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Searching for the one: Customer relationship management software selection

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Abstract

In a competitive environment that increasingly awards a clever approach to customer relationship management (CRM), firms need to systematize the way they interact with their customers. The relationships that often lay in the hands of managers and salespeople need to be thoughtfully organized to maximize both customer satisfaction and the effectiveness of the marketing efforts. CRM software packages can be an answer to organize and systematize the management of such commercial relationships. However, decision makers may not have the time and the competencies to identify the most suitable solution for their needs, among the hundreds existing, and may ultimately resort to an external expert. Since the existing methods to select a CRM software package suffer from several limitations, this article introduces a novel four-step method allowing to actively involve the decision makers in the CRM software package selection, simultaneously minimizing the effort requested to them and maximizing the extent to which the final choice suits their specific needs and preferences. The method resorts to a coordinated use of the analytic hierarchy process and of its fuzzy adaptation. The article also presents an exemplification of the method in a small Italian firm.

KEYWORDS

analytic hierarchy process, customer relationship management, decision support system, fuzzy analytic hierarchy process, multicriteria decision making

1 | INTRODUCTION

Evidence suggests that nurturing the relationships with the customers is among the most important factors to firms (Haislip & Richardson, 2017; Palmatier, Scheer, Houston, Evans, & Gopalakrishna, 2007; Rodriguez, Peterson, & Krishnan, 2018). This applies both to the business-to-consumer and to the business-to-business settings. However, relationships with customers may be managed in an unmethodical way, without systematically organizing prospecting and postsales activities. The valuable pieces of information that nearly every firm collects in their databases about their customers often remain poorly utilized (Stein, Smith, & Lancioni, 2013). Customer relationship management (CRM) systems are growing in importance as essential tools to exploit such data, enhancing sales, productivity, and customer satisfaction (e.g., Li, Huang, & Song, 2019; Rodriguez et al., 2018; Soltani & Navimipour, 2016), becoming the foundation of contemporary marketing strategy (Baran & Galka, 2016). In an encouraging prospect, the market for CRM software is facing increasing competition and a gradual stabilization of prices, allowing firms to select the most appropriate solutions to their budget. Precise requirements and specifications underlie the selection of a CRM software package (CRMSP) among the many products existing in the market. The process of assessing the characteristics of a CRMSP must be defined well before its acquisition and must be based on a firm's specific needs. A thorough decision process is needed to deploy a CRMSP in a firm especially due to the business reorganization needed to integrate a CRMSP in an already settled IT environment (Bull, 2003).

Indeed, the successfulness of a CRMSP adoption process is affected by the skills of the human resources that will be using it (Cruz-Jesus, Pinheiro, & Oliveira, 2019).

The remarkable number of CRMSPs available on the market requires methods for their selection, in consequence of the many criteria that must be considered to make a well-founded choice. The CRMSP must be tailored for the firm, it should require limited economic and human resources' effort, and be promptly deployed by specifically trained employees of firms.

In the literature, limited research (Colombo & Francalanci, 2004; Friedrich & Breitner, 2012; Jadhav & Sonar, 2009; Lee, Tang, & Sugumaran, 2014) has addressed the issue of studying objective structures for evaluating and selecting the most appropriate CRMSP. Although many studies addressed the theoretical analysis of models and criteria to select CRMSPs (Buttle, 2009; Colombo & Francalanci, 2004; Friedrich & Breitner, 2012; Jadhav & Sonar, 2009; Keil & Tiwana, 2006; Lee et al., 2014; Lin, 2003; Şen & Baraçlı, 2010), the operative methodological proposals to support decision making seem inadequate to analyse and evaluate the selection criteria and identify the most suitable CRMSP to meet the firms' needs thoroughly. In fact, the existing methods are characterized by rigid architectures, consent the use of a very limited set of decisional criteria, or ultimately allow the comparison among a few prefixed CRMSPs alternatives. Consequently, we advance that these approaches can be applied only in some specific environments, leaving out most companies willing to deploy a CRMSP. Instead, a decisional model should be flexible, allowing the selection of the most suitable criteria for the firm's specific needs and consent to compare various alternatives according to different environments and of specific requirements.

Choosing the most suitable CRMSP is of critical strategic importance, given that CRM implementation projects fail to achieve their expected outcomes in almost 70% of the cases (Farhan, Abed, & Ellatif, 2018). Therefore, this article advances the state of the art by proposing a novel CRMSP selection method that offers a wide range of evaluation criteria and a system to assist decision makers in the selection process. Such a method is complete, in that it takes into due consideration an extensive number of criteria and subcriteria characterizing CRMSPs advanced in the literature. Furthermore, it is generalizable and flexible, because the decisional model can be applied in any organizational context, the decision makers to define the elements of their own decisional tree (criteria, subcriteria, and alternatives). Thus, the decision makers can define the criteria and requirements in accordance with their firms' characteristics, weight their relative importance, and then choose their favourite alternative in line with their preferences. The proposed selection method resorts to the analytic hierarchy process (AHP; Saaty, 1980) to classify the most relevant criteria for the focal firm's needs and to fuzzy AHP (FAHP) (Wang & Chin, 2011) to identify the most suitable alternative. An illustrative implementation of the method in a small Italian firm is also presented in the article.

The structure of the paper is as follows: Section 2 presents the theoretical background of the study, Section 3 describes the method and its possible variants, Section 4 describes its implementation in a case study, and Section 5 draws the conclusions of this article, along with implications and future developments.

2 | THEORETICAL BACKGROUND

In recent years, several authors have investigated value creation in buyer–supplier relationships to the competitiveness of firms and have underlined the changing nature of buyer–supplier relationships in the digital era (Anderson & Narus, 1998; Ehret, 2004; Obal & Lancioni, 2013).

Evidence has suggested that it is extremely important to analyse the typology of knowledge acquired by buyers and sellers to increase sales and service volumes efficiently. Some studies have underlined the dimensions of value development through relationships with specific emphasis on the intangible factors that are important to achieve sustainable competitive advantage (Baxter, 2008; Salojärvi & Sainio, 2015). Recently, investigators have examined the balance degree between customers and suppliers—based on their reciprocal involvement—and the advantages that the parts perceive to obtain from the relation and their definition of the value proposition (Gummesson, 2004). Undoubtedly, relationships provide both buyers and sellers very specific resources that originate beyond their characteristics (Dyer & Singh, 1998). Rollins, Bellenger, and Johnston (2012) investigated the valuable contribution of customers to companies or business units, considered as "people involved in and influencing the buying process." Indeed, customer information can create value for companies, be their usage "action-oriented" (direct use of the information) or "knowledge-enhancing" (strategic use of information to bypass difficulties).

A use of CRM to assess the relevance of the relationships with customers to financial performance dates back to the late 1980s and, over the time, has proven to be a strategic tool for adding value to firm's profitability through the examination of customer satisfaction and loyalty processes (Mithas, Krishnan, & Fornell, 2005). There is almost general agreement that a well-suited CRM system, joined to advanced IT instruments, can help firms build and manage the relationships with their customers (Noori & Hossein Salimi, 2005; Y. Wang & Feng, 2012). Equally important, CRM helps delineate and trace the whole of interactions with customers and their development and maintenance (Lambert, 2009).

As Steel, Dubelaar, and Ewing (2013) stated referring to the paper of Anderson and Narus (1998), the relationships can be transactional or collaborative, so a firm has to decide whether it wants to focus on some specific categories of customers or interact indifferently with any of them. In both cases, before deploying CRM, each organization need to analyse the characteristics of its customers, the characteristics of the relationships with them, and the characteristics of their industry or market. Full knowledge of the kind of relationships exchanged with customers is crucial to deploy an appropriate CRM and therefore to obtain better returns on investment (Steel et al., 2013). Because CRM is based on the customers' available data collected by firms, it is fundamental that information would be accurate to use it at its best.

Indeed, it is not enough to invest in IT instruments like databases and CRMSPs to improve a firm's processes and customer experience: It is also necessary to invest in the capabilities to manage customer information (Rollins et al., 2012). On this topic, Wang and Feng (2012) have characterized some patterns of CRM capabilities such as the "customer interaction management capability," the "customer relationship upgrading capability," and the "customer win-back capability" as those among the firm's abilities that are able to build and manage relationships with customers the best.

In the last 20 years, the widespread diffusion of CRM systems has put into evidence that they can contribute to enhance sales management and strategic marketing activities and that their use can improve firm performance (Chari, Tarkiainen, & Salojärvi, 2016; Obal & Lancioni, 2013; Stein & Smith, 2009). Moreover, CRM data information can change the whole of CRM records into a powerful instrument able to analyse not only the firm–customer relationships for the decision-making process but also the evolution over time of their interactions (Stein et al., 2013). Linked to these aspects is the comprehension of the reasons for customers' leaving and customers' retention (Ahmad & Buttle, 2002). Furthermore, supplementary techniques can be added to grasp value from the CRM data, such as the data mining techniques. These techniques allow defining and developing a strategy within the firm, even if they require a heavy commitment to data processing (Ngai, Xiu, & Chau, 2009; Rygielski, Wang, & Yen, 2002). Indeed, CRM records can be a powerful instrument for decision making (Ahearne, Hughes, & Schillewaert, 2007). Among the many characteristics of CRMSPs, Ata and Toker (2012) have found that they positively affect organizational performance. Moreover, the personal interaction, a basic CRM component, is critical to add value to the interaction between organizations and to reduce the differences between the involved parts. The personal interaction consists of two important functions, presence and expertise, which are influenced by the "consistency of the actors" and the "troubleshooting events."

2.1 | The CRMSPs

Firms can rely on IT instruments and CRMSPs to store information about the customers and tailor their relationships with them (Nguyen & Mutum, 2012). As for sales management, CRMSPs represent a fundamental element of the firms' marketing approach because it saves the systematic account of the firms' sales, customer profiles, and ongoing promotions activities (Stein & Smith, 2009). CRMSPs also comprise functionalities capable of designing marketing campaigns, better allocating the available budget, making marketing plans, and managing the introduction of new products and services into the market. Moreover, a further area of functionalities of a CRMSP comprises many different integrated procedures that can be utilized to solve customers' problems, manage complaints, clarify doubts, or simply make sure of customer satisfaction, as well as to supply several technological procedures to manage call centres or customer information (Buttle, 2009). Usually, the deployment of a CRMSP implies changes and adaptation in firm business functions, including administration and finance (Adebanjo, 2003; Buttle, 2009), but it is often possible to combine a CRMSP with other systems, including those already in use at the firm. In addition, it is useful to remind that most CRMSPs allow working under remote control, making it possible to access and interact easily at any event (Buttle, 2009; Lee et al., 2014; Ngai et al., 2009).

Considering all of the above, a powerful structure of a CRMSP should reside in the following main characteristics: a key focalization on customer relationships by means of functional properties, such as sales, marketing, and customer service features; an adequate power to integrate and manage technology-based applications, such as hardware and software technical equipment; and a wide capability of managing internal organization activities and knowledge exchange by means of quality properties, such as completeness, maintainability, and portability.

2.2 | The selection of a CRMSP

Since its introduction in the late 1950s, the massive growth of IT in almost all industrial sectors have favoured many strategic dimensions of organizations' performance (Mithas & Rust, 2016). Software for accounting spread among firms rapidly. In the last decade, several enterprises have deployed CRMSPs to improve customer satisfaction and customer loyalty and thus improve profitability and revenue (Coltman, 2006; Lee et al., 2014). Organizations usually combine CRMSPs with databases to have the widest information on customers about sales, marketing, and services, to customize the interactions with them, and improve the customer lifetime value for the firm. These targets can be reached easily by deploying a CRMSP (Bose, 2002; Lee et al., 2014).

Precise requirements and specifications underlie the selection of one CRMSP among the many existing in the market. Because the business environment is marked by high uncertainty, the process of assessing a CRMSP characteristics involves numerous and complex problems. Firms' needs must be defined in terms of functionalities and features. The literature has underlined that CRMSPs demand much more care than other information technology tools (Bull, 2003). Ko, Kim, Kim, and Woo (2008) have highlighted that the adoption of a CRMSP requires initiating appropriate business changes, as well as information technology changes, to improve upon performance, quality, costs, flexibility, and responsiveness. Nevertheless, many firms set up CRM systems without having a full comprehension of the consequences on their business and verifying their compatibility with the whole of organizational goals and strategies (Battor & Battor, 2010).

The literature proposed several criteria to analyse CRMSPs and make a well-founded choice. We collected such criteria in Table 1.

As proposed by Friedrich and Breitner (2012) and Lee et al. (2014), the criteria can be classified according to the following four categories:

- *functional criteria* refer to the features of the CRMSP. They can vary in dependence on the firm's area in which the CRMSP has to be implemented (sales, marketing, or customer service);

TABLE 1 Criteria for the selection of a CRM software package

Criteria	Reference
Customers management; Email management; Opportunity management; Sales force activities; Sale lead tracking; Report generation; Marketing campaign management; Marketing analysis and forecasting; Knowledge management; Personalization; Computerized telephony services; Web-based services	Lin (2003)
Maintainability; Portability; Completeness; Personalizability	Colombo and Francalanci (2004)
Ease of implementation; Ease of customization; Reliability; Vendor reputation; Ease of use; Cost	Keil and Tiwana (2006)
Numbers of simultaneous users; Internal memory; External storage; Hardware platform; Openness; Interoperability; Compatibility; Source code; Scalability; Maintenance and upgrading; Number of modules; Number of independently installable modules; Number of workstations; Number of installations; Communication protocols; Middleware standard; DBMS standards; Adaptability; Programming languages; Communication standards; Platform variety; Customizable fields; Customizable reports; Time behaviour; Robustness; Backup and recovery; Security levels; Product history; Training; Tutorial; User manual; Consultancy; Communication; Demo; Response time of the vendor; Length of experience; Vendor popularity; Opinions-technical sources; Opinions-non-technical sources; Technical and business skills; References of existing customers; Troubleshooting guide; Ease of use; User interface; User types; Data visualization; Error reporting; Domain variety; Completeness; License cost; Installation and implementation cost; Training cost; Maintenance cost; Upgrading cost; Cost of hardware; Direct benefits; Indirect benefits	Jadhav and Sonar (2009)
Sales proposal; Sales contract; Ordering; Sales distribution; Invoicing; Sales forecasting; Sales analyses and reports; Marketing; Installability; Implementation and serviceability; Licensing arrangements; Multi-language support; Interoperability; Maintainability; Module completion; Portability; Interface standard; DBMS; Adaptability; Languages and development tools; Time behaviour; Efficiency; Stability; Reliability; Fault tolerance; Recoverability; Security; Market trends; Maturity; Consulting service; Resource behaviour; Availability of training and support; User documentation; Learnability; Testability; Vendor reputation; Vendor capability; Technical documentation; Usability; Understandability; Operability; User management tools; Accuracy; Suitability; Compliance; Conformance; Replaceability	Şen and Baraçlı (2010)
Account management; Contacts and customers management; Leads and opportunity management; Sales management; Relationships management; Reporting; Campaigns management; Customer service; Call centre; Internet; Project management; Industry specifics; Data integration; Deployment; Integration and infrastructure; Mobility; Field service; Modifiability and maintainability; Scalability; Portability; Performance and practicability; Reliability and robustness; Software and hardware requirements; Security; Popularity; Resources; Training and support; Usability; Timeliness; User acceptance; Maintenance cost; Migration cost; Preparation and Installation cost; Resources (both internal and external) cost; System (hardware/software) cost; Training and support cost; Upgrade cost	Friedrich and Breitner (2012)
Self-hosted; cloud-based	Buttle (2009); Lee et al. (2014)

Abbreviation: CRM, customer relationship management.

- *technical criteria* concern the hardware and software technical features. These criteria are crucial to the success of CRMSP deployment;
- *quality criteria* are strictly connected to the CRMSP capability of managing customer information at different levels of interactions. These criteria depend on the design features of the CRMSP; and
- *cost criteria* encompass the costs related to the CRMSP.

The decision-making process to compare alternatives according to many different criteria is a laborious procedure. The solution to the matter is offered by different methods, such as Multi-Criteria Decision Making (MCDM), AHP, and FAHP. Many methods are usually employed in selecting information systems, such as scoring, ranking, mathematical optimization, and multicriteria decision analysis. However, only a few investigators have dealt with CRMSP selection.

Colombo and Francalanci (2004) applied a hierarchical ranking model to classify 42 CRMSPs based on their functional, technical, and costs requisites. Quantitative measures and the multicriteria decision-making methodology of AHP have been employed to preselect a limited number of CRMSPs for an in-depth analysis, but no evaluation technique has been adopted to obtain an overall ranking of them. Although the authors affirm the effectiveness of their approach in obtaining an overall evaluation of CRMSPs' quality, based on complete preselection information, the ranking of CRMSPs cannot determine the final selection decision but only supports to preselect a restricted subset of packages to be further analysed. Therefore, as the authors themselves agree, the inclusion of technical variables should be extended to subsequent software selection phases. Further in-depth analyses should be applied to support the selection process of CRMSP against organizational requirements, and context-dependent criteria should be required to assess the alignment of the choice to the organizational requirements. Jadhav and Sonar (2009) proposed a theoretical methodology composed of seven stages where a generic list of evaluation criteria is provided. This list includes criteria related to the CRMSP functional and quality characteristics, its vendor, its cost and benefits, its associated hardware and software, the opinions from technical and non-technical sources, and its output. The authors succeeded in improving the process of evaluation and selection of the

software packages by means of their systematic review, but—as they themselves admit—their study fails to develop a framework including a software selection methodology, an evaluation technique, evaluation criteria, and a system to support the evaluation and selection of any CRMSP. Friedrich and Breitner (2012) proposed a CRM system model to select a CRMSP that could suit the particular needs of a company. The approach is based on a literature review, expert interviews, and two international online surveys to validate and refine the model. Following the steps of this theoretical model, after the identification of suitable CRMSPs based on quality, cost, functionality, and technical criteria, potential vendors are identified, and the final vendor is selected. The process mentioned above shows that the choice of the CRMSP is demanded to demo activities and to vendors' suggestions. The model does not consider the decisional role of managers, well acquainted with the firm environment where the CRMSP is to be deployed. Indeed, the proposed tool is not an MCDM based on managers' judgements. Lee et al. (2014) proposed a model based on AHP to select an open source CRMSP for small and medium enterprises (SMEs). The authors accounted for functionality and organizational perspectives, suggesting that their questionnaires are to be filled in by three domain experts in IT. One major drawback of this approach is that the proposed managerial tool does not appear to be generalizable, as the hierarchic tree is unadaptable to options, and allows for the use of a few criteria set-up in advance by the authors and of only three prefixed open source CRMSP alternatives. Consequently, this approach seems to be bound to a limited number of applications in special contexts and may not be implemented in virtually any environment.

Thus, as described above, limited research has addressed the issue of evaluating and selecting the most appropriate CRMSP. Even though the theoretical analysis of models and criteria to select CRMSPs appears complete and exhaustive, it emerges the inadequacy of the operative methodological proposals and decision support systems tools able to analyse and evaluate selection criteria and to identify the CRMSP that answers to the firm's needs exhaustively.

In conclusion, even though we recognize the seminal importance of the few, previously published methods for the CRMSP selection, we identified several flaws in them, which make their actual implementation often impractical. In fact, in our opinion, such methods (a) are unable to fully involve the firm's decision makers in the selection process, (b) only consider limited sets of possible criteria that may be used to select the CRMSP, and (c) have rigid structures that may not be generalized to different types of firms.

In this paper, we propose a method that allows going beyond the limits of the methods considered above, which will be described in the next section.

3 | METHOD

This article proposes a novel method to support firms in the selection of the most suitable CRMSP for their needs. The method resorts to MCDM methodologies and cost–benefit analysis. It consists of four steps, which are displayed in Table 2 and discussed in the following subsections. The implementation of the method requires the active collaboration of a CRM expert and of at least one decision maker from the firm (e.g., the entrepreneur/CEO of the firm or a figure coordinating the sales activities).

3.1 | Step 1—Analysis of the firm

First, the CRM expert should analyse the features and needs of the firm in which the CRMSP is to be implemented, considering how the firm's employees work and which activities will be affected by its implementation. Such analysis is conducted by interviewing the decision maker and/or other human resources from marketing or sales offices. As a result, the CRM expert will identify which features and functionalities are considered critical by the decision maker and which constraints must be taken into consideration during the choice of the CRMSP (e.g., budget constraints and a minimum number of contacts or accounts).

TABLE 2 Overview of the four steps of the proposed method

Steps	Subjects involved	Method	Outcome
Step 1—Analysis of the firm	CRM expert Decision maker *Human resources from marketing and sales	Interview	List of critical features, functionalities, and constraints expressed by the decision maker
Step 2—Choice of a set of criteria	CRM expert Decision maker	Analytic hierarchy process	List of criteria to be used to compare the CRMSPs
Step 3—CRMSPs prescreening	CRM expert	Review of existing CRMSPs	Shortlist of suitable CRMSPs
Step 4—Choice of the CRMSP	CRM expert Decision maker *Human resources from marketing and sales	Fuzzy analytic hierarchy process	Ranking of the shortlisted CRMSPs

Note. Asterisks describe the optional participation of the subject to the corresponding step.
Abbreviations: CRM, customer relationship management; CRMSP, CRM software package.

3.2 | Step 2—Choice of a set of criteria

After Step 1, the CRM expert identifies a set of criteria that allows the comparison of different CRMSPs according to the features and functionalities that are considered more important by the decision maker. Starting from the rather complete list of the possible decisional criteria that was proposed in Section 2.2 (Table 1), we synthesized a set of the most relevant ones, through the following strategy.

At first, we discarded the criteria that were (a) only evaluable while the CRMSP is actually deployed to the organization (such as "reliability" and "robustness"); (b) only evaluable after the deployment of the CRMSP, depending on the organizational environment (such as "user acceptance" and "timeliness"); and (c) outdated with respect to the current offer of CRMSPs, representing basic features that the vast majority of the CRMSPs support (such as "mobility" and "relationship management").

Second, we synthesized the criteria describing conceptually close features and classified according to the four categories described in Section 2.2 (Friedrich & Breitner, 2012; Lee et al., 2014), as follows:

A Functional criteria
- "basic operating features" synthesizes other criteria such as "number of simultaneous users," "number of installations," and "external storage";
- "accounts management" concerns the management of a user's contract and records;
- "leads and contacts management" encompasses the creation and management of contacts and customers, recording basic information about them, their relationship with the firm, the campaigns in which they have been involved, and their past purchases;
- "opportunity and sales management" describes how the CRMSP supports the salespeople to identify the leads and transform them into real opportunities;
- "email management" describes how the CRMSP supports customer service management through the exchange of emails with the customers;
- "reporting" designates how past data can be mined to make forecasts and statistics, to support the decision-making process, and to provide the firm with business intelligence tools;
- "project and activity management" includes the functionalities needed to develop and monitor projects and activities;
- "customer service" comprises the activities designed to meet the customers' needs and requests, helping them with solutions to a potentially wide range of problems, providing features spanning from sales assistance to call centres; and
- "activity and email marketing management" includes (a) mass email campaigns addressing specific customers or segments of customers, (b) initiatives devoted to nurturing customer loyalty or retention, and (c) data gathering for a better allocation of resources.

B Technical criteria
- "installation and configuration" describes the extent to which the CRMSP can be installed and configured straightforwardly, easily upgraded or extended in terms of new functionalities, and plainly migrated from other systems;
- "integration with third-party applications and with social media" describes the compatibility of the CRMSP with the firm's software, hardware, and network;
- "self-hosted" refers to the possibility of deploying the CRMSP on the firm's own servers, eventually on virtual machines;
- "cloud-based" describes whether the CRMSP can be executed on-cloud;
- "scalability" defines the extent to which the CRMSP can manage the growth of data;
- "customization" concerns the possibility of adapting the CRMSP to the needs of the firm both by adding newly available functionalities and by modifying source codes;
- "maintainability" refers to the possibility of making changes, fixing bugs, or solving problems;
- "performance and practicability" regards the time needed to respond to commands or to elaborate charts and reports; and
- "data security" pertains to the security of records and data, protection from unauthorized accesses, and selective access to the data.

C Quality criteria
- "popularity" refers to the developers' reputation, how long the tool has been on the market, what its market share is, and the users' appreciation of the CRMSP;
- "usability and intuitiveness of the interface" relates to the capability of the CRMSP of being user-friendly as much as possible so that limited training is required;
- "portability" concerns the possible integration of the CRMSP into the network of other systems already deployed to the firm; and
- "completeness" pertains the extent to which the CRMSP have a wide range of functionalities available in modules and submodules.

D Cost criteria
- "license or software costs" represents the cost of the license per-user if the CRMSP is cloud-based, or of the software, if it is self-hosted;
- "installation and configuration costs" concerns the cost of configuring the CRMSP, according to the needs of the firm, and to deploy it;
- "training and support costs" pertains to the cost to train the users and to support them in troubleshooting;
- "maintenance and upgrades costs" describes the cost of software maintenance processes by handling software and hardware problems, as well as the installation cost of possible future upgrades and the implementation of new functionalities; and

- "hardware infrastructural costs" describes the cost of new hardware needed to install the CRMSP, such as a workstation or a server if the CRMSP is self-hosted.

Because it would be unfeasible to compare different CRMSPs according to dozens of criteria, a reasonably small subset of the most relevant ones must be identified.

To achieve such goal, Step 2 requires the implementation of the AHP, an MCDM based on the multilevel hierarchical representation of a problem and on the following pairwise comparison among the elements of a level with respect to an element placed at the top level (Saaty, 1980). The comparisons are made through verbal judgements, stating whether two elements are equally important, or one is moderately more important, strongly more important, very strongly more important, or extremely more important than the other is to achieve a certain goal. Such judgments are converted into numerical values (1, 3, 5, 7, and 9, respectively, whereas even numbers from 2 to 8 are considered intermediate values). AHP was chosen for its ease of implementation and its great worldwide popularity among both scholars and practitioners (Di Bona, Silvestri, Forcina, & Falcone, 2017; Ho & Ma, 2018; Macharis, Turcksin, & Lebeau, 2012; Ortiz-Barrios et al., 2016; Ribas & da Silva Rocha, 2015).

Ideally, as recommended by Saaty (1980), AHP should not be used with more than 10 alternatives (i.e., in this case, 10 criteria per category) to avoid reducing the reliability of the judgments. The CRM expert should perform consistency checks on the judgments expressed by the decision maker, resorting to the consistency index. The ratio between such index and the random consistency index returns the consistency ratio (CR), which should ideally not be higher than 0.1. Otherwise, the judgments expressed by the decision maker may be too incoherent and would require a review of the most critical ones.[1] When consistency is below the recommended threshold, the judgments are mathematically synthesized into a vector of weights for each alternative (i.e., each lower level element, in our case the criteria) whose overall sum is 1. Intuitively, alternatives with larger weights are to be preferred over the others. In this case, as exemplified in Figure 1, at first, the decision maker is asked to pairwise compare the criteria classes with respect to the overall goal. We use two separate decisional trees for "benefit" criteria (functional, technical, and quality) and for "cost" criteria, as recommended when implementing a benefit/cost analysis with AHP.

Taking into consideration the pairwise comparisons in the former tree, for instance, the decision maker may want to give different importance to the quality criteria with respect to the technical ones. Subsequently, the decision maker compares each criterion with the others of the same class (the homogeneous comparison is crucial for the effective implementation of AHP). In the case of the "cost" decision tree, only the comparison among the cost criteria is needed.

As some of the criteria imply a certain basic knowledge of the features of CRMSPs, the CRM expert should assist the decision maker during the implementation of the AHP. Notably, the top criteria (according to their AHP weights) will not be equally distributed according to the four categories. Thus, the CRM expert and the decision maker may choose whether they want to pick the top ones for each class or stick to the overall ranking regardless of the criteria class. This step helps the decision maker to understand his or her own priorities with respect to the criteria and represents a decision support tool that can be flexibly adapted to subjective evaluations, with high-ranking criteria that may be discarded but taken into consideration as base prerequisites for the following steps of the procedure.

3.3 | Step 3—CRMSPs prescreening

Hundreds of CRMSPs are available on the market, and their number is ever growing due to the importance of the topic. The decision makers typically lack the experience and knowledge to orient themselves in such a vast offer and have little time to dedicate to the task. This may lead to hurriedly made choices of the most popular, cheaper or better-advertised CRMSP, without a proper analysis of its matching with the firm's characteristics, which may ultimately lead to its underuse or early abandonment.

Differently from the typical decision maker, a CRM expert has better chances to identify a shortlist of CRMSPs that may suit the firm's needs. Such shortlist of candidate CRMSPs would include all the features deemed fundamental according to the results of Step 1 and should be comparable along with all the criteria identified in Step 2. As a guideline, the CRM expert might identify a dozen of suitable

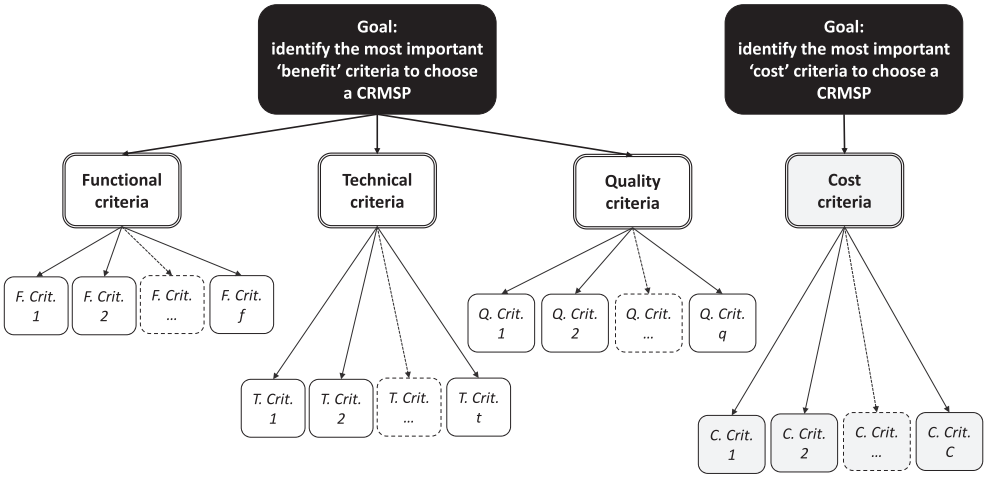


FIGURE 1 Analytic hierarchy process hierarchy structures for criteria selection. Legend: Double-line boxes describe the top level (criteria classes), single-line boxes describe the second level of the hierarchy (criteria for each criteria class), and grey boxes are cost criteria. CRMSP, customer relationship management software package

CRMSPs, and then propose to the decision maker a small subset of them, to make it easier for an inexperienced subject to compare one with another in Step 4.

3.4 | Step 4—Choice of the CRMSP

The shortlist of CRMSPs should be presented to the decision maker in full, through demonstrations and detailed descriptions. The CRM expert should also obtain quotations for each alternative.

The final selection of the CRMSP needs the implementation of another MCDM, the FAHP, an extension of the already presented AHP. FAHP is conceived to consider the uncertainty that characterizes comparisons between similar alternatives, mathematically formalizing the imprecision that is intrinsic in many problems (Kahraman, Cebeci, & Ruan, 2004). In our case, we consider that the CRM expert is likely to have identified a shortlist of highly suitable CRMSPs, whose differences on certain criteria may be small and lead the decision maker to uncertainty. Therefore, we deem FAHP particularly appropriate for this case.

FAHP shares with AHP the concepts of hierarchical structuring and pairwise comparison based on qualitatively expressed judgements but uses different algorithms to return the final vector of weights. Notably, starting from van Laarhoven and Pedrycz's (1983) early implementation of a "fuzzy extension of Saaty's priority theory," dozens of different approaches have been proposed in literature (Buckley, 1985; Calabrese, Costa, & Menichini, 2013; Chang, 1996; Gu & Zhu, 2006; He & Leung, 2002; Paul, 2015; Y.-M. Wang & Chin, 2011), and were applied to the most various areas of interest (e.g., Ballı & Korukoğlu, 2014; Calabrese, Costa, Levialdi, & Menichini, 2019; Joshi & Kumar, 2012; Ortiz-Barrios, Kucukaltan, Carvajal-Tinoco, Neira-Rodado, & Jiménez, 2017; Ribas & da Silva Rocha, 2015). Such methods typically resort to membership functions that transform the judgments through triangular, trapezoidal, or Gaussian functions (Kubler, Robert, Derigent, Voisin, & Le Traon, 2016). Among the many, Chang (1996) has achieved the largest popularity, probably due to its ease of implementation (Kubler et al., 2016), although its validity was harshly criticized in the past decade due to theoretical pitfalls (Y.-M. Wang & Elhag, 2006; Y.-M. Wang, Luo, & Hua, 2008). Therefore, despite its still very much lively popularity, we suggest resorting to more robust methods among those proposed in recent years (see the review of Kubler et al., 2016).

Among the many alternatives, we chose Wang and Chin's (2011) logarithmic fuzzy preference programming (LFPP) method, which formulates the priorities as logarithmic non-linear programming and derives crisp priorities from fuzzy pairwise comparison matrices. Such a method can be easily implemented through the Solver tool of Microsoft Excel, a software very familiar to most business consultants, making it ideally suitable for a CRM expert's needs. Therefore, using the LFPP version of FAHP, the shortlisted CRMSPs chosen in Step 3 are compared according to the criteria identified in Step 2.

The implementation of the FAHP requires a semantic scale like the one used for AHP, from which the judgements in the pairwise comparisons are translated into fuzzy numbers (Table 3). Starting from the three components of a triangular fuzzy number $\tilde{A} = (l,m,u)$, a membership function must be defined to convert the fuzzy scale into real numbers included in a range from 0 to 1. Different membership functions characterize the various FAHP approaches using triangular numbers (e.g., see Figure 2).

Likewise AHP, FAHP allows checking the consistency of the judgments expressed through triangular numbers, and the CR should be maintained below 0.1.

Once the pairwise comparisons matrices of the decision maker are built, the triangular numbers are synthesized according to the chosen FAHP algorithm. The method also allows the involvement of multiple decision makers, in which case the pairwise comparison matrices need to be synthesized by calculating the average triangular numbers. Principal components analysis may also be considered to aggregate the different judgements instead of geometric mean (Scala, Rajgopal, Vargas, & Needy, 2016). In the LFPP case, a non-linear priority model with several constraints needs to be solved minimizing an objective function (see Equation (1)).

TABLE 3 Semantic judgement and their corresponding AHP and triangular fuzzy scales

Definition	AHP scale	Triangular *fuzzy* scale (l, m, u)
Equal importance	1	(1, 1, 1)
One moderately more important than the other	3	(2/3, 1, 3/2)
One strongly more important than the other	5	(3/2, 2, 5/2)
One very strongly more important than the other	7	(5/2, 3, 7/2)
One extremely more important than the other	9	(7/2, 4, 9/2)

Abbreviation: AHP, analytic hierarchy process.

Membership function (Chang 1996)

$$\mu_{\tilde{A}}(x) = \begin{cases} \dfrac{x-l}{m-l} \; for\; l \le x \le m, \\ \dfrac{u-x}{u-m} \; for\; m \le x \le u, \\ 0 \quad otherwise \end{cases}$$

LFPP Membership function (Wang and Chin 2011)

$$\mu_{\tilde{A}}\left(\ln\left(\frac{w_i}{w_j}\right)\right) = \begin{cases} \dfrac{\ln\left(\frac{w_i}{w_j}\right) - \ln l_{ij}}{\ln m_{ij} - \ln l_{ij}} \; for \ln\left(\frac{w_i}{w_j}\right) \le \ln m_{ij}, \\ \dfrac{\ln u_{ij} - \ln\left(\frac{w_i}{w_j}\right)}{\ln u_{ij} - \ln m_{ij}} for \ln\left(\frac{w_i}{w_j}\right) \ge \ln m_{ij}, \end{cases}$$

FIGURE 2 Comparison between Chang's (1996) and Wang and Chin's (2011) membership functions

$$\begin{aligned} &\textit{Minimize } J = (1-\lambda)^2 + M\cdot\sum_{i=1}^{n-1}\sum_{j=i+1}^{n}\left(\delta_{ij}^2+\eta_{ij}^2\right)\\ &\textit{Subject to}\begin{cases} x_i - x_j - \lambda\ln\left(\frac{m_{ij}}{l_{ij}}\right)+\delta_{ij}\geq \ln l_{ij}, i=1,\ldots,n-1; j=i+1,\ldots,n\\ -x_i + x_j - \lambda\ln\left(\frac{u_{ij}}{m_{ij}}\right)+\eta_{ij}\geq -\ln u_{ij}, i=1,\ldots,n-1; j=i+1,\ldots,n\\ \lambda, x_i\geq 0, i=1,\ldots,n\\ \delta_{ij},\eta_{ij}\geq 0, i=1,\ldots,n-1; j=1+i,\ldots,n, \end{cases} \end{aligned} \quad (1)$$

where λ is the minimum membership degree, δ_{ij},η_{ij} are so-called deviation variables aimed to avoid λ taking negative values, $x_i = \ln w_i$ for $i = ,\ldots,n$, and M is a sufficiently large constant such as 10^3.

As a result, a vector of weights $w_i^* = exp(x_i^*)/\sum_{j=1}^{n} exp\left(x_j^*\right)$ included in the range 0–1 for each of the n alternatives is obtained.

In the typical case that both cost and benefit criteria have been chosen in Step 2, a cost–benefit analysis is needed. This implies the set-up of two decision trees, one for the benefit criteria and one for cost criteria. The judgements of the decision maker are synthesized through the FAHP, which returns two vectors of weights, one for the benefits, and one for the costs of each alternative. A benefit/cost ratio can be calculated for each of the alternatives so that the alternative with the larger ratio between its benefit and cost weights emerges as the favourite one of the decision maker.

3.4.1 | Variants to Step 4

Step 4 may be purposely adapted from case to case to meet the needs of the target firm and the competencies of the CRM expert.

The first adaptation of Step 4 would delegate the burden of the decision in full to the CRM expert. As a matter of fact, because the criteria have been identified and weighted by the decision maker in Step 2, the CRM expert is likely to be the most qualified person to compare the shortlisted CRMSPs according to the chosen criteria. On the one hand, this approach would remarkably reduce the effort requested to the decision maker (who would not need to test the shortlisted CRMSPs). On the other hand, some criteria are subjective in nature (e.g., usability, user management tools, and reporting), and the perceptions of the CRM may not coincide with those of the decision maker.

The second adaptation of Step 4 would use AHP instead of FAHP. Indeed, even though the latter method is meant to consider the uncertainty level more heavily than the former, also AHP is explicitly meant to deal with somewhat uncertain comparison and has controls that allow maintaining the consistency of the judgments made. The main reason for using AHP instead of FAHP derives from the lack of ready-to-use software packages to implement the latter, which therefore requires from the CRM expert the set-up of a Microsoft Excel spreadsheet, using the Solver tool. On the contrary, AHP may be easily implemented through the Super Decisions (2016) software package.

4 | CASE STUDY

This section presents an implementation of the CRMSP selection method in a small original equipment manufacturer based in the Southern Lazio, Italy. The firm produces industrial packaging machinery and operates in the B2B market. Despite its size, the firm has been experiencing a steep growth in its orders and regularly interacts with customers of any size, from SMEs to multinational companies. Such growth prompted the management to upgrade and optimize its internal processes, including the marketing one. In this section, we will describe the application of the method in this real case, following the four steps that make up the method.

4.1 | Step 1—Analysis of the firm

First, the features and the needs of the firm were analysed. Due to the growth rates mentioned before, the CEO of the firm emphasized the increasing need to systemize and manage customers and leads records, to support the salespeople during the negotiations, and to manage and realize the projects. Such need can typically be satisfied through a good CRMSP. Therefore, we identified the processes and the subjects whose work could have been affected by the implementation of a CRMSP, identifying the requirements needed to cope with their needs.

Consequently, we identified several critical functionalities, including customer and lead management, opportunity and sales management, project management functionalities, reporting functionalities, a calendar to define and to share the meetings and tasks, and an internal email client (or the possibility to integrate the software with the most popular email clients to manage the email exchanges with the stakeholders).

The CRMSP was expected to have an intuitive interface and high performance in terms of response time, but above all, it should have been (a) complete, (b) scalable, (c) customizable, and (d) self-hosted, that means the software should have been installed on the firm's server, not cloud-based. Furthermore, the CEO also established a maximum budget of €6.000 (e), for a minimum of five users allowed to use the software (f).

4.2 | Step 2—Choice of the set of criteria

We illustrated to the CEO of the firm (i.e., the decision maker) the rationale behind AHP and the pairwise comparisons and collected his judgements with respect to the criteria identified in Section 3.2, organized according to the AHP hierarchies described by Figure 1.

First, pairwise comparisons were performed among the three categories of benefit criteria (functional, technical, and quality; Table 4). For instance, the CEO affirmed that *functional criteria* are extremely more important than *technical criteria* to achieve the goal of the study; therefore, 9 and 1/9 are placed in the proper cells of the pairwise comparison matrix. The comparison matrix always has 1 on the diagonal (since the same alternative is as important as itself) and is

TABLE 4 Pairwise comparisons among the three benefit categories of criteria of the hierarchical structure

	Quality criteria	Functional criteria	Technical criteria	Normalized weight
Quality criteria	1	1/3	3	0.2308
Functional criteria	3	1	9	0.6922
Technical criteria	1/3	1/9	1	0.0770
CR = 0.000				

Abbreviation: CR, consistency ratio.

triangular. Notably, there is no inconsistency in the pairwise comparisons in Table 4, with an excellent CR of 0.

Subsequently, the CEO compared the criteria within the same criteria category, as exemplified in Tables 5 and 6 for the criteria within the quality and cost categories, respectively. The normalized weights of the criteria and the normalized weights of the (benefit) criteria are then multiplied to obtain the final weights, whereas the normalized weights of the cost criteria in Table 6 are taken without further operations, as shown in Table 7. In agreement with the CEO, we selected criteria pertaining to all the four categories, even though the mere ranking would have induced us to choose a set of criteria on the mere basis of their score, which would have implied excluding all the technical criteria. As a rule of thumb, we selected as many criteria from the benefit and cost classes that would exceed 50% of the overall weights. Picking a limited number of criteria is crucial to reduce the risk of inconsistent comparisons in Step 4. Table 7 shows which, among the original set of criteria, were chosen for the selection of the CRMSPs.

Notably, more functional criteria could have been chosen, given their normalized weights, but we selected only the first three in the ranking to give more space to the other criteria categories. Even though the third choice among the functional criteria "project and activities management" achieved the same weight of two criteria ("leads and contact management" and "sales and opportunity management"), we chose it on the basis of the CEO's point of view and considered the existence of the functionalities pertaining to the other two criteria as baseline requisites for the CRMSPs to be identified in Step 3. The first two criteria for the quality and for the cost categories were selected based on their weights. Finally, only one criterion from the technical category (which had the lowest normalized weight of the four) was chosen, the "performance" one, which was the second best of its category. Data security, which obtained a higher weight in the same category, was discarded in consideration of the fact that the CEO insisted on the importance of a self-hosted solution (despite its low weight) and concluded that in such a solution data security would have been an issue partly laying outside the CRMSP features. This implementation of our method emphasizes its nature of decision support system, which does not substitute the decision maker, but gives him or her useful insights to choose in a more nuanced way.

TABLE 5 Pairwise comparisons of the quality criteria

	1.	2.	3.	4.	Normalized weight
1. Completeness	1	1	5	5	0.3868
2. Usability and intuitiveness of the interface	1	1	7	7	0.4602
3. Popularity	1/5	1/7	1	3	0.0976
4. Portability	1/5	1/7	1/3	1	0.0554
CR = 0.063					

Abbreviation: CR, consistency ratio.

4.3 | Step 3—CRMSPs prescreening

Starting from the six prerequisites identified in Step 1 (completeness, scalability, customizability, self-hosted, max budget of €6.000, and min five users), we explored the offer of CRMSPs, selecting 15 suitable solutions based on their costs, functionalities, strengths, and weaknesses. Such alternatives were preliminarily analysed according to the above-mentioned prerequisites and the criteria identified in Step 2.

TABLE 6 Pairwise comparisons of the cost criteria

	1.	2.	3.	4.	5.	Normalized weight
1. Hardware infrastructural costs	1	1/9	1/9	1/9	1	0.0326
2. License or software costs	9	1	3	5	7	0.4967
3. Installation and configuration costs	9	1/3	1	3	7	0.2750
4. Training and support costs	9	1/5	1/3	1	5	0.1560
5. Maintenance and upgrades costs	1	1/7	1/7	1/5	1	0.0397
CR = 0.085						

Abbreviation: CR, consistency ratio.

TABLE 7 Normalized weights of the criteria

Category	Criteria	Normalized weights	Chosen
Cost	License or software cost	0.4966	Yes
	Installation and configuration cost	0.2752	Yes
	Training and support cost	0.1563	
	Maintenance and upgrades cost	0.0393	
	Hardware infrastructural cost	0.0326	
		Tot cost weights = 1	Tot chosen cost weights = 0.7718
Functional	Email management	0.1213	Yes
	Basic operating features	0.1138	Yes
	Project and activities management	0.1032	Yes
	Leads and contacts management	0.1032	
	Opportunity and sales management	0.1032	
	Accounts management	0.0804	
	Reporting	0.0371	
	Customer service	0.0160	
	Activity and email marketing management	0.0139	
Quality	Usability and intuitiveness of the interface	0.1062	Yes
	Completeness	0.0893	Yes
	Popularity	0.0225	
	Portability	0.0128	
Technical	Data security	0.0303	
	Performance	0.0147	Yes
	Customization	0.0110	
	Scalability	0.0067	
	Self-hosted	0.0048	
	Installation and configuration	0.0035	
	Integration with a third part application and with social media	0.0025	
	Cloud-based	0.0019	
	Maintainability	0.0016	
		Tot benefit weights = 1	Tot chosen benefit weights = 0.5485

The needed information was collected on the websites of the CRMSPs and through the available demo versions. For each of the 15 solutions and for each of the eight criteria identified in Step 2, we developed descriptive tables with brief judgments to have an overall view of the selected market offer (see Table 8 for an example concerning the two cost criteria). The analysis of such tables, also in view of the prerequisites and the eight criteria, allowed identifying a shortlist of five alternatives to be submitted to the CEO: vTiger, Bitrix24, iRevolution, SuiteCRM, and SuperOffice.

4.4 | Step 4—Choice of the CRMSP

For each of the five shortlisted CRMSPs, we selected a vendor, who provided the CEO with a demonstration and a detailed quote in line with the firm's requirements. After then, the FAHP was implemented as discussed in Section 3.4. Because both benefit and cost criteria were included, we performed a benefit/cost analysis. Therefore, two different FAHP models were completed: one for the six functional, technical, and quality criteria and one for the two cost criteria. The benefit/cost ratios were then calculated based on the resulting weights from the two models. The hierarchical structure that was considered for the FAHP of the six benefit criteria and the two cost criteria is exemplified in Figure 3.

As done in Step 2, the CEO was asked to pairwise compare (a) the six benefit criteria, (b) the five alternatives for each of the six criteria, (c) the two cost criteria, and, in the end, (d) the five alternatives for each of the two criteria. In this case, the comparison was not performed through Super Decisions, which does not support FAHP, but through a Microsoft Excel Spreadsheet that was conveniently set up for the occasion.

TABLE 8 Overview of the 15 solutions with respect to the selected cost criteria

CRMSP	License or software cost	Installation and configuration cost
Salesforce	Very high	Very high
vTiger	Low (in the self-hosted version)	Average
Sugar CRM	High	High
Teamleader	Average	Average
Insightly	Low (free for up to two users)	Average
SuperOffice	High (in the self-hosted version)	High
Zoho CRM	High	High
Pipedrive	Low	Average
Bitrix24	High (in the self-hosted version)	Average
Freshsales	Low (free for up to 10 users)	Average
Nimble	Average	Average
Capsule	Low (free for up to two users)	Average
Nutshell	Average	Low
iRevolution	Very high	High
SuiteCRM	Low	Average

Abbreviations: CRM, customer relationship management; CRMSP, CRM software package.

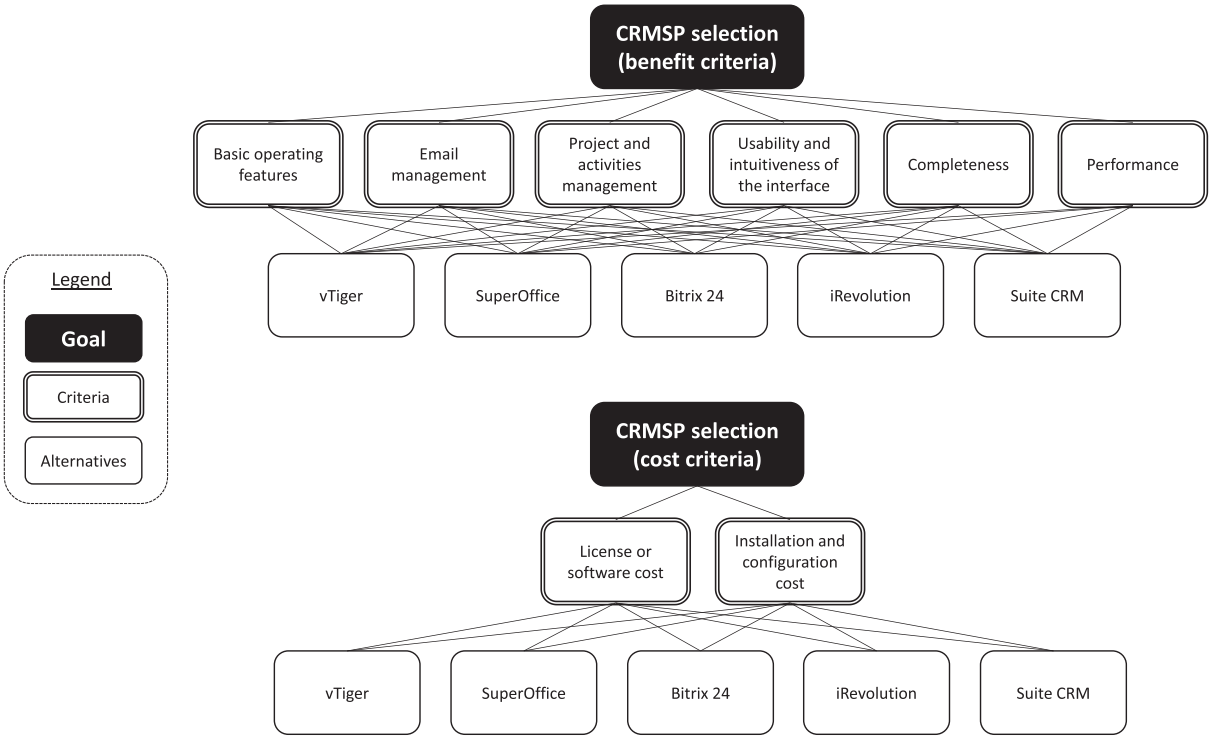
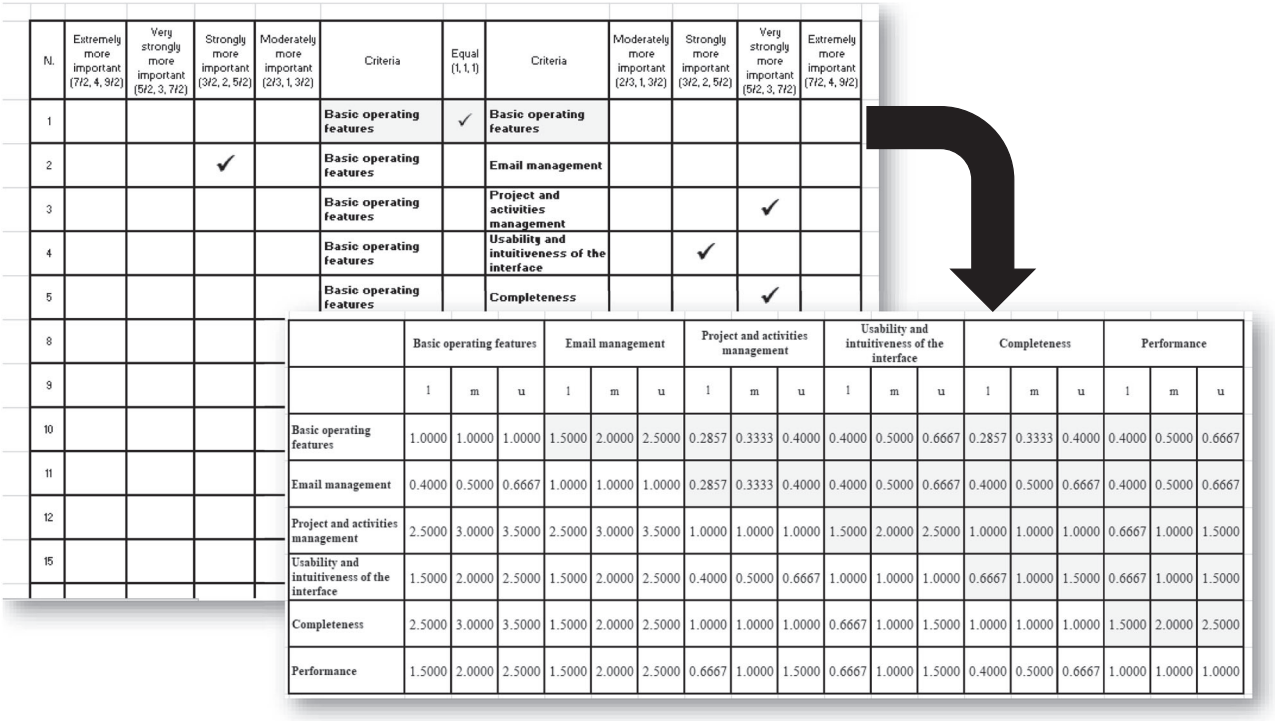


FIGURE 3 Hierarchical structure of the CRM software selection problem related to the eight criteria. CRM, customer relationship management; CRMSP, CRM software package

The CEO verbally expressed his judgments without any need to understand the complexity of triangular numbers. Figure 4 shows how, on Microsoft Excel, the verbal judgments are converted into triangular numbers in the case of the pairwise comparisons between the six benefit criteria.

Using Wang and Chin's (2011) LFPP method, we constructed the system of constraints showed in Section 3.4, aimed to identify the weights capable to minimize the objective function, returning the optimal values capable to mathematically describe the preferences of the CEO. The system was solved through the Microsoft Excel Solver



N.	Extremely more important (7/2, 4, 9/2)	Very strongly more important (5/2, 3, 7/2)	Strongly more important (3/2, 2, 5/2)	Moderately more important (2/3, 1, 3/2)	Criteria	Equal (1, 1, 1)	Criteria	Moderately more important (2/3, 1, 3/2)	Strongly more important (3/2, 2, 5/2)	Very strongly more important (5/2, 3, 7/2)	Extremely more important (7/2, 4, 9/2)
1					Basic operating features	✓	Basic operating features				
2			✓		Basic operating features		Email management				
3					Basic operating features		Project and activities management			✓	
4					Basic operating features		Usability and intuitiveness of the interface		✓		
5					Basic operating features		Completeness			✓	

	Basic operating features			Email management			Project and activities management			Usability and intuitiveness of the interface			Completeness			Performance		
	l	m	u	l	m	u	l	m	u	l	m	u	l	m	u	l	m	u
Basic operating features	1.0000	1.0000	1.0000	1.5000	2.0000	2.5000	0.2857	0.3333	0.4000	0.4000	0.5000	0.6667	0.2857	0.3333	0.4000	0.4000	0.5000	0.6667
Email management	0.4000	0.5000	0.6667	1.0000	1.0000	1.0000	0.2857	0.3333	0.4000	0.4000	0.5000	0.6667	0.4000	0.5000	0.6667	0.4000	0.5000	0.6667
Project and activities management	2.5000	3.0000	3.5000	2.5000	3.0000	3.5000	1.0000	1.0000	1.0000	1.5000	2.0000	2.5000	1.0000	1.0000	1.0000	0.6667	1.0000	1.5000
Usability and intuitiveness of the interface	1.5000	2.0000	2.5000	1.5000	2.0000	2.5000	0.4000	0.5000	0.6667	1.0000	1.0000	1.0000	0.6667	1.0000	1.5000	0.6667	1.0000	1.5000
Completeness	2.5000	3.0000	3.5000	1.5000	2.0000	2.5000	1.0000	1.0000	1.0000	0.6667	1.0000	1.5000	1.0000	1.0000	1.0000	1.5000	2.0000	2.5000
Performance	1.5000	2.0000	2.5000	1.5000	2.0000	2.5000	0.6667	1.0000	1.5000	0.6667	1.0000	1.5000	0.4000	0.5000	0.6667	1.0000	1.0000	1.0000

FIGURE 4 Triangular numbers corresponding to the pairwise comparisons between the six "benefit" criteria

function. As shown in Table 9, the resulting weights are used to calculate benefit/cost ratios. The ratios larger than 1 describe suitable alternatives, among which the largest ratio should be selected. As a result, the CEO chose and purchased the alternative vTiger.

For the sake of completeness, we implemented the CEO's judgements in both a standard AHP model (i.e., converting his judgments through Saaty's semantic scale) and in Chang's version of FAHP (1996). Whereas the former method returns precisely the

TABLE 9 Weights and benefit/cost ratios of the five alternatives

	W_b Benefit criteria weights	W_c Cost criteria weights	W_b/W_c Benefit/cost ratios	**Standard AHP B/C ratios**
vTiger	0.3126	0.1738	1.7987	9.363
SuperOffice	0.1848	0.2094	0.8825	0.610
Bitrix 24	0.1857	0.2084	0.8909	0.841
iRevolution	0.1261	0.2346	0.5375	0.086
Suite CRM	0.1909	0.1738	1.0983	4.847
Total	1.0000	1.0000		

Abbreviation: AHP, analytic hierarchy process.

TABLE 10 Comparison between benefit/cost ratios for LFPP, standard AHP, and Chang's version of FAHP

	LFPP B/C ratios	**LFPP ranking**	**Standard AHP B/C ratios**	**AHP ranking**	**Chang's FAHP B/C ratios**	**Chang's FAHP ranking**
vTiger	1.7987	1	9.3628	1	1.1277	1
SuperOffice	0.8825	4	0.6104	4	1.0235	2
Bitrix 24	0.8909	3	0.8409	3	0.9510	4
iRevolution	0.5375	5	0.0864	5	0.8974	5
Suite CRM	1.0983	2	4.8470	2	1.0004	3

Abbreviations: AHP, analytic hierarchy process; CRM, customer relationship management; LFPP, logarithmic fuzzy preference programming.

same ranking of LFPP (although with much more unbalanced ratios), the latter method returns a slightly different ranking that nonetheless still finds vTiger as the most favourable solution (see Table 10).

5 | CONCLUSIONS

Customers are increasingly becoming the Polar Star of firms operating in the most various industries, with customer satisfaction measures that are gradually becoming as important as financial ones. This context is especially valid for the B2B market, in which firms typically interact with a few customers that demand much attention and dedication. For the firms operating in the B2B market, a naïve approach to CRM, mainly relying on the competence of the salespeople, can cause the loss of interesting opportunities.

Therefore, there is a growing interest in tools that can support salespeople in the CRM. However, getting oriented in the offer of CRMSPs is increasingly difficult due to the vast number of alternatives and the variety of the features they offer. The decision makers often lack the experience and competence to choose the CRMSP that best suits their firms' needs. Thus, they may invest their limited resources in a solution equipped with superfluous functionalities or missing critical ones they did not think of in the first place, or they may discover too late that the service costs are much higher than the licensing ones. These are only a few of the causes that may bring to the early abandonment of a CRMSP, with a waste of time and resources.

When the decision makers resort to the help of a CRM expert to make an informed decision, the latter needs a usable method to advise the decision makers in a way that minimizes their loss of time while maintaining their fundamental involvement.

Because existing methods suffered from the limitations discussed in Section 2, this article proposed a novel method that resorts to a combination of AHP and FAHP. The method allows both the identification of the most important prerequisites and decisional criteria in view of the firm's needs and the selection of the most adequate CRMSP according to them. Furthermore, we showed how the method can be straightforwardly adapted to various circumstances and discussed its implementation in an Italian SME. Notably, the choice and purchase of a CRMSP is only the first step towards its actual implementation in a firm and the acceptance by the firm's salesforce. Because such implementation is an impervious process (Becker, Greve, & Albers, 2009), future studies may discuss how to facilitate it.

The method we proposed is susceptible of improvements, such as the identification of a "standard" set of generally valid criteria for firms operating in certain industries, or the development of an extended database of CRMSPs that described according to such general criteria. Furthermore, the proposed method could be implemented in a single information system (avoiding the joint usage of Super Decision and Microsoft Excel), becoming a ready-to-use tool for CRM experts or particularly knowledgeable decision makers. In fact, a simplified version of our model that uses AHP in both Step 2 and Step 4 could already be implemented in Super Decisions without difficulties.

The main limitation of our method lays in its need to be implemented by a CRM expert and therefore may not be used by the decision makers autonomously. The implementation of the method in a single information system, the development of a standard set of criteria, and the development of a database of CRMSPs described according to such criteria may lead to an automated decision support system not requesting the intervention of an expert.

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CONFLICT OF INTEREST

None.

ENDNOTE

[1] Software packages for the implementation of AHP, such as Super Decisions, allow punctually identifying the most incoherent judgments, also presenting how the consistency would improve after an appropriate modification.

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REFERENCES

Adebanjo, D. (2003). Classifying and selecting e-CRM applications: An analysis-based proposal. *Management Decision*, *41*, 570–577. https://doi.org/10.1108/00251740310491517

Ahearne, M., Hughes, D. E., & Schillewaert, N. (2007). Why sales reps should welcome information technology: Measuring the impact of CRM-based IT on sales effectiveness. *International Journal of Research in Marketing*, *24*, 336–349. https://doi.org/10.1016/j.ijresmar.2007.09.003

Ahmad, R., & Buttle, F. (2002). Customer retention management: A reflection of theory and practice. *Marketing Intelligence & Planning*, *20*, 149–161. https://doi.org/10.1108/02634500210428003

Anderson, J. C., & Narus, J. A. (1998). Business marketing: Understand what customers value. *Harvard Business Review*, *76*, 5–15.

Ata, U. Z., & Toker, A. (2012). The effect of customer relationship management adoption in business-to-business markets. *Journal of Business & Industrial Marketing*, *27*, 497–507.

Ballı, S., & Korukoğlu, S. (2014). Development of a fuzzy decision support framework for complex multi-attribute decision problems: A case study for the selection of skilful basketball players. *Expert Systems*, *31*, 56–69. https://doi.org/10.1111/exsy.12002

Baran, R. J., & Galka, R. J. (2016). *Customer relationship management: The foundation of contemporary marketing strategy*. New York: Routledge. https://doi.org/10.4324/9781315687834

Battor, M., & Battor, M. (2010). The impact of customer relationship management capability on innovation and performance advantages:

Testing a mediated model. *Journal of Marketing Management*, *26*, 842–857. https://doi.org/10.1080/02672570903498843

Baxter, R. (2008). Intangible value in buyer–seller relationships. In A. G. Woodside, F. Golfetto, & M. Gibbert (Eds.), *Advances in business marketing and purchasing* (Vol. 14) (pp. 27–98). Bingley, UK: Emerald Group Publishing Limited.

Becker, J. U., Greve, G., & Albers, S. (2009). The impact of technological and organizational implementation of CRM on customer acquisition, maintenance, and retention. *International Journal of Research in Marketing*, *26*, 207–215. https://doi.org/10.1016/j.ijresmar.2009.03.006

Bose, R. (2002). Customer relationship management: Key components for IT success. *Industrial Management & Data Systems*, *102*, 89–97. https://doi.org/10.1108/02635570210419636

Buckley, J. J. (1985). Fuzzy hierarchical analysis. *Fuzzy Sets and Systems*, *17*, 233–247. https://doi.org/10.1016/0165-0114(85)90090-9

Bull, C. (2003). Strategic issues in customer relationship management (CRM) implementation. *Business Process Management Journal*, *9*, 592–602. https://doi.org/10.1108/14637150310496703

Buttle, F. (2009). *Customer relationship management. Concepts and technologies* (Second ed.). Oxford: Butterworth-Heinemann.

Calabrese, A., Costa, R., Levialdi, N., & Menichini, T. (2019). Integrating sustainability into strategic decision-making: A fuzzy AHP method for the selection of relevant sustainability issues. *Technological Forecasting and Social Change*, *139*, 155–168. https://doi.org/10.1016/j.techfore.2018.11.005

Calabrese, A., Costa, R., & Menichini, T. (2013). Using fuzzy AHP to manage intellectual capital assets: An application to the ICT service industry. *Expert Systems with Applications*, *40*, 3747–3755. https://doi.org/10.1016/j.eswa.2012.12.081

Chang, D. Y. (1996). Applications of the extent analysis method on fuzzy AHP. *European Journal of Operational Research*, *95*, 649–655. https://doi.org/10.1016/0377-2217(95)00300-2

Chari, S., Tarkiainen, A., & Salojärvi, H. (2016). Alternative pathways to utilizing customer knowledge: A fuzzy-set qualitative comparative analysis. *Journal of Business Research*, *69*, 5494–5499. https://doi.org/10.1016/j.jbusres.2016.04.160

Colombo, E., & Francalanci, C. (2004). Selecting CRM packages based on architectural, functional, and cost requirements: Empirical validation of a hierarchical ranking model. *Requirements Engineering*, *9*, 186–203.

Coltman, T. R. (2006). Where are the benefits in CRM technology investment? Proceedings of the 39th Annual Hawaii International Conference on System Sciences (HICSS'06), *6*, 111c-111c. Kauia: IEEE.

Creative Decisions Foundation. (2016). Super Decisions. Retrieved February 15, 2018, from https://www.superdecisions.com/

Cruz-Jesus, F., Pinheiro, A., & Oliveira, T. (2019). Understanding CRM adoption stages: Empirical analysis building on the TOE framework. *Computers in Industry*, *109*, 1–13. https://doi.org/10.1016/j.compind.2019.03.007

Di Bona, G., Silvestri, A., Forcina, A., & Falcone, D. (2017). AHP-IFM target: An innovative method to define reliability target in an aerospace prototype based on analytic hierarchy process. *Quality and Reliability Engineering International*, *33*, 1731–1751. https://doi.org/10.1002/qre.2140

Dyer, J. H., & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review*, *23*, 660–679. https://doi.org/10.5465/amr.1998.1255632

Ehret, M. (2004). Managing the trade-off between relationships and value networks. Towards a value-based approach of customer relationship management in business-to-business markets. *Industrial Marketing Management*, *33*, 465–473. https://doi.org/10.1016/j.indmarman.2004.03.002

Farhan, M. S., Abed, A. H., & Ellatif, M. A. (2018). A systematic review for the determination and classification of the CRM critical success factors supporting with their metrics. *Future Computing and Informatics Journal*, *3*, 398–416. https://doi.org/10.1016/j.fcij.2018.11.003

Friedrich, I., & Breitner, M. H. (2012). Towards a process model for efficient customer relationship management system selection. Digitale Bibliothek Braunschweig.

Gu, X., & Zhu, Q. (2006). Fuzzy multi-attribute decision-making method based on eigenvector of fuzzy attribute evaluation space. *Decision Support Systems*, *41*, 400–410. https://doi.org/10.1016/j.dss.2004.08.001

Gummesson, E. (2004). Return on relationships (ROR): The value of relationship marketing and CRM in business-to-business contexts. *Journal of Business & Industrial Marketing*, *19*, 136–148. https://doi.org/10.1108/08858620410524016

Haislip, J. Z., & Richardson, V. J. (2017). The effect of Customer Relationship Management systems on firm performance. *International Journal of Accounting Information Systems*, *27*, 16–29. https://doi.org/10.1016/j.accinf.2017.09.003

He, M., & Leung, H. (2002). Agents in e-commerce: State of the art. *Knowledge and Information Systems*, *4*(3), 257–282.

Ho, W., & Ma, X. (2018). The state-of-the-art integrations and applications of the analytic hierarchy process. *European Journal of Operational Research*, *267*, 399–414. https://doi.org/10.1016/j.ejor.2017.09.007

Jadhav, A. S., & Sonar, R. M. (2009). Evaluating and selecting software packages: A review. *Information and Software Technology*, *51*, 555–563. https://doi.org/10.1016/j.infsof.2008.09.003

Joshi, K., & Kumar, S. (2012). Matchmaking using fuzzy analytical hierarchy process, compatibility measure and stable matching for online matrimony in India. *Journal of Multi-Criteria Decision Analysis*, *19*, 57–66. https://doi.org/10.1002/mcda.487

Kahraman, C., Cebeci, U., & Ruan, D. (2004). Multi-attribute comparison of catering service companies using fuzzy AHP: The case of Turkey. *International Journal of Production Economics*, *87*, 171–184. https://doi.org/10.1016/S0925-5273(03)00099-9

Keil, M., & Tiwana, A. (2006). Relative importance of evaluation criteria for enterprise systems: A conjoint study. *Information Systems Journal*, *16*, 237–262. https://doi.org/10.1111/j.1365-2575.2006.00218.x

Ko, E., Kim, S. H., Kim, M., & Woo, J. Y. (2008). Organizational characteristics and the CRM adoption process. *Journal of Business Research*, *61*, 65–74. https://doi.org/10.1016/j.jbusres.2006.05.011

Kubler, S., Robert, J., Derigent, W., Voisin, A., & Le Traon, Y. (2016). A state-of the-art survey & testbed of fuzzy AHP (FAHP) applications. *Expert Systems with Applications*, *65*, 398–422. https://doi.org/10.1016/j.eswa.2016.08.064

Lambert, D. M. (2009). Customer relationship management as a business process. *Journal of Business & Industrial Marketing*, *25*, 4–17. https://doi.org/10.1108/08858621011009119

Lee, Y.-C., Tang, N.-H., & Sugumaran, V. (2014). Open source CRM software selection using the analytic hierarchy process. *Information Systems Management*, *31*, 2–20. https://doi.org/10.1080/10580530.2013.854020

Li, Y., Huang, J., & Song, T. (2019). Examining business value of customer relationship management systems: IT usage and two-stage model perspectives. *Information & Management*, *56*, 392–402. https://doi.org/10.1016/j.im.2018.07.012

Lin, M. C. (2003). A study of mainstream features of CRM system and evaluation criteria. Proceedings of the 2003 American Society for Engineering Education Annual Conference & Exposition, 1–12. American Society for Engineering Education.

Macharis, C., Turcksin, L., & Lebeau, K. (2012). Multi actor multi criteria analysis (MAMCA) as a tool to support sustainable decisions: State of use. *Decision Support Systems*, *54*, 610–620. https://doi.org/10.1016/j.dss.2012.08.008

Mithas, S., Krishnan, M. S., & Fornell, C. (2005). Why do customer relationship management applications affect customer satisfaction? *Journal of Marketing*, *69*, 201–209. https://doi.org/10.1509/jmkg.2005.69.4.201

Mithas, S., & Rust, R. T. (2016). How information technology strategy and investments influence firm performance: Conjecture and empirical

evidence. *MIS Quarterly*, *40*, 223–245. https://doi.org/10.25300/MISQ/2016/40.1.10

Ngai, E. W. T., Xiu, L., & Chau, D. C. K. (2009). Application of data mining techniques in customer relationship management: A literature review and classification. *Expert Systems with Applications*, *36*, 2592–2602. https://doi.org/10.1016/j.eswa.2008.02.021

Nguyen, B., & Mutum, D. S. (2012). A review of customer relationship management: Successes, advances, pitfalls and futures. *Business Process Management Journal*, *18*, 400–419. https://doi.org/10.1108/14637151211232614

Noori, B., & Hossein Salimi, M. (2005). A decision-support system for business-to-business marketing. *Journal of Business & Industrial Marketing*, *20*, 226–236. https://doi.org/10.1108/08858620510603909

Obal, M., & Lancioni, R. A. (2013). Maximizing buyer–supplier relationships in the Digital Era: Concept and research agenda. *Industrial Marketing Management*, *42*, 851–854. https://doi.org/10.1016/j.indmarman.2013.06.002

Ortiz-Barrios, M. A., Kucukaltan, B., Carvajal-Tinoco, D., Neira-Rodado, D., & Jiménez, G. (2017). Strategic hybrid approach for selecting suppliers of high-density polyethylene. *Journal of Multi-Criteria Decision Analysis*, *24*, 296–316. https://doi.org/10.1002/mcda.1617

Ortiz-Barrios, M. A., De Felice, F., Negrete, K. P., Romero, B. A., Arenas, A. Y., & Petrillo, A. (2016). An AHP-topsis integrated model for selecting the most appropriate tomography equipment. *International Journal of Information Technology & Decision Making*, *15*, 861–885. https://doi.org/10.1142/S021962201640006X

Palmatier, R. W., Scheer, L. K., Houston, M. B., Evans, K. R., & Gopalakrishna, S. (2007). Use of relationship marketing programs in building customer–salesperson and customer–firm relationships: Differential influences on financial outcomes. *International Journal of Research in Marketing*, *24*, 210–223. https://doi.org/10.1016/j.ijresmar.2006.12.006

Paul, S. K. (2015). Supplier selection for managing supply risks in supply chain: A fuzzy approach. *International Journal of Advanced Manufacturing Technology*, *79*, 657–664. https://doi.org/10.1007/s00170-015-6867-y

Ribas, J. R., & da Silva Rocha, M. (2015). A decision support system for prioritizing investments in an energy efficiency program in *Favelas* in the city of Rio de Janeiro. *Journal of Multi-Criteria Decision Analysis*, *22*, 89–99. https://doi.org/10.1002/mcda.1524

Rodriguez, M., Peterson, R. M., & Krishnan, V. (2018). Impact of CRM technology on sales process behaviors: Empirical results from US, Europe, and Asia. *Journal of Business-to-Business Marketing*, *25*, 1–10. https://doi.org/10.1080/1051712X.2018.1424754

Rollins, M., Bellenger, D. N., & Johnston, W. J. (2012). Does customer information usage improve a firm's performance in business-to-business markets? *Industrial Marketing Management*, *41*, 984–994. https://doi.org/10.1016/j.indmarman.2012.01.004

Rygielski, C., Wang, J.-C., & Yen, D. C. (2002). Data mining techniques for customer relationship management. *Technology in Society*, *24*, 483–502. https://doi.org/10.1016/S0160-791X(02)00038-6

Saaty, T. L. (1980). *The analytic hierarchy process*. New York: McGrow-Hill.

Salojärvi, H., & Sainio, L.-M. (2015). CRM technology and KAM performance: The mediating effect of key account-related knowledge. *Journal of Business Market Management*, *8*, 435–454.

Scala, N. M., Rajgopal, J., Vargas, L. G., & Needy, K. L. S. (2016). Group decision making with dispersion in the analytic hierarchy process. *Group Decision and Negotiation*, *25*, 355–372. https://doi.org/10.1007/s10726-015-9445-7

Şen, C. G., & Baraçlı, H. (2010). Fuzzy quality function deployment based methodology for acquiring enterprise software selection requirements. *Expert Systems with Applications*, *37*, 3415–3426. https://doi.org/10.1016/j.eswa.2009.10.006

Soltani, Z., & Navimipour, N. J. (2016). Customer relationship management mechanisms: A systematic review of the state of the art literature and recommendations for future research. *Computers in Human Behavior*, *61*, 667–688. https://doi.org/10.1016/j.chb.2016.03.008

Steel, M., Dubelaar, C., & Ewing, M. T. (2013). Developing customised CRM projects: The role of industry norms, organisational context and customer expectations on CRM implementation. *Industrial Marketing Management*, *42*, 1328–1344. https://doi.org/10.1016/j.indmarman.2012.08.009

Stein, A. D., & Smith, M. (2009). CRM systems and organizational learning: An exploration of the relationship between CRM effectiveness and the customer information orientation of the firm in industrial markets. *Industrial Marketing Management*, *38*, 198–206. https://doi.org/10.1016/j.indmarman.2008.12.013

Stein, A. D., Smith, M. F., & Lancioni, R. A. (2013). The development and diffusion of customer relationship management (CRM) intelligence in business-to-business environments. *Industrial Marketing Management*, *42*, 855–861. https://doi.org/10.1016/j.indmarman.2013.06.004

van Laarhoven, P. J. M., & Pedrycz, W. (1983). A fuzzy extension of Saaty's priority theory. *Fuzzy Sets and Systems*, *11*, 199–227.

Wang, Y., & Feng, H. (2012). Customer relationship management capabilities. *Management Decision*, *50*, 115–129. https://doi.org/10.1108/00251741211194903

Wang, Y.-M., & Chin, K.-S. (2011). Fuzzy analytic hierarchy process: A logarithmic fuzzy preference programming methodology. *International Journal of Approximate Reasoning*, *52*, 541–553. https://doi.org/10.1016/j.ijar.2010.12.004

Wang, Y.-M., & Elhag, T. M. S. (2006). On the normalization of interval and fuzzy weights. *Fuzzy Sets and Systems*, *157*, 2456–2471. https://doi.org/10.1016/j.fss.2006.06.008

Wang, Y.-M., Luo, Y., & Hua, Z. (2008). On the extent analysis method for fuzzy AHP and its applications. *European Journal of Operational Research*, *186*, 735–747. https://doi.org/10.1016/j.ejor.2007.01.050

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