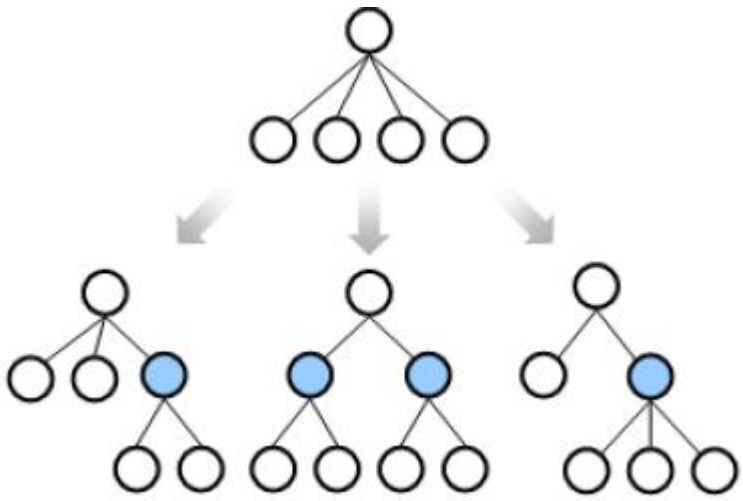
$$f.X_1 \times X_2 \times ... \times X_n \rightarrow Y. \quad (1)$$

This utility function maps all the combinations of lower-level attributes into an aggregate evaluation criterion *Y*; and the mapping is presented in a table where each row, also known as *decision rule*, provides the value of *f* for one combination of lower-level attribute values. This can be interpreted as an *if-then* rule, according to formulation (2) (*cf.* Bohanec, 2014):

$$\begin{aligned} &if\ X_1 = value_1\ and\ X_2 = value_2\ and\ \ ...\ and\ X_n = value_n, \\ &\qquad then\ Y = value\ (or\ value\ interval). \end{aligned} \quad (2)$$

Although weights/trade-offs are commonly used in multiple criteria evaluation systems, in qualitative multi-attribute models there is no need for such concern, namely because criteria are symbolic and utility functions are defined by decision rules. Still, weights can be defined, normalized or not, to fill in the gap between qualitative and quantitative methods (for discussion, see Bohanec *et al.*, 2013; Bohanec, 2014). It is worth noting, in addition, that to prevent combinatorial explosion, each aggregate attribute *Y* should have only two or three immediate descendants (*i.e. Xs*). Although this can be seen as an important methodological limitation of the DEXi models, it is worth highlighting that this can be easily managed and surpassed, during the structuring phase, by regrouping lower-level attributes and introducing new aggregate attributes, as illustrated in *Figure 1*. Due to its intrinsic characteristics as structuring methodological tool, cognitive mapping, when integrated with the DEX approach, holds great potential for facilitating this regrouping process.

Figure 1 – Restructure of a DEXi Tree of Attributes



Source: Bohanec (2014: 19).

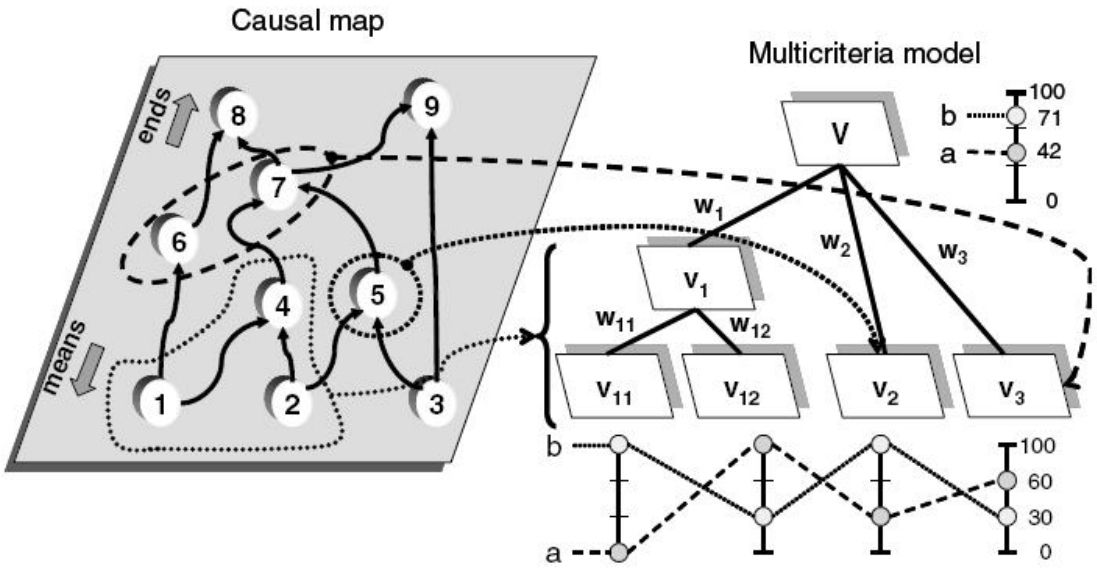
As Bohanec *et al.* (2013: 52) point out, "*by definition, an expert system must be able to deal with incomplete and uncertain knowledge*". Following this, and because of the subjective nature of the decision problem at hand, there appears to be considerable

scope to explore the development of an expert decision system/process, resulting from the combined used of cognitive maps and DEXi, to evaluate and improve real estate brokerage service. As described in the next section, the use of cognitive mapping allows key determinants of service quality evaluation (and their cause-and-effect relationships) to be explicit and understood, while DEXi allows choice alternatives to be evaluated based on those key evaluation attributes.

PROCESS DEVELOPMENT

We address real estate brokerage service evaluation and improvement based on the integrated use of cognitive maps and DEXi. *Figure 2* illustrates the sequence of procedural steps.

Figure 2 – Structuring Process from a Cognitive Map



Source: Montibeller and Belton (2006:787).

Basically, as shown in *Figure 2*, the decision process was organized in three main phases: i) the *structuring phase*, which is concerned with the use of cognitive mapping techniques to identify the evaluation attributes/criteria and the cause-and-effect relationships among them (see left part of *Figure 2*); ii) the *evaluation phase*, which is focused on the application of the DEXi approach to obtain a multiple criteria evaluation model (see right part of *Figure 2*); and iii) the *phase of recommendations*. Details are presented in the next subsections.

The Structuring Phase

The research that provided the basis for the structuring phase took place in two participatory workshops of about 4 hours each. During this period, several issues were addressed, including the construction and validation of a collective cognitive map, and the development of a tree of attributes, which was of crucial importance for the application of the DEXi methodology.

Participants

As widely recognized in the MCDA literature (*cf.* Belton and Stewart, 2002; Ferreira *et al.*, 2014a), the outputs obtained from the interaction of a group of experts are the key

source of data and knowledge used to conceive, with the assistance of a facilitator (*i.e.* scientist or researcher), a multiple criteria evaluation system.

Taking into account that *"early research found that the larger the group size the greater the diversity that can be encompassed but the lower the opportunity for each individual to contribute to discussion"* (Grinyer, 2000: 27), we tried to form a group that could be "easily manageable" (*i.e.* that could be available for the group sessions and, additionally, could allow us to collect a set of views on the decision problem at hand as diverse as possible). After several contacts, we were able to form a group of seven decision makers engaged in real estate brokerage activities, over the past 2-3 decades, in the metropolitan area of Lisbon. It is worth noting, as reported in the literature (*cf.* Belton and Stewart, 2002, Ferreira *et al.*, 2015a), that due to the process-oriented stance of our study, the technical procedures followed can work well with a different group of decision makers.

The group sessions were coordinated by one of authors of this paper – an experienced facilitator – accompanied by two assistants who were responsible for registering the results of the meetings (for further reading on the role of the facilitator, see Bell and Morse, 2013).

Problem Definition

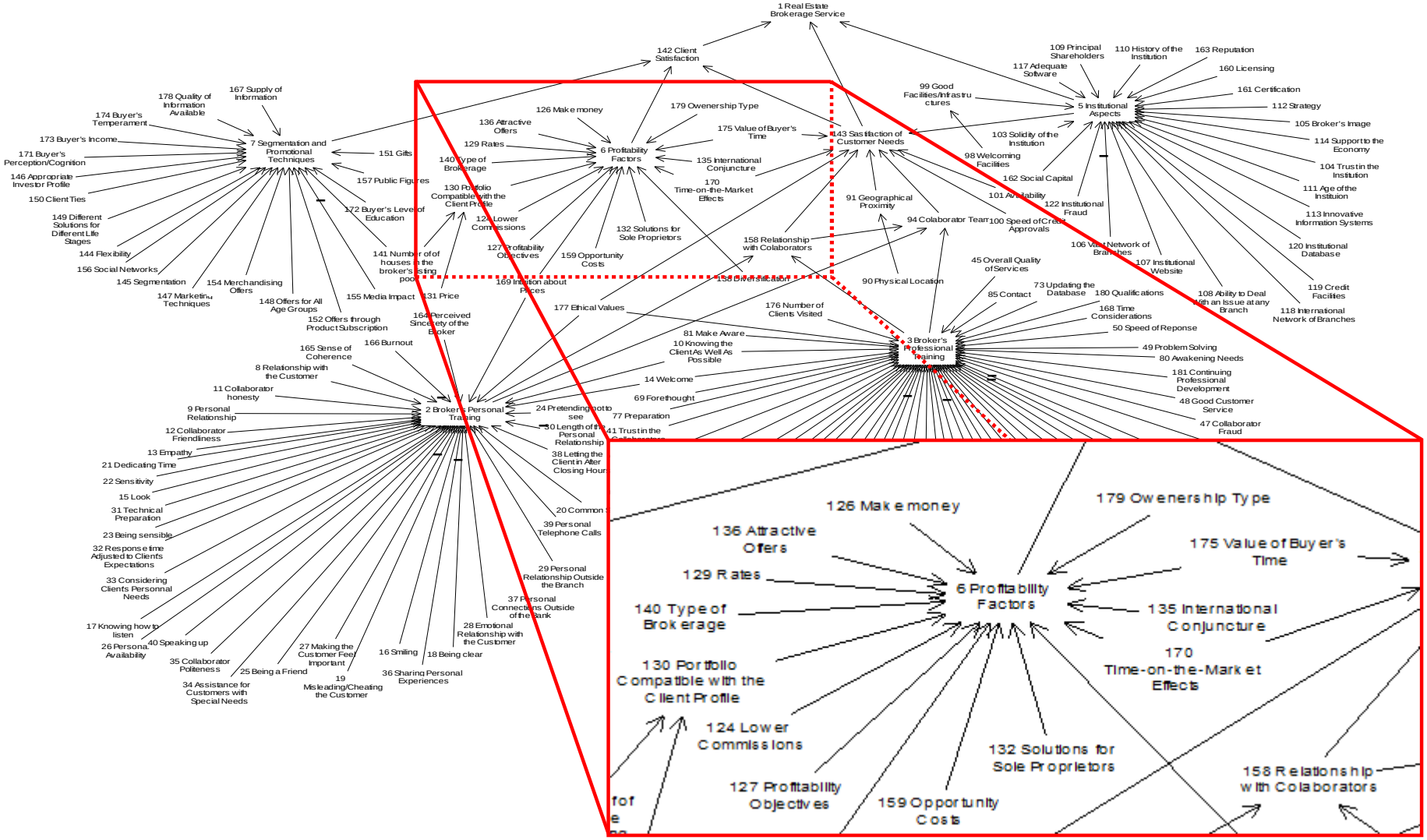
As previously outlined, this paper aims to combine cognitive maps and DEXi to develop a learning-oriented decision-making process for real estate brokerage service evaluation, concentrating on understanding the nature, the role and the interaction of the key evaluation aspects of real estate brokerage service quality.

The SODA Approach and the Collective Cognitive Map

We began the operational phase of our study following an approach known as SODA II, where the structuring process starts directly with a group meeting. Basically, this is a variant of the strategic options development and analysis (SODA) approach, also known as *Journey Making*, developed by Fran Ackermann and Colin Eden (*cf.* Ackermann and Eden, 2001; Eden and Ackermann, 2001). To ensure common understanding among the participants, this first group meeting was started with a careful presentation of the research objectives and of the methodological procedures to be followed. After this initial intervention, the panel members were provided with a brief explanation of the "post-its technique" (see Ackermann and Eden, 2001), and were asked the following trigger question: *"Based on your own values and professional experience, what are the characteristics of a great real estate broker?"*. In broad terms, the "post-its technique" consists of inviting the panel members to share opinions and experiences, to identify relevant evaluation references (*i.e.* criteria) for the problem at hand and, in sequence, to write the criteria on post-its. The basic rule is one criterion per post-it and, heavily based on the dialogue and interaction between the panel members, this usually allows a wide range of different (but interrelated) criteria to be made explicit (for technical details, see Ackermann and Eden, 2001; Ferreira *et al.*, 2015a and 2015b).

The second phase of the map construction consisted in grouping the post-its by clusters (also known as "areas of concern") and, in sequence, in the analysis of the cause-and-effect relationships between the criteria in each cluster. The results were then mapped using the *Decision Explorer* software (www.banxia.com), which allowed each cluster to be compared to others and provided the participants with a holistic view of the decision problem at hand. The process ended with the group's consensus on the form and content of the collective cognitive map. *Figure 3* presents the final version of the map.

Figure 3 – Final version of the collective cognitive map

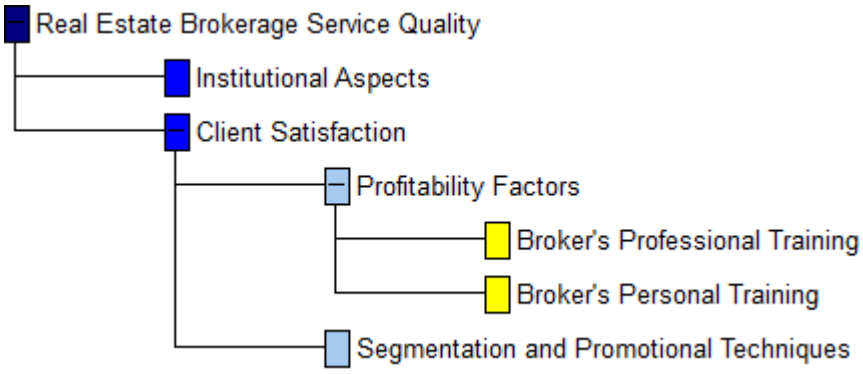


As already pointed out, *Figure 3* reflects the group's consensus on the criteria that can allow real estate brokerage service quality to be evaluated. Although context-dependent (*i.e.* it depends on the participants involved, session duration, facilitator skills and/or decision circumstances), the conception of our collective cognitive map allowed commonly omitted criteria to be taken into consideration in the decision process. The map also provided the group members with a holistic view of the issue at hand, which was important for a better understanding of the evaluation process and related concepts. In this vein, it should be emphasized that *"there is less emphasis on outputs* per se *and more focus on process"* (Bell and Morse, 2013: 962), meaning that the way the group members interact and what they can learn from the group interactions allows adjustments to take place in a very natural manner. As expected, this is a reflection of the constructivist nature of the process.

Tree of Attributes/Criteria

Based on the agreed upon cognitive map and following Keeney's (1992, 1994) methodological guidelines, the interactive procedure carried out during a second meeting aimed to construct a tree of attributes. As highlighted by Belton and Stewart (2002), this stage of the process is frequently considered more of an art than a science. However, it was greatly facilitated by the analysis of the map. *Figure 4* presents the final version of the tree, which was carefully tested, discussed and validated by the panel members.

Figure 4 – Tree of attributes



As can be seen in *Figure 4*, the tree structure of attributes can be interpreted as follows. In order to evaluate the service quality of a broker, the panel members considered *Institutional Aspects* and *Client Satisfaction*. *Client Satisfaction* is further decomposed into *Profitability Factors* and *Segmentation and Promotional Techniques*. *Profitability Factors*, in turn, are decomposed into *Broker's Professional Training* and *Broker's Personal Training*.

As discussed in the previous subsection, the focus with structuring methods is very much on the discussion and learning that result from the process of applying them itself. In this vein, the resulting tree of attributes is very interesting and a testament to the wealth of information that can be obtained through such methods. Indeed, as shown in *Figure 4*, the tree includes attributes typically reported in the literature, such as *Client Satisfaction* or *Profitability Factors*; but also adds new elements, such as those relating to *Segmentation and Promotional Techniques*, for example. With the tree of attributes approved by the panel members, the next step consisted in the evaluation phase.

The Evaluation Phase

The evaluation phase consists of the construction of scales and utility functions for the attributes previously identified. This procedure allows brokerage service quality to be locally evaluated in accordance with each attribute. In this study, the construction of utility functions, which included tests of mutual preferential independence, was implemented using the DEXi software (http://kt.ijs.si/MarkoBohanec/dexi.html). The process was conducted during a third meeting that lasted almost six hours.

Scales and Utility Functions

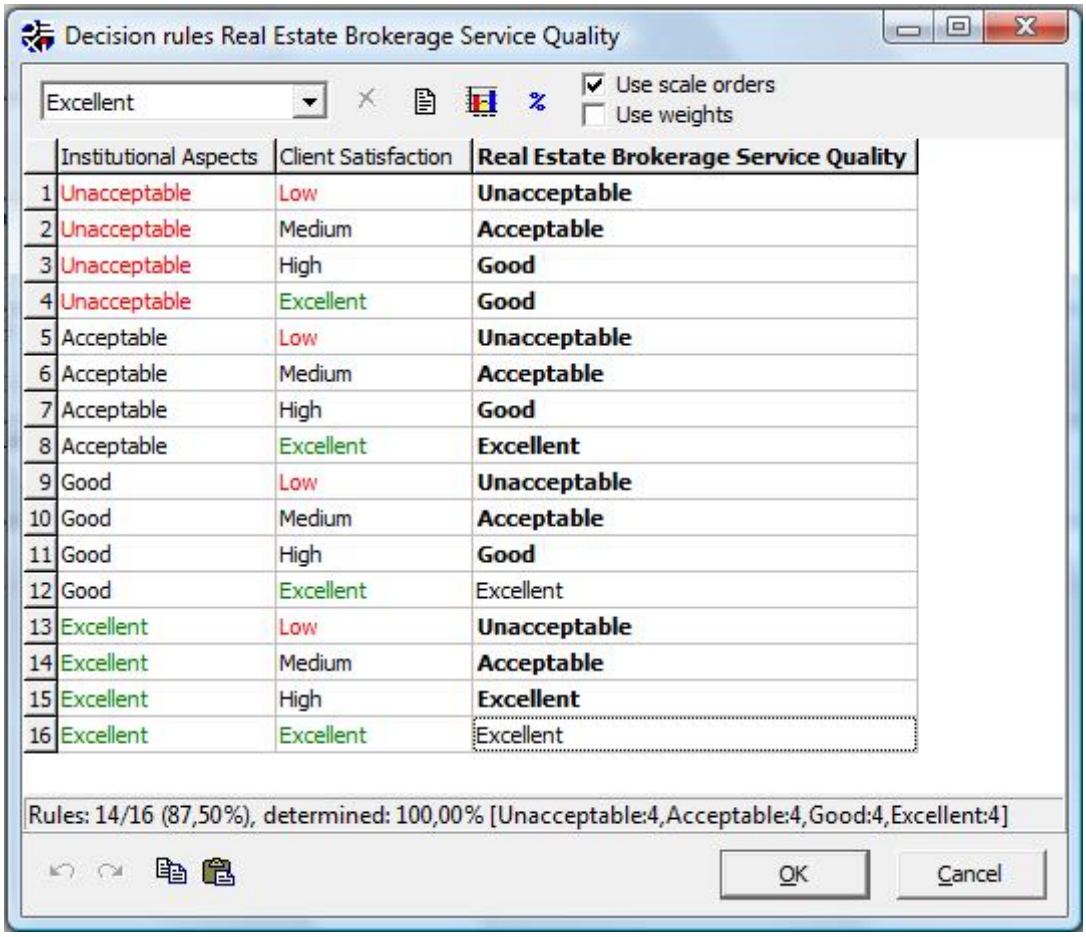
At this stage of the process, the panel members were asked to define qualitative scales for each attribute included in the model. As pointed out by Zupan *et al.* (1999), Jereb *et al.* (2003), Žnidaršič *et al.* (2008) and Bohanec (2014), this is an important procedure to establish the *if-then decision rules* that support the evaluation. *Figure 5* presents the local scales defined for our evaluation system.

Figure 5 – Local scales for real estate brokerage service evaluation

Attribute	Scale
Real Estate Brokerage Service Quality	Unacceptable; Acceptable; Good; ***Excellent***
├Institutional Aspects	Unacceptable; Acceptable; Good; ***Excellent***
└**Client Satisfaction**	Low; Medium; High; ***Excellent***
├Segmentation and Promotional Techniques	Bad; Acceptable; Good; ***Very Good***
└**Profitability Factors**	Bad; Acceptable; Good; ***Very Good***
├Broker's Personal Training	Bad; Acceptable; Good; ***Very Good***
└Broker's Professional Training	Bad; Acceptable; Good; ***Very Good***

As shown in *Figure 5*, the scales are qualitative, and resulted from the agreement reached among the panel members. According to the tree of attributes, the root attribute of the evaluation model (*i.e. Real Estate Brokerage Service Quality*), depends on two lower-level attributes: *Institutional Attributes* and *Client Satisfaction.* In this sense, the utility function that corresponds to *Real Estate Brokerage Service Quality* maps all the combinations (*i.e. decision rules*) of *Institutional Attributes* and *Client Satisfaction* into the values of *Real Estate Brokerage Service Quality* (*Figure 6*).

Figure 6 – Utility function for real estate brokerage service quality



	Institutional Aspects	Client Satisfaction	Real Estate Brokerage Service Quality
1	Unacceptable	Low	**Unacceptable**
2	Unacceptable	Medium	**Acceptable**
3	Unacceptable	High	**Good**
4	Unacceptable	Excellent	**Good**
5	Acceptable	Low	**Unacceptable**
6	Acceptable	Medium	**Acceptable**
7	Acceptable	High	**Good**
8	Acceptable	Excellent	**Excellent**
9	Good	Low	**Unacceptable**
10	Good	Medium	**Acceptable**
11	Good	High	**Good**
12	Good	Excellent	Excellent
13	Excellent	Low	**Unacceptable**
14	Excellent	Medium	**Acceptable**
15	Excellent	High	**Excellent**
16	Excellent	Excellent	Excellent

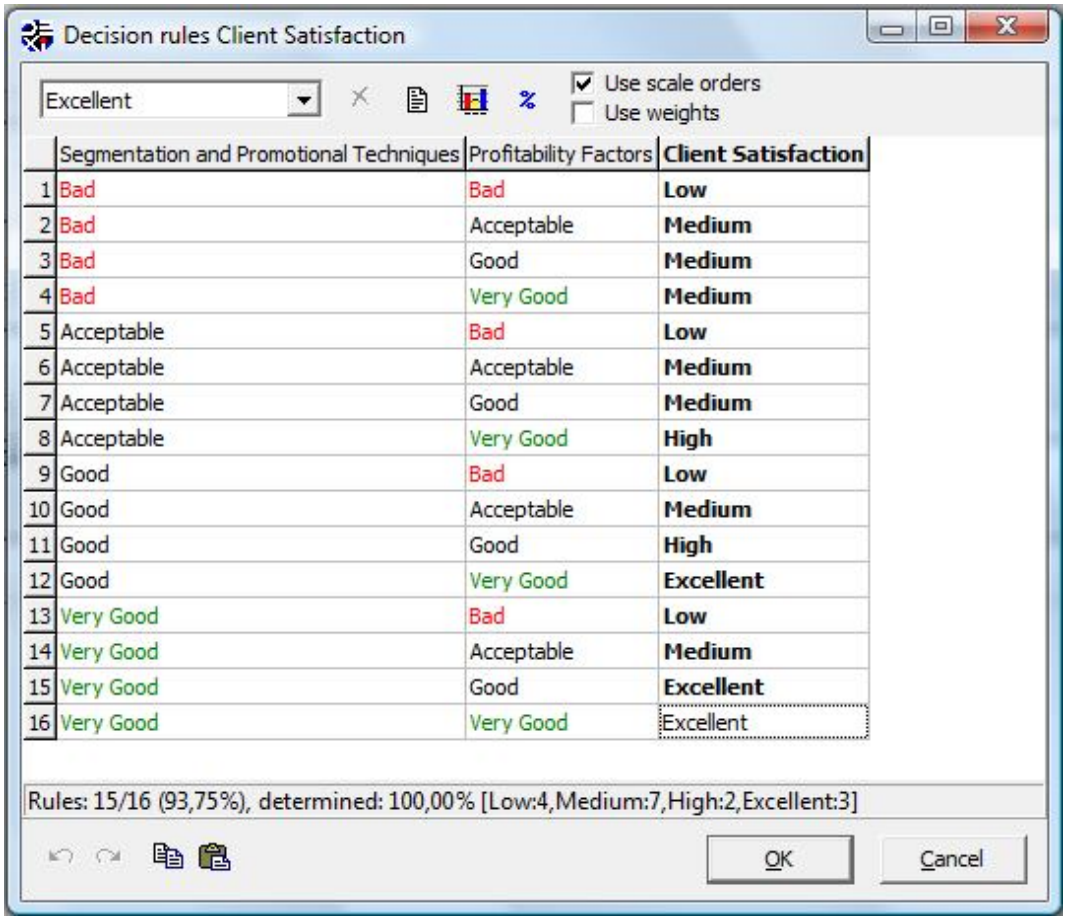
Following *Figure 6*, the attributes *Institutional Attributes* and *Client Satisfaction* have four values each, and the number of rows (*i.e. elementary decision rule*) is 4x4=16. This means that each row provides a value of *Real Estate Brokerage Service Quality* for one combination of *Institutional Attributes* and *Client Satisfaction.* The fourth row, for instance, means the following (*cf.* formulation (2)):

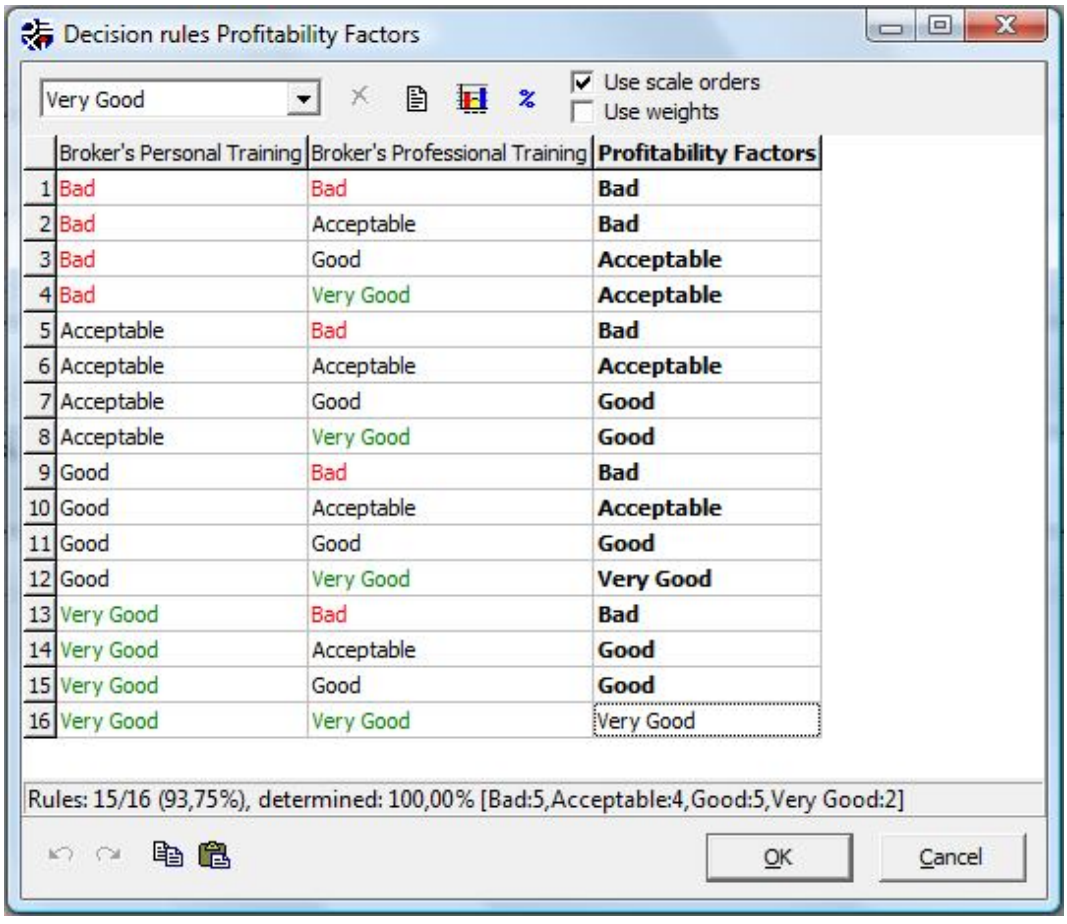
If *Institutional Attributes*=**Unacceptable and** *Client Satisfaction*=**Excellent**, **then** *Real Estate Brokerage Service Quality*=**Good**.

Remaining Elementary Decision Rules

Our evaluation systems has three aggregated attributes and, consequently, three utility functions. The first has already been presented in *Figure 6*. The remaining two are defined by the following elementary decision rules (*Figure 7*) (for technical details, see Bohanec, 2014).

Figure 7 – Remaining elementary decision rules and utility functions of the model





As discussed in *subsection 3.2*, although trade-offs among criteria are commonly used in multiple criteria evaluation systems, they are not a (major) concern in qualitative multi-attribute models (*cf.* Bohanec, 2014). Still, to strengthen the results of our study, we decide to introduce weights in our evaluation system.

Complex Decision Rules and Weights

Different MCDA methodologies can be applied to obtain the weight of the attributes included in our evaluation framework (for further reading, see Belton and Stewart, 2002). However, due to the process-oriented nature of our framework, the weights used were established by (simple) group negotiation. Although this procedure is not linear and inherently subjective, thus likely to be imprecise, it is worth mentioning that the software used (*i.e.* DEXi) allows for interactive explorations of changes in the inputs, offering support for the estimated values (see Bohanec, 2014). *Figure 8* presents the complex decision rules and the weights used in our study.

Figure 8 – Complex decision rules and weights of the model

	Institutional Aspects	Client Satisfaction	Real Estate Brokerage Service Quality
	14%	86%	
1	*	Low	Unacceptable
2	*	Medium	Acceptable
3	Unacceptable	>=High	Good
4	<=Good	High	Good
5	>=Acceptable	*Excellent*	*Excellent*
6	*Excellent*	>=High	*Excellent*

	Segmentation and Promotional Techniques	Profitability Factors	Client Satisfaction
	32%	68%	
1	*	Bad	Low
2	Bad	>=Acceptable	Medium
3	<=Acceptable	Acceptable:Good	Medium
4	*	Acceptable	Medium
5	Acceptable	*Very Good*	High
6	Good	Good	High
7	>=Good	*Very Good*	*Excellent*
8	*Very Good*	>=Good	*Excellent*

	Broker's Personal Training	Broker's Professional Training	Profitability Factors
	35%	65%	
1	Bad	<=Acceptable	Bad
2	*	Bad	Bad
3	Bad	>=Good	Acceptable
4	Acceptable:Good	Acceptable	Acceptable
5	Acceptable	>=Good	Good
6	>=Acceptable	Good	Good
7	*Very Good*	Acceptable:Good	Good
8	>=Good	*Very Good*	*Very Good*

Average weights

Attribute	Local	Global	Loc.norm.	Glob.norm.
Real Estate Brokerage Service Quality				
├Institutional Aspects	14	14	14	14
└**Client Satisfaction**	86	86	86	86
├Segmentation and Promotional Techniques	32	27	32	27
└**Profitability Factors**	68	59	68	59
├Broker's Personal Training	35	20	35	20
└Broker's Professional Training	65	38	65	38

Having completed this stage of the process, our evaluation system was tested through practical application. In order to do this, the panel members were asked, under conditions of strict confidentiality, to provide the research team with information on different real estate brokers (henceforth Alphas). The aim was to assess each broker on each of the previously defined attributes of service quality.

Evaluating Real Estate Brokerage Service Quality

Using information on 14 Alphas, randomly and anonymously provided by the panel members (*i.e.* two Alphas per participant), the group started this stage of the process by identifying local performance levels for each Alpha under evaluation. This exercise was extremely useful to test the evaluation system developed and increase the interest of the group. *Figure 9* illustrates this procedure, where two fictitious Alphas (*i.e. Good* and *Neutral*) where included to facilitate cognitive comparisons (for further details on this procedure, see Ferreira *et al.*, 2015c). *Figure 10*, in turn, shows the overall evaluation for each Alpha.

Figure 9 – Alphas' evaluation per attribute

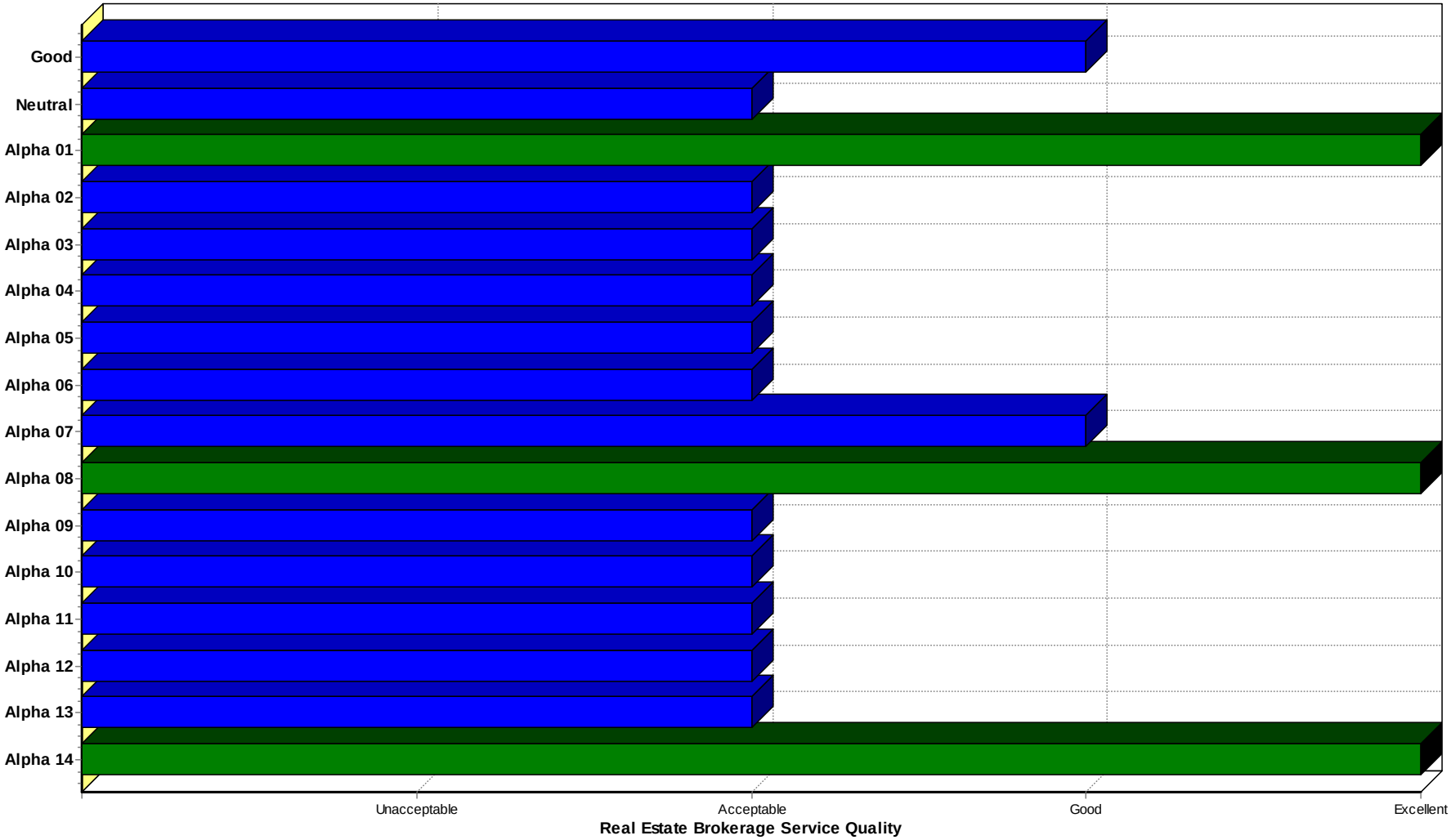
Attribute	Good	Neutral	Alpha 01	Alpha 02	Alpha 03
Real Estate Brokerage Service Quality	Good	Acceptable	*Excellent*	Acceptable	Acceptable
├Institutional Aspects	Good	Acceptable	Acceptable	Good	Good
└**Client Satisfaction**	High	Medium	*Excellent*	Medium	Medium
├Segmentation and Promotional Techniques	Good	Acceptable	Good	Good	Acceptable
└**Profitability Factors**	Good	Acceptable	*Very Good*	Acceptable	Acceptable
├Broker's Personal Training	Good	Acceptable	Good	Acceptable	Acceptable
└Broker's Professional Training	Good	Acceptable	*Very Good*	Acceptable	Acceptable

Attribute	Alpha 04	Alpha 05	Alpha 06	Alpha 07	Alpha 08
Real Estate Brokerage Service Quality	Acceptable	Acceptable	Acceptable	Good	*Excellent*
├Institutional Aspects	Good	Unacceptable	Acceptable	Acceptable	*Excellent*
└**Client Satisfaction**	Medium	Medium	Medium	High	*Excellent*
├Segmentation and Promotional Techniques	Good	Acceptable	Acceptable	Good	*Very Good*
└**Profitability Factors**	Acceptable	Acceptable	Good	Good	*Very Good*
├Broker's Personal Training	Good	Acceptable	Good	Acceptable	Good
└Broker's Professional Training	Acceptable	Acceptable	Good	Good	*Very Good*

Attribute	Alpha 09	Alpha 10	Alpha 11	Alpha 12	Alpha 13
Real Estate Brokerage Service Quality	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
├Institutional Aspects	Good	Acceptable	Unacceptable	Good	Good
└**Client Satisfaction**	Medium	Medium	Medium	Medium	Medium
├Segmentation and Promotional Techniques	Acceptable	Bad	Bad	Acceptable	Acceptable
└**Profitability Factors**	Good	Acceptable	Acceptable	Good	Good
├Broker's Personal Training	Good	Acceptable	Acceptable	*Very Good*	Good
└Broker's Professional Training	Good	Acceptable	Acceptable	Good	Good

Attribute	Alpha 14
Real Estate Brokerage Service Quality	*Excellent*
├Institutional Aspects	*Excellent*
└**Client Satisfaction**	*Excellent*
├Segmentation and Promotional Techniques	Good
└**Profitability Factors**	*Very Good*
├Broker's Personal Training	*Very Good*
└Broker's Professional Training	*Very Good*

Figure 10 – Alphas' overall evaluation



Due to the time-consuming nature of the process, and given the decision makers' limited availability, this last work session turned out to be quite intense. Although the participants reflected positively on the techniques used, it is worth underlying, as reflected in the title of the paper, that the evaluation of the Alphas cannot be seen as an end in itself but as a means to discuss the results and learn/improve from them.

Analyzing the Results

At this stage of the decision-making process, a final discussion of the outcomes is important to reflect further on the results and derive some practical lessons. Grounded on that discussion, important lessons are: i) the framework allowed for an effective evaluation of the 14 Alphas analyzed; ii) it was possible to involve all participants in the structuring process of the evaluation framework; and iii) the local comparisons (*i.e.* evaluation per attribute) of the real estate brokers proved to be a very useful exercise as it allowed for the identification of sources of low performance, which can facilitate the identification of improvement suggestions. In broad terms, it is worth noting that the significance of the debate is further augmented by the fact that our decision-making process, and resulting framework, can be applied to most classes of professionals, including accountants, consultants or lawyers.

Although the results achieved are encouraging, "plus-minus-1" and sensitivity analyses were additionally carried out to validate the results and to check the stability of the evaluation system. This type of analyses was particularly important to promote additional discussion among the participants, which was reinforced by the development of scatter and radar charts, as exemplified in *Figures 11* and *12*.

Figure 11 – Scatter/dominance chart of the alphas

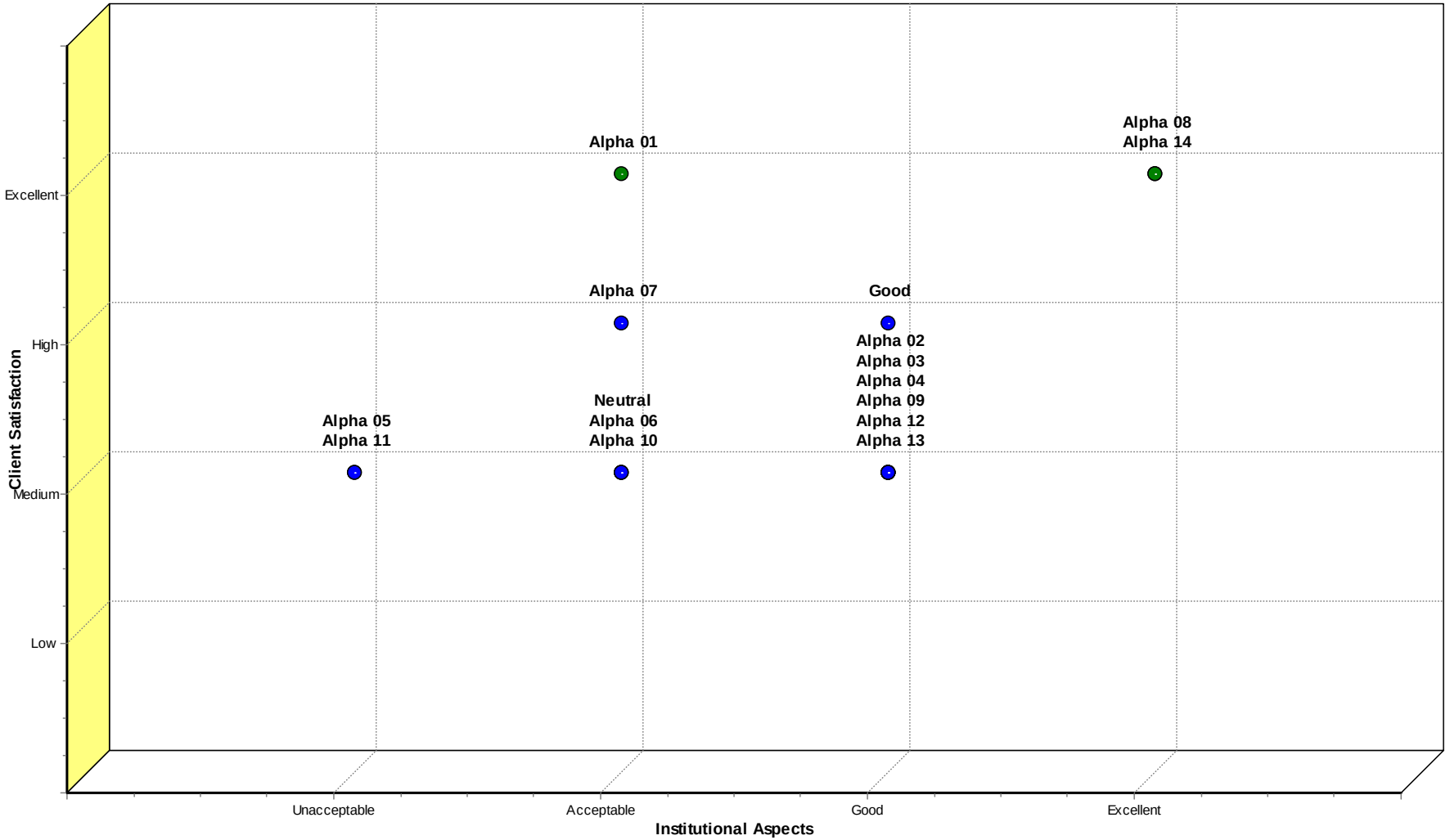
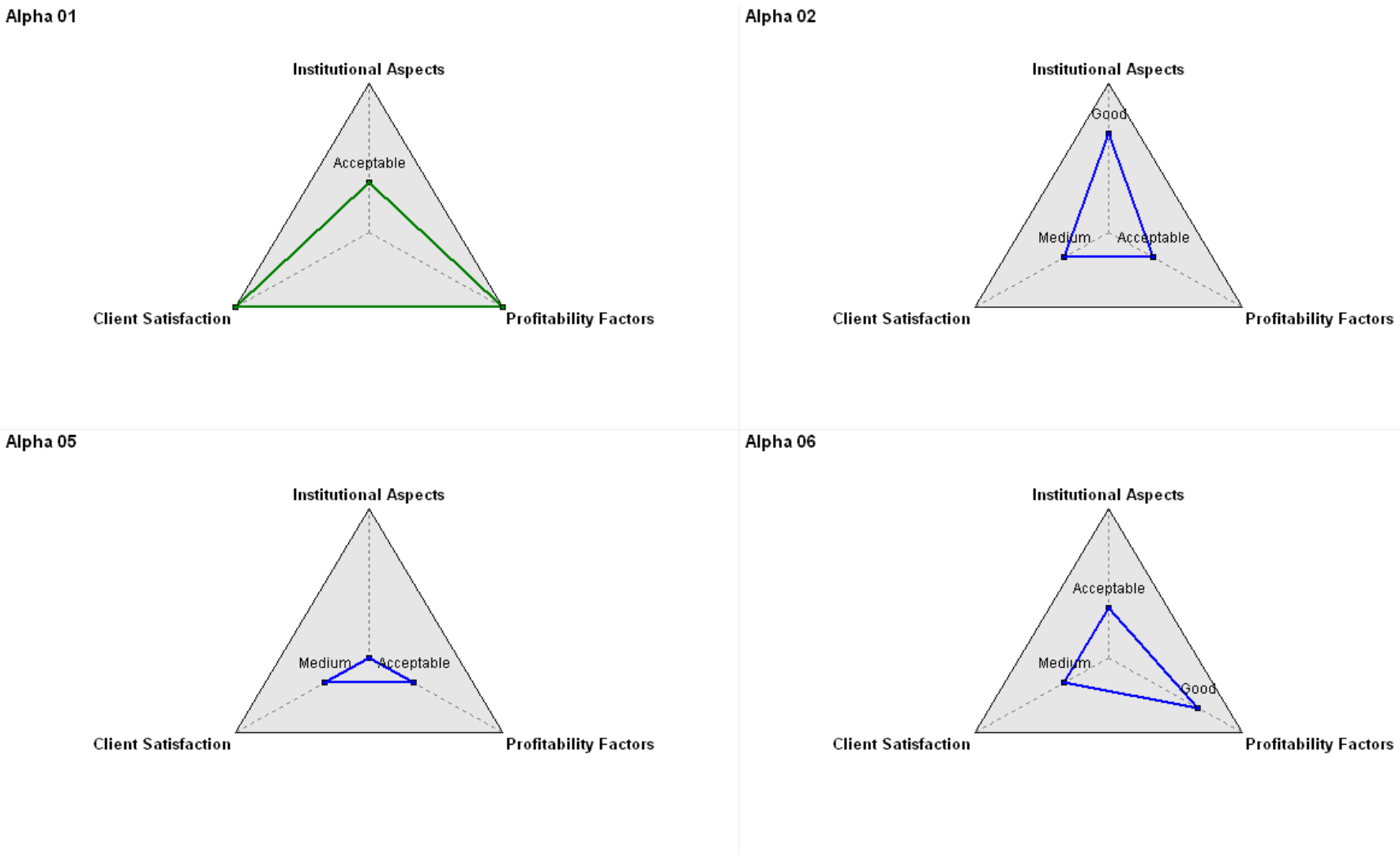


Figure 12 – Exemplificative radar charts



A scatter chart displays evaluation results according to two selected dimensions (*cf.* Bohanec, 2014). In the example provided in *Figure 11*, the dimensions selected were *Institutional Aspects* and *Client Satisfaction*. As can be seen, Alpha 08 and Alpha 14 dominate the others, meaning that they provide the best service quality. Radar charts, in turn, display evaluation results taking into account three or more dimensions, allowing for the identification of sources of low performance, which, again, facilitate the identification and desirable application of improvement suggestions. For example, the relatively low performance of Alpha 05 on the three dimensions considered reveals where this Alpha should improve to achieve a higher performance level overall. Following this, and more important than the evaluation obtained, one should bear in mind the constructivist stance of our study and, in this vein, these analyses served as catalysts for further discussion and were the basis of the recommendations phase.

The Recommendations Phase

The satisfaction expressed by the panel members provides some evidence that the combined use of cognitive mapping and DEXi holds great potential for real estate brokerage service evaluation. One should bear in mind, however, that our framework is process-oriented, meaning that it assumes a constructivist stance and should be regarded essentially as a learning mechanism. In addition, it should be taken into account that, *"notwithstanding attempts to take decisions in a rational manner, managerial decisions to act are* [...] *subjective in nature"* (Ormerod, 2013: 484) (for further discussion, see also Steiger and Steiger, 2008; Padova and Scarso, 2012; Partidario and Sheate, 2013). In this sense, generalizations and extrapolations of the results should be considered with caution; and further sensitivity, robustness and dominance analyses after any adjustment are strongly encouraged.

These caveats notwithstanding, the results of our framework are versatile and merit discussion. In particular, the framework's exhaustiveness not only confirms many of the evaluation criteria identified in previous studies, but also adds new attributes (and the factors underlying them) to the discussion, which allow for a much deeper understanding of the real estate brokerage service evaluation (*cf. Figure 3*). This can be useful not only for existing real estate brokers but also for potential new entrants in the sector. Again, we are unaware of any previous documented evidence reporting the combination of cognitive mapping with the DEXi approach in this domain, allowing for advances in theory and empirical research on real estate brokerage service and operational research.

CONCLUSION

Brokerage services are particularly important in the real estate industry, thus we integrate cognitive mapping with DEXi to assist in evaluating real estate brokerage service quality. Significant progress has been achieved over the years in evaluating service quality; however, previous studies observe that current available methodologies fail to comprehensively identify the driving forces behind this phenomenon (*cf.* Ferreira *et al.*, 2015a). In this sense, controversy persists regarding the manner by which service quality should be evaluated.

The proposed learning-oriented decision making process allows key attributes of real estate brokerage service to be identified in a comprehensive manner greatly reducing the number of hidden criteria *vis-a-vis* conventional approaches. This allows for greater transparency and fuller understanding of the evaluation process, allowing participating decision makers to: i) discriminate brokers according to an evaluation model that was built based on value judgments and semantic preferences; ii) increase transparency and understanding through group discussion and negotiation; iii) incorporate new elements in the decision-making process; and iv) formulate focused suggestions for improvement, considering the lower performance revealed by some of the Alphas.

As discussed in the previous section, our study is process-oriented, where the resulting framework assumes a constructivist stance and should be regarded essentially as a learning mechanism. Still, it is worth noting that proponents of the MCDA approach maintain that all decision making is subjective in nature; and making such subjectivity explicit and integrating it with objective data is, perhaps, its major contribution (*cf.* Santos *et al.*, 2002). As such, the framework presented in this study has managerial implications, which stem from the insights brought by the analysis of the cause-and-effect relationships between evaluation criteria and hold great potential for service quality improvement in this context.

Further research is warranted in this field of study, and we suggest: i) the replication of the decision-making process followed in this study in other service contexts, to further illustrate the potential of the integrated use of cognitive mapping and DEXi to improve understanding of service provision; ii) a panel study within a different location or with other expert panel to increase the generalizability of the results; and iii) a survey based on different panel studies to increase the reliability of the outcomes. We are confident that improvements and updates can help strengthen our achievements.

REFERENCES

Ackermann, F., & Eden, C. 2001. SODA – Journey making and mapping in practice. In J. Rosenhead, & J. Mingers (Eds.), *Rational analysis for a problematic world revisited: Problem structuring methods for complexity, uncertainty and conflict* (pp. 43-60). Chichester: John Wiley & Sons.

Agboola, A., Ojo, O. & Amidu, A. 2012. Investigating influences on real estate agents' ethical values: the case of real estate agents in Nigeria. *International Journal of Strategic Property Management*, 16(3), 298-315.

Armistead, C. 1990. Service operations strategy: Framework for matching the service operations task and the service delivery system. *International Journal of Service Industry Management*, 1(2), 6-16.

Bell, S. & Morse, S. 2013. Groups and facilitators within problem structuring processes. *Journal of the Operational Research Society*, 64(7), 959-972.

Belton, V., & Stewart, T. 2002. *Multiple criteria decision analysis: An integrated approach.* Dordrecht: Kluwer Academic Publishers.

Bohanec, M. 2014. *DEXi: Program for multi-attribute decision making user's manual.* Ljubljana, Slovenia: The Jožef Stefan Institute.

Bohanec, M., Cestnik, B. & Rajkovič, V. 2001. Qualitative multi-attribute modeling and its application in housing. *Journal of Decision Systems*, 10(2), 175-193.

Bohanec, M., Žnidaršič, M., Rajkovič, V., Bratko, I. & Zupan, B. 2013. DEX methodology: Three decades of qualitative multi-attribute modeling. *Informatica*, 37(1), 49-54.

Cepeda-Carrión, I., Leal-Millán, A., Ortega-Gutierrez, J. & Leal-Rodriguez, A. 2015. Linking unlearning with service quality through learning processes in the Spanish banking industry. *Journal of Business Research*, 68(7), 1450-1457.

Culiberg ,B. & Rojsek, I. 2010. Identifying service quality dimensions as antecedents to customer satisfaction in retail banking. *Economic and Business Review*, 12(3), 151-166.

Eden, C. & Ackermann, F. .2000. Mapping distinctive competencies: A systemic approach. *Journal of the Operational Research Society*, 51(1), 12-20.

Eden, C., & Ackermann, F. 2001. SODA – The principles. In J. Rosenhead, & J. Mingers (Eds.), *Rational analysis for a problematic world revisited: Problem structuring methods for complexity, uncertainty and conflict* (pp. 21–41). Chichester: John Wiley & Sons.

Efstathiou, J. & Rajkovič, V. 1979. Multiattribute decisionmaking using a fuzzy heuristic approach. *IEEE Transitions on Systems, Man, and Cybernetics*, SMC-9, 326-333.

Farzanegan, M. & Fereidouni, H. 2014. Does real estate transparency matter for foreign real estate investments? *International Journal of Strategic Property Management*, 18(4), 317-331.

Ferreira, F. & Jalali, M. 2015. Identifying key determinants of housing sales and time-on-the-market (TOM) using fuzzy cognitive mapping. *International Journal of Strategic Property Management*, doi: 10.3846/1648715X.2015.1052587.

Ferreira, F., Jalali, M,. Ferreira, J., Stankevičienė, J. & Marques, C. 2015a. Understanding the dynamics behind bank branch service quality in Portugal: Pursuing a holistic view using fuzzy cognitive mapping. *Service Business*, advance online publication 21 April, doi: 10.1007/s11628-015-0278-x.

Ferreira, F., Jalali, M., Meidutė-Kavaliauskienė, I. & Viana, B. 2015b. A metacognitive decision making based-approach to bank customer loyalty measurement and management. *Technological and Economic Development of Economy*, 21(2), 280-300.

Ferreira, F., Marques, C., Bento, P., Ferreira, J. & Jalali, M. 2015c. Operationalizing and measuring individual entrepreneurial orientation using cognitive mapping and MCDA techniques. *Journal of Business Research*, advance online publication 1 May, doi: 10.1016/j.jbusres.2015.04.002.

Ferreira, F., Santos, S. & Dias, V. 2014a. An AHP-based approach to credit risk evaluation of mortgage loans. *International Journal of Strategic Property Management*, 18(1), 38-55.

Ferreira, F., Santos, S., Rodrigues, P., & Spahr, R. 2014. Evaluating retail banking service quality and convenience with MCDA techniques: A case study at the bank branch level. *Journal of Business Economics and Management*, 15(1), 1–21.

Filipe, M., Ferreira, F. & Santos, S. 2015. A multiple criteria information system for pedagogical evaluation and professional development of teachers. *Journal of the Operational Research Society*, advance online publication 4 February, doi:10.1057/jors.2014.129.

Fülöp, G., Hernadi, B., Jalali, M., Meidutė-Kavaliauskienė, I. & Ferreira, F. 2014. Developing of sustainability balanced scorecard for the chemical industry: Preliminary evidence from a case analysis. *Engineering Economics*, 25(3), 341-349.

Gavrilova, T. & Leshcheva, I. 2015. Ontology design and individual cognitive peculiarities: A pilot study. *Expert Systems with Applications*, 42(8), 3883-3892.

Grinyer, P. 2000. A cognitive approach to group strategic decision taking: A discussion of evolved practice in the light of received research results. *Journal of the Operational Research Society*, 51(1), 21-35.

Grönroos, C. 1984. A service quality model and its marketing implications. *European Journal of Marketing*, 18(4), 36-44.

Howick, S. & Eden, C. 2011. Supporting strategic conversations: The significance of a quantitative model building process. *Journal of the Operational Research Society*, 62(5), 868-878.

Jalali, M., Ferreira, F., Ferreira, J. & Meidutė-Kavaliauskienė, I. 2015. Integrating metacognitive and psychometric decision making approaches for bank customer loyalty measurement. *International Journal of Information Technology and Decision Making*, http://dx.doi.org/10.1142/S0219622015500236.

Jereb, E., Bohanec, M. & Rajkovič, V. 2003. *DEXi: Računalniški program za večparametrsko odločanje*. Kranj: Moderna organizacija.

Johnston, R. 1995. The determinants of service quality: Satisfiers and dissatisfiers. *International Journal of Service Industry Management*, 6(5), 53-71.

Jung, J. & Jo, G. 2000. Brokerage between buyer and seller agents using constraint satisfaction problem models. *Decision Support Systems*, 28(4), 293-304.

Karatepe, O., Yavas, U. & Babakus, E. 2005. Measuring service quality of banks: Scale development and validation. *Journal of Retailing and Consumer Services*, 12(5), 373-383.

Keeney, R. 1992. *Value-focused thinking: A path to creative decision making*. Harvard: University Press Harvard.

Keeney, R. 1994. Creativity in decision making with value-focused thinking. *MIT Sloan Management Review*, 35(4), 33-41.

Lee, H. & Chulhyun, K. 2014. Benchmarking of service quality with data envelopment analysis. *Expert Systems with Applications*, 41(8), 3761-3768.

Love, P., Goh, Y., Hogg, K., Robson, S, & Irani, Z. 2011. Burnout and sense of coherence among residential real estate brokers. *Safety Science*, 49(10), 1297-1308.

Momparler, A., Carmona, P. & Lassala, C. 2015 Quality of consulting services and consulting fees. *Journal of Business Research*, 68(7), 1458-1462.

Montibeller, G. & Belton, V. 2006. Causal maps and the evaluation of decision options: A review. *Journal of the Operational Research Society*, 57(7), 779-791.

Nwogugu, M. 2007. Issues in disintermediation in the real estate brokerage sector. *Applied Mathematics and Computation*, 186(2), 1054-1064.

O'Donnell, S. & Geurts, T. 1995. Point: "competition and value-of-service pricing in the residential real estate brokerage market". *The Quarterly Review of Economics and Finance*, 35(3), 327-332.

Ormerod, R. 2013. Logic and rationality in OR interventions: An examination in the light of the 'critical rationalist' approach. *Journal of the Operational Research Society*, 64(4), 469-487.

Padova, A. & Scarso, E. 2012. Managing large amounts of knowledge objects: Cognitive and organisational problems. *Knowledge Management Research & Practice*, 10(3), 287-295.

Parasuraman, A., Zeithaml, V. & Berry, L. 1988. SERVQUAL: A multiple item scale for measuring consumer perceptions of service quality. *Journal of Retailing*, 65(1), 12-40.

Partidario, M. & Sheate, W. 2013. Knowledge brokerage-potential for increased capacities and shared power in impact assessment. *Environmental Impact Assessment Review*, 39(1), 26-36.

Raposo, M., Alves, H. & Duarte, P. 2009. Dimensions of service quality and satisfaction in healthcare: A patient's satisfaction index. *Service Business*, 3(1), 85-100.

Rudolph, P. 1998. Will mandatory licensing and standards raise the quality of real estate appraisals? Some insights from agency theory. *Journal of Housing Economics*, 7(2), 165-179.

Rutherford, R., Springer, T. & Yavas, A. 2005. Conflicts between principals and agents: Evidence from residential brokerage. *Journal of Financial Economics*, 76(3), 627-665.

Santos, S., Belton, V. & Howick, S. 2002. Adding value to performance measurement by using systems dynamics and multicriteria analysis. *International Journal of Operations & Production Management*, 22(11), 1246-1272.

Schroeter, J. 1995. Counterpoint: Competition and value-of-service pricing in the residential real estate brokerage market. *The Quarterly Review of Economics and Finance*, 35(3), 333-338.

Seth, N., Deshmukh, S. & Vrat, P. 2005. Service quality models: A review. *International Journal of Quality & Reliability Management*, 22(9), 913-949.

Steiger, D. & Steiger, N. 2008. Instance-based cognitive mapping: A process for discovering a knowledge worker's tacit mental model. *Knowledge Management Research & Practice*, 6(4), 312-321.

Vega-Vazquez, M., Revilla-Camacho, M. & Cossío-Silva, F. 2013. The value co-creation process as a determinant of customer satisfaction. *Management Decision,* 51(10), 1945-1953.

Yu, K. 2013. A measurement model for service capability from the customer perspective. *Service Business*, 7(4), 563-582.

Zalatar, W. 2012. Quantifying customers' gender effects on service quality perceptions of Philippine commercial banks. *Procedia – Social and Behavioral Sciences*, 57, 268-274.

Žnidaršič, M., Bohanec, M. & Zupan, B. 2008. Modelling impacts of cropping systems: Demands and solutions for DEX methodology. *European Journal of Operational Research*, 189(3), 594-608.

Zupan, B., Bohanec, M., Demšar, J. & Bratko, I. 1999. Learning by discovering concept hierarchies. *Artificial Intelligence*, 109(1/2), 211-242.