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Developing a Fuzzy Measurement of Alternatives and Ranking Compromise Solution Method for Determining Essential Barriers in Iranian Car Industry

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ABSTRACT

In some lateral alliances, firms coordinate their interactions in Supply Chain Management (SCM) via contracts. Successful implementation of contracts in lateral alliances remains challenging in practice because of the incomplete identification of implementation barriers by firms involved in the alliance. This paper investigates the implementation issues of lateral contracts. To identify the barriers, the literature and interview experts on the subject matter are reviewed. By adopting the novel Fuzzy Measurement of Alternatives and Ranking according to the Compromise Solution (FMARCOS) prioritization method, we evaluate the main barriers that firms face in the successful implementation of contracts discovered in our identification phase. A sensitivity analysis is conducted to demonstrate the stability and robustness of our proposed method. To check the reliability of the proposed model, a case study is solved with three methods of Multi-Criteria Decision-Making (MCDM) methods. The results show that they do not differ much from each other, which indicates the validity of this model. To validate the findings, a list of barriers is applied to assess a set of firms in the Iranian car industry, and more prepared firms are located as future partners of potential lateral alliances. The results are consistent with the common intuition toward these sample firms in the case study. The main contributions of this work include the application of the FMARCOS method in the study of the bidirectional implementation barriers, the consideration of novel aspects of implementation barriers unaddressed in the extant literature, and a real-case study in the Iranian car industry.

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1. INTRODUCTION

Coordination in Supply Chain Management (SCM) comprises four common mechanisms: information technology, information sharing, concerted decision making, and coordination contracts [1]. In implementing coordination mechanisms, firms face barriers of various types such as technological, financial, social, and knowledge and support dimensions [2]. Firms in the supply chain experience challenging relations if these barriers are not sufficiently scrutinized, and therefore, left ignored. To address these challenges, a recent lateral contract has been employed in various industries, in which firms simultaneously increase their share of product manufacturing capacity - capacity expansion and their efficiency- cost reduction by designing and following cost reduction programs. The pursuit of these two goals poses different kinds of challenges by creating managerial issues [3]. For example, the uncertain nature of demand for the products that are newly presented to the market makes the prediction of capacity for future demand a difficult task. As another example, investment in capacity has a lumpy nature and cannot be made in "bits and pieces", which necessitates over-investment in capacity. Therefore, these firms are likely to use their capacity in an underutilized manner.

The underutilized capacity may be used for other firms, which are interested in establishing an outsourcing relationship. There are various methods to carry out this type of relationship, in which lateral contracts are

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approached. We illustrate this approach with some examples. In the United States, Nestle and Ocean Spray have established a long-term relationship to share their capacity interchangeably. This means that Ocean Spray provides its extra production capacity to its partner in exchange for Nestlé's extra distribution capacity. In this partnership, Ocean Spray is responsible for filling the bottles needed in the final product and Nestle is in charge of supply and distribution. Therefore, firms can exploit their capacity fully based on the capacity strength point. In India, Fiat and Tata have formed a long-term partnership such that Fiat uses its extra capacity to produce cars for Tata and Tata shares its dealership network and marketing capacity with Fiat. This type of partnership is not limited to these cases and has a rising trend in other industries and geographic places.

Although this type of contract tries to alleviate the issues related to sharing capacity in co-manufacturing and co-distribution alliances, the incomplete identification of implementation barriers by partners of the alliance can critically damage the outcome. These days managers face challenging problems to provide the necessary resources that their company needs to fulfill its mission. Various economic, political, social, technological, and even environmental conditions constrain firms in their access to resources. These factors often necessitate firms to prioritize the implementation barriers and allocate the scarce resources most properly to guarantee the successful implementation of lateral contracts. This has been made possible solely by removing the most important obstacles to these implementation practices.

2. LITERATURE REVIEW

The barriers to the implementation of contracts common in the supply chain have extensively been studied in the literature. we provide some examples of these studies [4]: (1) examining the barriers to the implementation of green SCM in the construction industry. Their study has outlined nine essential barriers to contract implementation [5], (2) analyzing the interaction between barriers to implementing sustainable SCM. Their study has resulted in outlining 13 barriers to contract implementation in the context of sustainable SCM [6], (3) examining the barriers to the implementation of SCM, which is a case study of small- and medium-sized contracts in Turkey [7], (4) identifying the barriers of SCM (in manufacturing organizations based on a systematic literature review and identified the most critical barriers hindering the performance of the supply chain. They found 23 key SCM barriers, which help industrial practitioners and academic experts implement SCM [8], (5) investigating the building blocks of GSCM and developing a structure of GSCM implementation for the manufacturing industry. Their research results in a framework with five concepts, 22 dimensions, and 82 elements [9], (6) advancing perception of international similarities and dissimilarities in SCM prospects and practices, by scrutinizing the inherent differences between supply chain managers both in Scandinavia and America. They considered the definition of SCM as well as facilitators of and obstacles to SCM implementation. Their investigation leads to the understanding that SCM implementation is slower and more difficult than expected from the managers' viewpoint both in Scandinavian and American supply chains [10], (7) scrutinizing possible barriers to IT applications in the supply chain system of the Indian sugar industry and rank these barriers in terms of their severity [11], and (8) developing a conceptual framework by reviewing the pertinent GSCM literature and identifying the main barriers to GSCM implementation. They classified these barriers into five main classes, namely knowledge, technology, finances, outsourcing, and management. They also found that commitment of top management; changes in technologies and existing policies; improving the awareness of environmental issues; training and education; and waste management systems and implementation of efficient materials are among the best strategies to improve GSCM practices [12].

MCDM methods have widely been applied in the literature. In the manufacturing industry, these methods have been applied to solve problems of selection of FMS and industrial robots [13], suppliers of digital stores are ranked and evaluated based on Analytical Hierarchy Process (AHP) and TOPKOR methods [14], a method is proposed to propose based on a combination of fuzzy versions of the SWARA and MARCOS methods to select green suppliers [15], a method is proposed to choose the best online food delivery using a Pythagorean Fuzzy TOPSIS method [16], and a method is designed based on the MOORA method to select the best blanking die materials [17].

In this paper, we investigate whether there exists a tool to help managers find the most important barriers to implementing lateral contracts. We propose a decision-theoretic model, which enables firms to prioritize the implementation barriers. Our model belongs to the class of multi-attribute decision-making problems and is based on the FMARCOS method [18]. We first identify the barriers that are involved in the implementation of lateral contracts (i.e., list of barriers and review the pertinent literature to uni-directional alliances to identify the thirty most relevant barriers). Then, we scrutinize this list to filter out or add in the unrelated and related barriers by consulting with fifteen experts with a considerable background in industrial alliances. This provides the final list of barriers for lateral alliances to finalize our investigation for a proper list of barriers. Also, we validate the final list of barriers to demonstrate the applicability of our tool in real-life conditions. We find more prepared firms as future partners of potential lateral alliances by applying our list of barriers to assess a set of firms in the Iranian car industry. The results follow the common sense toward these selected firms and show the validity of our method.

As mentioned in the research literature, considerable research has been done on the types of coordination and the types of contracts in the supply chain with the provision of mathematical models. Identification and evaluation of supply chain barriers have also been done with a variety of multi-criteria decision-making (MCDM) methods. However, there has not been much research on bi-direction contracts in general. The barriers to implementing bi-directional contracts in the supply chain have not been much studied, especially based on MCDM methods. Bi-directional contracts are a sharing of resources and surplus capacity, while the one-way contract is a form of outsourcing - that is, outsourcing part of the firm's demand fulfillment mission to another firm. However, in the case of bi-directional contracts, this is not the case. In fact, in these contracts, the actions of each of the parties affect the other, so the issues of game theory are raised, which is beyond the scope of our discussion in this paper. This paper aims to review and analyze the barriers to implementing bi-directional contracts in the supply chain based on the FMARCOS method.

3. PROBLEM STATEMENT

This paper considers the Iranian car industry as a case study. In this industry, there are many challenges, which may be categorized as internal and external issues. External issues mainly deal with macro-economic parameters (e.g., currency rate and inflation) under the main impact of economic sanctions. On the other hand, internal issues are chiefly related to productivity and efficiency problems throughout the car supply chain requiring a better level of coordination and integration between the supply chain players. In this regard, the proper contract design plays an important role currently under the consideration of managers of Iranian car manufacturing firms. However, implementing these contracts in the car industry, especially bidirectional contracts, face various barriers with a multidimensional nature. This necessitates a multi-criteria decision making (MCDM) method for the problem. The experts interviewed in this method include experts from the Iranian car industry and related logistics and supply chain players.

3. 1. Fuzzy Number A fuzzy number $\tilde{A}$ is said to be a TFN on R provided that its membership function $\mu_{\tilde{A}}(X) = R \rightarrow [0,1]$ is equivalent to [15]:

$$\mu_{\tilde{A}}(X) = \begin{Bmatrix} \frac{x-l}{m-l} & l \le x \le m \\ \frac{u-x}{u-m} & m \le x \le u \\ 0 & \text{Otherwise} \end{Bmatrix} \quad (1)$$

where l and u denote the lower and upper limits of fuzzy number $\tilde{A}$, respectively, and m represents the modal value.

The TFN can be marked as $\tilde{A} = (l, m, u)$

$$\tilde{A}(ID) = \max_i \tilde{x}_{ij} \quad if \ J \in B \ \ and \ \ \min_i \tilde{x}_{ij} \quad if \ \ J \in C \quad (2)$$

The operation of TFN $\tilde{A}_1 = (l_1, m_1, u_1)$ and $\widetilde{A}_2 = (l_2, m_2, u_2)$ are as follows:

Addition: $\tilde{A}_1 = (l_1, m_1, u_1)$

$$\tilde{A}_1 \oplus \tilde{A}_2 = (l_1, m_1, u_1) \oplus (l_2, m_2, u_2) = (l_1 + l_2, m_1 + m_2, u_1 + u_2) \quad (3)$$

$$\tilde{A}_1 \otimes \tilde{A}_2 = (l_1, m_1, u_1) \otimes (l_2, m_2, u_2) = (l_1 \times l_2, m_1 \times m_2, u_1 \times u_2) \quad (4)$$

Subtraction:

$$\tilde{A}_1 - \tilde{A}_2 = (l_1, m_1, u_1) - (l_2, m_2, u_2) = (l_1 - u_2, m_1 - m_2, u_1 - l_2) \quad (5)$$

Division:

$$\frac{\tilde{A}_1}{\tilde{A}_2} = \frac{(l_1, m_1, u_1)}{(l_2, m_2, u_2)} = \left(\frac{l_1}{u_2}, \frac{m_1}{m_2}, \frac{u_1}{l_2}\right) \quad (6)$$

Reciprocal:

$$\tilde{A}^{-1} = (l_1, m_1, u_1)^{-1} = \left(\frac{1}{u_1}, \frac{1}{m_1}, \frac{1}{l_1}\right) \quad (7)$$

3. 2. Fuzzy MARCOS[1] The new fuzzy MARCOS method encompasses the following steps:

1) In this step, an elementary two-dimensional fuzzy matrix is constructed with decision alternatives as its rows and decision-making criteria as its columns.

2) Here, two generated alternatives are added to our matrix. The first one is defined as the worst fuzzy ideal alternative (AAI) and the second one as the best fuzzy ideal alternative (AI) [18]:

$$\tilde{X} = \begin{array}{c} \\ \tilde{A}(AI) \\ \tilde{A}_1 \\ \tilde{A}_2 \\ . \\ . \\ . \\ \tilde{A}_M \\ \tilde{A}(ID) \end{array} \begin{array}{c} \begin{array}{cccc} \tilde{C}_1 & \tilde{C}_2 & \cdots & \tilde{C}_n \end{array} \\ \begin{bmatrix} \tilde{x}_{ai1} & \tilde{x}_{ai2} & \cdots & \tilde{x}_{ain} \\ \tilde{x}_{11} & \tilde{x}_{12} & & \tilde{x}_{1n} \\ \tilde{x}_{21} & \tilde{x}_{22} & & \tilde{x}_{2n} \\ . & . & . & . \\ . & . & . & . \\ . & . & . & . \\ \tilde{x}_{m1} & \tilde{x}_{m2} & & \tilde{x}_{mn} \\ \tilde{x}_{id1} & \tilde{x}_{id1} & & \tilde{x}_{idn} \end{bmatrix} \end{array} \quad (8)$$

[1] Measurement Alternatives and Ranking according to Compromise Solution

The desirable criteria are categorized in set B and the undesirable criteria in set C [18,13]:

$$\tilde{A}(AI) = \min_i \tilde{x}_{ij} \; if \; J \in B \text{ and } \max_i \tilde{x}_{ij} \text{ if } J \in C \quad (9)$$

3) Matrix $\tilde{N} = [\tilde{n}_{ij}]_{m\times n}$ is needed to normalize our matrix in which nij is defined as follows:

$$\tilde{n}_{ij} = (n_{ij}^l, n_{ij}^m, n_{ij}^u) = \left[\frac{x_{id}^l}{x_{ij}^u}, \frac{x_{id}^m}{x_{ij}^u}, \frac{x_{id}^u}{x_{ij}^u}\right] \; if \; j \in C \quad (10)$$

$$\tilde{n}_{ij} = (n_{ij}^l, n_{ij}^m, n_{ij}^u) = \left[\frac{x_{id}^l}{x_{ij}^u}, \frac{x_{id}^l}{x_{ij}^m}, \frac{x_{id}^l}{x_{ij}^l}\right] \; if \; j \in B \quad (11)$$

where elements $x_{ij}^l, x_{ij}^m, x_{ij}^u$ and $x_{id}^l, x_{id}^m, x_{id}^u$ denote the elements of the matrix $\tilde{X}$.

4) $\tilde{V} = [\tilde{v}_{ij}]_{m\times n}$ is used to provide a weighted version of our matrix whose elements are defined as follows:

$$\tilde{v}_{ij} = (v_{ij}^l, v_{ij}^m, v_{ij}^u) = (\tilde{n}_{ij} \otimes \tilde{w}_{ij}) = (n_{ij}^l \otimes w_j^l, n_{ij}^m \otimes w_j^m, n_{ij}^u \otimes w_j^u) \quad (12)$$

5) Let $\tilde{S}_i$ denote the aggregation of fuzzy matrix $\tilde{V}$ as the summation of its elements; i.e. [13]

$$\tilde{S}_i = \sum_{i=1}^{n} \tilde{v}_{ij} \quad (13)$$

6) The following equations are applied to calculate the degree of utility relevant to alternative i:

$$K_i^- = \frac{s_i}{s_{a_i}} = \left(\frac{s_i{}^l}{s_{ai}{}^u}, \frac{s_i{}^m}{s_{ai}{}^m}, \frac{s_i{}^u}{s_{ai}{}^l}\right) \quad (14)$$

$$K_i^+ = \frac{s_i}{s_{id}} = \left(\frac{s_i{}^l}{s_{id}{}^u}, \frac{s_i{}^m}{s_{id}{}^m}, \frac{s_i{}^u}{s_{id}{}^l}\right) \quad (15)$$

7) Computation of fuzzy matrix $\tilde{T}_i$ based on Equation (16).

$$\tilde{T}_i = \tilde{t}_i = (t_i^l, t_i^m, t_i^u) = k_i^- \otimes k_i^+ = (k_i^{-l} + k_i^{+l}, k_i^{-m} + k_i^{+m}, k_i^{-u} + k_i^{+u}) \quad (16)$$

Then, it is required that define a new fuzzy number $\tilde{D}$ is defined by:

$$\tilde{D} = (d^l, d^m, d^u) = \max_i \tilde{t}_{ij} \quad (17)$$

Afterward, it is required to defuzzy the number $\tilde{D}$ by applying the expression $df_{crisp} = \frac{1+4m+u}{6}$ to obtain the df_{crisp} number [15].

8) The utility functions based on the worst and best ideal alternatives are denoted by $f(\tilde{k}_i^-)$ and $f(\tilde{k}_i^+)$, respectively.

Based on the best ideal alternative and the worst ideal alternative, utility functions are calculated by the following equations:

$$f(\tilde{k}_i^-) = \frac{\tilde{k}_i^-}{df_{crisp}} = \left(\frac{k_i^{-l}}{df_{crisp}}, \frac{k_i^{-m}}{df_{crisp}}, \frac{k_i^{-u}}{df_{crisp}}\right) \quad (18)$$

$$f(\tilde{k}_i^+) = \frac{\tilde{k}_i^+}{df_{crisp}} = \left(\frac{k_i^{+l}}{df_{crisp}}, \frac{k_i^{+m}}{df_{crisp}}, \frac{k_i^{+u}}{df_{crisp}}\right) \quad (19)$$

9) We are now ready to calculate the utility function of alternative i by the following equation:

$$f(k_i) = \frac{k_i^+ + k_i^-}{1 + \frac{1-f(k_i^+)}{f(k_i^+)} + \frac{1-f(k_i^-)}{f(k_i^-)}} \quad (20)$$

10) Finally, the alternatives are sorted to create a ranked list of alternatives.

Besides the design of the fuzzy MARCOS method, a novel linguistic size for comparing alternatives has been defined, which is demonstrated in Table 1. Here, an aggregate of nine linguistic terms and their TFN is determined [18].

4. RESEARCH METHODOLOGY

In this research, we first extract 30 criteria related to the implementation of uni-directional contracts by reviewing the pertinent literature. Then, we discussed these criteria with 15 experts in SCM and logistics to investigate the suitability of the criteria for lateral contracts. Our effort lead to the confirmation of six criteria for lateral contracts as summarized in Table 2.

Therefore, in this study, it is assumed that the barriers to implementing bilateral contracts include; lack of training for employees, the poor commitment by top management and employee, lack of motivation and employee involvement, fear of failure, unwillingness to change, and lack of corporate social responsibility. Previous studies of bilateral contracts have failed to consider the training, commitment, motivation, and responsibility aspects of bidirectional contracts [1, 33, 34]. Ignorance of these humanistic aspects has limited the existing literature.

TABLE 1. A newly determined size for evaluating potential solutions

Linguistic Term	Mark	TFN
Extremely poor	EP	(1,1,1)
Very poor	VP	(1,1,3)
Poor	P	(1,3,3)
Medium poor	MP	(3,3,5)
Medium	M	(3,5,5)
Medium good	MG	(5,5,7)
Good	G	(5,7,7)
Very good	VG	(7,7,9)
Extremely good	EG	(7,9,9)

5. NUMERICAL STUDY

Here, a numerical illustration of the results is provided in the context of the Iranian car industry. The necessary readiness for eight Iranian car manufacturing companies to implement lateral contracts is ranked based on nine criteria resulting from experts' opinions. First, the weight of each criterion is determined based on the average of three experts' opinions. Then, the companies are ranked using an MCDM method, named fuzzy MARCOS. After the first step where we construct the MADM model with eight alternatives and nine criteria. In the second step, we define two solutions, namely, fuzzy anti-ideal $\tilde{A}$ (AI) and fuzzy ideal $\tilde{A}$ (ID) based on Equation (8) and Equation (9) to extend the fuzzy initial matrix. This matrix is formed using linguistics ratings in which values are quantified by triangular fuzzy numbers. The ranking of the results is shown in Table 3.

TABLE 2. Categories of the issue

Item	Barriers	References	Description
1	Lack of training for employee	[7, 12-17]	Education and training are necessary for any organization to learn new concepts and apply them effectively.
2	Poor commitment by top Management and employee	[6, 13, 14, 18, 20]	Extreme barrier is poor commitment by the top management.
3	Lack of motivation and employee involvement	[13, 19, 20-24]	Optimistic behavioral elements include confidence, passion, and self-image, which must be improved. Negative behavioral elements include sarcasm, destructive criticism, status consciousness, and fear of estimation which must be minimized.
4	Fear of Failure	[1, 18, 30]	Companies must allow workers to do jobs without fear of failure and ensure that they will not lose their job.
5	Unwillingness to change	[1, 2, 6, 13, 19, 25, 26, 27, 28, 31]	Previous failure experience, lack of standard training and education, and inadequate level of resources are among the main factors which lead to resistance to change. These must be properly dealt with to overcome the unwillingness to change.
6	Lack of corporate social responsibility	[13, 16, 29, 32]	The concept of commitment and economic development and enhancing the quality of life of employees and their families and the general public.

6. SENSITIVITY ANALYSIS AND COMPARISON WITH OTHER METHODS

We show the stability and robustness of our method in this section. To demonstrate the stability of our method, we generate 10 sets of weights based on the simulation as illustrated in Figure 1 [35]. The order of alternatives based on these scenarios is depicted in Figure 2. As it is clear from this figure, ignoring the small change in A_2 and A_3, the order of alternatives is considerably stable in all scenarios.

The addition or removal of an alternative to the decision matrix may change the ranking of alternatives, which is an important weakness point present in the classic MCDM method [36, 37]. To check the robustness of our method, we first eliminate the worst alternative (i.e., A_5).

The simulated weights for 8 scenarios are shown in Figure 2.

We notice that the order of the remaining alternatives remains fixed and repeat the elimination process with A_8 as the second worst alternative. The order is the same as the pre-elimination step. We continue the elimination process in the same trend based on the scenarios listed in Table 4. It is evident that the order of alternatives(A1>A6>A2>A7>A3>A4>A8>A5) is not affected by eliminating the alternatives, which shows the robustness of our proposed method.

In this paper, we compared the fuzzy MARCOS model with three other MCDM models; namely, FSAW, FTOPSIS, and FMULTIMOORA. As shown in Figure 3, company 1 tops the ranking list in all three models due to its suitable infrastructure to implement lateral contracts. As can be seen, the results of the four models are so close

TABLE 3. Ranking the obtained results

Alternatives	*Ki*	RANK
A1	0.86	1
A2	0.63	3
A3	0.57	5
A4	0.54	6
A5	0.10	8
A6	0.76	2
A7	0.60	4
A8	0.21	7

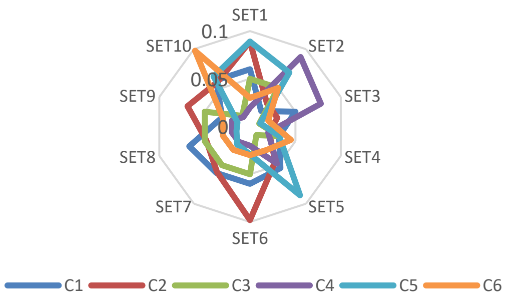

Figure 1. Simulated weights for scenarios

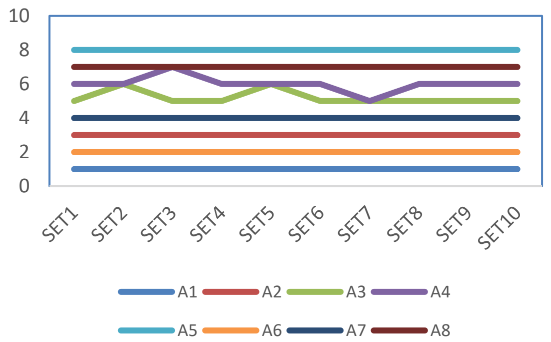

Figure 2. Ranking of airlines under different scenarios

TABLE 4. Rank reversal effect in the application

Alternative	Initial Rank	Scenario1	Scenario2	Scenario2
A1	1	1	1	1
A2	3	3	3	3
A3	5	5	5	5
A4	6	6	6	0
A5	8	0	0	0
A6	2	2	2	2
A7	4	4	4	4
A8	7	7	0	0

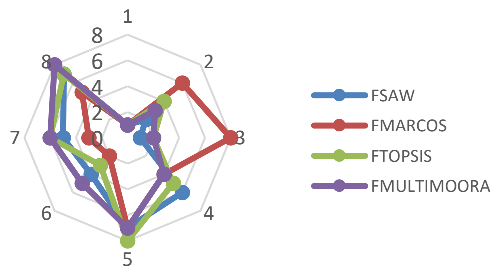

Figure 3. Comparison of the fuzzy TOPSIS, fuzzy SAW, and fuzzy MULTIMOORA methods

to each other. The application of the fuzzy method has enabled the experts to enhance the way they express their opinion about the companies.

7. MANAGERIAL INSIGHTS

As the results of the previous section indicate the company related to alternative number 1 ranks first regardless of the solution technique chosen to solve the ranking problem.

There is no surprise in such performance for alternative 1 since it has a significant background in critical success factors of a company. The company has improved the motivation of its employees by providing proper training and mentorship [38]. While adjusting the scope of its intended improvement at specific and broad levels of organizational enhancement [39]. This has both direct and indirect impacts on the performance of employees leading to the success of the company [40]. Since the company is highly active in Industry 4.0 projects, it has provided a sufficient level of management support, training, and external expert involvement as important success factors for such projects [41]. The company has also constantly been successful in escaping from business failure situations because it has been able to “operate as a sustainable entity” and avoid stopping operations and firing employees [42] by avoiding environmental mismatch and internal misalignment failure factors [43].

Based on these findings and considering the nature of automaking industries, the managers of car manufacturing firms should consider their employees as the core of bidirectional contracts implementation, hence, require to focus on their motivation, training, and mentorship issues. They need to concentrate on the sustainability of their firms in terms of social, economic, and environmental factors to guarantee the long-term operation of their manufacturing activities by avoiding both internal and external failure contexts.

8. CONCLUSION AND FUTURE STUDIES

Coordination in supply chain management is carried out based on various tools among which contracts are well-known for their impressive effect on coordinating relations of partners involved in the supply chain. In this paper, lateral contracts are investigated as they are understudied in the extant literature. We first extracted 30 criteria related to the implementation of uni-directional contracts by reviewing the pertinent literature. Then, we discussed these criteria with 15 experts in SCM and logistics to investigate the suitability of the criteria for lateral contracts. Our effort led to the confirmation of 6 criteria for lateral contracts. Subsequently, we identified the weights of these criteria using the expert method. Finally, we validated our method by solving the problem based on multi-criteria decision-making methods (MCDM), namely FMARCOS, FSAW, FTOPSIS, and FMULTIMOORA. This analysis resulted in the same ranking of put top sample firms (i.e., sample firms one and two). Based on our interview with experts, the background of the firm, its highly experienced experts in designing and forming contracts, and its administrative organization are among the reasons for these firms to top the list ranking. These results validated our method and showed its fitness for real-life applications.

This paper may be extended in several directions. For example, instead of using the fixed weights for criteria of lateral contracts implantation, novel methods (i.e., FARAS[1], FSWARA[2], and FIDOCRIW[3]) of comparison in MADM may be applied to the model Also, an extension of the MARCOS method based on such theories as grey theory and neutrosophic, single-valued intuitionistic fuzzy numbers is recommended.

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[1] Fuzzy Additive Ratio Assessment method

[2] Fuzzy Step-wise Weight Assessment Ratio Analysis

[3] Fuzzy Integrated Determination of Objective Criteria Weights

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Persian Abstract

چکیده

هماهنگ می کنند. اگرچه چنین رویکرد قراردادی در مدیریت زنجیره تامین هم در صنعت و هم در دانشگاه رایج است، اجرای موفقیت‌آمیز قراردادها در اتحادهای دو طرفه به دلیل شناسایی ناقص موانع اجرایی توسط شرکت‌های درگیر در اتحاد، در عمل چالش‌برانگیز است. این مقاله به بررسی مسائل اجرای قراردادهای دوطرفه می پردازد. برای شناسایی موانع، با استفاده از مرورادبیات و مصاحبه کارشناسان مرتبط با موضوع مورد بررسی قرار گرفت و در نهایت معیارهای اصلی موانع پیاده سازی قراردادهای دو طرفه استخراج گردید. در این تحقیق از روش تصمیم گیری جدیدی به نام روش ماکوس فازی جهت رتبه بندی شرکت ها مورد استفاده قرار گرفت بدین صورت که میزان آمادگی ۸ شرکت های خودروسازی در ایران جهت پیاده سازی قراردادهای دو طرفه مورد تحلیل قرار گرفت و میزان آمادگی این شرکت ها بر اسسا معیارهای استخراج شده مورد ارزیابی و اولویت بندی قرار گرفت.