Developing Integrated Management Systems using an AHP-Fuzzy VIKOR Approach

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Abstract

Integrated Management Systems (IMS) involves a strategy to manage multiple systems while meeting the needs and expectations of stakeholders. There are various management standards used for the development of IMS. This study aims to undertake research focused on how to develop an IMS. In this context, management standards including the International Organization for Standardization (ISO), Global Reporting Initiatives (GRI) and considers alternatives and integration potential at multiple levels (i.e., Strategic, Tactical and Operational). We assess criteria including continuous improvement, systematic management, integration, organizational learning, standardization and ability to cut through bureaucracy before a deeper dive into 28 sub-criteria. We then use an Analytical Hierarchy Process (AHP) approach to prioritize the main criteria and sub-criteria. Next, we include the use of Fuzzy VlseKriterijuska Optimizacija I Komoromisno Resenje (F-VIKOR) methods to prioritize alternatives. The contributions of this study reveal that systematic management and standardization are the most influencing criteria among six guiding principles. The ISO standard and GRI are the most suitable standards for the development of dynamic IMS. This study is the first of its kind to prioritize guiding principles of IMS. The outcomes of this study will assist business managers, organizations and policymakers in their decision-making regarding management standards for IMS development as well as improve sustainable business practices. Researchers will find new IMS insights and constructs for further empirical investigation.

***Keywords*:** Integrated Management System; IMS; Guiding Principles; Analytical Hierarchy Process; Fuzzy VIKOR

1. Introduction

Organizations operate in conditions characterized by permanent technological progress, competitiveness, and limited resources, all while staying on top of the changing needs of the consumer market. Given this, there is an immediate need for systems to help manage constant changes in the management and operation of these companies so that they can adjust to these evolving environments while remaining competitive. To evolve it is necessary for businesses to meet the requirements of their customers who expect continuous improvements in the quality and price of products and services (Nunhes, Bernardo, and Oliveira 2019).

It is also beneficial for companies to satisfy the demands of stakeholders who expect the organizations to be committed to the environment, social sustainability, and ethics (Chang and Yu 2001; Freeman, 1984). These stakeholders encourage participation in projects and promote the integration of management systems that enable organizations to stand out in the marketplace. To meet stakeholder requirements and compete in the market, it is necessary for companies to implement dynamic Management Systems (MSs). Contemporary systems typically include Occupational Health and Safety Management Systems (OHSMS), Environmental Management Systems (EMSs), Quality Management Systems (QMS), and Corporate Social Responsibility Management System (CSRMS) (Ikram et al., 2019b).

Considering all of the information these systems integrate, management to a large extent becomes more complex because of the increasing number of measures available across functions. This, in turn, can cause difficulties in system implementation and control, high costs, unreasonable obstacles from bureaucracy, and so on. Taking into account the similar structure of business systems, Integrated Management Systems (IMS) appear to be an appropriate strategy for managing the complex and diverse expectations and demands of stakeholders (Sroufe 2017). The IMS functions or elements that can be found in different systems (OHSMS, CSRMS, QMS, EMS), can be integrated gradually to provide better management, i.e., that saves time, resources, diminishes efforts by eliminating duplicate documentation, duties, and other administrative efforts (Gianni, Gotzamani, and Tsiotras 2017).

It was claimed that in 2017, about 1,556,758 certificates of all kinds all over the world were managed by the International Organization for Standardization (ISO). It was also reported that 1,058,504 of them were related to ISO 9001; 362,610 were related to ISO 14001; and 76,251 were related to OHSAS 18001 in 2017 (Ikram et al., 2019a). When you integrate more than one system, it becomes an IMS. Such systems can be disruptive, complicated to operate, and they include employees forced to make choices about processes and possible excessive administration generated by the system itself. To this end, employee co-operation can be easier to implement for one system than for two or more systems that are operated independently. When overcoming these obstacles, the synergy produced by integration has led to an enhanced performance at significantly lower costs for organizations (Vukšić, Bach, and Popovič 2013).

The integration of certified management systems can take place through the expansion of IMS. IMS seeks to take the benefits of synergies and its components to enable benefits to be widespread to other systems so that they work together (Rebelo, Santos, and Silva 2016). This cooperation will increase benefits such as process time reduction, human efforts, and the amount of economic and technical resources required. To do this, the IMS needs to be in line with the structure and culture of the organization, be included in its strategy and be associated with other business functions (Bernardo et al. 2017). Studies on IMS have largely covered approaches to combine the knowledge gained over the past two decades. It was claimed by Domingues et al. (Domingues, Sampaio, and Arezes 2016) that the analysis of successful cases, progress, and further investigation is very important in order to promote benchmarking, and therefore to make possible the building of stable foundations for the advancement of the IMS field of research. Prior work has looked at maturity levels, a theoretical summary of IMS research, its evolution and possibilities for future analysis. Prior reviews of the literature have distinguished the benefits and difficulties of IMS and its empirical analysis in terms of organizations located in various countries and from different areas.

In doing this, we also need to unpack the multiple criteria available to managers when making decisions about the development of IMS. For this, we can use the analytical hierarchy process (AHP) methods to calculate the weights of the elements (dimensions, criteria and indicators), and with the help of Fuzzy VlseKriterijuska Optimizacija I Komoromisno Resenje

(F-VIKOR) we can take this a step further to obtain the final rankings of alternatives closest to an ideal solution. Some of the advantages of using techniques for F-VIKOR methods include simplicity, rational, comprehensibility, and good computational efficiency with the ability to measure the relative performance for alternatives in a simple mathematical form.

The contributions of a study such as this start with providing new insights regarding ISO standards and GRI as we assess the extent to which they are the most suitable standards for the development of dynamic IMS. We see the AHP results as a foundation for understanding important and less important criteria for decision-makers and researchers as we uncover new insights that include meaningful subcriteria. Additional contributions come from the application of an F-VIKOR method as this can help extend prior findings and help prioritize the best alternatives to enhance and validate the consistency of results.

From the literature, it is possible to describe basic elements and factors that provide a starting point for researches and critical factors for success. We build on the literature in this study and while producing a list of metrics and indicators that are important to IMSs. It is worth noting a gap in the literature regarding the choice and definition of the development of IMS as we believe this has not been adequately investigated. Thus, the primary research questions addressed in this study is what are the most important criteria, i.e., guiding principles, for an IMS and how can they be prioritized in a way that adds value for both practitioners and researchers? In the following sections of this study, we review the literature. In the context of this literature review, six guiding principal criteria and 28 sub-criteria were received from the review of the literature. We then review the research methods. Here, we applied AHP as a technique to allocate weights to both criteria and sub-criteria utilizing a matrix of pairwise comparisons and has been used in similar ways in prior research (R. Handfield et al. 2002). Building on AHP, the VIKOR method is used for the classification of the priorities of various alternatives. This method has been criticized for ignoring hesitancies and uncertainties. To alleviate this disadvantage, fuzzy set theory, which helps consider uncertainties, was supplemented with this VIKOR method.

In this study, we attempt to evaluate the development of IMS based on a set of guiding principles as well as sub-indicators utilizing a Multi-Criteria Decision-making approach (MCDM). We then add F-VIKOR and F-AHP to help understand the prioritize outcomes of the study and to strengthen our methodological approach to assessing IMS. Later sections present the results and relevant discussion. Finally, we draw conclusions and offer options for further analysis and research.

2. Literature Review

IMS connect programs, processes, and people through sharing data, human and financial resources and infrastructure so as to fulfill the requirements of various stakeholders (Souza and Alves 2018). Stakeholder theory argues, the interconnected relationships between businesses and its stakeholder should create value for all of them (Freeman, 1984). Here, we see systems connecting and adding value to stakeholders in dynamic ways. Prior research has examined how elements of management systems affect one another. In this way, the separate improvement of the system is a sub-optimization whenever assessed from an overall systems managerial viewpoint. Thus, it is important to reexamine the integration of a management system's focus as per these different needs help develop a fundamental methodology for IMS sustained by top management using the addition of integrated components in the asset allocation process, in the advancement of firm's culture, in strategic planning, and in the mutual planning and the management of key procedures.

As indicated by Mežinska et al., (2015), IMS is essential to accomplish the targets in a combined approach, diminishing the odds of having a myopic functional and confined methodology. A myopic approach can hinder the integration and improvement of the IMS. Standardization guarantees the solidarity of the IMS and is upheld by the basic structure of the different management system standards. These standards offer key ideas that encourage the execution and integration of other mechanisms. The integration management components help make the system resilient (Finnegan and Currie 2010). The components and capacities typically integrated are manuals, approaches, targets and objectives, structure and duties, top management, work guidelines, archive and record control, training, inward correspondence, crisis reaction, execution and control of monitoring, nonconformity management and estimating, preventive and restorative activities, inside and outside audits and critical analysis. Different activities and tasks that are unrealistic to be integrated ought to be, at whatever point conceivable, reshape in such a way that they change collaboratively with integrated components and capacities (Loorbach et al. 2009).

In the last decade, researchers have considered multiple ways of dealing with IMS. For example, assessment of motivation, advantages, and pitfall of integration, the portrayal of the integration levels, integration of audits, integration process and models, along with guidance for the integration process (Kurdve et al. 2014). The advantages of integration are broadly seen as IMSs incorporate the improvement of firms productivity (decrease redundancies of tasks, human endeavors, time, and so on), progress of inward correspondence, organization image for external advantages, competitiveness, along with decreasing costs of managing each system independently (Arda, Bayraktar, and Tatoglu 2018). The pitfalls related to the integration process include the increment in management cost, experiencing social incompatibility and the multifaceted nature of internal management.

While we know integration is important, characterization of the integration procedure has four principle perspectives: integration level, (i.e., the degree accomplished by the IMS), audit mechanism, (i.e. inside and outside integrated level of audits), system integration, (i.e., models or mechanisms utilized) and integration technique (the number and usage sequencing of MSs chosen to integrate). This system integration can be attained with respect to a number of levels, assets, and strategies (Samaranayake and Toncich 2007). Regardless of the distinction, we find there are between levels of integration approaches; categorized three levels of IMS integration. The integration levels include addition (frameworks for quality, system domain, and so forth that are supervised in a different way, i.e., utilizing individual reports and we try to make this comparable), coalition (work guidelines that are completely incorporated), and integration (organizations can build a nonexclusive MS as their general system and incorporate every system in it).

Similarly, Simon et al. (2012) portray a three-level model in correspondence (interior coordination), conventional (comprehension of nonexclusive procedures and errands in the management process cycle) and integration (strengthening the culture of consistent improvement, learning and partner support). The integration of auditing is considered a basic way of strengthening the connection between MSs and can be characterized in multiple dimensions.

Integration audits, i.e., ISO 19011:2018 give direction on this process that is appropriate to all firms that need an audit system or to develop an audit management program. Contrasting this with previously published versions (ISO, 19001:2015) the revised version considers a more extensive approach to management system evaluation, including a way to deal with "consolidated/combined audits" when at least two management systems are audited simultaneously, as in IMSs. ISO 19011:2015 has favored the development of IMS and is helpful to the system integration process. Integration includes the sequence in which the systems are combined. Past studies show two potential methods for this: sequential integration, that first bases this on quality, and afterward executes the integration of different systems, or synchronous integration, where the integration of all systems happens together (Salomone 2008).

Different sets of guidelines for the integration of management systems have been developed in the IMS literature to assist firms in dealing with the integration process. Labodová (2004) has noted many differences in proposed guidelines and called for a worldwide standard for integrated adoption. From what we can find in our review of the literature, few models are dependent on the PDCA procedure/approaches (Sokovic, Pavletic, and Pipan 2010) and high-level ISO structures. The ISO introduced a new high-level structure (HLS) within its standards. this HLS is partitioned into 10 parts that plan to enhance the incorporation of ISO family management standards (ISO/IEC, 2016). The HLS is presented in the ISO standards that have had updates starting in 2015, which include ISO 9001 and ISO 14001, and ISO 45001 issued in 2018.

The adoption of new standards and methods to deal with modified ISO standards is a significant focus of importance to management. The revised ISO standards try to take into account the significance of risk-based thinking, interested parties, change control, strategic direction, knowledge management and leadership. ISO has additionally introduced some important initiatives in regards to IMS, as the issuance of the ISO guidelines provides different techniques, tools and practices to specifically develop IMS since 2015. In recent years, this includes the issuance of the high-level structure (HLS). This HLS exhibits the ISO's Annex SL, characterized as a systematic standard that intends to promote overlap between the different management standards systems and encourage their integration and utility by certified organizations. Both ISO 9001:2015 (QMS) and 14001:2015 (EMS) were reviewed on the basis of Annex SL guidelines (Bernardo 2014). In Table 1, we can see the types of approaches/methods used in prior IMS studies. To the best of our knowledge, none of these studies used AHP and F-VIKOR methods to prioritize the guiding principles in developing an IMS.

Table 1: Methods used in IMS studies

NO	IMS research conducted	Methods	Year	Reference

01	IMS: three different levels of integration	Qualitative study	2006	(Jørgensen, Remmen, and Mellado 2006a)
02	Synergies in standardized management systems: some empirical evidence	Survey study	2011	(Casadesús, Karapetrovic, and Heras 2011)
03	IMS: Experience of Indian Manufacturing organizations, Key Findings	Survey study	2010	(Khanna, Laroiya, and Sharma 2010)
04	IMS guiding principles	Review study	2019	(Nunhes, Bernardo, and Oliveira 2019)
05	Trends of IMS	Survey study	2017	(Ribeiro et al. 2017)
06	Assessment of IMS: a maturity model proposal	Survey study	2016	Domingues et al. (2016)
07	IMS and Sustainability performance	Qualitative study	2017	(Gianni, Gotzamani, and Tsiotras 2017)
08	Identification and analysis of the elements and functions integrable in integrated management systems	Qualitative study	2017	(Nunhes, Motta Barbosa, and de Oliveira 2017)
09	Lean-integrated management system: A model for sustainability improvement	Qualitative study	2018	(Souza and Alves 2018)
10	Do integration difficulties influence management system integration levels	Structural Equation Model (SEM)	2012	(Bernardo et al. 2012)
11	resources for Integrated Management Systems within resource-based and contingency perspective	Structural Equation Model (SEM)	2015	(Savino and Batbaatar 2015)
12	An integrated management systems approach to corporate social responsibility	Qualitative study	2013	(Asif et al. 2013b)
13	Integration and organizational change towards sustainability	Survey study	2017	(Sroufe 2017)
14	IMS towards sustainable and socially responsible firms	Survey study	2015	(Mežinska, Lapiņa, and Mazais 2015)
15	Integration of quality and environmental management practices affect firm performance? Mediating roles of quality performance and environmental proactivity	Structural Equation Model (SEM)	2018	(Arda, Bayraktar, and Tatoglu 2018)

Various decision criteria can be considered when developing an IMS. These criteria can help it to become a significant and efficient management system and improve sustainable business practices. We developed the decision criteria for IMS development for this study from the literature and then checked with experts to help confirm their validity. The main guiding criteria include Integration (at Strategic, Tactical and Operational levels), Continuous Improvement, Systematic Management, Reducing Bureaucracy, Standardization and Organizational Learning are all viable. Each of these criteria has a total of 28 sub-criteria. When summarizing the literature, Table 2 presents the decision criteria and sub-criteria for the development of an IMS.

Table 2: Most influencing decision criteria used in the development of an IMS

Criteria	Sub-criteria	References
Integration (Strategic, Tactics and Operational)-A1	Integrate systems at the tactical level (A11) Conduct integrated audits (A12) Integrate systems at the operational level (A13) Integrate systems at the strategic level (A14)	(Ikram et al., 2019; Asif et al., 2019; Gianni and Gotzamani, 2015; Bernardo et al., 2015; von Ahsen 2014)
Continuous Improvement-B1	Integrate the IMS with other programs, management systems and/or the entire supply chain (B11) Use organizational culture to support the development of the IMS (B12) Promote communication and interaction with stakeholders (B13) Go beyond legal compliance (B14) Identify opportunities to avoid and/or reduce waste(B15)	(Curkovic and Sroufe, 2011; Handfield et al., 2015; Jurburg et al., 2017; Ciravegna Martins da Fonseca et al., 2017; Narasimhan and Schoenherr, 2012; (Sajjad, Eweje, and Tappin 2015)
Systematic Management-C1	Consider stakeholders' needs (C11) Manage synergistically and provide human and financial resources to implement and maintain the IMS (C12) Align and/or integrate the responsibilities and authorities of top management and functional management and promote their engagement with the IMS (C13) Identify and work on the interrelationships between the systems (synergies and antagonisms) (C14)	(Rebelo et al., 2016; Carvalho et al., 2018; Asif et al., 2013; Bandaly et al., 2014)
Reducing Bureaucracy-D1	Reduce conflicts between documents, processes and procedures (D11) Eliminate duplication and inconsistencies between documents, processes and procedures (D12) Merge the documentation (D13) Simplify the documentation (D14)	(De Oliveira, 2013; Franco-Santos and Otley, 2018; Zhu et al., 2013; Baumgartner and Rauter, 2017; Papagiannakis et al., 2019)
Standardization E-1	Investing in workforce training (E11) Standardize documentation (E12) Standardize processes (E13) Standardize terms and concepts (E14) Developing mechanisms for internal communication (E15)	(Su et al., 2015; Shah and Shrivastava, 2014; Savino and Batbaatar, 2015; Souza and Alves, 2018; Hahn 2013)

Organizational Learning-F1	Develop multipliers and use incentive systems (F11) Engaging employees in the process of implementing the IMS (F12) Establish an effective flow of information (F13) Promote the sharing of individual and group-level knowledge and experiences (F14) Seek technical advice from experts (F15) Develop capacity for innovation and openness to change (F16)	(Bierema and Callahan, 2014; Longenecker and Fink, 2015; Brudan, 2010; Navimipour et al., 2018; Zhang and Zhu 2019)

3. Research Methods

For the purpose of this study, we find AHP, and fuzzy VIKOR methods as the best approach to extend prior work in the field and to choose the optimal management standards for IMS. Figure 1 represents the research framework guiding this study in which AHP is used as an initial developmental level of analysis that is then complemented with the help of experts to calculate the weights of the main guiding principles and the sub-criteria for the pairwise comparison matrix. Next, a Fuzzy VIKOR method is used to determine the optimal solution of IMS development based on the available management standards. To take researchers through our process of analysis and to try and provide a thorough context for our work, we next, provide a detailed description of the AHP and fuzzy-VIKOR methods employed in this study.

3.1. Analytical Hierarchy Process

AHP is one of the important and widely used MCDM methods to provide the solution of composite decision-making problems. In 1970s, Thomas L. Saaty introduced the concept of AHP (Harker and Vargas 1987). The primary components of AHP comprise pairwise comparisons, then develop and make a comparison of matrices to check their consistency. This technique helps all decision-makers rationalize, select, and rank complex criteria. The key AHP methodology steps are as follows (Thomas L. Saaty 1990).

Level 1. Developing the hierarchal structure of the decision-problem.

Level 2. By using the Saaty's point scale 1-9 for Pair-wise comparisons matrix for the decision-problem

Level 3. Calculation of a consistency Index (CI).

To check the consistency of the pair-wise comparison of the matrix, CI is used at this level. The formula of CI can be presented as (Cavallo 2017).

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

here λ_{max} indicates the eigenvalue and n represent the no. of main criteria

Step 4. Computing the Consistency Ratio (CR)

$$CR = \frac{CI}{RI} \tag{2}$$

Table 2 presents the random consistency index RI. The values of RI must be within a consistent region limit of 0.1. If the value of consistency ratio (CR) exceeds this, then the results can be inconsistent.

Table 2. Random Index (RI)

n	1	2	3	4	5	6	7	8	9	10
RI	0.00	0.00	0.058	0.90	1.12	1.24	1.32	1.41	1.45	1.49

In this study, the AHP method provides the weights of the main guiding principles and sub-principles for the development of IMS after the accomplishment of all steps. This method is also utilized in the F-VIKOR method to prioritize the proposed three management standards categories (i.e., the alternatives).

3.2. Fuzzy System Method

In 1965 Lofti A. Zedah first introduced fuzzy theory (Pradera et al. 2007). The main advantage of this theory to work with partial, incomplete, and uncertain data-based decision-problems. The fuzzy system comprises crisp sets, while the acceptance range of the fuzzy set numbers from 0 to 1. Here, 0 represents the unknown functions numbers, and 1 indicates known function numbers. There are various types of triangular fuzzy numbers (TFNs) which can be used to solve complex problems. The use of TFNs are very helpful in fuzzy situation (Solangi et al., 2019; Vinodh et al., 2014). Table 3 presents a detail description of the fuzzy number linguistic variables benchmarking scale used in MCDM complex problems (Kumar and Singh 2012).

Table 3. Fuzzy Number Linguistic variables

Scale number	Linguistic characteristic	TFNs scale value
1	Higly unfavorable (HU)	(0,0.05,0.15)
2	Unfavorable (U)	(0.1,0.2,0.3)
3	Fairly Unfavorable (FU)	(0.2,0.35,0.5)
4	Fairly (F)	(0.3,0.5,0.7)
5	Fairly Favorable (FF)	(0.5,0.65,0.8)
6	Favorable (F)	(0.7,0.8,0.9)
7	Highly Favorable (HF)	(0.85,0.95,1)

If ã represents the fuzzy number defined by a trio $X = (x, y, z)$. The membership function of TFN is described as:

$$\mu_X(x) = \begin{Bmatrix} 0, & x < 1 \\ \frac{x-x}{y-x} \; if & x \leq x \leq y \\ \frac{z-x}{z-y} \; if & y \leq x \leq z \\ 0, & x > 0 \end{Bmatrix} \quad (3)$$

The rest of the fuzzy set process is used and can be consulted as per (Kaya and Kahraman 2010).

3.3. Fuzzy VIKOR Method

In 1980, Opricovic introduced the concept of VIKOR method (Opricovic and Tzeng 2007). This method can compute the weights of alternatives and rank them in order to obtain the compromise solutions of a decision-problem with contradictory/conflicting criteria, as this approach can help decision-makers to reach a final decision. Here, the compromise solution is a feasible solution, which is the closest to the ideal, and a compromise means an agreement established by mutual concessions (Opricovic and Tzeng 2004). The levels of F-VIKOR is presented below:

Level 1. Performance-based fuzzy matrix development and the weight vector is as follows

$$\tilde{D} = \begin{array}{c} \\ O_1 \\ \vdots \\ O_n \\ \\ \end{array} \begin{array}{c} C_1 \; C_2 \cdots C_n \\ \begin{bmatrix} \tilde{p}_{11} & \tilde{p}_{12} & \cdots & \tilde{p}_{1n} \\ \tilde{p}_{21} & \tilde{p}_{22} & \cdots & \tilde{p}_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ \tilde{p}_{m1} & \tilde{p}_{m2} & \cdots & \tilde{p}_{mn} \end{bmatrix} \end{array} \tag{4}$$

$\tilde{W} = (w_1, w_2, w_3), \sum_{j=1}^{n} w_j = 1$

where O_i indicates the alternative i, i.e., i = $(1,2,3, \dots, \mathrm{m})$; C_j represents the indicators j, i.e., j = $(1,2,3, \dots, \mathrm{n})$; $\tilde{p}_{ij}$ represents the performance of alternatives by fuzzy rating O_i with respect to indicators C_j; and $\tilde{W}_j$ represent the fuzzy weight for each indicator. Thus, TFN can be written as $\tilde{p}_{ij} = (x_{ij}, y_{ij}, z_{ij})$.

Level 2. Calculation of all benefit criteria values $\tilde{p}_i^{+} = (x_i^{+}, y_i^{+}, z_i^{+})$ and the values of cost criteria $\tilde{p}_i^{-} = (x_i^{-}, y_i^{-}, z_i^{-})$. The set of benefit criteria is indicated as l^b whereas, l^c represent the set of cost criteria is follow as.

$$\tilde{p}_i^{+} = max_j \, \tilde{p}_{ij}, \qquad \tilde{p}_i^{-} = min_j \, \tilde{p}_{ij} \quad \text{for} \quad i \in l^b$$

$$\tilde{p}_i^{+} = min_j \, \tilde{p}_{ij}, \qquad \tilde{p}_i^{-} = max_j \, \tilde{p}_{ij} \quad \text{for} \quad i \in l^c. \tag{5}$$

Level 3. Determine the values of normalized fuzzy decision matrix $\tilde{D}_{ij}$:

$$\tilde{D}_{ij} = \frac{\tilde{p}_i^{+}(-)\tilde{p}_{ij}}{z_i^{+} - l_i^{-}} \qquad \text{for} \quad i \in l^b$$

$$\tilde{D}_{ij} = \frac{\tilde{p}_{ij}(-)\tilde{p}_i^{+}}{z_i^{-} - l_i^{+}} \qquad \text{for} \quad i \in l^c. \tag{6}$$

Level 4. Calculate the values $\tilde{S}_j = (\tilde{S}_j^x, \tilde{S}_j^y, \tilde{S}_j^z)$ and $\tilde{R}_j = (\tilde{R}_j^x, \tilde{R}_j^y, \tilde{R}_j^z)$:

$$\tilde{S}_j = \sum_{i=1}^{n} \tilde{W}_i (\times) \; \tilde{D}_{ij} \tag{7}$$

$$\tilde{R}_j = max_i \, \tilde{W}_i (\times) \, \tilde{D}_{ij} \tag{8}$$

Level 5. Calculate the values $\tilde{Q}_j = (\tilde{Q}_j^x, \tilde{Q}_j^y, \tilde{Q}_j^z)$:

$$\tilde{Q}_j = v \frac{\tilde{S}_j(-)\tilde{S}^{+}}{S^{-z} - S^{+x}} (+)(1 - v) \frac{\tilde{R}_j(-)\tilde{R}^{+}}{R^{-z} - R^{+x}} \tag{9}$$

here $\tilde{S}^{+} = min_j \, \tilde{S}_j$; $S^{-z} = max_j S_j^z$; $\tilde{R}^{+} = min_j \tilde{R}_j$; $R^{-z} = max_j R_j^x$

Moreover, v is presented as a group strategy weight for the majority of criteria $\tilde{S}_j$; whereas, $(1 - v)$ is the individual weight of $\tilde{R}_j$.

Level 6 & 7. Defuzzify $\tilde{S}_j$,$\tilde{R}_j$ and $\tilde{Q}_j$ values, respectively. According to the crisp values of S, R, and Q prioritize the alternatives to the shrinking order of crisp values, and the results are three prioritizing results$\{O\}_S$,$\{O\}_R$ and $\{O\}_Q$, respectively.

Level 8. To satisfy two subsequent conditions, propose a solution to the alternative $O^{(1)}$ which is the optimal solution of the measure Q:

Condition 1: suitable benefit: $Ben \geq DQ$

Where $ben = \frac{[Q(O^{(2)}) - Q(O^{(1)})]}{[Q(O^{(m)}) - Q(O^{(1)})]}$ is the benefit rate of alternative $O^{(1)}$ placed first compared with the alternative with the second-ranked $O^{(2)}$ in $\{O\}_Q$ and the threshold $DQ = \frac{1}{(m-1)}$

Condition 2: Decision making stability: Let alternative $O^{(1)}$ should also be considered optimal ranked by S or Q values. This should satisfy both conditions CI and C2 or at least one. If both the conditions are not satisfied then a set of comprising solution is suggested, which can be defined is followed as:

Condition satisfied 1: Alternative $O^{(1)}$ and $O^{(2)}$ if only (condition 2) is not satisfied, or:

Condition satisfied 2: Alternative$O^{(1)}$,$O^{(2)}$,..., $O^{(M)}$ if (condition 1) is not satisfied; $O^{(m)}$ is determined by the relation:

$\frac{[Q(O^{(M)}) - Q(O^{(1)})]}{[Q(O^{(m)}) - Q(O^{(1)})]} < DQ$ for maximum M. The locations of the alternatives are in closeness.

4.3. Experts survey utilization

It is challenging to try and select a suitable number of experts selected for involvement in a study such as this one. Several studies have used different numbers of experts to obtained reliable results; for example Shah et al., (2019) utilized 14 experts to analyze the barriers of clean energy technology by using MCDM method. Whereas, Solangi et al., (2018) chosen 5 experts and a survey methodology for AHP and TOPSIS inputs and analysis.

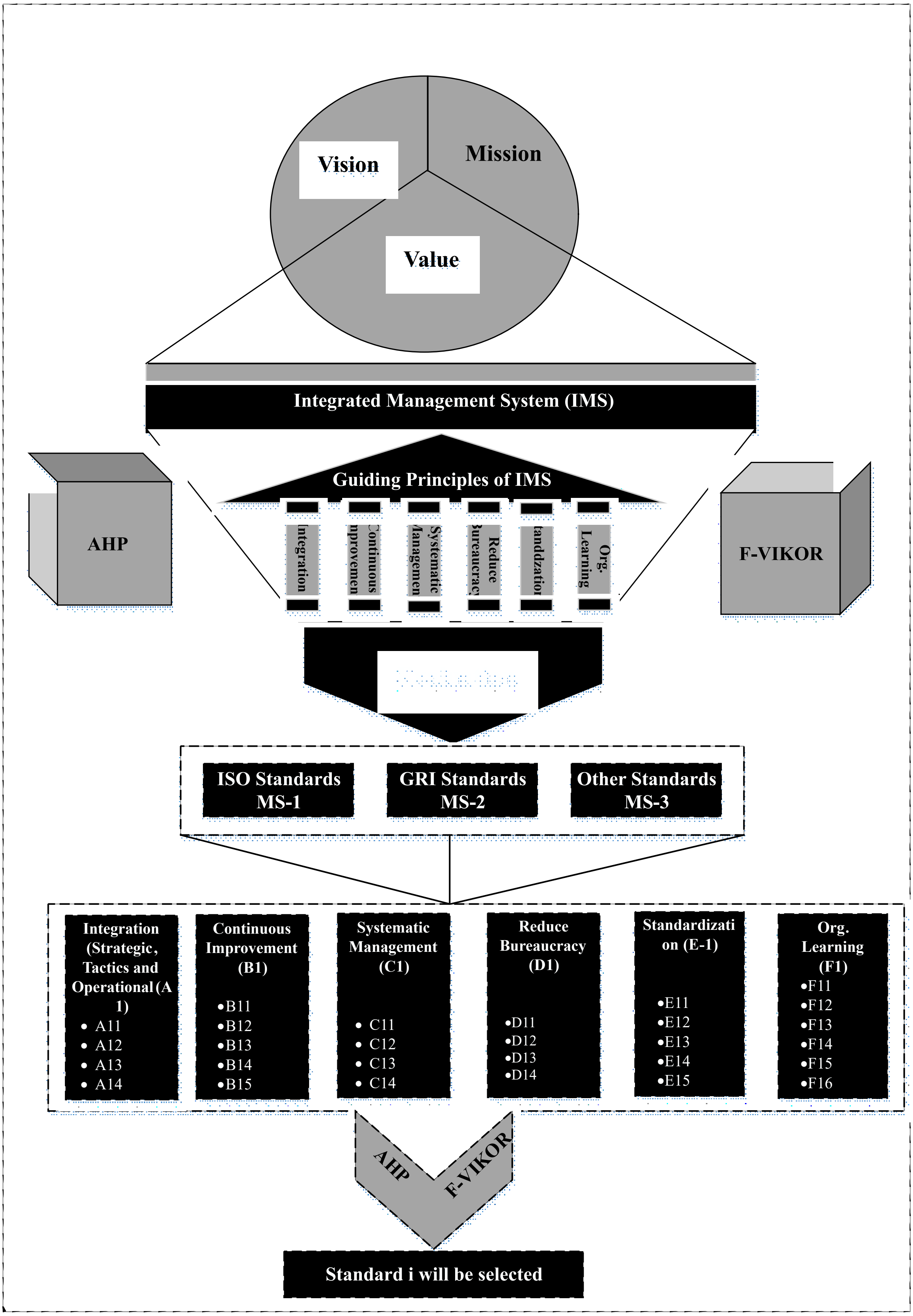

Fig. 1. *The research framework of the study*

For this study, we conducted an online survey though webmail with the help of 10 experienced experts before applying the AHP and F-VIKOR methods, since weights scored by the individuals can be conflicting (Vafaeipour et al. 2014). The participants in this study were academic professors, research analysts, policymakers, stakeholders, and managers who were all asked to score their responses based on the TFN linguistic variables for IMS development. The experts all had more than 15 years' work experience, and they are very familiar with the industry and IMS research context. We validated the expert's results using CI and RI proposed by Saaty (T L Saaty 1980).

The use of AHP helped develop the pair-wise comparisons matrix of the main criteria and sub-criteria. Next, the F-VIKOR methodology was employed to prioritize suitable standards. Using the research framework of this study helps to reach an ideal solution of IMS development with our results presented next in the following section.

4. Results and Discussion

The results of this study help to show how the integration of AHP and F-VIKOR methods can enable planners and policymakers in developing IMS and in the development of strategic decision-making processes. It is the first kind of study to assess the development of an IMS by prioritizing the main IMS indicators and sub-indicators using these methods. Our investigation into IMS lays a foundation for corporations and decision-makers to further determine the application and research framework of this study, as a suitable rationalization for the selection and development of international management standards.

4.1. AHP results

A pairwise comparison matrix of the AHP method was employed to calculate the individual expert weight scores using a geometric mean (Krejčí and Stoklasa 2018). In this study, a group decision- making technique was used to determine the weight of the main criteria and the sub-criteria. Six main criteria considered include Integration (at multiple levels), Continuous Improvement, Systematic Management, Reduced Bureaucracy, Standardization, and Organizational Learning, to enable the AHP analysis. In the first part of the AHP method, 6 main criteria weights were obtained, and in the second part, 28 sub-criteria of the study were then assessed.

4.1.1. The Ranking of main criteria

The AHP methodology helped to determine the weights of the main criteria at the hierarchy level. The main criteria results are in Table 4 showing that Systematic Management is the most significant criteria with a weight of (0.3379) followed by Standardization (0.2326), Integration (0.1735), Organizational Learning (0.1165), Reduced Bureaucratization (0.0793) and Continuous Improvement (0.0602), respectively. The detailed main criteria weights are in Fig 2. Systematic Management plays a vital role in the development of IMS, and can improve organizational performance. Standardization is the second most prioritized criteria in this study after systematic management as the implementation of management standards has the goal of the organization to standardize business processes and meet the stakeholder expectations.

According to the weight calculation of main criteria of the study, the Integration and Organizational Learning criteria took their places on the third and fourth priorities. The integration of the management systems at the strategic, tactical, and operational levels is another important indicator to the development of IMS. Moreover, developing and maintaining IMS is a process of continuous reconstruction and adaptation to updates and innovations.

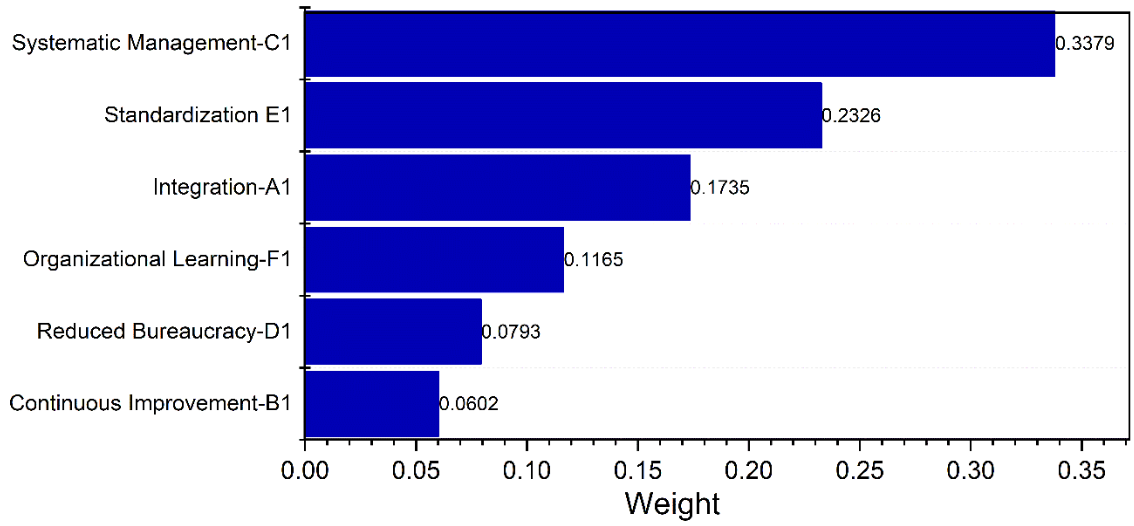

Fig.2. *The ranking of main criteria in the development of IMS*

Reduced Bureaucracy is identified as the fifth important criterion since each management standard seeks to combat excess bureaucracy by reducing and simplifying processes in the organization.

Table 4 Ranking of the main criteria

Main Criteria	Code	Weight	Rank
Systematic Management	C1	0.3379	1st
Standardization	E1	0.2326	2nd
Integration (Strategic, Tactics and Operational)	A1	0.1735	3rd
Organizational Learning	F1	0.1165	4th
Reduced Bureaucracy	D1	0.0793	5th
Continuous Improvement	B1	0.0602	6th

The organization needs bureaucratic stabilization, efficiency, and appropriate structures to enable employees to perform their tasks in a better way. Finally, Continuous Improvement is considered a less influential criteria having the lowest weight determined by fuzzy AHP. Paradoxically, the continuous improvement indicator should support the development improvement of the other criteria. Next, the 28 sub-criteria of the study were evaluated through the experts' feedback using a pairwise comparisons matrix.

4.1.2. The Sub-criteria ranking

This section addresses the result of all sub-criteria provided in Figure 3 to 9.

Integration (Strategic, Tactics, and Operational) sub criteria's: The ranking of sub-criteria within the category (A1) is as follows: A14>A11>A13>A12. Here, the integration of IMS at the strategic level has been reported as the most important and influencing sub-criteria of A14 by obtaining the weight 0.4418. This ranking represents a feasible justification as integration is the main pillar of IMS development. Integration of management standards is the most commonly based on a top-down approach, in which integration processes handle operational and tactical issues solved by integration of strategic decisions (Poltronieri et al. 2018).

The second highest weight obtaining sub-criteria within the category is to integrate systems at the tactical level (A11) with 0.3038 weight. It is observed in other studies the objectives, indicators, and business processes of intermediate levels in the organization should be tactically integrated to measure performance (Tuczek, Castka, and Wakolbinger 2018). Integrated systems at the operational level (A13) obtained 0.1590 weight and is the third most important sub-criteria within the category presented in Fig. 3. This has been addressed in the literature regarding the integration of management standards which focus on the input and output of businesses processes to identify customers and monitor the business environment that can be integrated trough work instructions and control of documentation (Tsai and Chou 2009).

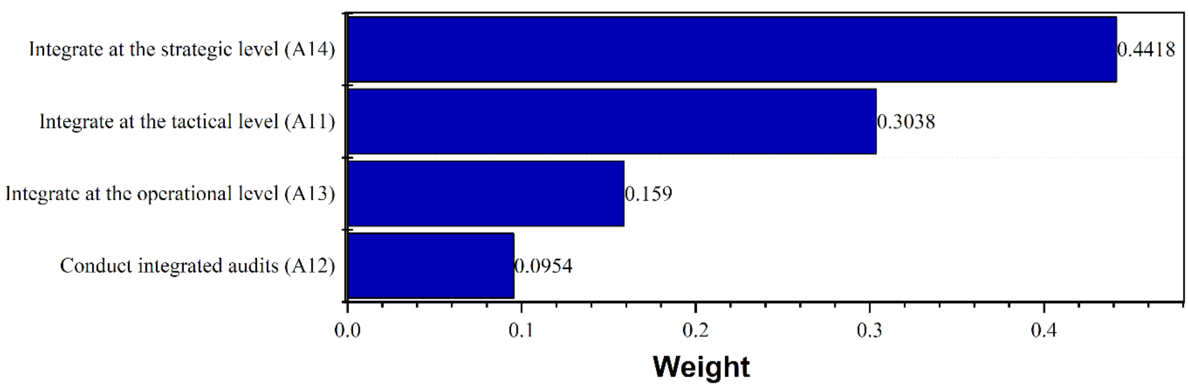

Fig. 3. *The ranking of Integration sub criteria*

Lastly, within this category, conducting an internal audit (A14) sub-criteria received a 0.0954 weight and appeared fourth in the order. Integrated audits are more effective than several audits with different audit teams as is advisable for an organization to improve workforce skills by integrating training and development. The integration of audits also motivates employees to thoughtfully combine their activities and responsibilities with IMS (Guerrero-Baena, Gómez-Limón, and Fruet 2015).

Continuous Improvement: Under the continuous improvement (B-1) category, the ranking of sub criteria is obtained as follows B12>B15>B14>B13>B11 and presented in Fig. 4. Use of organizational culture to support the development of the IMS (B12) obtained a weight 0.4245. The results illustrate an organization should be focused on continuous improvement through identification and analysis processes according to organizational culture as this approach can help solve problems. Prior work has suggested managers should develop continuous improvement programs for IMS based on the PDCA cycle (López-Fresno 2010). The second highest sub-criteria as per the weight allocation within the category is Identified Opportunities to Avoid and Reduce Waste (B15) with the weight of 0.2673. The literature reveals that PDCA is an opportunity for organizations to optimize their processes and

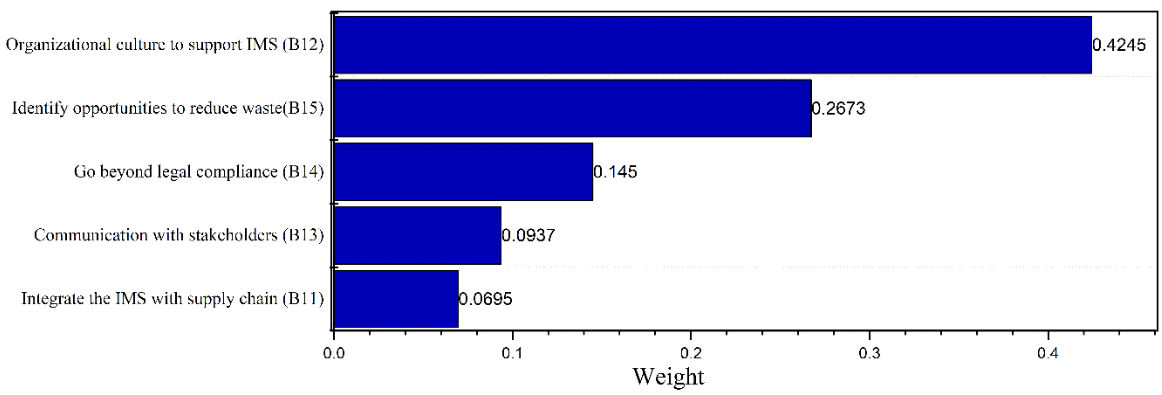

Fig. 4. *The ranking of continuous improvement sub-criteria*

reduces waste, through the proper utilization of company resources. PDCA approaches support the organization when standardizing improvements to reduce company costs and waste.

Go Beyond Legal Compliance (B14) obtained 0.1450 weight and is in the third position within this category as it can be essential for continuous company improvement and compiance with the requirements of all the sustainability tools such as quality, environmental, health, and safety management standards when developing IMS (Ikram et al., 2019).

The fourth sub-criteria under the continuous improvement category promotes Communication With Stakeholders (B13) with a weight of 0.0937. When organizations develop a lean infrastructure as part of the continuous improvement of the IMS they are also meeting stakeholder needs. Last in this category is Integrate the IMS with Supply Chains (B11) obtained a weight of 0.0695. Here, we see the continuous improvement of the IMS also emphasizing the development of an integrated decision support program for supply chain management that takes into account stakeholders to strategically improve production processes and balance the system for supplier sustainability.

Systematic Management: Based on the result presented in Fig. 5, the ranking of sub-criteria within systematic management to develop IMS as follows C13>C14>C12>C11 with consistency ratio 0.0032. Align and Integrate the Responsibilities of top management and functional management and promote their engagement with the IMS (C13) holds the first position within the systematic management category with the highest weight of 0.3332. The process of IMS development is important for the integration and maintenance of business processes based on top management commitment and their engagement with the development of an IMS. Moreover, identifying and working on the Interrelationships Between the Systems (C14) holds the second position within the category receiving a weight of 0.3269. The difference between C13 and C14 weights observed as low 0.0063, implying an almost equal contribution and importance in the development of IMS. Identifying and analyzing the factors that play important roles in the integration of IMS enables companies to adopt a systematic management approach that can create synergies and reveal disconnects between systems. The third and fourth sub-criteria within the systematic management and development of IMS is Company Resources (C12) and Stakeholder Needs (C11) which received weights 0.2195 and 0.1204 respectively.

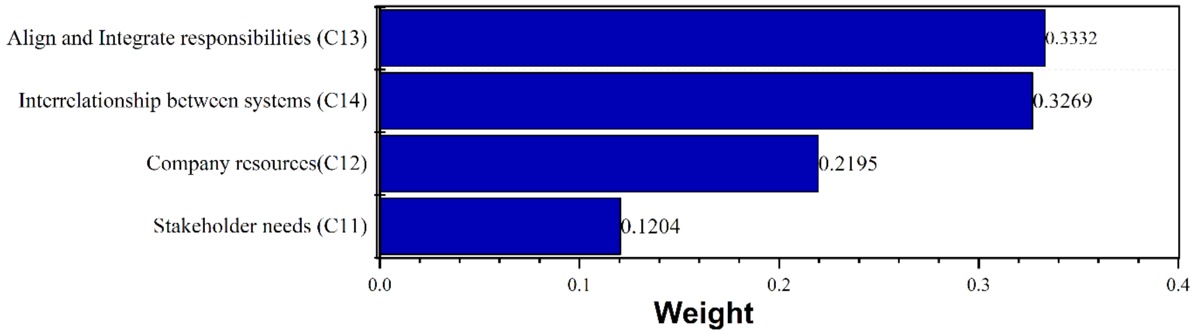

Fig 5. *The ranking of systematic management sub-criteria*

Here we see it necessary for top management in helping to develop a structured approach to meet the need of stakeholders while creating a balanced and effective allocation of resources within the company.

Reduced Bureaucracy: The ranking of sub-criteria with the category is D12>D11>D14>D13. Eliminate Duplication and Inconsistencies between documents, processes, and procedures (D12) obtained highest weight of 0.4970. Next, Reduce Conflicts between documents, processes, and procedures (D11) comes in second with the weight of 0.2840 as presented in Fig. 6. Bureaucratic stability is very important for organization survival by enabling employees to perform their duties. The weights of Standardizing and Simplify Documentation (D14) along with Merge the Documentation (D13) were calculated as 0.1284 and 0.0907, respectively. In order to develop IMS, the Reduced Bureaucracy of management standards is important and enabled through integrating the management procedures, manuals, processes, authorizes, and responsibilities. The effective development of IMS enables the elimination of duplicate documents and makes documentation simpler through merging techniques.

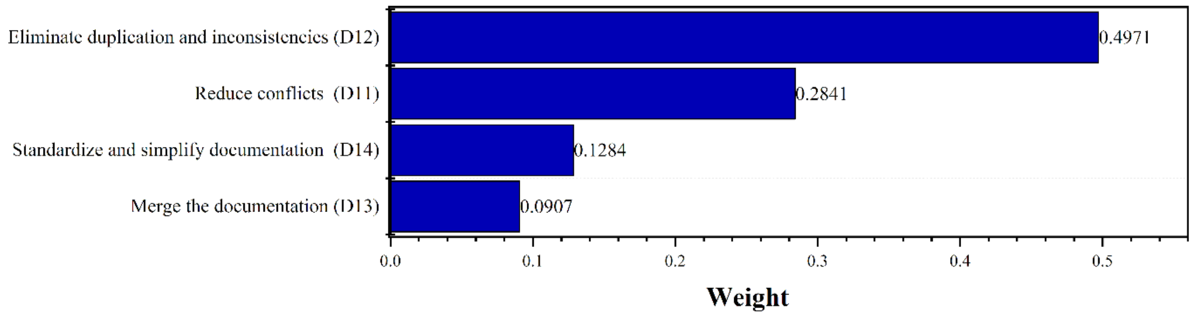

Fig. 6. *The ranking of Reduced Bureaucracy sub-criteria*

Standardization: We know all sub-criteria are important, and are particularly interested in standardization. From the result presented in Fig. 7, the ranking of sub-criteria within the standardization category are as follows E14>E13>E12>E15>E11. The first and highest sub-criteria of standardization is Standardize Terms and Concepts (E14) with a weight of 0.3925. The standardization of IMS connected with a SDCA cycle (standard, Do Check, Act), is a guidance tool helping management to develop a system to improve the effectiveness of IMS. Standardized Processes (E13) ranks second with a weight of 0.2597. Next, Standardize Documentation (E12) holds the third position with a weight of 0.1723. From this we can see the logic of having an organization focus on both practices and processes and with this also encompassing the required documentation for IMS. To overcome the obstacles during the implementation of IMS, the standardization of documentation helps managers to improve the distribution, controlling, and the issuing of requisite documents.

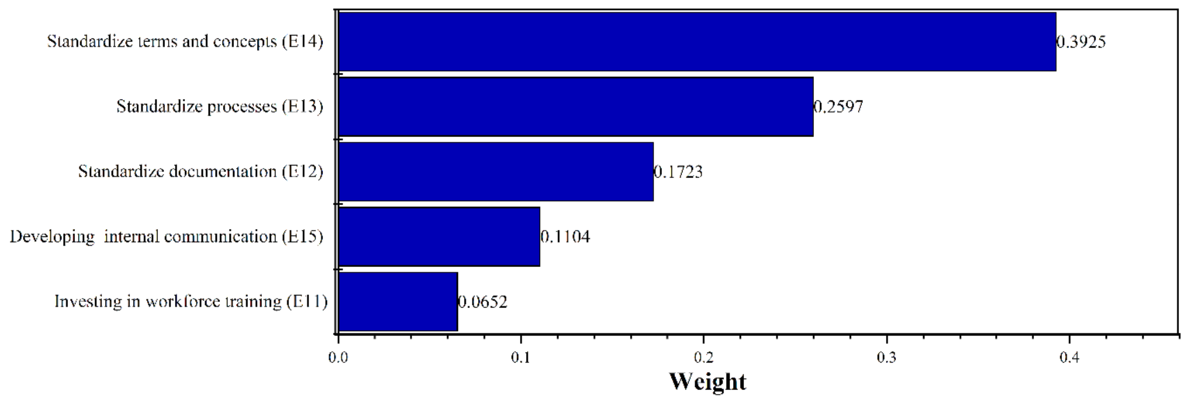

Fig. 7. *The ranking of Standardization sub-criteria*

Finally, Developing mechanisms for Internal Communication (E15) and Investing in Workforce Training (E11) come in with weights of 0.1104 and 0.0652, respectively.

Organizational Learning: under the organizational learning category, the ranking of sub-criteria is F12>F14>F16>F11>F13>F15 presented in Fig 8. Engaging Employees in the process of implementing the IMS (F12) obtained the highest weight and ranked top sub-criteria within the category at 0.3885. Organizational Learning is an important pillar for the development of IMS, which motivates employees to create opportunities for improvements as well as the effective monitoring of the system. Next, the Promotion of Knowledge Sharing at the individual and group level (F14) holds the second position within the category with a weight of 0.2286. Here we can see the implementation of IMS facilitates the creation and sharing of knowledge and can help improve communication in an organization.

The third highest sub-criteria to develop IMS within the category is the development of a capacity for Innovation and Openness to Change (F16) with a weight of 0.1364. The Development of Multipliers and Use of Incentives (F11) is fourth at 0.1230.

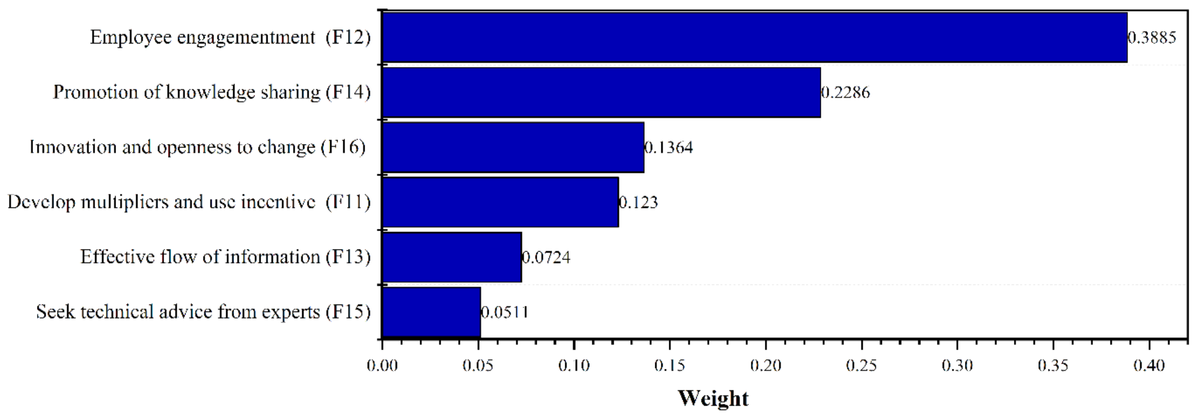

Fig. 8. *The ranking of organization learning sub-criteria*

The final sub-criterion rounding out organizational learning are the establishment of an Effective Flow of Information (F13) and Seeking Technical Advice from Experts (F15) as these are considered less influential with weights of 0.0724 and 0.0511.

4.2 Sub criteria's overall ranking

The final weight of sub-criteria was calculated through multiplying each sub-criteria priority weight by the weight of its respective category. The final weights are presented below in Table 5.

Table 5: Final weights of sub-criteria

Main Criteria's	Main criteria weights	Sub criteria's codes	Consistency Ratio (CR)	Priority weight	Final weight
Integration (Strategic, Tactics and Operational)	0.1735	A11	0.0050	0.3038	0.0527
		A12		0.0954	0.0165
		A13		0.159	0.0766
		A14		0.4418	0.0276
Continuous Improvement	0.0602	B11	0.0071	0.0695	0.0042
		B12		0.4245	0.0256
		B13		0.0937	0.0056
		B14		0.145	0.0087
		B15		0.2673	0.0161
Systematic Management	0.3379	C11	0.0032	0.1204	0.0407
		C12		0.2195	0.0742
		C13		0.3332	0.1126
		C14		0.3269	0.1104
Reduced Bureaucracy	0.0793	D11	0.0001	0.2841	0.0225
		D12		0.4971	0.0394
		D13		0.0907	0.0072
		D14		0.1284	0.0102
Standardization	0.2326	E11	0.0230	0.0652	0.0152
		E12		0.1723	0.0401
		E13		0.2597	0.0604
		E14		0.3925	0.0913
		E15		0.1104	0.0257
Organizational Learning	0.1165	F11	0.0120	0.123	0.0143
		F12		0.3885	0.0453
		F13		0.0724	0.0084
		F14		0.2286	0.0266
		F15		0.0511	0.006
		F16		0.1364	0.0159

The overall ranking of sub criteria's for the development of IMS based on final weights are presented in Fig. 9. The criteria of sub-criteria for IMS is as follows:

C13>C14>E14>A14>C12>E13>E11>F12>C11>E12>D12>A14>F14>E15>B12>D11>A12>B15>F16>E11>F11>D14>B14>F13>D13>F15>B13>B11

For the development of IMS, Align and Integrate the Responsibilities has the highest weight (11.26%) among all sub-criteria followed by the Interrelationship Between Systems (11.04%). Standardize Terms and Concepts and Integrate Systems at the Operational Level are given higher importance with weights of (9.13%) and (7.66%). To round out these results, the last three, and less influential sub-criteria in the development of IMS are Seek Technical Advice from Experts (0.60%), Promote Communication and Interaction with Stakeholders (0.56%), and Integrate the IMS with other programs, management systems and the entire Supply Chain at (0.42%).

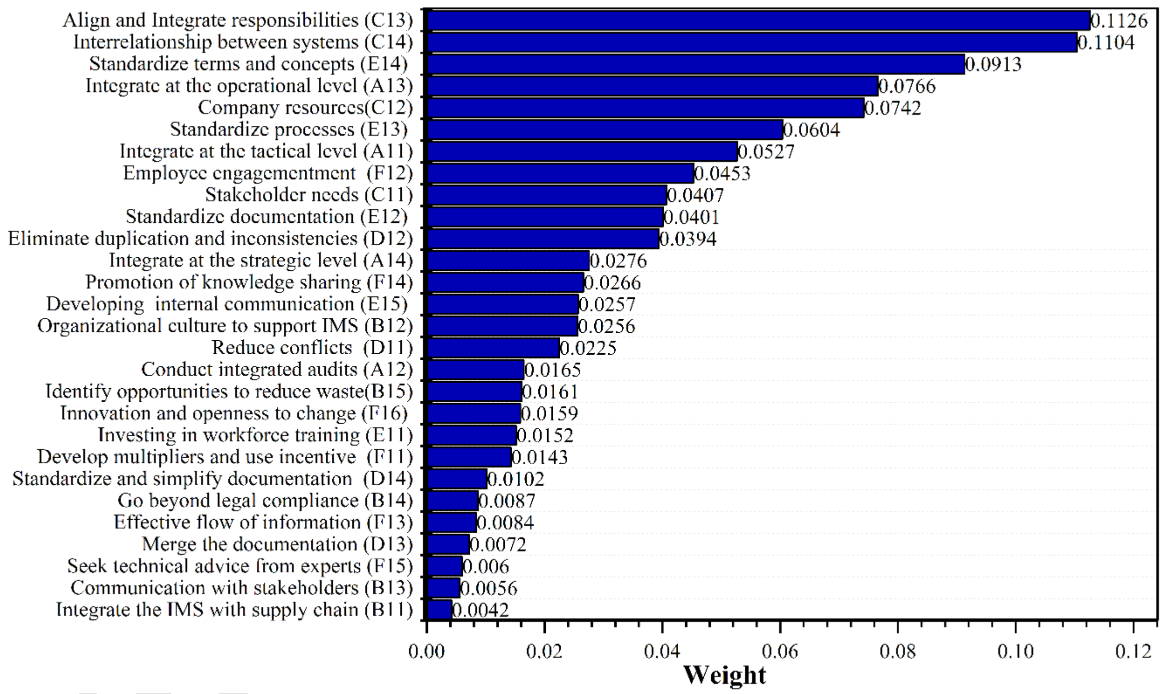

Fig. 9. *The overall ranking of sub-criteria*

4.3. Fuzzy VIKOR results

To expand our insights beyond the analysis of the criterion analysis, we also want to know which management standards are important to develop IMS. In this section, the ranking of three main categories of management standards ISO, GRI, and other standard (EMAS, SA8000, EU Eco-Label, and BSI standards), have been analyzed by employing a fuzzy VIKOR approach. A group of experts provided inputs to this analysis, and we utilized a group decision-making approach to determine the results. The fuzzy decision matrix and weighted normalized decision matrix using a TFNs rating scale have was obtained after the comparison of the alternatives against each sub-criteria. When doing so, we considered all the criteria included in this study as beneficial to a firm when pursuing these types of systems and standards.

In the implementation of F-VIKOR method, the management standards having the lowest Q_i value were prioritized as highly suitable management standards for the development of an integrated management system. The S, R, and Q values are in Table 6. The summary ranking of the alternatives is provided according to the lowest value of Q in Table 7.

Our results recommend the ISO standards (MS-3) as best suited management standards for the development of IMS followed by GRI standards (MS-1) and other standards; EMAS, SA8000, EU Eco-Label and BSI standards (MS-2) respectively. The ordered ranking of different management standards is significant since it has provided the best and less valuable standards for the development of IMS. The ISO standards (MS-3) obtained the highest weight 0.0267, followed by GRI standards (MS-1) and other management standards (MS-2) by obtaining the weights 0.0296 and 0.0730, respectively. While the weighting can help in prioritizing one standard over another, all of these standards can develop IMS. Moreover, all these standards are both popular and widely adopted ensuring business improvement regarding quality and the improvement of sustainable business practices (Souza and Alves 2018).

Table 6: S, R and Q values

Alternative	S_i	R_i	Q_i
GRI standards	0.0885	0.0188	0.0296
Other standards	0.1705	0.0201	0.0730
ISO standards	0.1713	0.0164	0.0267

Table 7. Prioritization of alternatives according to lowest Q values

Alternative	Q_i	Rank
ISO standards	0.0267	1st
GRI standards	0.0296	2nd
Other standards	0.0730	3rd

The AHP and F-VIKOR method has been used effectively and systematically to address important developmental aspects of IMS. The methods applied to this study do not come without limitations as much of the information needed for assessing criteria is qualitative in nature. The values reflect the belief structure of those involved in this study. While we had a diverse group of experts, and we believe our results are generalizable, any firm can make this a more customizable approach to the selection and implantation of systems by including their own stakeholders and managers from across all business functions when assessing criteria.

The results of this study are enabled by the research framework, experts' feedback, and builds on related work in the field. Therefore, this study can help managers, along with industries and policymakers in the selection of feasible management standards to develop resilient (Finnegan and Currie 2010), integrated management systems across an organization and supply chains.

5. Conclusions

The objective of this study to identify and prioritize the important criteria as to the degree to which they help with the development of an integrated management system. We build on the findings of prior studies showing interconnected relationships of management systems and the importance of including stakeholders (Souza and Alves 2018). Numerous guiding criteria were identified from the literature, and we built off of prior work in the field and identified criteria with the help of experts. To this end, twenty-eight guiding principles were assessed and prioritized under the main six categories of Integration (at the Strategic, Tactics, and Operational levels), Continuous Improvement, Systematic Management, Reduced Bureaucracy, Standardization, and Organizational Learning. In this study, the AHP method helped determining the six main criteria and 28 sub-criteria weights obtained from the additional input of various experts' through the pairwise comparison process and resulting matrix.

Limitations include the models developed with the help of experts, and in choosing this approach, there will always be some bias in the process. Future use of the approach used in this study can include more diverse experts, and managers more focused on functions within a firms most impacted by systems implementation and integration. There is also a limitation related to the availability of data. Managers involved in a MCDA process will have limited access to data across all criteria or an entire large multinational organization as the reason for developing these systems can stem from a lack of integrated information. Resolving these issues will require careful consideration by practitioners as to who is involved in the decision analysis process and why, and realize that the inputs are qualitative in nature and doing this analysis only one time, is a great place to start, but a tragic place to stop as the analysis, criteria, and outcomes should be revisited to assess performance of the IMS over time and as part of the auditing of systems and stakeholders engagement.

Contributions of this study start with the AHP results. They reveal that Systematic Management, Standardization, and Integration are the top-ranked criteria for managers and decision-makers to focus on. Whereas, Align and Integrate the Responsibilities and authorities, Identification and Work on the Interrelationships Between the Systems and Standardize Terms and Concepts have emerged as the top-ranked sub-criteria of the study respectively. Additional insights and contributions to the field are extended with the additional application of a Fuzzy based VIKOR method assessment. This helps to extend our prior findings to prioritize the three highest ranked and most adaptable management standards alternatives while also enhancing and validating the consistency of the overall results. According to the F-VIKOR analysis, ISO management standards are the most suitable standards for the development of IMS, followed by GRI and then other management standards. The results of this study should be a call to action for decision-makers and policy advocates in that IMS can provide a dynamic integration opportunity with dynamic benefits. As shown in this study, scholars can develop important criteria from the literature, build on this prior work while combining insight from experts in the field to now develop a new understanding of systems and their integration, while also contributing to the development of theory with contemporary approaches to decision analysis. To this end, the results of this study provide insights other scholars can use to further develop theory involving multiple management standards (MMSs), stakeholder theory (Freeman, 1984) along with integrated management systems (IMS), their implementation, barriers, and how to help ensure their success. The methods used in this study provide a powerful yet relatively simple method for making decisions. This useful approach should be of interest to both practitioners, policymakers, and researchers for resource allocation, project prioritization and selection. The methods used in this study provide a path toward further replication of similar studies and allows for the capture of strategic goals as a set of weighted criteria that you then use to select projects and inform change management. Multi criterion decision-making methodologies have been used successfully in various applications and industrial sectors. There should be more emphasis of MCDA on interdisciplinary and social decision problems due to their complex nature. Future studies can and should be developed as AHP techniques are combined with other techniques and help integrate systems, supply chains, cities, and countries as we prioritize goals such as the United Nations seventeen sustainable development goals (SDGs).

It should be comforting for managers to know that standards are already in place to help with implementation and integration processes. Systems are great enablers of change, measurement, management, and the reporting of performance. The guiding principles and criteria uncovered in this study can help save time and improve impacts for practitioners while also providing the start to a new area of research from scholars. It is also good to know that both quality and environmental management systems can and should be integrated so that firms can find more dynamic benefits that can even extend into supply chains.

This study is significant and a first of its kind, considering the development of IMS, which can help to realize the most suitable management standards for systematic sustainable development and global reporting of company practices and the systems that measure, manage, and report on these activities. Managerial implications include but are not limited to IMSs enabling organizations to conduct integrated audits, engage employees, assessments, and to optimize processes and resources. When managers integrate systems, it can help reduce the time it takes to conduct transactions, perform activities, reduce interruption, while reducing costs.

When systems become part of integrated management, they help to enable a proven strategic planning approach to uncover the tools and actions available for change management and performance metrics that can include sustainability (Sroufe, 2018). Future research calls for the integration of more criteria and sub-criteria as this integration trend is not going away. With only six guiding principles and twenty-eight sub-criteria employed from the available literature; the number of criteria can be expanded by taking into account the other associated management system parameters and goals. Various other MCDM techniques can also be utilized in future work to compare and contrast results, find new insights and extend this study. Finally, this study can be further refined and extended to explore the barriers for implementation of integrated management standards and extensions to capturing the United Nation's Sustainable Development Goals (SDGs).

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Appendix-A

1. Pairwise comparisons matrix of Integration sub criteria

	A11	A12	A13	A14	Priority	Rank
A11	1.0000	2.7663	2.0000	0.7579	0.3038	2nd
A12	0.3615	1.0000	0.5296	0.2091	0.0954	4th
A13	0.5000	1.8882	1.0000	0.3333	0.1590	3rd
A14	1.3195	4.7818	3.0000	1.0000	0.4418	1st

2. Pairwise comparisons matrix of the sub-criteria of Continuous Improvement

	B11	B12	B13	B14	B15	Priority Weight	Rank
B11	1.0000	0.1803	0.7579	0.3615	0.2971	0.0695	5th
B12	5.5467	1.0000	4.5731	3.1777	1.6438	0.4245	1st
B13	1.3195	0.2187	1.0000	0.7579	0.3147	0.0937	4th
B14	2.7663	0.3147	1.3195	1.0000	0.5000	0.1450	3rd
B15	3.3659	0.6084	3.1777	2.0000	1.0000	0.2673	2nd

3. Pairwise comparisons matrix Systematic Management sub criteria

	C11	C12	C13	C14	Priority Weight	Rank
C11	1.0000	0.5743	0.3540	0.3615	0.1204	4th
C12	1.7411	1.0000	0.6084	0.7579	0.2195	3rd
C13	2.8252	1.6438	1.0000	0.9221	0.3332	1st
C14	2.7663	1.3195	1.0845	1.0000	0.3269	2nd

4. Pairwise comparisons matrix of Reduced Bureaucracy sub criteria

	D11	D12	D13	D14	Priority Weight	Rank
D11	1.0000	0.5610	3.1777	2.2206	0.2840	2nd
D12	1.7826	1.0000	5.3481	3.8981	0.4970	1st
D13	0.3147	0.1870	1.0000	0.6988	0.0907	4th
D14	0.4503	0.2565	1.4310	1.0000	0.1284	3rd

5. Pairwise comparisons matrix of the sub-criteria of Standardization

	E11	E12	E13	E14	E15	Priority Weight	Rank
E11	1.0000	0.3615	0.2971	0.1748	0.5296	0.0652	5th
E12	2.7663	1.0000	1.0000	0.3147	1.2457	0.1723	3rd
E13	3.3659	1.0000	1.0000	0.8706	3.0000	0.2597	2nd
E14	5.7203	3.1777	1.1487	1.0000	3.6801	0.3925	1st
E15	1.8882	0.8027	0.3333	0.2717	1.0000	0.1104	4th

6. Pairwise comparisons matrix of Organizational Learning

	F11	F12	F13	F14	F15	F16	Priority Weight	Rank
F11	1.0000	0.3010	1.6438	0.4152	3.0000	1.0000	0.1230	4th
F12	3.3227	1.0000	4.8287	2.3522	5.6738	3.0000	0.3885	1st
F13	0.6084	0.2071	1.0000	0.3147	1.5157	0.4503	0.0724	5th
F14	2.4082	0.4251	3.1777	1.0000	3.9487	2.0477	0.2286	2nd
F15	0.3333	0.1762	0.6598	0.2532	1.0000	0.3147	0.0511	6th
F16	1.0000	0.3333	2.2206	0.4884	3.1777	1.0000	0.1364	3rd