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Integrating sustainability into strategic decision-making: A fuzzy AHP method for the selection of relevant sustainability issues

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ABSTRACT

The United Nations aspirational agenda for sustainable development calls for the shared efforts of governments, business sector, society and stakeholders to promote prosperity while protecting the planet. In the business perspective, the joint pursuit of both durable competitive advantages and long-term benefits for society are not just the result of companies' reactions to goals of institutions or demands of stakeholders. Rather, they depend on a holistic integration of sustainability in companies' strategic decision-making.

This paper proposes an application of the fuzzy Analytic Hierarchy Process (AHP) method for selecting those sustainability issues that are most relevant for creating shared value for both business and society, and that should be the focus of strategic planning and management. The integration of the ISO 26000 framework with the method permits a holistic treatment of all areas of sustainability. The paper also illustrates to managers how the method should be applied in practice through a step-by-step application to a medium-sized company operating in the water technology sector. Finally, its usefulness as a managerial tool for strategic decision-makers is discussed.

1. Introduction

When companies fail to integrate sustainability into their processes, strategies and long term vision, their business activities risk generating negative impacts on environment and society. Stakeholders, that are becoming increasingly aware of the role of companies in the sustainability transition, have the power to make choices that rewards companies demonstrating true commitment to sustainability (Govindan, 2018). As a result, company competitiveness and social wellbeing are becoming progressively interrelated (Porter and Kramer, 2011; Rodriguez-Melo and Mansouri, 2011). Moreover, on September 2015, the United Nations adopted a new global agenda aimed to lead the world toward a sustainable development path through a joint commitment of national governments, companies and a wide range of stakeholders (Howard-Grenville et al., 2017).

For the aforementioned reasons, companies are pushed to devote greater attention to the environmental and social impact of their activities, with the aim of obtaining both sustainable competitiveness and positive economic results (Di Manno et al., 2015; Farla et al., 2012; Kolk and Van Tulder, 2010; Michelon et al., 2013). However if a company invests in sustainability without a strategic approach, in simple reaction to institutional or stakeholder requests, it risks moving into activities unrelated to its core business and strategies (Porter and Kramer, 2006). Porter and Kramer (2006) argue that strategic investment in sustainability must serve for more than improving public image, and should instead lead to innovation, opportunity and competitive advantage and, ultimately, sustainable development in the long term. Nevertheless, top managers often formulate and implement sustainability strategies without aligning them with organizational ones (Ahmed and Sundaram, 2012), because sustainability appears difficult to integrate in the strategic decision-making process (Vandaele and Decouttere, 2013). Thus, innovative management methods will be essential for organizations in any sector to support a holistic integration of sustainability goals into strategic decision-making (Howard-Grenville et al., 2017).

So far, the majority of contributions in this research field "either have been theoretical, or have only focused on very specific issues of corporate sustainability integration" (Engert et al., 2016). In response to this research shortcoming, this study proposes a fuzzy AHP method to support strategic decision-makers in the choice of the most relevant sustainability aspects with the purpose of generating shared value, taking account of the company's strategic positioning, capacities and

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internal activities (Porter and Kramer, 2006; Porter and Kramer, 2011). The inclusion of core subjects and issues of the ISO 26000 standard in the proposed fuzzy AHP method allows a holistic and comprehensive analysis of all areas of sustainability (Hahn, 2013). Indeed, previous research underlines that multi-criteria decision-making methods can deal effectively with the intrinsic multidimensionality, complexity and subjectivity of sustainability problems (Ishizaka and Siraj, 2018; Merad et al., 2013), especially when they are combined with fuzzy techniques (Diaz-Balteiro et al., 2017; Mardani et al., 2015). Among other methods, we adopt the fuzzy AHP approach proposed by Calabrese et al. (2016), which resolves the zero-weight issue, taking into account Wang et al.'s (2008) criticisms of Chang's (1996) widely applied method.

The rest of this paper is organized as follows. The following section provides a review of the literature on the integration of sustainability into strategic decision-making and discusses the shortcomings in this research field. In the next section, the fuzzy AHP method is illustrated in detail. The fourth section provides an application of the method to a small and medium enterprise (SME). Results of the application, managerial implications and conclusions complete the study.

2. Literature review

Many authors have argued that the integration of sustainability into business strategies is fundamental to the achievement of lasting competitiveness, and wellbeing of stakeholders, employees, and society in general (Engert et al., 2016; Galbreath, 2009; Scherrer et al., 2007). Some have specified that such attempts must address the three dimensions of corporate sustainability (economic, environmental and social), together with their impacts and interactions (e.g. Baumgartner and Ebner, 2010; Engert et al., 2016; Lozano, 2015). These three dimensions in fact offer an approach to integrate sustainability into strategic management (Kleine and Von Hauff, 2009), serving as a conceptual framework for the relative decision-making processes (Bonn and Fisher, 2011; Epstein and Roy, 2001).

Furthermore, Michelon et al. (2013) observed that a strategic and stakeholder oriented approach to sustainability enhances company performance. Accordingly, companies should prioritize sustainability initiatives based on their stakeholder demands and focus their resources to these initiatives. Cairns et al. (2016) expressed the necessity of practical methods to support strategic planners in addressing expectations and perceptions of stakeholders with different sustainability demands.

Accepting that sustainability should be embedded in business strategies, some authors have then proposed theoretical models for the merger of sustainability thinking in processes of strategy formulation (e.g. Galbreath, 2009; Nathan, 2010; Stead and Stead, 2000). Among theoretical contributions on the topic, Heslin and Ochoa (2008), for example, specify seven strategic social responsibility principles accompanied by 21 examples, and suggest five guidelines for the integration of social responsibility into business strategies. Lloret (2016) states that sustainable strategic management must consider three domains, in order to address sustainability boundaries: a market-industry view, a resource-based view and an institutionally based view, respectively related to stakeholders, sustainable leadership, and corporate governance. Ahmed and Sundaram (2012) propose a generic sustainable business transformation roadmap, supported by a framework for integrated sustainability modelling and reporting. Gond et al. (2012) explore the role of management control systems in the integration of sustainability into organization strategies.

Other authors offer more ground for development of operative instruments. Azapagic (2003) states that corporate sustainability can succeed only if embedded in the company's vision and strategy. For this purpose, the author proposes a framework that integrates the general principles of corporate sustainability into corporate practice, providing systematic, step-by-step guidance toward a more sustainable business. Vandaele and Decouttere (2013) suggest a model that permits to integrate sustainability criteria into R&D portfolio decision making.

According to Porter and Kramer (2006), sustainable strategic management should identify the areas of reciprocal dependence between the company and society. The company should take a strategic and operational approach that aims for shared value, meaning that it should invest in those sustainability activities that can simultaneously benefit the company and overall society. To operationalize this approach, the authors suggest what they call the ‘looking outside in’ framework, based on an earlier ‘diamond’ framework (Porter, 1990), which supports the integration of sustainability and social responsibility into strategic decision-making. The framework assists in identifying the external drivers that could affect the business, meaning the social influences on the company. Complementary to this is the ‘looking inside out’ framework, based on the ‘value chain’ framework (Porter, 1985), which assists in the identification of the internal drivers, meaning the company activities that could affect society.

Hahn (2013) proposes ISO 26000 to standardize processes of strategic management concerning sustainability. The author argues there is still no consistent understanding of what corporate sustainability should really embrace, and that the main reasons for the lack of a strategic approach are the uncertainty, ambiguity, lack of knowledge and perceived complexity regarding sustainability issues. In this context, the ISO 26000 standard could provide guidance to all types of organizations. Castka and Balzarova (2008) also suggest the ISO 26000 standard to managers, to be used in combination with the Porter and Kramer (2006) framework for the analysis of company strategy and competitiveness.

The contribution by Engert et al. (2016) is the first to conduct a thorough review of the theme of embedding sustainability into strategic management. The authors state that “prior studies in this field have documented a number of diverse issues as being important. These studies have either been theoretical, or have only focused on very specific issues of corporate sustainability integration” (Engert et al., 2016, p. 2842). Thus, there is increasing interest in the theme of incorporating sustainability into strategic decision-making and there has been wide acceptance of the need for a more holistic approach to sustainability (Espinosa et al., 2008; Lozano, 2015). Nevertheless, the many theoretical contributions have not been accompanied by adequate practical instruments. Engert et al. (2016) conclude that “future research should move from focusing on whether or not companies need to integrate corporate sustainability into strategic management to how this could be done in practice” (p. 2843).

In response to this research shortage, the current paper proposes a method to integrate sustainability into strategic decision-making. The sustainability driven strategies of the companies should be formulated with the aim of generating shared value (Porter and Kramer, 2006, 2011) and according to a holistic approach (Lozano, 2015), to prevent the adverse effects of partitioning and reductionism in sustainability management. A further advantage of the proposed method concerns a specific requisite highlighted by the literature: that of the necessity of operative approaches to effectively engage different groups of internal and external stakeholders, which at times have conflicting interests regarding sustainability issues. The proposed method permits a multi-stakeholder approach to the decision process, serving as a further tool in favor of the need of integrating sustainability into organizational strategies (Wals and Schwarzin, 2012).

Finally, all companies need to prioritize the initiatives that address the most relevant sustainability issues, meaning those with the highest potential for creation of shared value (Michelon et al., 2013). This aspect is especially important for SMEs, which tend to have lesser resources and greater constraints on capabilities. Indeed, SMEs are often unable to identify and respond to opportunities for gaining competitive advantage through sustainability activities (e.g. Hahn, 2013; Simpson et al., 2004; Revell and Blackburn, 2007; Brammer et al., 2012). The proposed method is particularly useful to SMEs as a starting point for

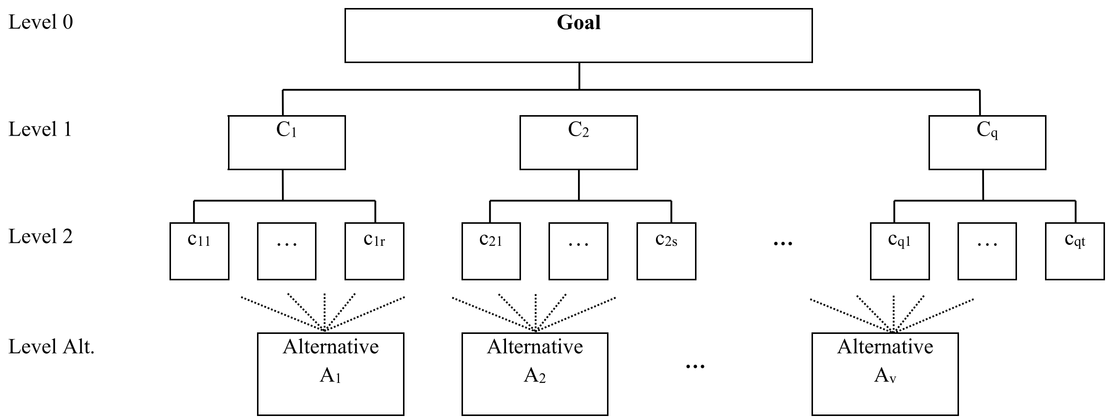

Fig. 1. Generic fuzzy AHP hierarchical structure.

overcoming the limitations they face in integrating sustainability into strategic decision-making.

3. A fuzzy AHP method for selecting relevant sustainability issues

3.1. Theoretical background: AHP and fuzzy AHP

Previous research underlines that multi-criteria decision-making methods can deal effectively with the intrinsic multidimensionality, complexity and subjectivity of sustainability issues (Merad et al., 2013; Wang, 2015). In particular, AHP is ever more prevalent among MCDM methods, mainly because of its understandability in theory and the simplicity in application (Wang et al., 2009). The AHP method (Saaty, 1980) permits the use of qualitative parameters in evaluating and prioritizing different decisional alternatives, and for this has been applied widely in the field of sustainability decision-making (e.g. Govindan et al., 2014; Srdjevic et al., 2007; Tsai et al., 2010).

After having identified the hierarchical structure of the problem (Fig. 1), the method proceeds by pair-wise comparison of the elements constituting the hierarchy (criteria, sub-criteria and alternatives).

Each comparison evaluates the relative importance of a pair of elements with respect to a higher level criterion from the view of the decision-making goal. The evaluation process takes into consideration subjective opinions, collected through questionnaires and provided in terms of exact numerical values. Nevertheless, the discrete evaluation scale of AHP cannot reflect the inherent uncertainty and vagueness always introduced by human judgments (Tesfamariam and Sadiq, 2006).

Undeniably, decisions about sustainability and social responsibility typically involve lengthy time horizons, indefiniteness, high uncertainty and ambiguity, which make it exceptionally difficult to quantify the implications for the company and stakeholders (Wals and Schwarzin, 2012). However, it is clear that the managers must in some way understand the potential effects and performances of their decisions, for effective integration of sustainability into the company strategy (Epstein and Roy, 2001).

Even if the main drawback of AHP is the high number of pair-wise evaluations required for completing large matrices, they become useful when the decision maker has difficulties to rank criteria and alternatives holistically and directly with respect to an upper-level criterion (as in our case). In this circumstance, pair-wise comparisons, on which AHP is based, are the most user transparent and technically sound method for determining weights representing the relative importance of alternatives and criteria (Zardari et al., 2015). Alongside these advantages, we recognize that a high number of pair-wise evaluations could make the decision-makers fatigued affecting the consistency of their judgments. To contain such critical issue one of the authors of this study has acted as facilitator during the judgment process of the application described in Section 4. When applying the proposed method, the facilitator should firstly explain the meaning of criteria and alternatives composing the hierarchical structure of the problem and then assist decision-makers in their choice.

Methods based on pairwise comparisons can be effective when criteria and alternatives are strongly interrelated (such as in sustainability decision-making problems), because they force the decision-makers to give through consideration to all elements of the decision problem (Hajkowicz et al., 2000). On the contrary, multi-criteria methods that utilize direct rating of criteria and alternatives (e.g. SMART) may require less effort by decision-makers, but their procedure for determination of weight coefficients is less accurate for interactions (Hajkowicz et al., 2000; Konidari and Mavrakis, 2006). Compared to these methods, AHP is more suitable for determining weight coefficients because it allows decision-makers a better understanding of the relative importance of interacting alternatives and criteria (Konidari and Mavrakis, 2006). Indeed, in AHP decision-makers focus on two elements at a time and it should provide a more precise evaluation (Ishizaka and Siraj, 2018).

Given the complexity of the problem and the consequent risk of inconsistency, another reason to choose AHP is the flexibility of its consistency thresholds, against other methods that need perfect consistency in order to calculate weights (e.g. MACBETH) (Ishizaka and Nemery, 2013). AHP threshold can be reduced or increased depending on the tolerance of the decision-makers (Alonso and Lamata, 2006).

Moreover, we choose to integrate AHP with fuzzy logic that allows to take care of the imprecision or vagueness inherent in the subjective evaluations (Mardani et al., 2015; Raut et al., 2017). Fuzzy AHP has been widely applied to sustainability strategic decision-making which is characterized by multi-dimensionality of the sustainability goal and the complexity of socio-economic systems (e.g. Moktadir et al., 2018; Thamsatitdej et al., 2015). The use of fuzzy numbers permits appropriate representation of the subjective preferences in AHP pair-wise comparisons and the resulting fuzzy AHP method is thus suited to handling the uncertainty in decision-making problems involving subjectivity (Krohling and de Souza, 2012; Somsuk and Laosirihongthong, 2014). The fuzzy AHP technique considers both qualitative and quantitative decision-making criteria, and so permits a multi-dimensional evaluation of sustainability decisions (Chan et al., 2008). The possibility of including qualitative criteria is particularly useful for cases where evaluation of company performance concerns ethical aspects of social responsibility (Azapagic, 2003). In such situations, fuzzy AHP technique can be integrated with group decision-making processes and used to conduct evaluations according to a multi-stakeholder perspective (Dong et al., 2015). This feature is particularly important for the strategic prioritization of sustainability aspects, as addressed in the present paper, where the involvement of stakeholders in the decision-making process is of fundamental importance (Michelon et al., 2013;

Wals and Schwarzin, 2012).

There are various types of fuzzy numbers and, among these, the fuzzy triangular numbers (TFNs) are well suited to analytical purposes and permit the effective representation and manipulation of linguistic variables (Pedrycz, 1994).

Fuzzy AHP is utilized for converting linguistic assessments into TFNs and generate comparison matrices from which derive fuzzy weights. Different methods have been developed for the management of the fuzzy comparison matrices and for weighting of the fuzzy AHP decisional elements (criteria, sub-criteria and alternatives) (Kubler et al., 2016). Among these methods, the fuzzy AHP method proposed by Chang (1996) is widely used. However, Wang et al. (2008) have demonstrated that the method can identify incorrect priorities due to the allocation of "zero weights" to some decisional elements, which are consequently excluded from the analysis. In order to overcome the "zero weight" criticality, we apply the fuzzy AHP method proposed by Calabrese et al. (2016). This method also adopts the consistency test suggested by Kwong and Bai (2003) which allows addressing the problem of consistency in classical fuzzy AHP. As an addition to the method of Calabrese et al. (2016), the current paper provides for the calculation of weights of alternatives and their overall ranking.

The following sections illustrate how apply the fuzzy AHP method to the selection of relevant sustainability issues. The aspect of group decision-making as part of the AHP application is further detailed in Section 3.4.

3.2. The hierarchical structure

The decision-making criteria of the proposed fuzzy AHP method are based on the Porter and Kramer's (2006) 'looking outside in' and 'looking inside out' frameworks, and thus reflect the goal of achieving shared value in the selection of the sustainability issues to be addressed in the company's strategy and business practices. These decision-making criteria permit the company to integrate the sustainability approach into its strategic management, identifying the areas of reciprocal influence between company and society. These reciprocal influences can be superimposed, and if the sum is positive, they can offer opportunities for the creation of shared value. For these reasons, the 'value chain' activities are used to assess the impacts of a company's business activities, while the 'competitive context' dimensions are used to assess how the conditions of the company locations (e.g. transportation infrastructure) affect its ability to compete (Porter, 1985, 1990; Porter and Kramer, 2006).

In addition, based on the observations of Castka and Balzarova (2008) and Hahn (2013), we develop the decision-making hierarchy of the fuzzy AHP method in such a manner as to consider the 'core subjects' and 'core issues' of ISO 26000 standard (hereafter referred to as 'ISO subjects' and 'ISO issues') as alternatives for pair-wise comparison. The ISO standard offers a globally acknowledged, practical approach, "intended to help all organizations, whatever their starting point, integrate social responsibility into the way they operate" (ISO, 2010, p. 69). Thus, the integration of the ISO 26000 framework in the method permits thorough treatment of all areas of sustainability from a holistic perspective (Hahn, 2013). The fundamental sustainability themes (ISO subjects) are not equally applicable to all companies (ISO, 2010), therefore the proposed method permits the evaluation of the relevance of the different areas of sustainability (ISO subjects and issues) in terms of their potential to generate shared value. The outcome is the identification, from a shared value and holistic viewpoint, of the highest priority ISO subjects and ISO issues to be integrated into the company's strategic and operational processes.

The problem of selecting relevant sustainability issues is structured in different hierarchies. Particularly, the multi-level hierarchical structure of the proposed method (Figs. 2–3 of the paper) allows taking into account both the company's competitive environment and its internal activities as key drivers for strategic decision-making (levels 1, 2, 3 of Figs. 2–3). In addition, the proposed method embeds ISO 26000 subjects and issues (level 4 of Figs. 2–3) allowing a holistic treatment of all areas of sustainability in decision-making. For this reason, among the various multi-criteria methods that have proved to be useful for resolving problems within sustainability (Diaz-Balteiro et al., 2017; Ishizaka and Nemery, 2013; Kahraman et al., 2015; Mardani et al., 2015), we selected fuzzy AHP that allows structuring decision-making criteria in multiple hierarchical levels while other methods do not allow it (e.g. MACBETH differences between criteria and non-criteria only). One of the hierarchies serves for the selection of ISO subjects (Fig. 2). The remaining hierarchies serve for the selection of the issues pertaining to the different ISO subjects under the ISO 26000 framework (Table 1). Of this second group, we present only the hierarchy of ISO issues under the ISO subject of 'the environment' (Fig. 3). All the other ISO issues hierarchies are analogous to the one presented, and for reasons of brevity are not included in the paper.

3.3. Transforming decision-maker evaluations into relative weights

Using the fuzzy AHP hierarchies described above, decision makers consider the pairs of 'value chain' activities, 'competitive context' dimensions, and ISO subjects and issues, and evaluate their relative importance to the goals, using linguistic terms (see level 0 in Fig. 2 and in Fig. 3). These linguistic evaluations are then transformed into TFNs by means of the conversation scale presented in Table 2.

The TFNs are organized in fuzzy comparison matrices (Eq. (1)):

$$\widetilde{A} = (\widetilde{a}_{ij})_{n\times n} = \begin{bmatrix} (1,1,1) & \cdots & (l_{12}, m_{12}, u_{12}) & \cdots & (l_{1n}, m_{1n}, u_{1n}) \\ (l_{21}, m_{21}, u_{21}) & \cdots & (1,1,1) & \cdots & (l_{2n}, m_{2n}, u_{2n}) \\ \vdots & & \vdots & & \vdots \\ (l_{n1}, m_{n1}, u_{n1}) & \cdots & (l_{n2}, m_{n2}, u_{n2}) & \cdots & (1,1,1) \end{bmatrix} \tag{1}$$

where

$$\widetilde{a}_{ij} = (l_{ij}, m_{ij}, u_{ij}) = (\widetilde{a}_{ji})^{-1} = \left(\frac{1}{u_{ji}}, \frac{1}{m_{ji}}, \frac{1}{l_{ji}}\right), \ i, j = 1, \ldots n;\ i \neq j \tag{2}$$

is a TFN representing the relative importance of item i with respect to j expressed by the decision maker from the perspective of the upper-level criterion. Each TFN consists of a triplet (l_{ij}, m_{ij}, u_{ij}) where l_{ij} represent the smallest value, m_{ij} the most probable value and u_{ij} the highest possible value of any linguistic judgment (Table 2). The comparison matrices (Eq. (1)) are symmetric and n represents the number of items belonging to the hierarchical level under analysis.

By applying the fuzzy AHP method of Calabrese et al. (2016) to all the comparison matrices (***Steps 1*** to ***4***, below), it is possible to determine the relative weights of the 'value chain' activities, 'competitive context' dimensions, ISO subjects and ISO issues, avoiding the problem of zero weights. As an addition to the method of Calabrese et al. (2016), the current paper provides for the calculation of weights of alternatives and their overall ranking (***Step 5***).

Step 1. *Conversion of fuzzy matrices*

The matrix (Eq. (1)) has to be converted into a crisp comparison matrix by applying the centroid defuzzification method (Yager, 1981). The conversion formula for TFNs is (Wang and Elhag, 2007):

$$a_{ij}(\widetilde{a}_{ij}) = \frac{l_{ij} + m_{ij} + u_{ij}}{3}, \ i, j = 1, \ldots, n \tag{3}$$

Step 2. *Consistency test*

In order to examine consistency of the crisp comparison matrix, the test prescribes to calculate the consistency index (*CI*) and the consistency ratio (*CR*) as follows:

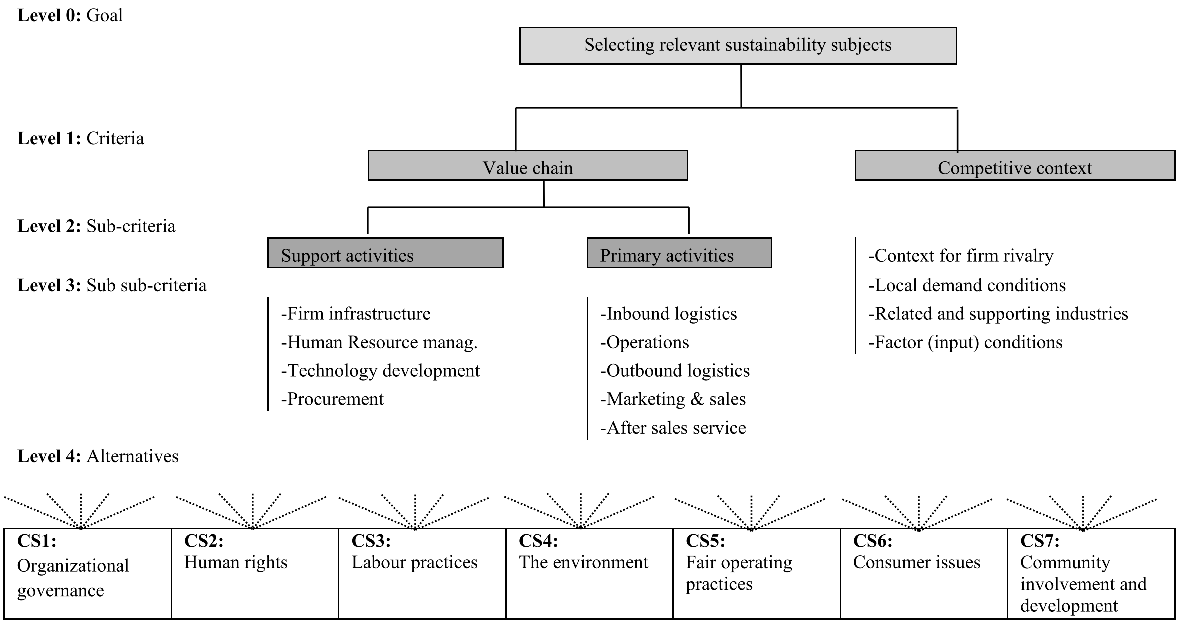

Fig. 2. Fuzzy AHP hierarchy for ISO subjects.

$$CI = \frac{(\lambda_{\max} - n)}{n - 1} \tag{4}$$

$$CR = (CI - RI\,(n))100\% \tag{5}$$

where $\lambda_{\max}$ is the highest eigenvalue of the matrix and $RI(n)$ is a random index whose value depends on the matrix's dimension n (Table 3).

The matrix is consistent if CR (Eq. (5)) is smaller than 10% (Forman, 1990). Nevertheless, the threshold of tolerance can be modified according to the scope of the analysis (Alonso and Lamata, 2006; Dodd et al., 1993). In case of inconsistency, it is necessary to proceed with a matrix review process asking decision-makers to provide new comparison judgments. These judgments have to be organized in a new matrix and analyzed as illustrated in Step 1 and 2. The review process has to continue until consistency is achieved.

Step 3. *Local priority weights*

Local priority weights of criteria, sub-criteria and alternatives (Figs. 2 and 3) have to be calculated by summing items in the rows of the consistent fuzzy matrix (Eq. (6)) and then normalizing the row sums by means of Eq. (7).

$$\widetilde{RS}_i = \sum_{j=1}^{n} \tilde{a}_{ij} = \left(\sum_{j=1}^{n} l_{ij}, \sum_{j=1}^{n} m_{ij}, \sum_{j=1}^{n} u_{ij} \right), \; i = 1, \; \ldots, n \tag{6}$$

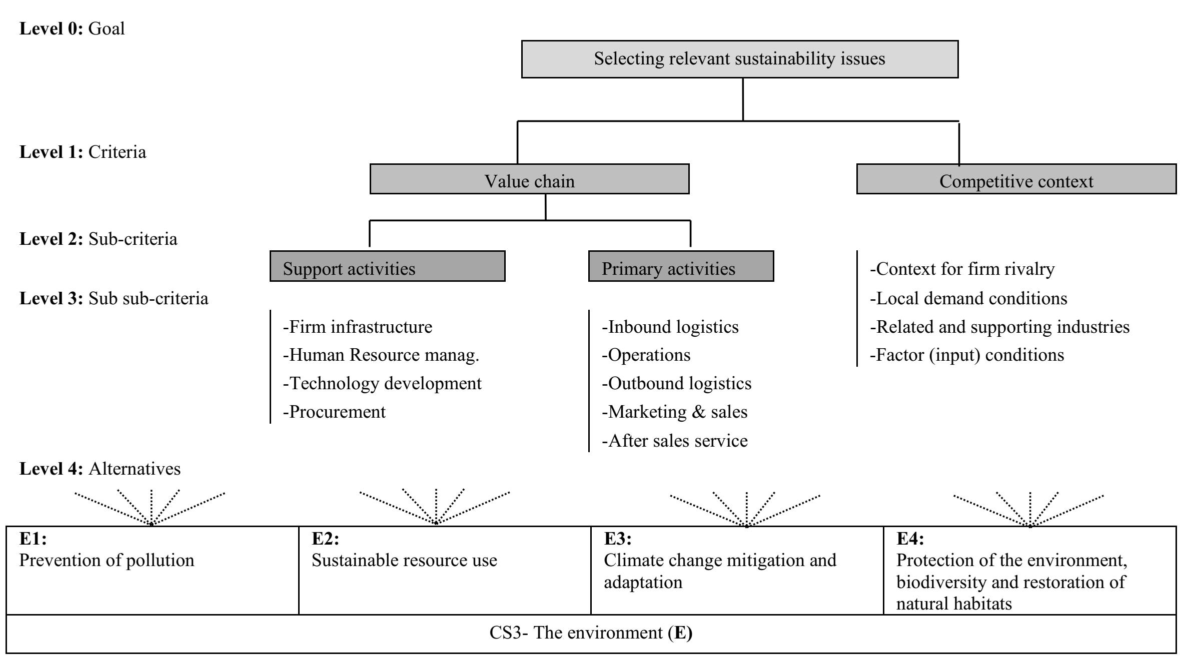

Fig. 3. Fuzzy AHP hierarchy for ISO issues belonging to 'the environment'.

Table 1
The ISO 26000 framework for social responsibility.

ISO core subjects	ISO issues
CS1: Organizational governance (OG)	–
CS2: Human rights (HR)	HR1: Due diligence
	HR2: Human rights risk situations
	HR3: Avoidance of complicity
	HR4: Resolving grievances
	HR5: Discrimination and vulnerable groups
	HR6: Civil and political rights
	HR7: Economic, social and cultural rights
	HR8: Fundamental principles and rights at work
CS3: Labour practices (LP)	LP1: Employment and employment relationships
	LP2: Conditions of work and social protection
	LP3: Social dialogue
	LP4: Health and safety at work
	LP5: Human development and training in the workplace
CS4: The environment (E)	E1:Prevention of pollution
	E2: Sustainable resource use
	E3: Climate change mitigation and adaptation
	E4: Protection of the environment, biodiversity and restoration of natural habitats
CS5: Fair operating practices (FOP)	FOP1: Anti-corruption
	FOP2: Responsible political involvement
	FOP3: Fair competition
	FOP4: Promoting social responsibility in the value chain
	FOP5: Respect for property rights
CS6: Consumer issues (CI)	CI1: Fair marketing, factual and unbiased information and fair contractual practices
	CI2: Protecting consumers' health and safety
	CI3: Sustainable consumption
	CI4: Consumer service, support, and complaint and dispute resolution
	CI5: Consumer data protection and privacy
	CI6: Access to essential services
	CI7: Education and awareness
CS7: Community involvement and development (CID)	CID1: Community involvement
	CID2: Education and culture
	CID3: Employment creation and skills development
	CID4: Technology development and access
	CID5: Wealth and income creation
	CID6: Health
	CID7: Social investment

Table 2
Triangular fuzzy conversion scale (Chang, 1996; Lee, 2010).

Linguistic scale	Triangular fuzzy conversation scale	Triangular fuzzy reciprocal scale
Equally important	(1,1,1)	(1,1,1)
Weakly more important	(1,3/2,2)	(1/2,2/3,1)
Moderately more important	(3/2,2,5/2)	(2/5,1/2,2/3)
Strongly more important	(2,5/2,3)	(1/3,2/5,1/2)
Extremely more important	(5/2,3,7/2)	(2/7,1/3,2/5)

Table 3
RI of random matrices (Alonso and Lamata, 2006).

n	3	4	5	6	7	8
RI(n)	0.58	0.9	1.12	1.24	1.32	1.41

$$\widetilde{S}_i = \frac{\widetilde{RS}_i}{\sum_{j=1}^{n} \widetilde{RS}_j} = \left(\frac{\sum_{j=1}^{n} l_{ij}}{\sum_{j=1}^{n} l_{ij} + \sum_{k=1,k\neq i}^{n} \sum_{j=1}^{n} u_{kj}}, \frac{\sum_{j=1}^{n} m_{ij}}{\sum_{k=1,}^{n} \sum_{j=1}^{n} m_{kj}}, \frac{\sum_{j=1}^{n} u_{ij}}{\sum_{j=1}^{n} u_{ij} + \sum_{k=1,k\neq i}^{n} \sum_{j=1}^{n} l_{kj}} \right) = (l_i, m_i, u_i), \quad i = 1, \dots, n \tag{7}$$

Finally, the crisp weights are calculated converting fuzzy weights as follows:

$$w_i = S_i(\widetilde{S}_i) = \frac{l_i + m_i + u_i}{3}, \ i = 1, \ \dots, n \tag{8}$$

By normalizing the weights relative to the hierarchical level under examination (criterion, sub-criterion and alternative levels), we obtain the vector of the normalized local weights. For the hierarchical structure in Fig. 1, the vector of normalized weights for the level 1 criteria is given by:

$$W_{C_{loc}} = (w_{C_{1_{loc}}}, w_{C_{2_{loc}}}, \dots, w_{C_{q_{loc}}}) \tag{9}$$

where q is the number of criteria in the problem.

The local weights for the level 2 criteria (for example for criterion C_1, Fig. 1) are given by:

$$W_{C_{1_{loc}}} = (w_{c_{11_{loc}}}, w_{c_{12_{loc}}}, \dots, w_{c_{1r_{loc}}}) \tag{10}$$

where r is the number of sub-criteria for C_1. Concerning the local weights for the alternatives, given a criterion for comparison c_{ij}, the vector of local weights for the alternatives to c_{ij} is given by:

$$W_{A_{c_{ij_{loc}}}} = \left(w_{A_{1c_{ij_{loc}}}}, w_{A_{2c_{ij_{loc}}}}, \dots, w_{A_{vc_{ij_{loc}}}} \right) \tag{11}$$

where v is the number of alternatives under the problem.

Step 4. *Global priority weights*

Global priority weights of sub-criteria have to be calculated by multiplying local weights of sub-criteria and criteria along the hierarchical structures. For all criteria belonging to the highest hierarchical level the global weights are equal to those local. Given the example of hierarchical structure depicted in Fig. 1, the vector of global weights for the criteria belonging to level 1 is given as:

$$W_{C_{glob}} = \left(w_{C_{1_{glob}}}, w_{C_{2_{glob}}}, \ldots, w_{C_{q_{glob}}}\right) = \left(w_{C_{1_{loc}}}, w_{C_{2_{loc}}}, \ldots, w_{C_{q_{loc}}}\right) \tag{12}$$

where $w_{C_{i_{loc}}}$ ($i = 1, \ldots, q$) are the normalized local weights of criteria calculated as shown in *step 3*.

The global weights of criteria belonging to the level 2 of Fig. 1 are instead expressed by means of:

$$W_{c_{glob}} = \begin{pmatrix} w_{c_{ij_{glob}}} = w_{c_{1j_{loc}}} \cdot w_{C_{1_{glob}}} & i = 1; j = 1, \ldots, r \\ w_{c_{ij_{glob}}} = w_{c_{2j_{loc}}} \cdot w_{C_{2_{glob}}} & i = 2; j = 1, \ldots, s \\ \ldots & \\ w_{c_{ij_{glob}}} = w_{c_{qj_{loc}}} \cdot w_{C_{qglob}} & i = q; j = 1, \ldots, t \end{pmatrix} \tag{13}$$

where $w_{C_{i_{glob}}}$ are the normalized global weights of the q criteria (level 1 in Fig. 1); $w_{c_{ij_{loc}}}$ are the normalized local weights of sub-criteria (level 2 in Fig. 1), for which the calculation is shown in *step 3*; and r, s, and t are the numbers of sub-criteria belonging to each criterion (level 2 in Fig. 1). Concerning the alternatives, given a criterion for comparison c_{ij}, the vector of the global weights is given by:

$$\begin{aligned} W_{A_{c_{ij_{glob}}}} &= \left(w_{A_{1c_{ij}\,glob}}, w_{A_{2c_{ij}\,glob}}, \ldots, w_{A_{vc_{ij}\,glob}}\right) \\ &= \left(w_{A_{1c_{ij}\,loc}} \cdot w_{c_{ij_{glob}}}, w_{A_{2c_{ij}\,loc}} \cdot w_{c_{ij_{glob}}}, \ldots, w_{A_{vc_{ij}\,loc}} \cdot w_{c_{ij_{glob}}}\right) \end{aligned} \tag{14}$$

Step 5. *Overall weights and ranking of alternatives*

The overall ranking of alternatives is based on the global weight values from the fuzzy AHP method. For the hierarchical structure in Fig. 1, the overall weights and the ranking of alternatives can be calculated as follows:

$$w_{A_i} = \sum_{j=1}^{r} w_{A_{ic_{1j}\,loc}} \cdot w_{c_{1jglob}} + \sum_{j=1}^{s} w_{A_{ic_{2j}\,loc}} \cdot w_{c_{2jglob}} + \ldots + \sum_{j=1}^{t} w_{A_{ic_{qj}\,loc}} \cdot w_{c_{qjglob}} \quad i = 1, \ldots, v \tag{15}$$

where v is the number of alternatives in the hierarchical structure (Fig. 1). By applying the formula (15) for each alternative of the problem, it is possible to obtain the vector of final weights of alternatives as:

$$W_A = (w_{A_1}, w_{A_2}, \ldots, w_{A_v}) \tag{16}$$

The vector (Eq. (16)) allows to obtain the overall ranking of alternatives: the higher is the final weight w_{A_i} ($i = 1, \ldots, v$), the higher is the rank of the alternative.

3.4. Participation by multiple stakeholders in the fuzzy AHP method

A strategic approach to sustainability requires that companies engage stakeholders in their decision-making, because they are valuable in contributing to the corporate success and avoid unprofitable and non-productive sustainability initiatives (Michelon et al., 2013). Moreover, "managers find that in order to create value sustainably and ethically, it is necessary to balance the interests of various stakeholders" (de Gooyert et al., 2017). For this reason, the proposed method is designed so that companies can directly involve different stakeholders in the process of selecting the most relevant sustainability issues. The stakeholders in effect become joint decision-makers. The proposed fuzzy AHP method can be adopted whether the company opts for inclusion of a single type of stakeholder or prefers to consult a mix of different types of stakeholders (e.g. employees, suppliers, clients). In both cases, the evaluation process involves the construction of different comparison matrices for each stakeholder involved. Each stakeholder carries out the pair-wise comparison between the criteria and the alternatives under the criteria, as described in Section 3.3. The results from the comparisons are organized as comparison matrices, which are then tested for consistency as specified in Step 1. The matrices concerning the same pair-wise comparisons are aggregated in a single matrix. The aggregation is conducted using the weighted averages of the judgments, thus taking account of the levels of different levels of importance attributed to the various stakeholders (Kao and Liu, 2001).

The involvement of both internal and external stakeholders (e.g. employees, clients, local community or consumer associations) achieves a multi-stakeholder contribution to the decisions, taking account of the different knowledge and expectations of the various groups. The method is designed to elicit and balance the contributions of different stakeholders in consideration of their knowledge concerning the company and its operational contexts, working toward the achievement of shared value (Porter and Kramer, 2006). The involvement of both internal and external stakeholders (e.g. employees, clients, and local community or consumer associations) thus achieves multi-stakeholder contribution to the decisions, taking account of the different knowledge and expectations of the various groups. The calculation of weighted averages takes account of the different levels of knowledge, through the allocation of different weights to each type of stakeholder considered. The weights are expressed in percentages, and should be attributed by the company's top management on the basis of their knowledge of the organization and its competitive context. The proposed method can assist the top managers in mediating between different opinions, avoiding or calming conflicts concerning identification of the relevant sustainability issues, both at the internal level and involving external shareholders, and instead adopting a constructive, contributory approach. The attribution of the weights to the different stakeholder types can be changed over time in response to internal and external changes.

4. Application of the proposed method

In order to provide practitioners and managers with a guideline of how the method should be applied, in this section we present the example of its step-by-step application to ACMO Group SpA, a medium firm specialized in the design and manufacturing of hydraulic valves and systems. The company is well suited as an empirical illustrative case, since it operates in a business segment with high sustainability impacts (Muga and Mihelcic, 2008; Mahgoub et al., 2010; Hellström et al., 2000). In addition, the ACMO's board of directors was interested in making sustainability an integral part of the company strategy and business processes as soon as possible. For this reason, the ACMO's top management was available to provide feedback on the method usefulness and reliability.

4.1. Stage 1: comparison and ranking of decisional criteria

When the company is medium-sized, it is particularly important to involve the CEO in identifying the relevant areas for sustainability strategy, as the stakeholder with the deepest knowledge of the company's processes and organization. Therefore, the interviews were conducted with the ACMO's CEO (in this case also the company owner). ACMO is just beginning to integrate sustainability into strategic management, and this places extra responsibility on the CEO to take part in the evaluation, both to select the relevant issues and to gain knowledge concerning sustainability commitments, to be transmitted to others. The first stage involves the evaluation of the company's internal activities and the dimensions of its competitive context, leading to a ranking of their relevance in terms of potential for generating shared value. The first stage supports the company in development of knowledge about the competitive dimensions with greatest influence on its potential strategies for socially responsible conduct, and about the impacts of its business activities on society.

All the comparative judgments gathered to this point are converted

Table 4
Pair-wise fuzzy judgments for sub-criteria of 'support activities'.

	Firm infrastructure			HR management			Technology development			Procurement		
	l	m	u	l	m	u	l	m	u	l	m	u
Firm Infrastructure	1	1	1	1	1	1	2/5	1/2	2/3	1/2	2/3	1
HR Management	1	1	1	1	1	1	1/2	2/3	1	1	1	1
Technology Development	3/2	2	5/2	1	3/2	2	1	1	1	1	3/2	2
Procurement	1	3/2	2	1	1	1	1/2	2/3	1	1	1	1

to TFNs using the scale in Table 2, and organized in type (Eq. (1)) matrices. Each matrix is subject to the consistency test as described in steps 1 and 2 of the method (Section 3.3 above). The consistency test must be repeated until consistency is established.

Table 4 shows the TFNs representing an example of pair-wise comparisons of sub-criteria under 'support activities'.

The data processing is applied in steps, as illustrated in Section 3.3. The step 1 to 3 procedure is first applied to the main criteria (level 1 in Fig. 2), second to the criteria under 'value chain' and 'competitive context' (level 2 in Fig. 2) and third to the sub-criteria under 'support activities' and 'primary activities' (level 3 in Fig. 2). At this point, we have five matrices for the ACMO example. Below, we detail how determine the final weights of decisional sub-criteria concerning 'support activities'.

Step 1. *Conversion of fuzzy matrices*

Using formula (3), a crisp comparison matrix (Table 5) can be derived from the fuzzy comparison matrix (Table 4).

Step 2. *Consistency test*

The matrix (Table 5) is tested for consistency and the results show that it is verified (CI = 0.0252 and CR = 0.028).

Once the data from all the comparisons between criteria have been gathered, and all the fuzzy comparison matrices (Eq. (1)) have been identified as consistent, the next step is to determine the local and global weights, applying steps 3 and 4 for each matrix. For reasons of brevity in presenting the ACMO example, we provide only the determination of weights for the sub-criteria under the 'support activities' criterion.

Step 3. *Local priority weights*

Row sums RS_i and normalized row sums S_i are determined for the rows of Table 4 (sub-criteria). Tables 6 and 7 summarize, respectively, the row sums and normalized row sums for the sub-criteria of 'support activities'. For the sake of brevity, the calculation of RS_i (Eq. (6)) and S_i (Eq. (7)) are detailed only for the sub-criterion 'firm infrastructure' (respectively RS_1 and S_1), as follows:

$$\widetilde{RS}_1 = (1,1,1) \oplus (1,1,1) \oplus (0.4,0.5,0.6667) \oplus (0.5,0.6667,1) = (2.9,3.1667,3.6667)$$

$$\tilde{S}_1 = \left(\frac{2.9}{19.4}, \frac{3.1667}{17}, \frac{3.6667}{15.17}\right) = (0.1495,0.1863,0.2418)$$

Table 6
Row sums for sub-criteria of 'support activities'.

		l	m	u
Firm infrastructure	$\widetilde{RS}_1$	2.9	3.1667	3.6667
HR management	$\widetilde{RS}_2$	3.5	3.6667	4
Technology development	$\widetilde{RS}_3$	4.5	6	7.5
Procurement	$\widetilde{RS}_4$	3.5	4.1667	5

Table 7
Normalized row sums for sub-criteria of 'support activities'.

		l	m	u
Firm infrastructure	$\tilde{S}_1$	0.1495	0.1863	0.2418
HR management	$\tilde{S}_2$	0.1780	0.2157	0.2685
Technology development	$\tilde{S}_3$	0.2621	0.3529	0.4310
Procurement	$\tilde{S}_4$	0.1875	0.2451	0.3145

The crisp weights of sub-criteria pertaining to 'support activities' are obtained by applying Eq. (8). Then, via normalization, the local weights are:

$$W_{loc} = (0.1904, 0.2183, 0.345, 0.2463)$$

Step 4. *Global priority weights*

The global weights of the decisional criteria (Table 8) are determined by multiplying the local weights of the criteria and sub-criteria along the hierarchical structure. For instance, the global weight of 'firm infrastructure' (4.76%) is calculated by multiplying the global weight of the 'support activities' criterion (25%) by the local weight of 'firm infrastructure' (19.04%).

4.2. Stage 2: comparison and ranking of ISO subjects

Building from the first stage, the second one allows the company to select the sustainability areas (Table 1) that the company is most adapted to develop, again taking account of its internal capacities and the competitive context. The ISO 'core subjects' are considered in pair-wise comparison relative to the decisional criteria composing the fuzzy AHP hierarchical structure (Fig. 2). For each comparison, the stakeholder evaluates which ISO subject is more influenced by the specific 'value chain' activity or dimension of 'competitive context' under examination.

All the gathered linguistic judgments are converted to TFNs using

Table 5
Pair-wise crisp judgments for sub-criteria of 'support activities'.

	Firm infrastructure	HR management	Technology development	Procurement
Firm infrastructure	1	1	0.52	0.72
HR management	1	1	0.72	1
Technology development	2	1.5	1	1.5
Procurement	1.5	1	0.72	1

Table 8
Local and global weights of decision criteria.

Criteria lev. 1	Criteria lev. 2	Criteria lev. 3	Local weight		Global weight		
			Criteria lev. 2	Criteria lev. 3	Criteria lev. 1	Criteria lev. 2	Criteria lev. 3
Value chain					**50%**		
	Support activities		**50%**			25%	
		Firm infrastructure		19.04%			4.76%
		HR management		21.83%			5.46%
		Technology development		34.50%			8.62%
		Procurement		24.63%			6.16%
	Primary activities		50%			25%	
		Inbound logistics		17.53%			4.38%
		Operations		22.75%			5.69%
		Outbound logistics		18.97%			4.74%
		Marketing & sales		15.96%			3.99%
		After sales service		24.79%			6.2%
Competitive context					**50%**		
	Context for firm strategy and rivalry			29.82%		14.91%	
	Local demand conditions			20.73%		10.36%	
	Related and supporting industries			27.03%		13.52%	
	Factor (input) conditions			22.42%		11.21%	

the Table 2 scale and organized in type (Eq. (1)) matrices. This produces a total of 13 matrices, each with seven dimensions. Each matrix is subject to the consistency test presented in steps 1 and 2 (Section 3.3). The fuzzy AHP procedure continues determine the local and global weights of the ISO subjects, applying steps 3 and 4 for each matrix, as shown in the stage 1. Table 9 shows the local weights for all ISO subjects in the ACMO example.

Table 10 presents the global and the overall weights for all the ISO subjects obtained for the ACMO example. On the basis of the weights obtained for both the criteria (Table 8) and the alternatives (Table 9), we then proceed with determination of the overall weights and rankings of the ISO subjects, applying the formulae presented in step 5, which summarizes all the global weights relative to all the decisional criteria under 'support activities', 'primary activities' and 'competitive context' (levels 2 and 3 in Fig. 2). For example, the overall weight for the subject 'the environment' (CS4) is given by Eq. (15):

$$\begin{aligned} w_{CS_4} &= 0.1054\cdot 0.0476 + 0.095\cdot 0.0546 + 0.1974\cdot 0.0862 + 0.1802 \\ &\quad \cdot 0.0616 + 0.1429\cdot 0.0438 + 0.1507\cdot 0.0569 + 0.1671\cdot 0.0474 + 0.151 \\ &\quad \cdot 0.0399+ \\ &\quad + 0.136\cdot 0.062 + 0.1378\cdot 0.1491 + 0.1275\cdot 0.1036 + 0.1546 \\ &\quad \cdot 0.1352 + 0.165\cdot 0.1121 = 0.1487 \end{aligned}$$

Applying Eq. (15) for each alternative of the problem, we obtain the vector of final weights of ISO subjects, which allows obtaining the overall ranking of alternatives:

$$W_{CS} = (0.1477, 0.1198, 0.143, 0.1487, 0.1548, 0.1464, 0.1395)$$

4.3. Stage 3: comparisons and ranking of ISO issues

The next stage in the fuzzy AHP procedure is to deal with the hierarchies of ISO issues derived from the ISO 26000 framework (Table 1). Fig. 3 provides the example of the hierarchy for the ISO issues pertaining to the ISO subject 'the environment'. As for the comparisons between the ISO subjects (Section 4.3, stage 2), the ISO issues are also compared in pairs relative to decisional criteria. There are 13 comparison matrices in all, each of which has dimensions equal to the number of ISO issues under consideration. The only ISO subject for which there is not this third stage of comparing, processing and ranking the ISO issues is the subject 'organizational governance', for which the ISO standard does not indicate issues.

For brevity, we do not present the calculations for all of the ISO issues in the ACMO example. However, the procedures are the same as the ones illustrated in the stage 2. Table 11 presents the global and the overall weights for all the ISO issues under 'fair operating practices', which is the most relevant ISO subject obtained for the ACMO example.

5. Results

5.1. Decisional criteria

The outcomes of the method application were examined in a follow-up interview with the CEO to demonstrate the method effectiveness. Table 8 presents the local and global weights of decisional criteria for ACMO SpA. The results show that the company's internal activities and competitive context have equal relevance in the creation of shared value. Similarly, 'support activities' and 'primary activities' under 'value chain' both have the same relevance. Examining 'support activities' in more detail, we see that among these, 'technology development' is the most relevant, with a weight of 8.62%, followed by 'procurement' with 6.16%. In the follow-up interview, ACMO's CEO confirmed the coherence of these results with the strategic positioning of the company in the industry of water technologies. The core business of ACMO is the technical design of innovative and highly customized hydraulic equipments. For the manufacturing process, ACMO relies heavily on the production capacity of selected third-party partners and a network of sub-suppliers. For this reason, procurement activities must be in line with technical development: the design of products realized by ACMO's technical office is a mandatory requirement in the selection of sub-suppliers. Technical requirements, quality and accuracy of materials are among the selection criteria used by ACMO's procurement office for the selection of sub-suppliers.

Concerning 'primary activities', the greatest weight is for 'after sales services' (6.2%) while the lowest one is for 'marketing and sales' (3.99%). In the follow-up interview, the CEO declared that the results are consistent with ACMO's business practices, which are highly attentive to customer satisfaction, including through after-sales service. Moreover, ACMO collaborates with a big commercial partner that considers after-sales service activities a key element of its value chain. ACMO develops and provides customized products with high technological content, competing in a segment where marketing campaigns would have little effect. For this, the relatively low weight observed for 'marketing and sales' (3.99%) would appear coherent with the overall business activities.

Turning to the decisional criteria for 'competitive context', the dimension with the greatest influence for ACMO is 'context for firm strategy and rivalry', with a weight of 14.91%. This relatively high

Table 9
Local weights of ISO subjects.

Core subjects	Decision criteria: Firm infrastructure	HR management	Technology development	Procurement	Inbound logistics	Operations	Outbound logistics	Marketing & sales	After-sales service	Context for firm strategy and rivalry	Local demand conditions	Related and supporting industries	Factor (input) conditions
CS1 Organizational governance	21.29%	11.89%	10.97%	15.67%	10.95%	10.46%	11.62%	14.54%	13.66%	17.14%	17.51%	15.88%	14.48%
CS2 Human rights	12.07%	19.77%	11.23%	10.39%	12.36%	11.73%	14.77%	12.98%	10.2%	9.88%	9.88%	12.58%	13.05%
CS3 Labour practices	11.13%	20.62%	14.15%	11.79%	16.28%	16.53%	15.75%	14.09%	11.78%	18.02%	15.67%	10.89%	10.96%
CS4 Environment	10.54%	9.45%	19.74%	18.02%	14.29%	15.07%	16.71%	15.10%	13.6%	13.78%	12.75%	15.46%	16.5%
CS5 Fair operating practices	17.62%	13%	14.67%	14.74%	19.04%	18.86%	15.75%	14.09%	15.55%	15.15%	14.73%	16.41%	14.05%
CS6 Consumer issues	10.63%	9.49%	16.53%	13.18%	15.75%	15.6%	13.23%	15.10%	19.66%	13.27%	16.19%	12.91%	17.44%
CS7 Community involv. and devel.	16.71%	15.74%	12.7%	16.20%	11.33%	11.73%	12.16%	14.09%	15.55%	12.76%	13.26%	15.87%	13.52%

Table 10
Overall results of ISO subjects.

ISO issues	Decision criteria: Firm infrastructure	HR management	Technology development	Procurement	Inbound logistics	Operations	Outbound logistics	Marketing & sales	After-sales service	Context for firm strategy and rivalry	Local demand conditions	Related and supporting industries	Factor (input) conditions	Overall weights	Ranking
CS1	1.01%	0.65%	0.95%	0.97%	0.48%	0.59%	0.55%	0.58%	0.85%	2.56%	1.81%	2.15%	1.62%	14.77%	3
CS2	0.58%	1.08%	0.97%	0.64%	0.54%	0.67%	0.70%	0.52%	0.63%	1.47%	1.02%	1.70%	1.46%	11.98%	7
CS3	0.53%	1.12%	1.22%	0.73%	0.71%	0.94%	0.75%	0.56%	0.73%	2.69%	1.62%	1.47%	1.23%	14.3%	5
CS4	0.50%	0.52%	1.70%	1.11%	0.63%	0.86%	0.79%	0.60%	0.84%	2.06%	1.32%	2.09%	1.85%	14.87%	2
CS5	0.84%	0.71%	1.27%	0.91%	0.83%	1.07%	0.75%	0.56%	0.96%	2.26%	1.53%	2.22%	1.57%	15.48%	1
CS6	0.51%	0.52%	1.42%	0.81%	0.69%	0.89%	0.63%	0.60%	1.22%	1.98%	1.68%	1.74%	1.95%	14.64%	4
CS7	0.80%	0.86%	1.09%	1%	0.5%	0.67%	0.58%	0.56%	0.96%	1.9%	1.37%	2.14%	1.52%	13.95%	6

CS1 Organizational governance
CS2 Human rights
CS3 Labour practices
CS4 Environment
CS5 Fair operating practices
CS6 Consumer issues
CS7 Community involv. and devel.

Table 11
Overall results of ISO issues under 'fair operating practices'.

ISO issues	Decision criteria													Overall weights	Ranking
	Firm infrastructure	HR management	Technology development	Procurement	Inbound logistics	Operations	Outbound logistics	Marketing & sales	After-sales service	Context for firm strategy and rivalry	Local demand conditions	Related and supporting industries	Factor (input) conditions		
FOP1	0.99%	1.35%	1.58%	1.59%	0.7%	0.9%	1%	0.99%	1.06%	2.37%	2.38%	1.99%	1.91%	18.81%	5
FOP2	0.94%	0.93%	1.58%	0.92%	1%	1.22%	1.09%	0.61%	1.42%	3.23%	2.26%	3.29%	2.77%	21.26%	1
FOP3	1.17%	0.99%	1.83%	1.31%	0.74%	1.06%	0.81%	0.84%	1.06%	3.39%	2.19%	2.91%	2.24%	20.54%	2
FOP4	0.72%	1.09%	1.48%	0.96%	1.07%	1.48%	1.09%	0.72%	1.53%	3.12%	1.66%	2.67%	2.25%	19.84%	3
FOP5	0.94%	1.09%	2.15%	1.38%	0.87%	1.02%	0.76%	0.84%	1.12%	2.8%	1.88%	2.67%	2.03%	19.55%	4

FOP1: Anti-corruption
FOP2: Responsible political involvement
FOP3: Fair competition
FOP4: Promoting social responsibility in the value chain
FOP5: Respect for property rights

weight shows the strategic importance attributed to obtaining sustainable competitive advantage, primarily involving tactics for differentiation from the company's competitors. In the follow-up interview, the CEO confirmed that ACMO has a dynamic approach to strategic management based on a continuous study of the competitive context. The analysis of ACMO's competitors is functional to pursue a strategy of product differentiation based on high and distinctive levels of quality, customization and after-sales services.

The high weight for 'related and supporting industries' (13.52%) is coherent with the fact that ACMO is part of a larger corporate group, which plays a role in the competitive context for its associates or subsidiaries.

5.2. ISO subjects

The results in Table 10 indicate that in aiming for sustainable strategies and business practices, ACMO should concentrate on the area of 'fair operating practices' which is the subject with the highest overall weight (15.48%). According to ISO 26000, 'fair operating practices' concern "the way an organization uses its relationships with other organizations to promote positive outcomes" (ISO 26000, 2010). In the follow-up interview, the CEO clarified that ACMO's business success would be inextricably linked to the ability to create fruitful collaborations with institutions and commercial subjects. This ISO subject, in the CEO opinion, offered the best possibilities for ACMO development, taking account of both the activities of the internal value chain and the company's competitive context.

Unexpectedly, 'human rights' is the ISO subject least relevant to implementation of corporate sustainability and social responsibility (11.98%). In the follow-up interview, the CEO explained that ACMO's business activities do not involve other nations where this ISO subject is perceived to be problematic. ACMO periodically audits its suppliers and, up to now, it has been found that there is no risks of human rights' violations.

5.3. ISO issues

For the sake of brevity, we discuss only the relative importance of the ISO issues under 'fair operating practices', which is the most relevant ISO subject to ACMO's sustainable strategies. Under 'fair operating practices', the ISO issue with the highest rank is 'responsible political involvement' (21.26%). In the follow-up interview, the CEO clarified that this result is coherent with the fact that ACMO's products are often used in public works such as public infrastructures for water supply, compelling ACMO to collaborate with local institutions such as municipalities. In addition, ACMO's CEO considers universities as valuable partners both for technology development and for the recruiting of highly qualified resources. As suggested by the 'good practices' of ISO 26000, one possible sustainability initiative should concern training employees to increase their knowledge about responsible political involvement and inform them about how ACMO promotes and sustains productive relationships with its internal and external stakeholders.

6. Managerial implications

The proposed fuzzy AHP method supports the selection of relevant sustainability issues and their integration into the company's strategic decision-making. The method considers the company's 'value chain' activities and its 'competitive context', in order to rank the relevance of the ISO subjects and issues from a holistic and shared value perspective.

The staged structure of the fuzzy AHP method is highly useful for firms that have scarce resources to devote to the strategic selection of relevant sustainability issues. Indeed, given the results of the first (Section 4.1) and second stage (Section 4.2), the company can decide to address only the ISO issues that pertain to the most relevant ISO subjects. Considering the typical resource constraints of a SME, it is possible to apply the third stage (Section 4.3) to the most relevant ISO subjects and then return to the evaluation of the remaining subjects at a future time, in order to be able to fractionate its sustainability commitment over time. By ranking the relevance of the ISO issues, the company can identify priorities for integrating the sustainability 'good practices' suggested by the ISO 26000 standard in its operating processes. These 'good practices' are particularly useful in the initial stages of sustainability implementation for their attitude to create shared value for both the company and society (Hahn, 2013).

In 2017, two years after this study began, the authors met with the ACMO's CEO to assess, with his support, the managerial implications of the method. According to the CEO, the implementation of the method contributed to enhance awareness about sustainability in the business practices. In addition, being the fuzzy AHP method based on the ISO 26000 guidelines, it forced him to approach sustainability holistically and as a complex and multifaceted path of innovation and economic growth for its business.

The CEO stated that the method requires a considerable effort in terms of comparison between criteria and alternatives. Nevertheless, the required effort was less than the benefit obtained from its implementation because it allowed a deep and guided thinking on sustainability integration into ACMO's competitive strategies. Therefore, the net benefit of the direct and intensive involvement of the CEO in the method implementation has been overall perceived as beneficial. According to the CEO judgment, the net benefits of the method can be extended to all SMEs because the broad-spectrum thinking that the method favors is essential for developing the strategic decisions of the CEO. Indeed, the CEOs of SMEs are often too absorbed by the daily management of their businesses and they have neither the time nor the opportunity to be stimulated to strategic reasoning, which is vital to the survival and growth of a SME (Calabrese and Costa, 2015).

The guidelines provided by the method implementation are consistent with the sustainability vision of the CEO for his company. In particular, the ACMO's CEO emphasized the strategic importance of a structured connection with institutional stakeholders, such as government ministries, municipalities, consortia and universities. A prominent institutional stakeholder of ACMO is the Ministry of Economic Development, through its "National Industry Plan 4.0 2017–2020", for incentivizing innovative investments, new infrastructures, and skills/research on Industry 4.0 technologies. The ACMO's CEO highlighted that the policies of tax relief provided by the National Industry Plan 4.0 are crucial for supporting ACMO, as well as the other innovative SMEs, toward sustainability-oriented innovation. In addition, ACMO has been promoter of a SMEs training day and exhibition for strengthening the culture of sustainability among the SMEs of the North-East of Italy and to communicate to stakeholders its strategic plans on sustainability. This initiative is consistent with the ISO "good practices" related to the "responsible political involvement" issue. The fuzzy AHP application has indicated this "responsible political involvement" as particularly significant for integrating sustainability in ACMO's strategic decision-making. Other particularly important "good practice" for ACMO are the partnership agreements with universities that lead ACMO to improve the energy efficiency of its products and to limit their negative environmental impacts.

For the competitive features of the market in which it operates, ACMO has to dynamically formulate and reformulate strategies to adapt itself to an increasingly unstable and complex competitive environment. In this respect, the application of the proposed method provided ACMO a tool for reviewing strategy supporting its transition to sustainability.

7. Discussion and conclusions

Sustainability is the most important challenge of the 21th century. In order to remain successful and competitive, companies have to embrace the transition to sustainability incorporating sustainability into their processes, strategies and long term vision. For this reason, there is increasing interest in the topic of integrating sustainability into strategic decision-making. Nevertheless, a review of the literature revealed shortcomings in this field of sustainability research. Even if, various researches present sustainability strategies a company may follow, there is a scarcity of practical methods for integrating sustainability into strategic decision-making from a shared value and holistic perspective (Engert et al., 2016). Moreover, the review revealed the scarcity of methods for gathering and evaluating the conflicting expectations of different types of stakeholders on the sustainability initiatives of companies (e.g. Matos and Silvestre, 2013). Also, there is a lack of methods for integrating sustainability into strategic decision-making under resource and capability constraints, such as those that often limit SMEs and prevent them from gaining a competitive advantage from sustainability-led opportunities (e.g. Hahn, 2013).

In response to the highlighted shortcomings, this paper proposes a fuzzy AHP method, providing practical support for strategic decision-makers in the prioritization of the most relevant sustainability aspects. The sustainability issues used as decisional alternatives are those listed in the ISO 26000 standard (ISO subjects and issues).

The decisional criteria composing the fuzzy AHP hierarchies integrate the 'value chain' activities and the 'competitive context' dimensions. The proposed method allows the company to identify the ISO issues and subjects with greatest potential to generate shared value, taking account of the company's strategic positioning, capacities and internal activities (Porter and Kramer, 2006; Porter and Kramer, 2011). The method thus assists the company in the selection of the ISO subjects and issues around which to develop sustainability strategies. The company can also identify specific sustainability initiatives for integration into its business processes, by using the fuzzy AHP method to identify levels of priority for the 'good practices' of social responsibility, suggested under the ISO 26000 standard.

Successful companies prioritize sustainability initiatives based on stakeholder demands and on corporate capabilities that are particularly suitable to create value for different stakeholder groups (Michelon et al., 2013). For this reason, direct stakeholder engagement plays a crucial role for integrating sustainability into strategic decision-making (Wals and Schwarzin, 2012). The proposed fuzzy AHP method is structured to permit direct stakeholder involvement in evaluating the relevance of the ISO subjects and issues. The company can consult both external and internal stakeholders, in both cases of potentially different types. The method assists the company in synthesizing the stakeholders' opinions, mediating among their judgments and by assigning them different levels of importance. The capacity to mediate among potentially contrasting opinions supports the company in managing conflicts. In addition, direct involvement in evaluating the relevance of the different areas assists the stakeholders in understanding the company's true sustainability context and commitment, thus activating processes of positive communication and organizational learning.

Companies with limited resources to invest in sustainability can benefit from the staged structure of the proposed fuzzy AHP method, since it assists in identifying the most relevant issues on which to concentrate their efforts. The companies can use the rankings to identify specific strategies and focus their operational initiatives. In particular, given the results of the first and second stage of the proposed method, the company can decide to address only the ISO issues related to the most important ISO subjects. Then, the company can return to the evaluation of the remaining subjects at a future time.

The application of the method to a medium-sized firm specialized in the design and manufacturing of hydraulic valves and systems, illustrates the effectiveness of the method in the case of an SME that intends to undertake the integration of sustainability into its strategic and operational processes. According to the SME's CEO, the implementation of the method contributed to enhance awareness about sustainability in the business practices. In addition, being the fuzzy AHP method based on the ISO 26000 guidelines, it forced him to approach sustainability holistically and as a complex and multifaceted path of innovation and economic growth for its business.

In future studies, the use of the fuzzy AHP method could be expanded by providing for medium to long-term application involving different types of stakeholders, plotting different views of strategic development and so suggesting different paths of sustainability implementation within the company. In addition, it would be worthy to compare the different paths of strategic development, analyzing its costs and benefits according to the company's contributions to sustainable development.

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