Received 14 May 2015
Revised 18 September 2015
Accepted 19 September 2015

Multicriteria model for selecting TQM consultancy and certification services

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Abstract

Purpose – The purpose of this paper is to establish the need and the importance of adopting a structured model to support the decisions by using a multicriteria focus to guide drawing up a methodological framework. In addition, this study considers the maturity level of the organization, and the importance of continuous improvement after implementing ISO 9001.

Design/methodology/approach – This study presents a scientific technical foundation of the qualifying and selection criteria of the consultancy and Accredited Certification Body (ACB) by using ISO standards, and the guidance document CB25, which is related to quality. Finally, a numeric application with realistic data is undertaken using the PROMETHEE II method, and the GAIA plan.

Findings – The development of this study provides a new insight into the importance for selecting consultancy, and certification services in order to implement quality management systems within organizations.

Research limitations/implications – The current study is limited to the quality management services. If necessary to apply the same model to other areas, it is necessary looking for documents and regulations of this field. In addition, this model is focussed on a model for small or medium companies, which are still trying to achieve a higher position in the sector, and do not have experts in quality management.

Originality/value – The differential of this study is the foundation of the criteria for the proposed model. Other studies choose these criteria without any scientific basis. On the other hand, this study goes over many documents.

Keywords Quality management, Certification, ISO standards, Multicriteria decision

Paper type Research paper

1. Introduction

The globalization of the economy, including the change to global markets, the creation of new trading blocs, and the advent of technology, prompted the growth of competitiveness. Therefore, as markets became increasingly competitive, organizations had to adapt to this new worldwide scenario. New strategies had to be implemented, and the organizational comfort has been replaced by a frantic and daily struggle pursuing a place in a mutual variable market, with increasingly demanding customers. The search for quality through continuous improvement using quality management systems (QMS) is unquestionably the strategy most used by old and new organizations, and certainly the one that offers the most significant results in this new business context. The implementation of a QMS will result in improving the quality of processes and products, due to the meeting of the specifications required for certifications as well as improving the company's image and trust in it in the market place, thereby assisting the organization to achieve its goals. According to Garvin (1988), time, resources, and money must be invested in the search for quality, and its enthusiasts offer several reasons to do so, such as attending to environment issues, safety at work, achieving competitiveness, and improving quality to gain greater profitability. Implementing a

Benchmarking: An International Journal
Vol. 23 No. 7, 2016
pp. 1736-1750

1463-5771
DOI 10.1108/BIJ-05-2015-0049

QMS requires effort, planning and everyone's involvement, efficient leadership, and the top management commitment (Valmohammadi, 2011; Laohavichien *et al.*, 2011).

The initial stages of selecting consultancy services and certification services through an Accredited Certification Body (ACB) play an important role and are the focus of this study.

In order to select a quality consultancy and the most appropriate ACB for an organization, this study sought establish the need and the importance of adopting a structured model for decision support focussed on multicriteria.

The methods applied in the research comprise a review of the literature on quality management (QM), multicriteria and of the following standards:

- ISO 9001:2008 – QMS – requirements;
- ISO 10014:2006 – QM – guidelines for realizing financial and economic benefits;
- ISO 10019:2005 – guidelines for the selection of QMS consultants and use of their services;
- Guidance document from the Brazilian Committee of Quality: CB25 – guidelines for the selection and hiring of consultancy, training and certification of QMS services – 2011;
- ISO/IEC 17021:2011 – conformity assessment – requirements for bodies providing audit and certification of management systems; and
- ISO 19011:2011 – guidelines for auditing management systems.

Finally, a decision model with qualifying, and selection criteria based on the ISO standards is drawn up, and then a numerical application with realistic data is given in order to illustrate the use of the model. One of the differentials of this study is the use of ISO standards related to quality at the stage of establishing the criteria.

2. The role of the consultancy services and ACB

According to the Brazilian National Classification of Economic Activities (CNAE), the consultancy is classified as an interactive process conducted by an external agent that brings changes for the company, and assumes responsibilities for supporting executives and professionals of the company and its customers in a decision-making process, but it has no control of the situations.

Therefore, a consultancy can be seen as a service that provides support to managers or business owners, thereby assisting strategic decision making and having a huge impact on the actual and future results of the organization.

However, according to Maekawa *et al.* (2013), there are some barriers that have to be dealt with and must receive special attention when seeking to implement the QMS: the financial constraints, top management disengagement, bureaucratic processes, resistance to change, lack of knowledge about their own rules, and so on. These adversely affect the implementation and maintenance of the QMS and sometimes this leads to the abandonment of the implementation by the organization due to failure.

We can define Continuous improvement as an organizational process based on a culture focussed on incremental improvement, which demands behavioral changes and new organizational structures. These behavioral changes can be brought by a leader or induced by a slow process of organizational change (Oprime *et al.*, 2012). In this case,

consultancies very often play an important role inside organizations, for certification purposes, and to maintain the QMS.

According to O'hanlon (2001), the role of an ACB is to conduct audits to determine what adjustments a company needs to make to obtain certification, which is the process that a company undergoes to achieve certification based on ISO 9001:2008.

According to the Brazilian Committee of Quality, through the guidance document (2011), an ACB has to prove its accreditation to audit, and supply certification based on ISO 9001:2008. Therefore, it can demonstrate the competence of its auditors as well as proof that it complies with the regulations and standards of the International Accreditation Forum (IAF) and its criteria.

2.1 Related standards

In this section, the standards that will support the selection of the qualifying, and selection criteria, which deal effectively with the competitive factors of the organization, are set out and form part of the decision model proposed.

For Slack *et al.* (2009), the qualifying criteria do not necessarily indicate an organization's competitiveness. Their importance is attributed to competitive aspects where the performance of production must be above a determined level that the client can perceive. Thus, a performance lower than the "qualifying" degree will probably disqualify the company from the consumer's point of view.

Slack *et al.* (2009) complement this by saying that the selection criteria significantly influence the realization of the business. Consumers consider those criteria as the main reasons why a product or service is provided successfully. What matters is that increasing the performance of a selection criterion increases the demand, or at least there will be the perspective that it will increase. These criteria are exhibited in Item 5.

It is worth mentioning that the standards followed do not have a certification purpose, except for ISO 9001.

ISO 9001. This covers the adoption and approach of the methodology to implementation, practice and improvement of the efficacy of a QMS, in a way that prompts customer satisfaction to grow because the company complies with the specifications. There is evidence that the organization has the ability to offer products or services that comply not only with the applicable regulations but with satisfactorily meet customers' expectations. Moreover, continuous improvement processes are used to increase its customers' satisfaction while the company ensures that it does so in accordance with its customers' regulatory requirements.

ISO 10014. Its target is senior management, and its goal is to monitor the financial and economic components of the organization to generate benefits by the following of specific guidelines, allowing the perception for such purposes. It targets management, and its purpose is to communicate, facilitate, and execute the application of principles and to select tools that assure the sustainability of an organization. It relates the focus between the client, the leadership, people's involvement, systemic approach, continuous improvement, decision making, and relationships with suppliers.

ISO10019. This offers guidance on how to select QMS consultants as well as how to use their services. Its most important application is to support organizations in selecting a QMS consultant. It helps in the process to evaluate the capacity needed for a consultancy in QMS, thereby enabling the expectations and needs of organizations to be completely satisfied about how to construct a consultancy contract and how to best specify the services to be rendered.

Guidance document from the Brazilian Committee of Quality: CB25. This gives the necessary information to support those interested in acquiring a QMS certification for their organizations, with ISO 9001 being the one most sought after; then, it recommends how to best select and hire certification services (ACB), if the organization presents a certain level of maturity for this. Otherwise, this guidance document offers the positive recommendation that consultancy services should be hired and training given to staff in order to qualify the organization for a certification.

ISO 17021. This standard covers the requirements for ACB companies that provide auditing, and QM certification. Even though it is very general, it outlines auditing conditions for management systems and targets specifications in a reliable way so that they cover the applicable requirements.

ISO 19001. This standard does not have the function or goal of establishing requirements; however, it provides guidelines about audit programs, planning, and implementation of a management system auditing as well as guidelines on evaluating auditors, the audit team and assessing their competences.

3. Proposing a decision model

The methodological framework shown Figure 1 provides guidelines on hiring consultancy services, and then an ACB to certificate the QMS:

(1) In order to implement the QMS correctly, an organization must understand what its maturity level is in relation to QM to deal with the processes and practices required by the system. Therefore, it is very important to evaluate the maturity level of an organization. ISO 10014:2008 – guidelines for the perception of the financial and economic benefits – assigns scores (from 1 to 5) to establish the organizational maturity level. According to ISO 9004:2009 – managing for the sustained success of an organization – a QM approach, any organization with a satisfactory maturity level achieves sustained success, because it can act in the crucial processes that maintain this level in an efficient and effective way. Thus, it is important to identify the company's maturity level to deal with the needs, satisfaction, and expectations of the interested parties. It is also important to monitor organizational changes, to define strategies and policies to

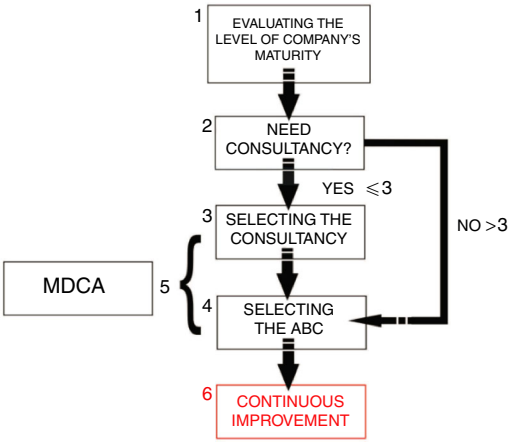

Figure 1.
Decision model

promote motivation, commitment, trust, and organizational involvement, to consider possible areas of innovation and improvement, to define relevant goals, to establish solid relations with suppliers, and through partnerships to manage its resources and processes carefully.

(2) The maturity level of the organization must be identified to establish whether or not there is a need to hire a consultant, in order to prepare for implementing a QMS. Considering and utilizing the organizational maturity scale stipulated by ISO 10014, for the decision model proposed in this study, the following points are considered: the organization that has a maturity level of $\leqslant 3$ will need to hire a consultant for the QMS implementation process, because it does not have the enough maturity needed to deal with this practice. When an organization achieves a score of > 3, it will be able to implement a QMS without needing to hire a consultant, but simply support from its own employees. Then, selecting an ACB for the purposes of certification, according to the standard, a maturity score of > 3 represents approximately 75-100 percent of occurrence, and with few exceptions adopting QMS practice is very usual.

(3) The process for selecting a consultant will depend on qualifying, and selection criteria. These were prepared based on the ISO standards, and the document already introduced which gives guidelines.

(4) Just as in the process for selecting a consultant, qualifying and selection criteria will be needed to select an ACB.

(5) This study seeks to demonstrate the importance of a decision support model, which is the problematic choice, and proposes the most appropriate multicriteria method for these circumstances.

(6) Continuous improvement is indispensable if an organization's processes are to be successful, maintained, and improved. It is an interactive process. This means that new actions for improvement can be proposed arising from an evaluation of the findings obtained, the organization, and the knowledge achieved by an improvement action on a certain subject of study.

Therefore, it is important to highlight that implementing a QMS as well as maintaining it are not finished after a certification auditing process, or even recertification. On the contrary, an organization needs to work in an uninterrupted and continuous way in order to not lose or decrease the levels that it has reached.

It is worth highlighting the importance of ISO 9004:2009 in this stage. This ISO is about the needs and expectations of all relevant interested parties, and provides orientation for the systematic and continuous improvement of an organization's global efficiency. In addition, this standard has an auto-evaluation tool that uses five maturity levels toward sustained success.

Thus, the multicriteria model helps in the difficult stage of choosing a consultancy properly (if needed) and an ACB, thus positively influencing the bedding down process of a QMS as shown in Figure 1.

4. Criteria

According to Almeida (2013), a consistent family of criteria must comply with many properties, such as being able to represent all aspects (goals) of the problem (exhaustively) with no redundancies.

According to Gomes and Gomes (2012), consumers perceive some characteristics such as price, quality, durability, aesthetics, and so on. These characteristics receive the denomination of attributes. Also, when these attributes receive the minimum of information about consumers' preferences, these attributes become criteria.

The decision criteria may be quantitative, when corresponding to attributes such as price, speed, areas, etc. (which are evaluated with well-defined numerical scales) or may be qualitative such as comfort, quality, environmental impacts, and so on (for which there are no defined units of measurement). The criteria can have, in a specific problem, a maximization or minimization (Gomes and Gomes, 2012, pp. 104-105).

There are few applications of multiple-criteria decision making in total quality management (TQM) problems in the literature. For instance, a multicriteria evaluation model to evaluate the expected service quality is proposed in an airport passenger service environment (Tsai *et al.*, 2011) selecting technologies that will support the aims of strategic TQM (Madu *et al.*, 1996); ranking of critical factors for TQM implementation in Shanghai manufacturing industry (Chin *et al.*, 2002); selection of lean manufacturing systems (Gurumurthy and Kodali, 2008); selecting improvement initiatives and QM approaches in three companies in Thailand (Thawesaengskulthai, 2010); quality function deployment combined with decision support system (Andronikidis *et al.*, 2009); measuring quality service combined with multicriteria method (Jerônimo and Medeiros, 2014); evaluation of retail service quality (Sreekumar and Satpathy, 2015).

Saremi *et al.* (2009) in their study entitled "A systematic decision process for selecting external consultant in TQM program" build a decision model for consultancy selection. The company and its directors decided to implement the TQM in order to obtain competitive advantages. Regarding weights, these should be determined using the decision maker's preference. However, regarding the criteria, the decision maker's knowledge was not usually enough to choose them. It is worth highlighting in this study that Saremi *et al.* (2009) report that the five selection criteria were determined by the council, without showing any scientific basis or supporting standard for this. This also occurs with Kabir and Sumi (2014), the study is intended for TQM consultant selection through integrating two multicriteria methods. However, there was not a scientific technical foundation of the criteria as well.

On the other hand, in this paper, besides selecting consultancy, selecting ACB is performed. After a detailed study of the standards and analysis of the few journals related to the subject, we considered the following decision criteria:

- qualifying criteria for consultancy;
- selection criteria for consultant;
- qualifying criteria for an ACB; and
- selection criteria for ACB (Tables I-IV).

5. Choosing a multicriteria method

According to Almeida (2013, p. 20), "a multicriteria method consists of a methodological formulation or a theory, with a well-defined axiomatic structure that may be used to build a decision model that aims to find the solution to a specific decision problem."

Criterion	Theoretical foundation	Evaluation
Management practices	ISO 10019, topic 4.2.5.3, recommends that the QMS consultant has relevant knowledge about management practices in order to comprehend how the QMS integrates and interacts with the organizational global management, including its human resources, and thereby ensuring the company's goals	Number of consultancies conducted the quality field: $\geqslant 3$ qualified < 3 disqualified
Work experience	ISO 10019, topic 4.2.6, recommends that the QMS consultant has relevant work experience in professional, technical, and management aspects. These work experiences may involve the practice of judgment, solving problems, and communication with all the interested parties about the past important work experience and realizations available to the organization. The pertinent experience of the consultant can include the combination of one or more requirements	To have at least two years of experience in the market to be qualified
Ethical considerations	ISO 10019, topic 4.2.6, recommends that the company considers several ethical topics when selecting a QMS consultant such as confidentiality of the given information, remaining impartial when the organization selects certification/registration bodies	In order to be qualified, there should be no history of unethical practices

Table I.
Qualifying criteria for consultant

It is important to highlight that in some multicriteria methods this is of huge relevance on observing the question related to the comprehension that may exist between the criteria in the aggregation model. Therefore, these methods can be classified as compensatory and non-compensatory. According to Almeida (2013), these methods have the following characteristics:

- Compensatory: in these methods, what is sought is to compensate the lowest performance of an alternative in a specific criterion through a better performance in other criterion, taking into account the trade-offs between the criteria in the alternative evaluation.
- Non-compensatory: we can say that a binary relation P is not compensatory when the preferences between x and y only depend on the subsets of criteria that benefit x and y. Observe then, that there is no dependence on the preferential relation between x and y among the many levels of each one of the criteria (Fishburn, 1976).

Although the use of these methods is constant and classic, there are a few criticisms. For example, Costa *et al.*, (2013) say that the compensatory method under its logic can mask the results when a performance that is considered very bad in a determined criterion may be compensated for in a criterion which has a very good performance, thus creating a misleading impression about the overall good performance of a set of criteria.

However, when creating a decision model, choosing an appropriate multicriteria method is a very hard and important stage. This choice connects to several factors, for instance, the decision maker's preference structure.

Criteria	Theoretical foundation	Evaluation	Type of criterion
1. Contract condition (C_1)	According to CB25: some considerations to select consultancy are: To analyze the strategic adaptation according to the organization's culture, target goals, and conditions to be imposed by contract	Likert scale: 1 – lack of clarity, and details 2 – little clarity 3 – intermediate clarity 4 – satisfactory clarity 5 – high level of clarity and details	Type I: usual criterion
2. Payment methods (C_2)	According to CB25: one of the considerations to select a consultant is: To discuss deadlines for conducting projects, and pricing should consider the cost/benefits relationship, before formalizing a contract with the consultant	Likert scale: 1 – payment at sight 2 – two instalments 3 – between three and six instalments 4 – between seven and ten instalments 5 – 12 instalments ps.: considering the consulting process lasts 12 months	Type I: usual criterion
3. Aggregation of knowledge for the Company (C_3)	According to CB25: … To create an learning environment, in a way that the developed knowledge developed during the consultancy work is consolidated throughout the organization, paying special attention being paid to the comprehension and adoption of quality management principles	Likert scale: 1 – any kind of activity with the employees is developed 2 – consultancy develops lectures 3 – consultancy develops training courses 4 – consultancy develops lectures and training courses 5 – consultancy develops lectures, training courses and motivational or awareness activities	Type I: usual criterion
4. Competence over the consultancy's field (C_4)	According to CB25: The consultancy must prove through the project references already done that it has the competency needed (technical competency, training, and professional experience) to conduct and coordinate the projects that it will be responsible for	Likert scale: number of consultancies provided in the past: 1 – none 2 – one 3 – two 4 – three 5 – four or more	Type I: usual criterion
5. Consultant references (C_5)	ISO 10019, topic B.2 recommends that the evaluation must be based on the examination of objective evidence, including the following items: reference of previews works, books and articles published about quality management, interview with organizations that used this service, experience about the knowledge of similar organizations, etc.	Based on evidential documents, evaluation of the professional and scientific/academic historic of the consultant: 1 – very bad 2 – bad 3 – average 4 – good 5 – very good	Type I: usual criterion

(*continued*)

Table II.
Selection criteria for consultancy

Criteria	Theoretical foundation	Evaluation	Type of criterion
6. Costs (C_6)	According to ISO 10019, annex A, topic A.1.2.e: the organizational costs needed to support the consultancy activities must be included in the contract in a clear way	Price of the consultancy for 12 months (R$ 000's – Brazilian currency)	Type II: quasi-criterion
7. Specific knowledge (C_7)	ISO 10019, topic 4.2.5, recommends that the QMS consultants have reasonable knowledge about the company's products, its processes, and customers' expectations before starting the service. Also, the consultants have to comprehend the relevant key factors for the product sector in which the organization operates. They should apply this knowledge	To evaluate through evidential documents and company's historic: 1 – lack of knowledge 2 – little knowledge 3 – regular knowledge 4 – satisfactory knowledge 5 – high knowledge	Type I: usual criterion

Table II.

The preference structure is so important that if it does not represent the decision maker's options very well, the chances of creating an inappropriate decision model are already high. Moreover, the decision maker's rationality must be evaluated adequately with the relation situation-problem, which must be aligned with the chosen method (Almeida, 2013).

In order to conduct this study based on the concepts introduced, the most appropriate method in this case, which is a selection problem, is the PROMETHEE II method. It is non-compensatory and based on using the net flow $\phi(a)$, which is obtained as follows: $\phi(a) = \phi^{+}(a) - \phi^{-}(a)$. Having as base the indicator $\phi(a)$, we have the organization of the alternatives in a descending order, which establishes a complete pre-order between the alternatives (Almeida, 2013).

According to Oslo *et al.* (1995), PROMETHEE II calculates the positive and negative preference flows for each alternative. The positive flow happens when one alternative is dominated by the others. PROMETHEE II allows a complete ranking to be drawn up, totally based on the counterweight of the two preference flows. Thus, the ranking is influenced by the weights allocated to the criteria.

Depending on the general criteria set for the criterion j, the decision maker may be required to define the parameters q_j, p_j, and s_j. These parameters have the following meanings, according to Brans and Mareschal (1992):

- indifference threshold (q_j): this represents the biggest difference between $f_j(a)$ and $f_j(b)$ below which the decision maker considers that a and b are indifferent;
- preference threshold (p_j): this is the smallest value of this difference over which the decision maker expresses a strict preference in favor of a stock; and
- threshold (s_j): this corresponds to an average degree of preference and is between a threshold of preference q and a threshold of strict preference p.

For Brans and Vincke (1985) there are six types of criteria: type I – usual criterion (no threshold), type II – quasi-criterio (q threshold), type III – criterion with linear preference (p threshold), type IV – level-criterion (q and p thresholds), type V – criterion with linear preference and indifference area, and type VI – Gaussian criteria.

Criteria	Theoretical basement	Evaluation
Impartiality	According to CB25: For an ACB to offer a certification that provides confidence, it must be impartial and perceived as impartial. One factor that alters impartiality, for example, is the threat of self-evaluation when a person or body evaluates their own work	Is the ACB demonstrably impartial? Yes – qualified No – disqualified
Accreditation of the ACB by a signatory agency of Mutual Recognition Agreement	According to CB25, the ACB must: Demonstrate to the potential client that it is accredited by an Accreditation Body which is a signatory to the mutual recognition agreement of the International Accreditation Forum – IAF; thus, it is in accordance with the standards and regulations that allow it to audit and grant QMS certifications based on ISO 9001	Is the ACB accredited? Yes – qualified No – disqualified
Compliance with the AIF's criteria	According to CB25, the ACB must: Demonstrate that it complies with the AIF's criteria such as the dimensioning of the relation auditor/day of audits and the auditors qualification relative to the scope of the certification, providing and explaining the AIF guidelines to the client, in order to clarify all questions about the proposal	Does the ACB comply with AIF's criteria? Yes – qualified No – disqualified
Knowledge about the Company's business management practices	According to ISO 17021, appendix A, this is one of the pieces of knowledge that the ACB has to define for specific functions of certification According to ISO 19001, topic 7.2.3.1C, one of the pieces of knowledge necessary for the auditor is about the company's business management and all the organizational context of the audited company	In order to be qualified, the ACB must have certificated at least two companies from the same business as the company that is hiring it
Personal behaviors	According to the ISO 17021 standard, annex D, the desired personal behaviors for the people involved are: ethical, professionalism, confidence, organization, etc.	Based on the records of the ACB and on the contact between company-ACB, does it have good personal behaviors? Yes – qualified No – disqualified

Table III.
Qualifying criteria for an ACB

The software Visual Promethee is the most recently developed one. It includes all standard multicriteria characteristics: PROMETHEE rankings, a 2D and a 3D GAIA plan, tools for analyzes of sensibility, of weight, and data management. Furthermore, in order to improve the GDSS (group decision support system) capacities, the multi-scenario model was extended, this being a tool inherited from Decision lab software (Mareschal, 2012). For this study, we used this software because it is more complete.

5.1 Application of the decision model

Aiming to illustrate the model, we conducted a numerical application with realistic data to choose a QMS consultancy and an ACB. For this model, a textile company with 300 employees was considered. It is classified as a medium-size company. This paper demonstrates only the consultancy selecting process.

Criteria	Theoretical foundation	Evaluation	Type of criterion
1. Costs(C_1)	Cost is always one of the most relevant factors in any decision, within most companies	Certification price (R$ 000's – Brazilian currency)	Type II: quasi-criterion
2. Certification proposal(C_2)	According to the guidance document CB25 from ABNT, companies must hire an ACB based on its proposal and on its record of certifications done, with a proposal that covers: goals of the services to be reached, scope of the services to be provided, comprehensiveness of the process, organizational groups, company's areas, its accredited body, resources involved, etc.	1 – lack of clarification and details 2 – little clarification 3 – intermediate clarification 4 – satisfactory clarification 5 – high level of clarification and details	Type I: usual criterion
3. Transparency (C_3)	According to ISO 17021, topic 4.5, a certification body needs to provide public access or published appropriate information about its audit and certification processes, and about the status of certification of any organization. Transparency is a principle of access or divulgation of appropriate information	Level of transparency of the information: 1 – very low 2 – low 3 – intermediate 4 – high 5 – very high	Type I: usual criterion
4. Ability of responses and complaints(C_4)	According to ISO 17021 standard, topic 4.7, the parties that place their trust in the certification expect to have their complaints investigated and, if well founded, they want to make sure that the complaints will be dealt with adequately and with reasonable efforts made to solve them	To evaluate by corroborative documents and historic of the company 1 – lack of knowledge 2 – little knowledge 3 – regular knowledge 4 – satisfactory knowledge 5 – high knowledge	Type I: usual criterion
5. Knowledge about the client's sector, products and business	According to ISO 17021 standard, annex A, this is one piece of knowledge that an ACB has to define for the specific functions of certification	To evaluate through evidential documents and records of the company 1 – lack of knowledge 2 – little knowledge 3 – regular knowledge 4 – satisfactory knowledge 5 – high knowledge	Type I: usual criterion

Table IV.
Selection criteria for an ACB

We considered three scenarios in order to analyze this problem. Each one corresponds to a specific vector (the weight of which satisfies the different company's needs) as shown in the following list:

(1) Scenario 1: in this scenario, only the cost assumes a different weight compared to the other criteria, since most medium-size companies have this criterion as the most important one.

(2) Scenario 2: in this scenario, the criteria assume different weights thereby simulating the board of directors of the companies that assumes a hierarchical importance over the criteria.

(3) Scenario 3: in this scenario, all the criteria assume the same weight, in order to obtain a result not influenced by the criteria, but rather for the performance of the consultancy company in a general way. This case does not often occur in the real world.

First, a set of nine companies was obtained; however, only three of them provided enough information and met the qualifying criteria. These consultancies were nominated as consultancy A, B, and C (Table V).

In this scenario 1, the results obtained are as shown in Table VI (Figure 2).

The GAIA plan allows a visual analysis of the decision problem. The alternative consultancy B produced the highest net flow, as can be seen from the Promethee rankings (right side of the Figure). This alternative is farther from the origin and is toward the axis of decision π (which is in red on the left side of the Figure) and has the best performance on criterion Aggregation of knowledge for the Company. In addition, we can see that the alternative consultancy A, which had worst performance, is at the opposite point of the same axis.

By the same way, two more decision matrices were generated for scenarios 1 and 2 as well as the outranking flows and GAIA plans. For scenarios 1 and 2, alternative B kept obtaining the highest net flow (0.6 and 0.4736, respectively).

6. Final considerations

The development of this study provided a new insight into the importance for selecting consultancy and certification services in order to implement QMS within organizations.

Moreover, this study is about the whole selection process in the light of knowledge, utilizing ISO standards, and the guidance document of the ISO quality CB25 to establish the criteria for this goal. It also emphasizes organizational maturity, which will determine whether or not there is a need to hire a consultant. Then, what is emphasized is that decision making should be guided by a structured model that uses a multicriteria method. This means that this study does not have precedents, which opens pathways for new studies. The model proposed provides a decision based on scientific knowledge for companies when they select a QMS consultant and/or make use of the services of an ACB.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7
Preferences							
Min/Max	Max	Max	Max	Max	Max	Min	Max
Weight	0.07	0.07	0.07	0.07	0.07	0.58	0.07
Threshold of Indifference (q)	–	–	–	–	–	5,000.00	–
Evaluations							
Consultancy A	3	5	4	5	2	55,000.00	3
Consultancy B	4	5	5	5	3	40,000.00	3
Consultancy C	1	1	2	5	2	40,000.00	3

Table V. Decision matrix

	$\phi^+(a)$	$\phi^-(a)$	ϕ
Consultancy B	0.5	0.035	0.465
Consultancy C	0.29	0.28	0.01
Consultancy A	0.175	0.65	−0.475

Table VI. Outranking flows for consultancies for scenario 1

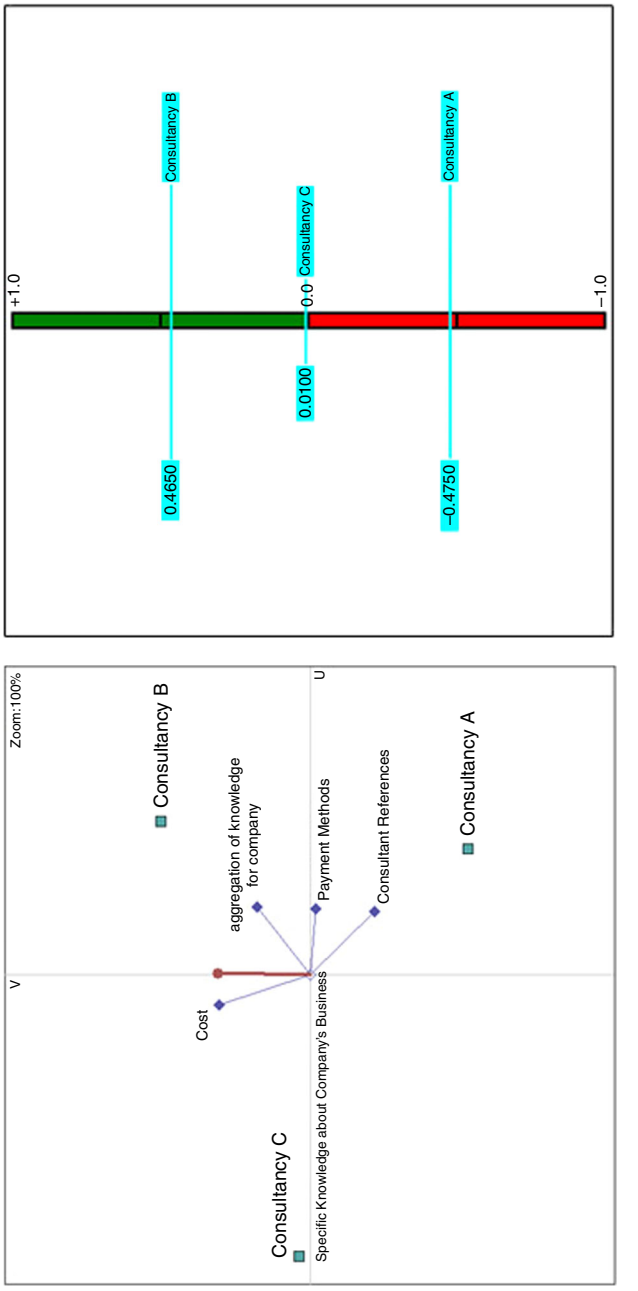

Figure 2.
Gaia Plan, and Promethee rankings for consultancy for scenario 1

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