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Sustainability Service Chain Capabilities in the Oil and Gas Industry: A Fuzzy Hybrid Approach SWARA-MABAC

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ABSTRACT

This study aims to redefine the capabilities of the service supply chain in the Iranian oil and gas industry, where the concept of service chains has remained underdeveloped due to a traditional focus on conventional service chains. It seeks to compare the capabilities of the oil and gas service supply chain to those in other sectors and explore whether applied research is necessary to improve service chain performance. The study was conducted in three stages, involving ten petroleum and natural gas experts. The first stage focused on identifying key capabilities, yielding seven significant capabilities and 28 critical sub-capabilities. In the second stage, the SWARA fuzzy hybrid approach was employed to weigh and prioritize these capabilities, while the fuzzy MABAC methodology was used for strategic decision-making. Finally, the model's sensitivity was assessed using fuzzy methods to validate the findings. The results highlight the highest priority capability for service providers: the ability to utilize information for updating information processing capacity in making decisions within the service supply chain. The selected location, G1, emerged as a key area of focus. This approach presents a novel method for optimizing service supply chain locations within the oil and gas sector. This paper introduces a unique approach to selecting optimal service supply chain locations in the oil and gas industry, addressing critical gaps in previous research. Employing advanced fuzzy hybrid methodologies provides valuable insights into improving service chain capabilities, offering a competitive advantage for companies operating in this sector.

1. Introduction

Services can be defined as economic activities that produce intangible benefits such as convenience (time, place, shape) and psychological satisfaction [1]. The service sector has been a vital driver of economic development in developed countries [2]. According to the data provided by the World Bank, the service sector contributes more than 60% of GDP every year in the world over the period 1995-2022. In advanced economies like the United States, the service industry contributes

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up to 90% of the national income, and recent studies reveal its rapid growth even in developing countries like the BRICS nations [3]. Despite this growth, services still lag behind production in terms of excellence and performance. Successful manufacturing organizations typically integrate the supply, manufacturing, and delivery of their core products through effective information systems [4]. Zhao *et al.,* [5] suggest that manufacturers should focus on integrating business models with services. In the field of service supply chains, creating new resources to support a service-oriented approach is a complex process. Applying capabilities through internal and external interactions, knowledge development, and skill enhancement is crucial for this approach. Thus, organizations can strengthen their supply chains by incorporating a network of service-related capabilities [6].

The substantial growth of the global service sector over the past five decades necessitates innovation and efficient service delivery to support the global economy [7]. The emergence of a modern service industry aligns with the development of a service supply chain, which involves closer interaction between customers and suppliers [8]. While there are established research topics in service marketing and operations management [9], few studies explore how service providers can enhance value through process integration beyond their organizational boundaries. The complexity of developing standard service models and designing delivery processes might contribute to the limited research in this area. From a company and organizational perspective, the lack of centralized management of required services within companies could explain the absence of a formal approach to service supply chain management [10]. Some researchers have found that service companies often provide services within chains rather than independently, highlighting the significance of a supply chain centered around services.

This study aims to identify oil and gas service chain capabilities using fuzzy SWARA-MABAC methods. Given the uncertain operating environment of the Oil and Gas (O&G) industry, these Multi-Criteria Decision Making (MCDM) methods prioritize service chain capacity. The oil and gas industry significantly contributes to a country's revenue, enabling infrastructure development in sectors like education, healthcare, and IT. Various studies have addressed O&G matters such as supplier selection [11-13], contract selection and construction [14]. Among these topics, service chain capabilities in the oil and gas sector emerge as a critical yet relatively unexplored area. This study addresses this gap by evaluating the Supply Chain Management (SCM) service capability within the O&G industry. Consequently, this study addresses crucial questions: which supply chain capability should be given the highest priority in the O&G industry in Iran? Among the countries used in the current study, which one has the highest rank in terms of the supply chain capabilities?

The paper comprises five sections. Following the introduction, the second section showcases the paper's contribution, research questions, and background. Section two encompasses a comprehensive literature review, contextualizing the research topic. The third section outlines the research methodology, including methods, research procedures, and influential factors. Section four employs the methods detailed in section three, alongside sensitivity analysis, to analyze the data. Lastly, section five presents a comprehensive discussion and conclusion, encapsulating the key insights of the paper.

2. Literature review

2.1 Contextual Setting

Due to technological advancements, modern companies have ample opportunities to efficiently manage their operations within complex supply chains, even in sectors as intricate as O&G, ensuring comprehensive consideration of all processes during supply chain decision-making [15]. The Iranian government aims to achieve self-sufficiency and localization in its O&G industry, providing a fertile ground for companies to cultivate and effectively apply knowledge in their operations. This proactive approach enhances the industry's understanding and expertise among experts and managers. Throughout supply chain history, ownership concentration has been a recurring trend. "High-tech" operations are often segregated from "non-high-tech" operations, while "high-capital management operations" are commonly managed distinctly from "labor-intensive" operations in traditional contexts. Companies frequently segregate large-scale operations that offer standardized products and services from small-scale operations catering to customized offerings, reflecting a practice observed across the manufacturing sector. From an operational standpoint, qualitative homogeneity among customers and products is preferable for a company. This practice ensures operational efficiency and cohesion, benefiting both the company and its clients.

2.2 Service Supply Chain and Oil and Gas Research

In a study conducted by Boon-Itt *et al.,* [16], the authors evaluated the capabilities of the service supply chain management process. The study involved developing and validating a measurement scale for Service Supply Chain Management (SSCM) process capability constructs. The Q-sort method and confirmatory factor analysis were used to analyze the results. Using Structural Equation Modelling (SEM) and partial least square (PLS), Saleh *et al.,* [17] investigated the relationship between supply chain components, capabilities, and performance. Their study indicated that a company's supply chain capabilities played a significant mediating role between components and supply chain performance. Elgazzar and Elzarka [18] developed a service supply chain model through an analysis of the Egyptian service industry. Findings highlighted the distinction between the service and manufacturing sectors, leading to challenges in quantifiable service quality assessment and SSC comparisons. This paper's framework offers a practical, quantifiable tool for Service Supply Chain (SSC) performance measurement. Studies consistently demonstrate that sustainable supply chain management, dynamic capabilities, and sustainable business management positively influence business sustainability. Nürk [19] examined smart business and SCM, identifying key concepts to reduce SC complexity and increase agility while optimizing business performance and objectives. The study suggests that Industry 4.0 innovations, including Smart Services and block chain technology, hold potential for increased autonomy and cross-organizational network effects within SC ecosystems. Kareem *et al.,* [20] examined dynamic capabilities within the supply chain in relation to operational performance. Their study included 208 manufacturers in the sample and applied SEM to model their products. Empirical results demonstrated significant and positive correlations between supply chain dynamic capabilities (collaboration, agility, and responsiveness) and operational performance. However, integration capability appeared to have no significant impact on operational performance. The summary of the studies is presented in Table 1.

Table 1
Research related to oil and gas and service supply chain

Author/s	Method
[16]	Q-sort
[17]	structural equation modeling
[20]	structural equation modeling SEM
[21]	Rough ANP-TOPSIS
[22]	IFDEMATEL-ANP-SAW
This study	Fuzzy SWARA-MABAC

2.3 Service Supply Chain - Capabilities and Background

In Table 2, the key research in the realm of service supply chain and its associated capabilities has been outlined.

Table 2
Research related to service supply chain and capabilities

Title	Authors	Suggested capabilities	Method
Performance evaluation of professional service supply chain based upon DEA & AHP models	[23]	1. Cooperative (joint) performance 2. Operational performance of the service 3. Customer satisfaction/service performance	DEA & AHP
Measuring Service Supply Chain Management Processes the Application of the Q-Sort Technique	[16]	1. Demand management 2. Capacity and resource management 3. Customer relationship management 4. Management of communication with non-contributors 5. Order process management 6. Service performance management 7.Technology and information management	Q-Sort
Port Service Supply Chain Performance Evaluation based on GRA	[24]	1. Customer satisfaction 2. Financial conditions 3. Cost conditions 4. Joint development	Entropy/ GRA
A framework for measuring the performance of service supply chain management	[25]	1. Performance of the service supply chain 2. Customer service 3. Company management	FAHP
Performance Indicators in a Service Supply Chain	[26]	1. Demand management 2. Capacity and resource management 3. Customer relationship management 4. Managing the relationship with the supplier 5. Order process management 6. Service performance management 7. Technology and information management 8. Financial affairs of the service supply chain	Classification in terms of input or output variables in the service supply chain
Evaluation of Service Supply Chain Performance Criteria with DANP Method	[27]	1. Service supply chain operations 2. Customer service 3. Company management	DANP

Title	Authors	Suggested capabilities	Method
Service supply chain environmental performance evaluation using grey based hybrid MCDM approach	[28]	1. Participation and commitment of shareholders 2. Adoption of green technologies and methods 3. Preference for using environmentally friendly materials 4. Green cooperation 5. Compliance with regulations 6. Training and participation of employees 7. Recycling, reuse and disposal 8. Green image	ELECTRE and VIKOR
Service supply chain management process capabilities: Measurement development	[16]	1. Capability of the relationship management process with the supplier 2. Service performance management process capability 3. Technology and information management process capability 4. Service order management process capability 5. Capability of customer relationship management process 6. Demand management process capability 7. Resource management process capability	Quick Sort
Supply chain management in the service sector: an applied framework	[18]	1. Information flow management 2. Customer relationship management 3. Management of communication with non-suppliers 4. Demand management 5. Service delivery management 6. Cash flow management 7. Capacity and skill management 8. Knowledge management 9. Risk management	Review of previous researches
A framework for evaluating the performance of sustainable service supply chain management under uncertainty	[29]	1. Environmentally conscious design 2. Designing environmental service operations 3. Environmentally sustainable design	F.Delphi & ANP

2.4. Service supply chain capabilities

Several efforts have been made by researchers to identify service supply chain management capabilities [30]. These efforts have led to the identification of seven main dimensions for understanding service supply chain capabilities:

i. Demand Management (DM):

Managing service delivery is challenging due to heterogeneous and volatile demand, alongside the intangible nature of services. The demand management process involves balancing customer demand using current information for accurate forecasting and service delivery, aiming for customer satisfaction and efficient service [31].

ii. Capacity and Resource Management Process Capability (CAP):

Service capacity refers to the maximum output in a given timeframe with predefined resources. Due to heterogeneous demand and simultaneous production-consumption of services, firms must continually update capacity and resource information. CAP encompasses aspects like service capacity planning, workforce and customer scheduling, as well as facilities and equipment management, ensuring optimal resource utilization [5].

iii. Customer Relationship Management Process Capability (CRM):

Effective customer communication aids in understanding individual needs. Given diverse customer demands, understanding their needs is crucial for demand and capacity management, fostering loyalty and retention. CRM involves maintaining long-term customer relationships through information systems and understanding customer needs, enhancing satisfaction at various levels [32].

iv. Supplier Relationship Management Process Capability (SRM):

SRM entails developing and maintaining long-term relationships with suppliers, vital for strategic goals and competitiveness. It serves as a platform for service companies to interact with suppliers, especially for supply chain and logistics service providers, supporting planning and coordination across various domains [33].

v. Order Process Management Process Capability (OPM):

Distinct from manufacturing, service orders are placed after the customer's request. OPM includes order processing, status checking, and customer communication, requiring detailed customer understanding due to non-standardized service needs [30].

vi. Service Performance Management Process Capability (SPM):

SPM involves managing and enhancing service processes to align performance with expectations. Although service delivery and performance are interconnected, some differentiate them, considering SPM's role in improving service quality and enhancing customer satisfaction [34].

vii. Information and Technology Management Process Capability (ITM):

Information flow management is crucial for identifying demand, sharing information, and reducing uncertainty. Information technology aids in processing information, reducing decision-makers' uncertainty , covering the service industry's inherent uncertainty through adequate processing capabilities [35].

3. Research Methodology

To enhance efficiency and competition in the oil and gas industry, this study aims to identify and prioritize service supply chain capabilities that can contribute to improved efficiency and competitiveness within the sector. Various methods (Figure 1) have been employed to describe the phenomena and conditions under study. Descriptive research is utilized to either provide decision-making support or explain the current situation. For the execution of this research, ten specialists were selected using a simple sampling method, as the subject's specialization and the challenge of identifying experts in this field necessitated such an approach. Further detailed information about the study can be found in Figure 1 below.

While numerous MCDM methods exist worldwide, each possesses specific advantages and disadvantages. Fuzzy Numbers: In this dynamic world, decision-making is challenging due to evolving situations. Consequently, decision makers struggle to convey their preferences using precise data. Fuzzy numbers aid decision makers in expressing their inclinations within uncertain environments.
FMABAC: This method relies on elementary mathematics for computation, rendering a comprehensive and ultimately more reliable outcome.

FSWARA: SWARA is a general tool employed for calculating criteria weights within the realm of performance measurement and the corresponding importance levels. It stands out as one of the few

MCDA methods based on a rational dispute resolution approach. Similar to other MCDA methods, experts also play a crucial role in providing decision-making inputs.

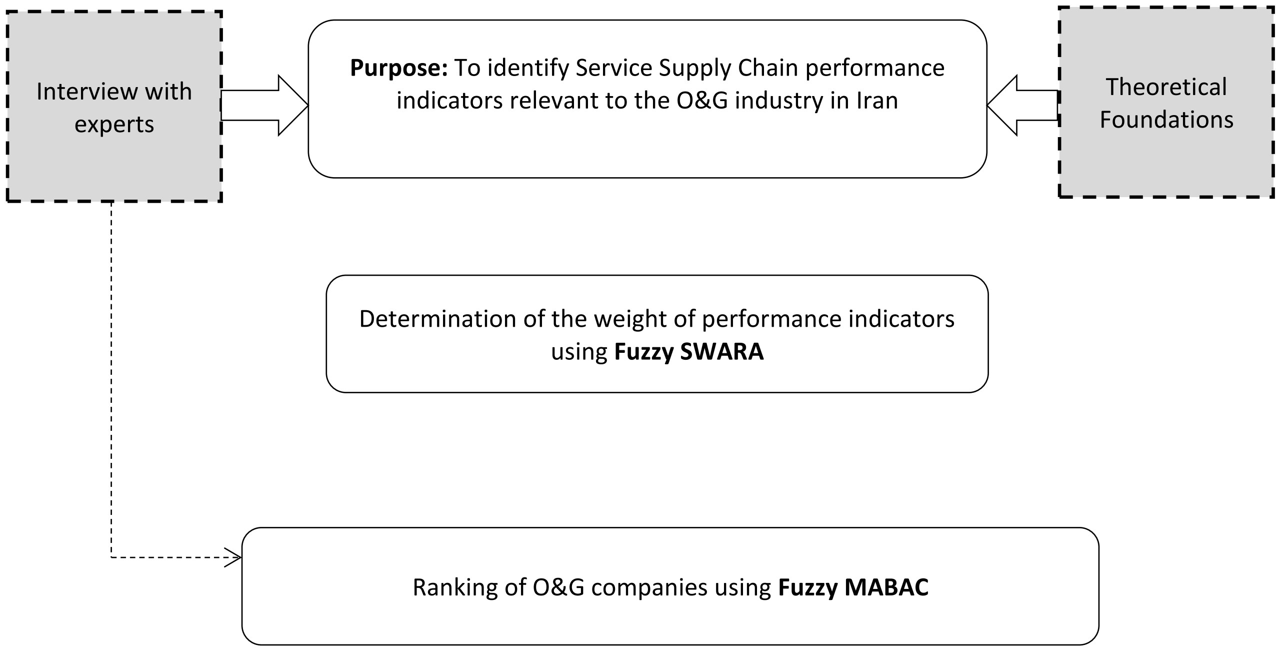

Fig. 1. Research procedure

3.1. Fuzzy SWARA

There is a need to weigh indicators to address multi-indicator decision-making challenges [36]. As a result of this effort, SWARA, or Step Weighted Average Ratio Analysis, has emerged as a significant method for indicator weighting [37]. In comparison to other techniques, SWARA offers several advantages: it evaluates expert opinion accuracy on weight indicators, is straightforward to compute, and necessitates fewer indicator comparisons. Furthermore, SWARA offers more accurate results for multi-criteria decision-making than alternative [15]. For instance, the SWARA method can be employed to gauge the satisfaction of the target market for tourist services.

Numerous factors contribute to inaccurate decision-making, including inadequate, incomplete, or inaccessible information. To address these challenges, fuzzy multi-criteria decision methods were developed to handle inaccuracies in assessing indicator importance and ranking alternative performance based on these indicators. The following steps were taken to weigh indicators using the fuzzy approach:

Step 1: The indicators were categorized according to their importance. After a set of indicators has been categorized, experts then rank the definition of each criterion in terms of importance. In the provided example, the most important value is assigned the top rank, the least important value receives the lowest rank, and the remaining values are ranked in between these two extremes. Table 3 illustrates the importance of indicators using fuzzy scaling, which is used for assessing the significance of indicators [38]. It is essential to calculate the relative weights of variables ($\tilde{S}j$) based on the second-order criterion, i.e., the extent to which the criterion c_j is more critical than criterion $\tilde{C}_j$+ 1.

Table 3
Linguistics variable [39]

Linguistic term	Fuzzy number
Equally important	(1,1,1)
Moderately less important	(2/3,1,3/2)
Less important	(3/2,2/1,5/2)
Very less important	(5/2,3/1,7/2)
Much less important	(7/2,4/1,9/2)

Step 2: Calculate the relative weights' importance ($\tilde{S}$j) based on the mean value. To assess the significance of the second-ranked criterion, it is essential to identify the criterion, $\tilde{c}_j + 1$, which is most significant among the c_j criterion.

Step 3: We calculate the coefficient K_j as follows:

$$\tilde{K}_j = \begin{cases} 1 & j = 1 \\ \tilde{S}_{j+1} & j > 1 \end{cases} \tag{1}$$

Step 4: The recalculated weight measurement ($\tilde{q}_j$) is given by:

$$\tilde{q}_j = \begin{cases} 1 & j = 1 \\ \frac{\tilde{q}_{j-1}}{\tilde{K}_j} & j > 1 \end{cases} \tag{2}$$

Step 5:. Calculate the values of the criteria weights ($\widetilde{W}$) so that their sum equals one:

$$\widetilde{W}_j = \frac{\tilde{q}_j}{\sum_{k=1}^{m} \tilde{q}_j} \tag{3}$$

Where w_j represents the relative weight of the criteria.

Step 6: Convert the weights related to the relative fuzzy significance into the non-fuzzy method (definite number) based on the surface center (COA) method:

$$W_j^{non} = \frac{\left(w_j^u - w_j^l\right) + \left(w_j^m - w_j^l\right) + \left(w_j^l\right)}{3} \tag{4}$$

A higher value corresponds to a higher rank.

3.2. Fuzzy MABAC approach

Several multi-criteria decision techniques exist, and among them, the MABAC method stands out as one of the most recent and widely used methods. This approach employs a multi-criteria decision model to rank options based on various factors. According to Pamucar and Cirovic in their 2015 article [40], they originally developed this method. The MABAC method offers several advantages, notably its simplicity in mathematical calculations, which generates stable results based on a straightforward mathematical approach. Due to its consideration of potential profit and loss values, this method provides the necessary insights to achieve optimal outcomes. Additionally, the MABAC method can be combined with other approaches to further enhance the quality of results. Consequently, it can be deduced that MABAC proves itself as a valuable prioritization tool, aptly catering to the needs of business leaders. The following steps can be followed to address this problem effectively.

Step 1: Definition of the initial decision matrix (X): where j represents the number of options, and i denotes the number of possibilities, specifying the total number of criteria. X represents the preference of DM.

$$\tilde{X} = \begin{bmatrix} \tilde{X}_{11} & \cdots & \tilde{X}_{1j} \\ \vdots & \ddots & \vdots \\ \tilde{X}_{i1} & \cdots & \tilde{X}_{ij} \end{bmatrix} \tag{5}$$

Step 2: Normalization of the primary decision matrix N :(Normal decision matrix(N) is obtained using the following expressions:

$$\tilde{N} = \begin{bmatrix} \tilde{t}_{11} & \cdots & \tilde{t}_{1j} \\ \vdots & \ddots & \vdots \\ \tilde{t}_{i1} & \cdots & \tilde{t}_{ij} \end{bmatrix} \tag{6}$$

For profit-type criteria:

$$\tilde{t}_{ij} = \frac{\tilde{x}_{ij} - \tilde{x}_i^-}{\tilde{x}_i^+ - \tilde{x}_i^-} \tag{7}$$

For cost type criteria:

$$\tilde{t}_{ij} = \frac{\tilde{x}_{ij} - \tilde{x}_i^+}{\tilde{x}_i^- - \tilde{x}_i^+} \tag{8}$$

where $\tilde{x}_{ij}$, $\tilde{x}^+$, $\tilde{x}^-$ represent the elements of the decision start matrix (x) and values $\tilde{x}^+$, $\tilde{x}^-$ are calculated as follows:

$\tilde{X}_i^+ = MAX\ (\tilde{x}_1, \tilde{x}_2 \ldots \tilde{x}_n)$ and represents the values of the maximum criteria observed by the other options.

$\tilde{X}_i^- = MIN\ (\tilde{x}_1, \tilde{x}_2 \ldots \tilde{x}_m)$ and represents the minimum values of the criteria observed by the other option.

t_{ij} shows the normalized value of x_{ij}

Step 3: The weight matrix elements ($\tilde{V}$) are calculated.

The following equations are used to calculate the element of the weight matrix ($\tilde{V}$):

$$\tilde{V}_{ij} = \tilde{W}_i \times \tilde{t}_{ij} + \tilde{W}_i \tag{9}$$

In the example above, t_{ij} denotes the elements of the normal matrix (N), and w_i denotes the weight coefficients of the criteria. Using the above equation, we can determine the matrix V.

$$\tilde{V} = \begin{bmatrix} \tilde{V}_{11} & \cdots & \tilde{V}_{1n} \\ \vdots & \ddots & \vdots \\ \tilde{V}_{m1} & \cdots & \tilde{V}_{mn} \end{bmatrix} = \begin{bmatrix} \tilde{W}_1 \times \tilde{t}_{11} + \tilde{W}_1 & \cdots & \tilde{W}_n \times \tilde{t}_{1n} + \tilde{W}_n \\ \vdots & \ddots & \vdots \\ \tilde{W}_1 \times \tilde{t}_{m1} + \tilde{W}_1 & \cdots & \tilde{W}_n \times \tilde{t}_{mn} + \tilde{W}_n \end{bmatrix} \tag{10}$$

where n is the total number of criteria and m is the total number of options.

Step 4: Calculation of the approximate boundary area matrix ($\tilde{G}$).

The approximate area of the boundary is determined for each criterion as follows:

$$\tilde{g}_i = \left(\prod_{j=1}^{m} \tilde{V}_{ij}\right)^{1/m} \tag{11}$$

$\tilde{V}ij$ represents the weight matrix elements ($\tilde{V}$), and m represents the number of alternatives (m).

Once gi is calculated, the matrix of approximate boundary ranges is calculated based on the criteria of G and is in the format Nx1 (n represents the number of criteria selected for the options presented).

$$\tilde{G} = [\tilde{g}_1, \tilde{g}_2 \ldots\ldots \tilde{g}_n] \tag{12}$$

Step 5: Calculate the alternative distance matrix element for the approximate boundary range ($\tilde{Q}$)

$$\tilde{Q} = \begin{bmatrix} \tilde{q}_{11} & \cdots & \tilde{q}_{1n} \\ \vdots & \ddots & \vdots \\ \tilde{q}_{m1} & \cdots & \tilde{q}_{mn} \end{bmatrix} \tag{13}$$

To determine the distance between the alternatives from the approximate boundary region ($\tilde{q}_{ij}$), the difference between the elements of the weight matrix ($\tilde{V}$) and the boundary values of the approximate regions ($\tilde{G}$) is taken into account.

$$\tilde{Q} = \tilde{V} - \tilde{G} = \begin{bmatrix} \tilde{V}_{11} & \cdots & \tilde{V}_{1n} \\ \vdots & \ddots & \vdots \\ \tilde{V}_{m1} & \cdots & \tilde{V}_{mn} \end{bmatrix} - [\tilde{g}_1, \tilde{g}_2 \ldots\ldots \tilde{g}_n] \tag{14}$$

$$\tilde{Q} = \begin{bmatrix} \tilde{V}_{11} - \tilde{g}_1 & \cdots & \tilde{V}_{1n} - \tilde{g}_n \\ \vdots & \ddots & \vdots \\ \tilde{V}_{m1} - \tilde{g}_1 & \cdots & \tilde{V}_{mn} - \tilde{g}_n \end{bmatrix} = \begin{bmatrix} \tilde{q}_{11} & \cdots & \tilde{q}_{1n} \\ \vdots & \ddots & \vdots \\ \tilde{q}_{m1} & \cdots & \tilde{q}_{mn} \end{bmatrix}$$

The variable *gi* represents the approximate boundary areas for the criterion $\tilde{C}_i$, the variable $\tilde{V}_{ij}$ represents the heavier matrix elements ($\tilde{V}$), n represents the number of criteria, and m represents the number of options. A_i may refer to an approximate area of the border ($\tilde{G}$), an approximate area above the border ($\tilde{G}^+$) or an approximate area below the border ($\tilde{G}^-$). In other words, $\tilde{A}_i = \{\tilde{G} \vee \tilde{G}^+ \vee \tilde{G}^-\}$. A_i ,G^+ indicates the area in which the ideal option ($\tilde{A}^+$) is located, while $\tilde{G}^-$ indicates the area in which the counter-ideal alternative ($\tilde{A}^-$) is located within it (Figure 2).

The dependence of *Ai* on the option to the approximate region ($\tilde{G}$, $\tilde{G}^+$*or* $\tilde{G}^-$) is determined based on the following equation:

$$\tilde{A}_i \epsilon \begin{cases} \tilde{G}^+ & if \quad \tilde{q}_{ij} > \tilde{g}_i \\ \tilde{G} & if \quad \tilde{q}_{ij} = \tilde{g}_i \\ \tilde{G}^- & if \quad \tilde{q}_{ij} < \tilde{g}_i \end{cases} \tag{15}$$

Consequently, for the Ai option to be selected as the best choice from a given set, it must belong to the approximate upper field ($\tilde{G}^+$) to the greatest extent possible. For example, imagine consider an Ai option with 5 upper approximate criteria (out of 6 criteria), along with one approximate lower criterion ($\tilde{G}^-$). In this scenario, this option is nearly or equally close to the ideal for 5 criteria, and nearly or equally close to the counter-ideal for the remaining criterion. Specifically, if the value of $\tilde{q}ij>0$ (i.e. $\tilde{q}ij$ is above or equal to the upper approximate area ($\tilde{G}^+$), the option is closely aligned with or equal to the ideal option. Conversely, if the value of $\tilde{q}_{ij}$ is 0 (i.e. $\tilde{q}_{ij}$ is below or equal to the lower approximate area ($\tilde{G}^-$), then the option $\tilde{A}_i$ is closely aligned with or equal to the anti-ideal option.

Step 6: Rank the options.

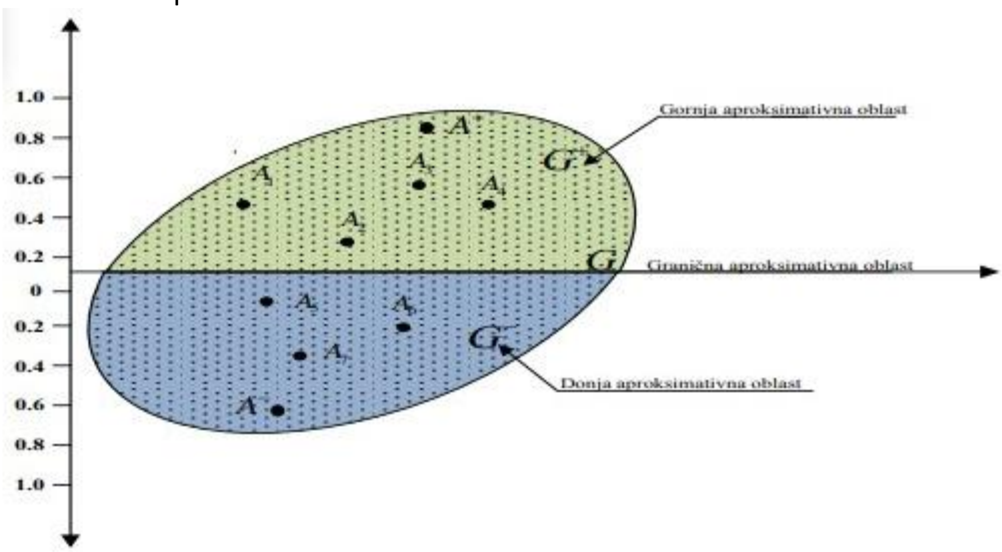

Fig. 2. MABAC Method

We calculate the value of the criterion functions based on the alternatives by summing the distances between the alternative options and the boundaries of the approximation range. To compute the final values of the standard performance of the alternatives, we sum the elements of the Q matrix row by row:

$$\tilde{S}\iota = \sum_{j=1}^{n} \tilde{q}_{ij} \, , j = 1,2, \dots, n \quad i = 1,2, \dots, m \tag{16}$$

Here, n represents the number of criteria, and m represents the number of alternative options.

Step 7: Final ranking of options.

After subtracting the Si values from the initial ranking, the final rank of the obtained options is determined. The following formulas can be employed to differentiate between the options. The coefficient α signifies the level of risk acceptance.

$$defazzy\, S = [(\tilde{t}_3 - \tilde{t}_1) + (\tilde{t_2} - \tilde{t}_1)]3^{-1} + \tilde{t}_1$$

$$defazzy\, S = [\alpha\tilde{t}_3 + \tilde{t}_2 + (1-\alpha)]2^{-1} \quad (17)$$

The alpha value can be selected from the range of 0 to 1, and a common choice is often 0.5.

3.3 Triangular fuzzy sets

It's intriguing to observe that a fuzzy number constitutes a generalization of a standard real number, implying that it doesn't denote a solitary value, but rather a connected set of potential values, each carrying a weight between 0 and 1. When dealing with any fuzzy event, (l, m, r) is referred to as a Triangular Fuzzy Number. Here, "l" signifies the smallest plausible value, "m" represents the most probable value, and "r" corresponds to the largest attainable value.

Various techniques are employed in descriptive research to elucidate conditions and phenomena with greater precision. In essence, descriptive research is formulated to enhance comprehension of the present scenario or contribute to more informed decision-making. To conduct this study, a total of 10 specialists were chosen using an easy sampling method. The selection was influenced by the specialized nature of the subject area and the challenges in identifying professionals for this study. Their willingness to participate was another criterion for selection. The considerations involved in specialist selection can be observed in Table 4.

Table 4
DMs information

Number	Education	Experience	Field	Position
1	PhD	20	Oil	Manager
2	PhD	28	Oil	Deputy
3	MSc	31	Oil	Top adviser
4	MSc	19	Gas	Expert
5	BSc	22	Gas	expert
6	BSc	24	Oil	Manager
7	PhD	20	Gas	Manager
8	MSc	28	Gas	Deputy
9	MSc	30	Oil	Deputy
10	MSc	17	Gas	Top adviser

After a thorough review of the theoretical underpinnings, a questionnaire was developed in accordance with Table 5. During this process, 28 sub-indicators were scrutinized to discern the seven primary capabilities of the service supply chain. Table 5. Identification of capabilities and sub-indicators in a questionnaire prepared by researcher [16].

Table 5
Questionnaire questions

Row	Capability	Sub-factor	Description
1	SRM	SRM1	Ability to build long-term relationships with suppliers in the service supply chain
		SRM2	Ability to maintain close relationships with a limited number of suppliers in the service supply chain
		SRM3	Ability to focus on key suppliers to improve service chain quality in the service supply chain

Row	Capability	Sub-factor	Description
		SRM4	Ability to create a partnership plan with suppliers for the benefit of the entire service supply chain through information sharing (e.g., service development, sourcing, supply planning and procurement)
2	SPM	SPM1	Ability to perform accurate and reliable service process
		SPM2	Ability to provide appropriate customer service, in the right place and at the right time
		SPM3	Ability to provide standard services
		SPM4	Ability to improve service quality and meet customer needs
3	ITM	ITM1	The service provider has an IT system to share information with customers in the service supply chain
		ITM2	The service provider has an IT system to share information with suppliers in the service supply chain
		ITM3	The service provider can use information to update the information processing capacity to make decisions in the service supply chain
		ITM4	Use new technology to increase the service channel through which customers and suppliers can contact the organization
4	ORM	ORM1	Ability to process the steps to complete the order correctly step by step (E.g. ordering, ordering, order entry, order filling, and order status reporting)
		ORM2	Ability to simplify the service ordering process using the information technology system
		ORM3	Service order processing from order taking to customer service is fast and accurate
		ORM4	Provide the ability to deliver services as promised to the right customer, in the right place and at the right time
5	CRM	CRM1	The focus is on customer satisfaction as the center of corporate activities in the service supply chain
		CRM2	Communicate Optimistic communication with customers in service
		CRM3	Ability to manage customer relationships in the service supply chain to create a sense of before and after service
		CRM4	Ability to communicate effectively with customers to benefit from brand loyalty in the service supply chain
6	DM	DM1	Ability to focus on forecasting, scheduling allocation and goal setting functions
		DM2	Ability to simulate different service demand needs
		DM3	Ability to predict service demand accurately in high-risk and uncertain situations through up-to-date demand information
		DM4	Ability to adjust and match customer service demand with capacity
7	CAP	CAP1	Ability to define service capacity in the service provider
		CAP2	Ability to match service capacity with uncertain demand
		CAP3	Ability to manage tangible resources (eg facilities, labor and capital) to work with optimal service capacity
		CAP4	Ability to manage intangible resources (eg skills, experience and knowledge) to work with optimal service capacity

4. Analysis and Results

After conducting a thorough assessment and identification of service supply chain capabilities, ten experts were engaged to assess the significance of indicators within the service supply chain. This assessment was conducted using a research spectrum that encompassed their understanding of service supply chain capacities. Employing the fuzzy ranking method, we present the outcomes of our research in Appendix A (Tables A1-A5).

Based on the output from the table and considering the maximum weight, it has been concluded that 3ITM holds the highest weight. Additionally, it has been determined that 2ORM and 3CRM should be ranked as the second and third priorities, respectively. Furthermore, after re-polling the main variables following Table 6, the estimated weights of the variables are as follows.

Table 6
The weight of capabilities' factors

No.	Importance	b_j	k_j	q_j	w_j	Weight
1	CRM	-	(1,1,1)	(1,1,1)	(0.440,0.435,0.393)	0.423
2	SPM	(1.32,0.666,0.55)	(2.32,1.666,1.55)	(0.431,0.600,0.645)	(0.189,0.261,0.253)	0.235
3	OPM	(0.274,0.75,0.322)	(1.274,1.75,1.322)	(0.338,0.342,0.487)	(0.148,0.148,0.191)	0.163
4	ITM	(0.474,1.025,1.635)	(1.474,2.025,2.635)	(0.229,0.168,0.184)	(0.100,0.073,0.072)	0.082
5	DM	(1,1,1)	(2,2,2)	(0.114,0.084,0.092)	(0.050,0.036,0.036)	0.041
6	CAP	(0.286,0.353,0.258)	(1.286,1.353,1.258)	(0.088,0.062,0.073)	(0.038,0.026,0.028)	0.031
7	SRM	(0.243,0.456,0.147)	(1.243,1.456,1.147)	(0.070,0.042,0.063)	(0.030,0.018,0.024)	0.025

This paper developed the fuzzy MABAC method to identify ten crucial, sensitive, and strategic regions in the oil and gas industry by surveying experts and determining priorities based on key indicators. Due to sensitivity concerns, the specific names of these regions have been avoided and their abbreviations have been used instead. Considering the limited space available in the article and the orientation of the tables, the researchers selected the most critical tables to present the output of the fuzzy MABAC model. The researcher posed questions to a group of ten research experts, using a scale of +1 to indicate a positive indicator and -1 to indicate a negative indicator. The questionnaire focused on seven main indicators, each of which had already been assigned weights, as well as ten priority areas requiring attention. Given the service supply chain indicators within each of the identified locations in the oil and gas field, the impact within the following range was considered: If you were to analyze the influence of each of the indicators in the service supply chain within the specified locations in the oil and gas industry, how would you assess the impact within the following range? Moreover, the calculation of data for ranking companies is mentioned in Appendix A (Tables A1-A5). Tables 7 and 8 demonstrate the final ranking of gas companies by fuzzy MABAC. Figure 3 Shows the output of the results.

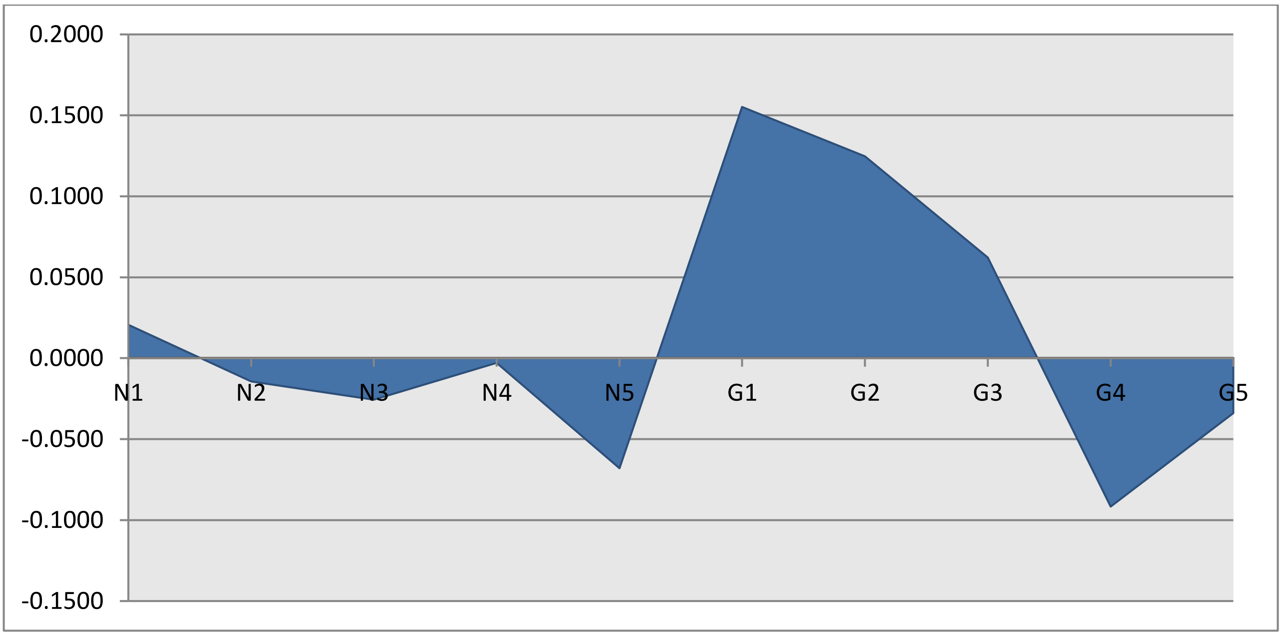

Fig. 3. Graph of priorities factors

Table 7
Spectrum of answering fuzzy MABAC questions

Linguistic Criteria		Result
Very Poor	Very Poor	(1,0,0)
Poor	Poor	(3,1,0)
Medium to Poor	Medium Poor	(5,3,1)
Fair	Fair	(7,5,3)
Medium to Good	Medium Good	(9,7,5)
Good	Good	(10,9,7)
Very Good	Very Good	(10,10,9)

Table 8
Prioritization of selected oil and gas locations

Alt.		S_i		Defuzzification	Rank
N1	-0.3380	0.0204	0.4038	0.0287	4
N2	-0.3423	-0.0081	0.2982	-0.0174	6
N3	-0.3742	-0.0217	0.3183	-0.0259	7
N4	-0.3456	-0.0081	0.3328	-0.0070	5
N5	-0.4085	-0.0738	0.2927	-0.0632	9
G1	-0.2531	0.1467	0.5712	0.1549	1
G2	-0.2619	0.1520	0.4694	0.1198	2
G3	-0.3044	0.0772	0.4022	0.0584	3
G4	-0.3997	-0.1226	0.2483	-0.0914	10
G5	-0.3782	-0.0321	0.3205	-0.0299	8

4.1 Sensitivity Analysis

We decided to explore Alpha values ranging from 0 to 1, in addition to using equation (20), to calculate the defuzzified weight for each alternative, as depicted in Figure 4. Notably, this calculation aided in adjusting the defuzzified weight for every alternative. With the shift in Alpha from 0 to 1, there were slight alterations in the rankings of companies N5, G4, and G5. The rankings of these companies were affected by the variation in Alpha, leading to shifts in their standings across different Alpha values.

However, the outcomes also reveal that within specific company groups, such as N5, G4, and G5, Alpha values of 0.9, 0.6, 0.7, and 0.2 are closely clustered in terms of ranking. Conversely, other Alpha values would yield diverse results, depending on the specific Alpha type employed. Since all Alpha values were adjusted, companies N5, G4, and G5 consistently ranked as the least significant. This constancy in their rankings underscores their sustained status as the least important entities.

Analyzing the sensitivity analysis results for the prominent companies, G1, G2, and G3, across different Alpha values demonstrates substantial discrepancies. As a result, decision-makers must exercise heightened vigilance during the decision-making process. In this study, an Alpha value of 0.5 was used for computation. Therefore, decision-makers who opt for low-risk, optimistic approaches (high Alpha) reduce the likelihood of failure. Conversely, decisions founded on high-risk, pessimistic approaches (low Alpha) entail considerable failure risks, warranting careful consideration.

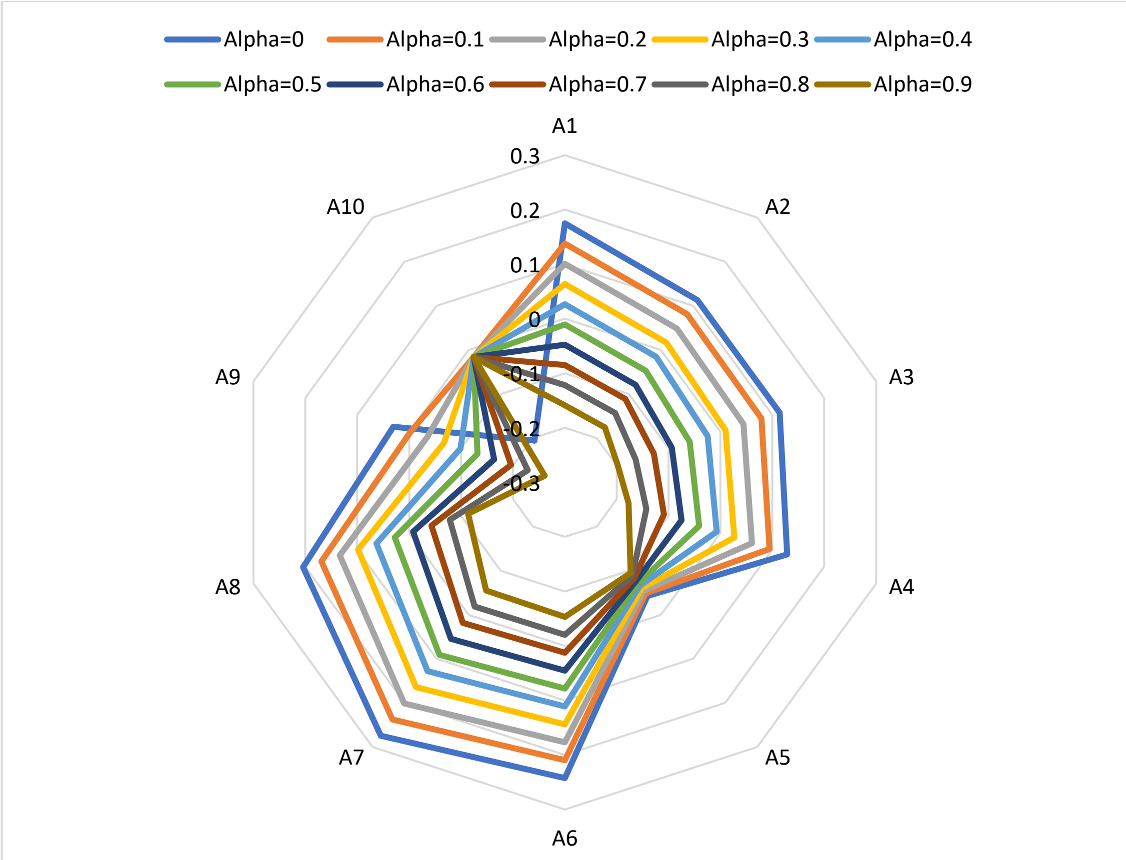

Fig. 4. Sensitivity Analysis

5. Discussion and Conclusions

This study contributes to the identification of the optimal site for providing service capabilities in the Oil and Gas (O&G) industry's Supply Chain Management (SCM). In order to address this research gap, the relevant factors influencing site selection were extracted and subsequently tailored to this research by incorporating Decision Makers' (DMs) preferences. These factors were then ranked using the Fuzzy Simple Weighted Average Ratio Analysis (FSWARA) method. Subsequently, the sites proposed earlier were prioritized using the Fuzzy Multi-Attributive Border Approximation and Comparison (FMABAC) method, incorporating the weights obtained through FSWARA. The results of this study contribute to bridging the research gap concerning optimal site selection for service capability SCM in the O&G industry, both in terms of theory and methodology.

The findings of this paper exhibit both similarities and differences in comparison to other research. For instance, aligning with Boon-itt *et al.,* [16] whose factors were adopted as benchmarks, both papers concur that Customer Relationship Management (CRM) holds the highest priority among main criteria. However, divergence emerges in the sub-criteria. While this paper assigns the highest priority to factor 3ITM, Boon-itt *et al.,* [16] prioritize 2SRM. These measurement scales are tailored for the service sector, capturing its unique attributes, while mirroring processes akin to manufacturing settings.

The study's outcome enables managers to harness Supply Chain Management (SCM) capabilities within service management, offering an alternative to the traditional service measurement paradigm. By concentrating on outsourcing, companies can enhance competitiveness by gaining a strategic edge. Tracking the development of SCM capabilities, companies can monitor and enhance these capabilities to bolster their SCM. The multifaceted nature of SCM features fosters seamless functioning across organizational domains, fostering a stronger manager-employee relationship and cross-functional proficiency. Notably, experts rate the Customer Relationship Management process as the most crucial, with a score of 0.423 out of five.

Subsequent rankings allocate a score of 0.235 to service performance management and 0.164 to order management process capability. These outcomes affirm 3ITM as the most substantial factor, with 2ORM and 3CRM identified as second and third priorities, respectively. These findings yield valuable theoretical and practical implications for SCM processes. The development of SSCM process capability scales stands as a pivotal stride towards theoretical advancement. While earlier studies underscore the value of inter organizational or SSCM process capabilities this study advances the understanding and empirical evidence of SSCM process capabilities.

By shaping the conceptual framework of SSCM and substantiating our findings, this study elucidates SSCM process capabilities within the context of oil and gas companies. Our approach demonstrates the practical dimensions of SSCM process capabilities applicable to the industry. The study also presents a comprehensive inventory of organizational actions for managers to bolster SSCM processes' ability to enhance service supply chains in oil and gas. This underscores how companies can gain a competitive edge through SSCM process capabilities. Thus, managers must consider these capabilities and comprehensive planning to facilitate the service process and infrastructure.

This study demonstrates that utilizing the methodology applied herein, which has wider applicability, can identify and prioritize SSCM capabilities for future endeavors. However, limitations stemming from restricted access to DMs hindered research. Their demanding roles posed challenges in gathering responses, considering their busy schedules. This model's potential extends beyond the present industry, with future research incorporating different types of Multiple-Criteria Decision-Making (MCDM) techniques and fuzzy sets to further investigate its effectiveness.

Conflict of Interest:
The authors have no relevant financial or non-financial interests to disclose.

Data Availability
Data is available on request.

Appendix A

Table A1
Weight of fuzzy SWARA

No.	Criteria	Importance	b_j	k_j	q_j	w_j	Weight	Total Weigt	Rank
1	SRM	2 SRM	-	(1,1,1)	(1,1,1)	(0.460,0.484,0.386)	0.444	0.06396	7
2		1 SRM	(0.667,0.5,0.4)	(1.667,1.5,1.4)	(0.599,0.666,0.714)	(0.275,0.322,0.276)	0.292	0.0420	8
3		3 SRM	(0.465,1.5,0.23)	(1.465,2.5,1.23)	(0.408,0.266,0.580)	(0.187,0.128,0.224)	0.180	0.02593	15
4		4 SRM	(1,1,1)	(2,2,2)	(0.165,0.133,0.290)	(0.075,0.064,0.112)	0.084	0.0121	26
5	SPM	1 SPM	-	(1,1,1)	(1,1,1)	(0.456,0.579,0.429)	0.489	0.0704	4
6		3 SPM	(0.37,1.74,0.53)	(1.37,2.74,1.53)	(0.729,0.364,0.653)	(0.332,0.210,0.280)	0.273	0.0393	11
7		2 SPM	(1.36,0.5,0.444)	(2.36,1.5,1.444)	(0.308,0.242,0.452)	(0.140,0.140,0.193)	0.159	0.0229	18
8		4 SPM	(1,1,1)	(2,2,2)	(0.154,0.121,0.226)	(0.070,0.070,0.096)	0.079	0.0113	27
9	ITM	3 ITM	-	(1,1,1)	(1,1,1)	(0.537,0.496,0.450)	0.495	0.0713	1
10		1 ITM	(1.12,0.66,0.5)	(2.12,1.66,1.5)	(0.471,0.602,0.666)	(0.252,0.298,0.299)	0.284	0.0409	9
11		2 ITM	(1,1.5,1.04)	(2,2.5,2.04)	(0.235,0.240,0.326)	(0.126,0.119,0.146)	0.131	0.0188	20
12		4 ITM	(0.5,0.373,0.42)	(1.5,1.373,1.42)	(0.156,0.174,0.229)	(0.083,0.086,0.103)	0.090	0.0129	25
13	ORM	2 ORM	-	(1,1,1)	(1,1,1)	(0.520,0.503,0.459)	0.494	0.0711	2
14		1 ORM	(1-1-1)	(2-2-2)	(0.5-0.5-0.5)	(0.260-0.251-0.229)	0.247	0.0355	14
15		3 ORM	(1-1.2-0.63)	(2-2.2-1.63)	(0.25-0.227-0.306)	(0.130-0.125-0.140)	0.132	0.0190	19
16		4 ORM	(1.32-0.76-0.44)	(2.32-1.76-1.44)	(0.107-0.128-0.211)	(0.055-0.071-0.097)	0.075	0.0108	28
17	CRM	3 CRM	-	(1-1-1)	(1-1-1)	(0.535-0.496-0.450)	0.493	0.0710	3
18		4 CRM	(1.12-0.66-0.5)	(2.12-1.66-1.5)	(0.471-0.602-0.666)	(0.252-0.298-0.299)	0.283	0.0407	10
19		2 CRM	(1-1.5-1.04)	(2-2.5-2.04)	(0.235-0.240-0.326)	(0.126-0.119-0.146)	0.130	0.0187	21
20		1 CRM	(0.5-0.373-0.42)	(1.5-1.373-1.42)	(0.156-0.174-0.229)	(0.083-0.086-0.103)	0.090	0.0129	24
21	DM	2 DM	-	(1-1-1)	(1-1-1)	(0.547-0.454-0.377)	0.460	0.0662	6
22		1 DM	(1.32-0.760-0.404)	(2.32-1.76-1.404)	(0.413-0.568-0.712)	(0.226-0.258-0.268)	0.251	0.0361	13
23		3 DM	(0.616-0.5-0.303)	(1.616-1.5-1.303)	(0.255-0.378-0.546)	(0.139-0.171-0.206)	0.173	0.0249	16
24		4 DM	(0.607-0.5-0.4)	(1.607-1.5-1.4)	(0.158-0.252-0.390)	(0.086-0.114-0.147)	0.116	0.0167	22
25	CAP	3 CAP	-	(1-1-1)	(1-1-1)	(0.520-0.441-0.458)	0.473	0.0681	5
26		2 CAP	(1.43-0.652-0.54)	(2.43-1.652-1.54)	(0.411-0.605-0.649)	(0.214-0.267-0.297)	0.259	0.0373	12
27		4 CAP	(0.343-0.444-1.05)	(1.343-1.444-2.05)	(0.306-0.418-0.316)	(0.159-0.184-0.144)	0.162	0.0233	17
28		1 CAP	(0.506-0.74-0.45)	(1.506-1.74-1.45)	(0.203-0.240-0.217)	(0.105-0.106-0.099)	0.103	0.0148	23

Table A2
Matrix of aggregation of experts' opinions

	CRM			SPM			ORM			ITM			DM			CAP			SRM		
	L	M	R	L	M	R	L	M	R	L	M	R	L	M	R	L	M	R	L	M	R
	0.393	0.435	0.44	0.253	0.261	0.189	0.191	0.148	0.148	0.072	0.073	0.1	0.036	0.036	0.05	0.028	0.026	0.038	0.024	0.018	0.03
		1			1			1			1			-1			1			1	
N1	10.00	14.00	18.00	6.00	8.00	10.00	7.00	10.00	13.00	4.00	6.00	10.00	12.00	17.00	22.00	14.00	19.00	24.00	5.00	7.00	10.00
N2	5.00	7.00	9.00	9.00	13.00	16.00	8.00	11.00	13.00	7.50	10.40	13.00	2.00	3.00	5.00	4.00	6.00	7.00	8.10	12.00	16.00
N3	7.00	10.00	13.00	9.00	12.00	15.00	3.90	6.70	9.60	4.00	6.90	10.00	3.70	4.00	5.00	2.00	5.00	8.00	9.00	12.00	15.00
N4	4.00	6.20	9.20	10.00	14.00	17.00	8.50	11.30	13.40	10.00	14.00	19.00	10.00	14.00	18.00	3.00	4.00	5.00	8.50	10.00	12.00
N5	5.00	7.00	9.00	7.00	10.00	13.00	7.00	10.00	14.00	10.00	15.00	19.00	15.00	21.00	27.00	7.00	12.00	16.00	6.00	7.00	13.00
G1	10.80	15.00	21.00	10.00	13.00	17.00	6.30	9.30	12.00	8.00	12.00	14.00	15.00	21.00	27.00	17.00	23.00	28.00	2.00	4.00	7.00
G2	11.00	15.00	17.00	11.00	15.00	19.00	2.00	5.00	7.00	9.00	12.00	15.00	5.00	7.00	9.00	13.00	17.00	20.00	4.00	6.00	9.00
G3	8.00	11.00	13.00	12.00	16.00	20.00	3.00	6.00	10.00	7.00	10.00	13.00	7.00	10.00	13.00	9.00	12.00	13.00	9.00	12.00	13.00
G4	2.00	3.40	6.30	8.60	11.00	15.80	9.30	12.00	16.00	8.50	11.30	13.40	2.00	3.00	4.00	2.00	4.00	7.00	2.00	4.00	7.00
G5	7.70	10.70	13.40	5.00	8.00	11.00	7.00	10.00	12.00	5.00	8.00	12.00	1.00	2.00	3.00	6.00	9.00	12.00	6.00	9.00	12.00

Table A3
Normalized matrix

	CRM			SPM			ORM			ITM			DM			CAP			SRM		
	L	M	R	L	M	R	L	M	R	L	M	R	L	M	R	L	M	R	L	M	R
	0.39	0.44	0.44	0.25	0.26	0.19	0.19	0.15	0.15	0.07	0.07	0.10	0.04	0.04	0.05	0.03	0.03	0.04	0.02	0.02	0.03
		1.00			1.00			1.00			1.00			-1.00			1.00			1.00	
N1	0.42	0.63	0.84	0.07	0.20	0.33	0.36	0.57	0.79	0.00	0.13	0.40	0.19	0.38	0.58	0.46	0.65	0.85	0.21	0.36	0.57
N2	0.16	0.26	0.37	0.27	0.53	0.73	0.43	0.64	0.79	0.23	0.43	0.60	0.85	0.92	0.96	0.08	0.15	0.19	0.44	0.71	1.00
N3	0.26	0.42	0.58	0.27	0.47	0.67	0.14	0.34	0.54	0.00	0.19	0.40	0.85	0.88	0.90	0.00	0.12	0.23	0.50	0.71	0.93
N4	0.11	0.22	0.38	0.33	0.60	0.80	0.46	0.66	0.81	0.40	0.67	1.00	0.35	0.50	0.65	0.04	0.08	0.12	0.46	0.57	0.71
N5	0.16	0.26	0.37	0.13	0.33	0.53	0.36	0.57	0.86	0.40	0.73	1.00	0.00	0.23	0.46	0.19	0.38	0.54	0.29	0.36	0.79
G1	0.46	0.68	1.00	0.33	0.53	0.80	0.31	0.52	0.71	0.27	0.53	0.67	0.00	0.23	0.46	0.58	0.81	1.00	0.00	0.14	0.36
G2	0.47	0.68	0.79	0.40	0.67	0.93	0.00	0.21	0.36	0.33	0.53	0.73	0.69	0.77	0.85	0.42	0.58	0.69	0.14	0.29	0.50
G3	0.32	0.47	0.58	0.47	0.73	1.00	0.07	0.29	0.57	0.20	0.40	0.60	0.54	0.65	0.77	0.27	0.38	0.42	0.50	0.71	0.79
G4	0.00	0.07	0.23	0.24	0.40	0.72	0.52	0.71	1.00	0.30	0.49	0.63	0.88	0.92	0.96	0.00	0.08	0.19	0.00	0.14	0.36
G5	0.30	0.46	0.60	0.00	0.20	0.40	0.36	0.57	0.71	0.07	0.27	0.53	0.92	0.96	1.00	0.15	0.27	0.38	0.29	0.50	0.71

Table A4
Weighted Normalized Matrix

	CRM			SPM			ORM			ITM			DM			CAP			SRM		
	L	M	R	L	M	R	L	M	R	L	M	R	L	M	R	L	M	R	L	M	R
N1	0.56	0.71	0.81	0.27	0.31	0.25	0.26	0.23	0.26	0.07	0.08	0.14	0.04	0.05	0.08	0.04	0.04	0.07	0.03	0.02	0.05
N2	0.46	0.55	0.60	0.32	0.40	0.33	0.27	0.24	0.26	0.09	0.10	0.16	0.07	0.07	0.10	0.03	0.03	0.05	0.03	0.03	0.06
N3	0.50	0.62	0.69	0.32	0.38	0.32	0.22	0.20	0.23	0.07	0.09	0.14	0.07	0.07	0.09	0.03	0.03	0.05	0.04	0.03	0.06
N4	0.43	0.53	0.61	0.34	0.42	0.34	0.28	0.25	0.27	0.10	0.12	0.20	0.05	0.05	0.08	0.03	0.03	0.04	0.04	0.03	0.05
N5	0.46	0.55	0.60	0.29	0.35	0.29	0.26	0.23	0.27	0.10	0.13	0.20	0.04	0.04	0.07	0.03	0.04	0.06	0.03	0.02	0.05
G1	0.58	0.73	0.88	0.34	0.40	0.34	0.25	0.23	0.25	0.09	0.11	0.17	0.04	0.04	0.07	0.04	0.05	0.08	0.02	0.02	0.04
G2	0.58	0.73	0.79	0.35	0.44	0.37	0.19	0.18	0.20	0.10	0.11	0.17	0.06	0.06	0.09	0.04	0.04	0.06	0.03	0.02	0.05
G3	0.52	0.64	0.69	0.37	0.45	0.38	0.20	0.19	0.23	0.09	0.10	0.16	0.06	0.06	0.09	0.04	0.04	0.05	0.04	0.03	0.05
G4	0.39	0.47	0.54	0.31	0.37	0.33	0.29	0.25	0.30	0.09	0.11	0.16	0.07	0.07	0.10	0.03	0.03	0.05	0.02	0.02	0.04
G5	0.51	0.63	0.70	0.25	0.31	0.26	0.26	0.23	0.25	0.08	0.09	0.15	0.07	0.07	0.10	0.03	0.03	0.05	0.03	0.03	0.05

Table A5
Distance of Alternatives from Table 8

	CRM			SPM			ORM			ITM			DM			CAP			SRM		
	L	M	R	L	M	R	L	M	R	L	M	R	L	M	R	L	M	R	L	M	R
N1	-0.13	0.10	0.32	-0.05	-0.07	-0.06	0.01	0.01	0.02	-0.09	-0.02	0.05	-0.04	-0.01	0.03	-0.01	0.01	0.04	-0.02	0.00	0.02
N2	-0.23	-0.06	0.11	0.00	0.02	0.01	0.02	0.02	0.02	-0.08	0.00	0.07	-0.02	0.01	0.04	-0.02	0.00	0.01	-0.02	0.01	0.03
N3	-0.19	0.01	0.20	0.00	0.00	0.00	-0.04	-0.02	-0.02	-0.09	-0.02	0.05	-0.02	0.01	0.04	-0.03	-0.01	0.01	-0.01	0.01	0.03
N4	-0.25	-0.08	0.11	0.02	0.04	0.03	0.03	0.02	0.02	-0.06	0.02	0.11	-0.04	0.00	0.03	-0.03	-0.01	0.01	-0.01	0.00	0.02
N5	-0.23	-0.06	0.11	-0.03	-0.03	-0.02	0.01	0.01	0.03	-0.06	0.02	0.11	-0.05	-0.01	0.02	-0.02	0.00	0.02	-0.02	0.00	0.02
G1	-0.11	0.12	0.39	0.02	0.02	0.03	0.00	0.00	0.01	-0.07	0.01	0.08	-0.05	-0.01	0.02	-0.01	0.01	0.04	-0.03	-0.01	0.01
G2	-0.11	0.12	0.29	0.04	0.05	0.05	-0.06	-0.04	-0.05	-0.07	0.01	0.09	-0.03	0.01	0.04	-0.01	0.01	0.03	-0.02	0.00	0.01
G3	-0.17	0.03	0.20	0.05	0.07	0.06	-0.05	-0.03	-0.01	-0.08	0.00	0.07	-0.03	0.00	0.04	-0.02	0.00	0.02	-0.01	0.01	0.02
G4	-0.29	-0.14	0.05	0.00	-0.01	0.01	0.04	0.03	0.05	-0.07	0.00	0.08	-0.02	0.01	0.04	-0.03	-0.01	0.01	-0.03	-0.01	0.01
G5	-0.17	0.02	0.21	-0.06	-0.07	-0.05	0.01	0.01	0.01	-0.09	-0.01	0.07	-0.02	0.01	0.05	-0.02	0.00	0.02	-0.02	0.00	0.02

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