Ranking of Outsourcing Risks in Supply Chain of Automotive Industry Using Fuzzy AHP and Fuzzy Inference System

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Abstract

Competition is the driving force of today's economy and it is vital for organizations to gain competitive advantages. In recent years, outsourcing has been the focus of managers as a tool for developing organizations and improving productivity. This study deals to analyze the outsourcing risks of the supply chain in the automotive industry using fuzzy inference systems. For this purpose, in the first stage, outsourcing risk identified using research literature, then to summarize, a questionnaire is designed and provided to the experts of the automotive industry. Some of the factors were eliminated by experts' opinion and finally, nine main criteria (preparedness, selectivity, implementation, organizational output, supply, production, distribution and environment risk) and 43 sub-criteria were identified. Then, for each risk, three components of severity, probability and seriousness were measured and performance analysis criteria were identified and weighted by experts in the fuzzy hierarchical process. Research results after prioritizing, show that "inappropriate planning" with the weight of 0.029921 is in the first priority and "production capacity" and "the danger of war" risks with the weight of 0.02964 jointly were in the second priority. Finally, using a fuzzy inference system, the outsourcing risks in the supply chain of Saipa automotive company is analyzed to get the performance evaluation.

Keywords

Risk, Outsourcing, Supply Chain, Fuzzy Inference System

1. Introduction

One of the most important research topics in the literature on supply chain management (SCM) is supply chain risk management [1-4]. According to Turkmen and McCormack, this interest is driven by the uncertainty of the economic world, with business approaches such as increasing inland and international outsourcing and information technology development that involves the development of complex global chains [5]. Despite their major benefits, the wider supply chain is more vulnerable and puts organizations at higher levels of risk. If organizations fail to keep up with the speed of day science, they will inevitably get out of the square. Managers in developing countries have a strong interest in outsourcing as a potential value competition and production [6-8]. Outsourcing as a tool for developing organizations and enhancing productivity in the form of downsizing has been the focus of managers and executives in recent years. The term outsourcing is usually used when companies break down activities or vertical. The term was coined at the end of the 1980s for the subcontracting of management information systems [9]. The term outsourcing has in many cases been used to make decisions about getting out affairs. Terms such as making, buying, merging, or

disrupting activities refer to outsourcing, and some authors have used outsourcing to refer to vertical integration decisions [10].

Along with the benefits, it brings to organizations; it also brings risks and perils. Therefore implementation and adjustment of outsourced risk management is an important issue that should not be overlooked. Research shows that increased outsourcing can reduce costs and reduce the need for investment in facilities, equipment, and manpower. On the other hand, there is evidence that increased outsourcing can reduce innovation and control over tasks. In fact, outsourcing of business processes is estimated at $ 112 billion in 2004 and $ 128 billion in 2005 and is expected to grow at an average of 9.6%, while the world's average industrial economy is at 6.7%. Outsourcing is a strategy for sharing the risks and perils of investment and business. In outsourcing, in fact, management can create a portfolio for different areas of their business and select different contractors and different ways of outsourcing for the organization's activities, while reducing costs and using capital and the power of other companies also mitigates risks such as the risk of technology failure, technical knowledge, skills, and so on. Organizations use different and sometimes proprietary methods for outsourcing. There are different methods of outsourcing that can be categorized into different formats with different perspectives.

In general, the purpose of this research is to analyze the risks of supply chain outsourcing in the automotive industry using fuzzy inference systems. Recent advances in technology are moving towards increasing dynamics and making changes in life. In a supply chain, because creating a risk event at one point causes risk and disruption to other parts of the chain, trying to eliminate one particular risk may lead the supply chain to another risk. Therefore, it is important that all supply chain components have a common understanding of supply chain risk. Research shows that increased outsourcing can reduce costs and reduce the need for investment in facilities, equipment, and manpower. On the other hand, there is evidence that increased outsourcing can reduce innovation and control over tasks.

2. Research Background

In this section, some related theoretical backgrounds are presented.

2.1 Risk Management

The risk is events or unknown possible situations that affect the goals if they occur in a negative or positive way. Each of these events or situations has distinct causes and identifiable results and consequences [11]. Risk is the combination of the probability of an event and the extent of its consequences. Risk management is one of the major management topics that involve planning, organizing, monitoring and controlling all aspects of a project, including risk identification, measure it, risk response development and risk response control. Risk management is the process of identifying risks, assessing risks and trying to reduce risks at an acceptable level [12]. Risk management is a system that organization while identifying and analyzing risks, adopts a set of techniques and strategies to deal with them, and the degree of success of risk management depends on its ability to assess risks, employ the optimal combination of strategy, and provide appropriate feedback. The supply chain risk management tool mechanism is used to assess and separate risks in a cost-effective way. An appropriate risk management approach, if implemented well, can help

managers identify the appropriate control factors to implement the security needed to fulfill the organization's mission, thereby ensuring the survival of the organization and safeguarding the organization from the small and large risks [13].

2.2 The Concept of Outsourcing and Its Goals

Outsourcing consists of two words “out” and “sourcing”. Outsourcing as one of the tools of organization development and product promotion in recent years has been the focus of organization managers in our country. So to define outsourcing, we first need to clarify the meaning of deposit. Deposit refers to the assignment of work, responsibilities, and decision-making rights to another person. Outsourcing is the work that one organization does for another organization and gradually creates a kind of participation chain in the activities of the organization.

Outsourcing, traditionally known as the decision to buy or build, is the contractual assignment of domestic business to inland or international external suppliers [14]. This occurs when a company assigns a whole or a part of domestic business to a foreign provider. Outsourcing is defined as the strategic use of external resources for activities typically performed by internal forces and resources. In other words, outsourcing is transferring a function, combination or part of a specific function or activity to an outsourced contractor that is aimed at reducing costs, increasing specializing in tasks and improving the quality of services or finished products [15]. Choosing the activities to outsource is one of the most important decisions in this field.

2.3 Outsourcing Risks

Outsourcing is an appropriate way for organizations to reduce costs, focus on the main processes of service improvement, improve skills, reduce the time from idea to market and increase overall competitive advantage. Despite the potential benefits, outsourcing can also cause problems. Some of these risks in related literature [16-18] are as follows.

• Difficulty controlling outsourced processes.
• Organization dependency on suppliers.
• Changes in the working conditions of the organization over time.
• Difficult to return to pre-outsourcing conditions.
• Uncontrolled impact on staff of the organization.
• Reduce the feeling of job security in the staff of the organization.
• Increase initial costs.
• Need for the organization to monitor suppliers.
• Changing the nature of costs.
• Increased risk
• Possession transition.

2.4 Supply Chain

One of the most fundamental parts of any organization is the supply chain, which coordinates and provides the needs of all units from the initial stages such as procurement to final stages such as delivery and after-sales service. A variety of definitions of supply chain management are provided: Supply chain management is a partnership-based goal of linking extracurricular business operations

to a shared vision of market opportunity. In fact, this is a comprehensive management that can continue from raw material supply to final customer purchases [19]. The supply chain encompasses all activities related to the flow and conversion of goods from the material to the final consumer, as well as related information flows. Stedler defines: "The supply chain is a set of organizations that are divided into upstream and downstream organizations that seek to create value for the final customer through a variety of activities or processes" [15]. Mensa and Marcio (2014) also consider the supply chain to be a hierarchical chain of partners involved in the production process that supplies materials and transforms them into the final product or service in order to meet customer demand. The definition of supply chain management by the Global Supply Chain Association (GSCF) is developed as follows: "Supply chain management is the integration of key end-user business processes through main suppliers that provides products, services, and information that add value to customers and other stakeholders" [20]. Supply chain management has become a technical asset for the current state of global competition. The SCM strategies aim to be highly competitive, changes in product quality and customer service levels, and optimal performance in the field of operation, economical and environmentally friendly.

2.5 Fuzzy Inference System

In classical management science, using systematic and rational methods, managerial issues are analyzed and quantitative models are presented to assist managers in decision making. Therefore, it is based on precise and definite data and therefore in these methods ambiguous and fuzzy data have no place in modeling. Fuzzy science can design models that, like humans, are capable of intelligently processing qualitative information [21]. The fuzzy inference system provides a systematic process for converting a knowledge base into a nonlinear mapping [22]. For this reason, knowledge-based systems (fuzzy systems) are used in engineering and decision-making applications.

A fuzzy inference system has the following components:

1) A fuzzy maker at the input that converts numeric values of variables into a fuzzy set.
2) The fuzzy rule base is a set of if-then rules.
3) Fuzzy inference engine that converts inputs into outputs with a series of actions.
4) Defuzzi fication maker that converts the fuzzy output to a definite number.

The steps of the fuzzy inference system that can be seen in Figure 1 are as follows.

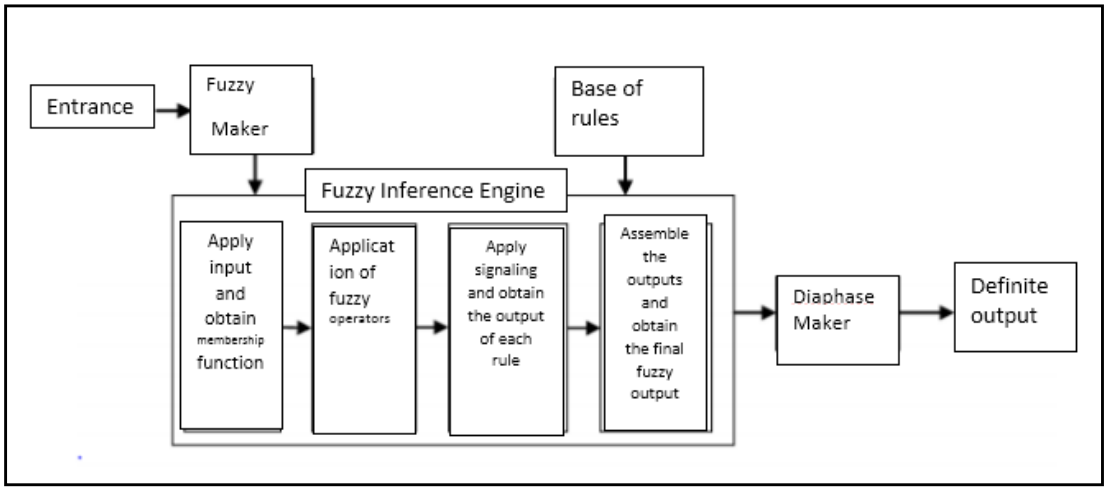

Figure1. Fuzzy inference system

3. Methodology

This research is theoretical-practical in terms of purpose and A little qualitative in terms of the nature of the data and cross-sectional in terms of data collection time. Also in terms of data collection in theoretical studies is library type and in the practical study is field type. The data collection tool for library studies is book and article and for field studies, it is a questionnaire. In gathering information and filling out questionnaires, academics are surveyed with doctoral degrees as academic experts. The research methodology is presented to continue step by step.

3.1 Step One

The first step is to identify the risks of outsourcing the supply chain in the automotive industry .In order to identify outsourcing risks, we first look at books, articles, and journals. The most important risks of outsourcing of the supply chain in the automotive industry are extracted from previous and most frequent researches and considered as the most important risks of outsourcing in the supply chain in the automotive industry.

3.2 Step Two

In this section, according to the factors identified in the previous section, a questionnaire was designed and distributed among a number of academic experts to complete.The validity of the questionnaire due to its clarity and appearance, the rationality of the questions was used by experts and validity was confirmed. The reliability of the questionnaire was calculated using Cronbach's alpha coefficient using SPSS software and Cronbach's alpha coefficient was 0.9 which is acceptable because it is higher than 0.8.

3.3 Step Three and Four

At this stage after testing and analyzing the results of the questionnaire Supply chain outsourcing risks are identified to comprising four key criteria. Risks are categorized into nine criteria of Preparation, Selection, Implementation, Output, Organizational, Supply and production and Environmental distribution risk are categorized.

3.4 Step Five

At this stage, the status of each batch is determined using the SPSS software and the single sample T technique.

3.5 Step Six

Due to the different weightings of the criteria for supply chain outsourcing risks in the automotive industry and the inability of the fuzzy inference system to apply the weighting of the analysis criteria, in this research, this problem has been solved by presenting a new method. By combining fuzzy AHP and fuzzy inference techniques, risk weighting and prioritization is performed.

3.6 Step Seven

At this stage, the 3 components of "risk probability", "risk severity", and "risk seriousness" are introduced as the primary components and basic requirements for coding.

3.7 Step Eight

At this stage, a questionnaire was designed to determine the importance of risk factors for supply chain outsourcing in the automotive industry and to identify risk components, risk severity, and seriousness, and to weigh the risk components. Data is obtained through questionnaires. Then prioritizing and ranking outsourcing risks is obtained and the results are analyzed. Fuzzy numbers are equivalent to the alternate variables of verbal changes obtained from the questionnaire.

The outsourcing risks are weighted using a fuzzy AHP technique that is one of the multiple criteria decision-making methods. The basis of this method is based on pair wise comparisons. This starts with the creation of the decision tree, which is at the first level, the goal; at the second level, the decision criteria, and at the third, the decision options. For "n" given criterion, the weight of each criterion is obtained by pairwise comparison of the criteria. To evaluate options in the face of criteria, each option is evaluated in pairs, and in face of each criterion is independently evaluated, and the degree of articulation between the numbers 1 and 9 is assigned.

3.8 Step Nine

Domain input variables:

Low: (0, 1, 2) Medium: (1, 2, 3) High: (2, 3, 4) Domain Output Variable: VL: Very low (1)

L: Low (1-1.49) ML: Medium downward (1.50-1.99) MH: Medium upward (2-2.49)

H: High (2.50-2.99) VH: Very high (3)

3.9 Step Ten

At this stage, a questionnaire was designed to examine the relationship between risks and components and made available to experts to complete. Then in this stage, the linguistic variables are converted to fuzzy numbers and the average of these numbers is obtained, then these numbers are fuzzified and the scores of the relationship between the components and the risks are obtained.

Then by inserting the relationship points between the risks and components into the MATLAB software, the fuzzy if-then rules are planned considering the weight of each risk.

3.10 Step Eleven

Evaluating the ranking of supply chain outsourcing risks identified in the automotive industry using the proposed approach and determining their importance.

4. Results and Findings

The results of the first and second steps of the research aimed at identifying outsourcing risks in the supply chain. A list of outsourced risks was prepared by searching the studies, then summarizing and filtering them based on the number of duplicates in the background and eliminating overlapping factors and interviewing experts. Then, according to the third and fourth steps of the study, according to this questionnaire outsourcing risks are assessed with their weight of importance. The importance weights of the factors are calculated by expert opinion using geometric mean and Excel software. The results along with the weight of significance are presented in Table1.

Table1. Outsourcing risks in the supply chain

Weight of importance	Sub- Criterion	Criterion	Row
0.0382	Deciding on the risk of outsourcing the project	Risk of preparation	1
0.036	Potentially high cost		
0.0289	Risk of selective asymmetry	Selective risk	2
0.0354	Outsourcing Contract Risk		
0.0333	Staff Resistance Risk	Implementation risk	3
0.254	Risk of non-supervision		
0.0260	Moral Risk of Outsourcing		
0.0238	Outsourcing Instability Risk		
0.0292	Information security risk	Output Risk	4
0.0364	analysis of costs and benefits risk		
0.0395	Failure of management policies	Organizational risk	5
0.0364	Government policy		
0.0258	human mistake		
0.0239	Poor communication between supply chain		
0.0365	Non-commitment in the Green Supply Chain		
0.0398	Capacity constraint	supply risk	6
0.0342	Key supplier failure		
0.0298	Low-quality supplier		
0.0364	Material Risks		
0.0321	Inventory risks		
0.0250	Supplier Financial Instability		
0.0295	Product Design Risk	Production Risks	7
0.0288	Production capacity risk		
0.0365	Demand risk		
0.0395	Production quality risk		
0.0265	Improper planning		
0.0236	Prediction error		

0.0365	Worker Strike		
0.0395	Risk of machinery and equipment		
0.0342	Long time between start and finish of the		
0.0352	Risk of change in technology		
0.0281	Close to airport		
0.0321	Road quality		
0.0295	Demand fluctuations		
0.0274	Demand Forecast Risk	Distribution Risks	8
0.0350	Market-Related Risks		
0.0336	Inability to use green fuel		
0.0328	Risk of damage to the product		
0.0311	Political instability		
0.0329	Economic risks		
0.0265	Natural disasters occur during project	Environmental risk	9
0.0211	war		
0.0294	terrorism		

Then, to check the status of each batch of statistical tests, it is first necessary to organize and summarize the data in a significantly understood and communicated.Descriptive statistics methods are used for this purpose. These statistics are often represented in the form of descriptive statistics, one-dimensional tables, graphs, Center orientation features (median and mean) and dispersion tendency indices (range of variation, variance, standard deviation, skewness, elongation, and quadrature).

In this part how the research criteria and sub-criteria are distributed based on the most important central indices such as mean and dispersion indices such as variance and standard deviation will be considered. Table 2 shows the status of the descriptive statistics of the criteria and sub-criteria. The data in this table are calculated using SPSS software.

Table2. Descriptive statistics of criteria and sub-criteria

Elongation	Skewness	Variance	Standard deviation	Average	Criterion and sub criterion
0.004	0.040	0.404	0.635	3.675	preparation Risk
-0.451	-0.233	0.657	0.810	3.575	Selective risk
0.724	-0.715	0.545	0.738	3.622	Implementation risk
-0.399	-0.118	0.678	0.824	3.392	Output Risk
-0.274	-0.253	0.568	0.754	3.563	Organizational risk
-0.229	-0.217	0.487	0.698	3.577	supply risk
0.543	-0.515	0.377	0.614	3.742	Production Risk
0.395	-0.299	0.414	0.643	3.424	distribution risk
-0.649	-0.183	0.763	0.873	3.127	Environmental risk

The mean of all criteria and sub-criteria understudy is higher than 3, and since in Likert Five-choice range a mean above 3 indicates that the criterion is important in the above statistical population, so this factor indicates the influential role of the criteria and sub-criteria expressed in the effective components in this research.

After the scale was approved, the data are collected using t single sample test that has been used to prove the research hypotheses. Since the five-point Likert scale is used, the statistical expression of the research hypotheses is as follows:

$$H_0: \mu <= 3$$
$$H_1: \mu > 3$$

The test was conducted at a confidence level of 95%. So the error level is 0.05 In other words, the error level is α=5%; Therefore, if the test statistic value (significant value 1 or the same P-Value) is lower than the error level, the null hypothesis will be rejected and the test claim, is the relevant research hypothesis, will be confirmed. Otherwise, there would be no reason to reject the null hypothesis. T sample test was used to examine the significance of each of the research criteria.
Based on the results in Table 3, the significance of the obtained values for the criteria is calculated to be smaller than the error level (0.9). So the null hypotheses are rejected. Also, the upper and lower limit of the confidence interval is greater than zero (positive) and given that the numerical mean value is greater than thee, the researchers claim is confirmed. Therefore, with a confidence of 95%, all the identified criteria can be of good importance.

Table3. Single-sample t test results

Confidence interval		Significant value	Average	t value	Research Dimensions
upper limit	Lower limit				
0.758	0.591	0.000	3.675	15.946	preparation Risk
0.681	0.469	0.000	3.575	10.672	Selective risk
0.718	0.525	0.000	3.622	12.665	Implementation risk
0.500	0.284	0.000	3.392	7.148	Output Risk
0.662	0.464	0.000	3.563	11.228	Organizational risk
0.668	0.485	0.000	3.577	12.418	supply risk
0.822	0.661	0.000	3.742	18.165	Production Risk
0.508	0.339	0.000	3.434	9.900	distribution risk
0.241	0.012	0.030	3.127	2.178	Environmental risk

Then, according to the seventh step of the research, in order to identify the research components, the sub-criteria identified by the experts in the research literature that have been approved and finalized include 43 sub-criteria. Also, the components of analysis are extracted from the research literature and finally, 3 components are finalized. The pairwise comparisons matrix was used to determine component weight. In the pairwise comparisons matrix, all elements of each cluster must be compared in pairs. So if there is" *n*" element in a cluster comparison will be made.,
Therefore, pairwise comparisons have been made from the point of view of a group of experts. Experts' views have been quantified using the fuzzy scale.
First, the experts' point of view is gathered. Then the view of the experts is fuzzy. The geometric mean method has been used to integrate the experts' point of view in the fuzzy AHP method.

According to the results of the expert opinion aggregation, the pairwise comparison matrix is presented in Table 4.

Table4. Paired Comparison Matrix of Principal Components of Research

	C3			C2			C1		
1.334	1.602	1.892	1.191	1.522	1.903	1	1	1	C1
1.510	1.990	2.496	1	1	1	1.903	1.522	1.191	C2
1	1	1	0.401	1.990	0.662	1.892	1.602	1.334	C3

Based on the obtained final normal weight:
Probability with a normal weight of 0.410 is the highest priority.
The intensity with a normal weight of 0.377 is the second priority.
Deterioration with a normal weight of 0.212 is the last priority.
Now, the range of input and output variables defined by the experts is considered in the triangular membership function. three linguistic variables including low, medium, and high are considered for inputs as shown in Figure 2, and for its output, six linguistic terms defined as very low, low, medium down, medium up, high, very high, which is shown in Figure 3.

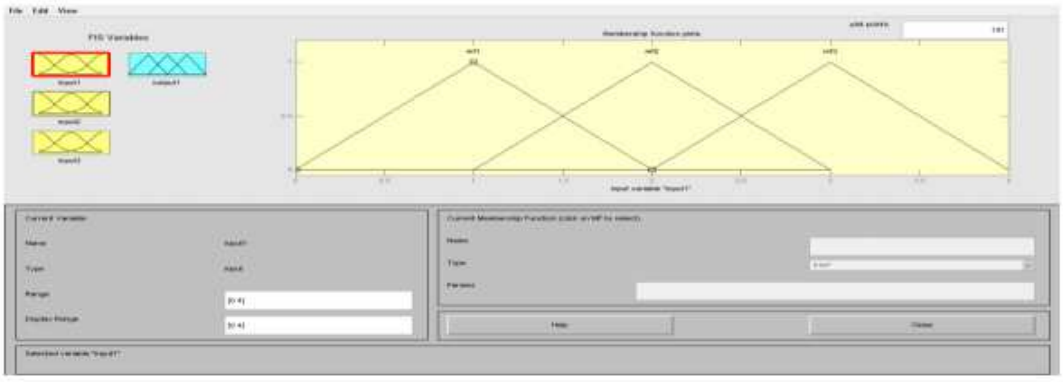

Figure2. Input variables

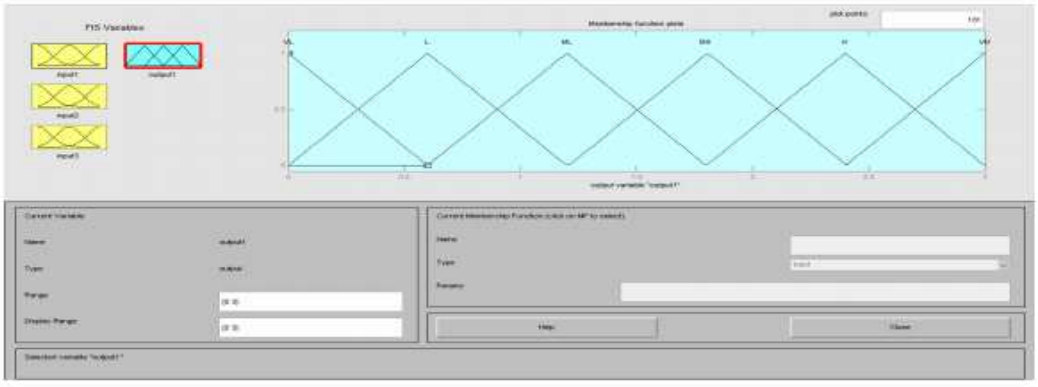

Figure3. Output Variable

At this stage, due to the different weights of the components of the information system analysis in the post-implementation phase and the inability of the fuzzy inference system to apply the weighting criteria, this problem is solved by presenting a method, which is as follows.
If W_i is considered the i^{th} weight criterion and A_i is the number of points of the ith criterion and also for membership functions of input variables that are low, medium, high, respectively consider the numbers 1, 2, and 2 (mentioned earlier), the following rule is taken for this:

If: $\sum W_i A_i = 1$, Then Very Low
If: $1 < \sum W_i A_i < 1.49$, Then Low
If: $1.50 < \sum W_i A_i < 1.99$, Then Midium Low
If: $2 < \sum W_i A_i < 2.49$, Then Midium High
If: $2.50 < \sum W_i A_i < 2.99$, Then High
If: $\sum W_i A_i = 3$, Then Very High

At this stage, in order to determine the rank of each sub-criterion, weights are normalized and prioritized by importance [23]. The results are summarized in Table 5.

Table5. Overall Prioritization of Sub-Criteria

Normal weight	Weight	Deterioration	Intensity	Possibility	Sub Criterion	Criterion
0.02069	1.57	1.467	2.000	2.667	Deciding on the risk of outsourcing the project	preparation Risk
0.02556	1.94	2.600	2.267	1.933	Potentially high cost	
0.01963	1.49	2.067	1.267	2.467	Risk of selective asymmetry	Selective risk
0.02029	1.54	2.133	2.133	1.333	Outsourcing Contract Risk	
0.02319	1.76	1.400	2.800	2.133	Staff Resistance Risk	Implementation risk
0.02372	1.8	2.600	2.733	1.267	Risk of non-supervision	
0.01871	1.42	2.200	2.067	1.200	Moral Risk of Outsourcing	
0.02503	1.9	2.667	2.800	1.400	Outsourcing Instability Risk	
0.01621	1.23	1.667	1.400	2.067	Information security risk	Output Risk
0.01647	1.25	2.533	1.867	1.200	analysis of costs and benefits risk	
0.01660	1.26	1.333	1.467	2.667	Failure of management policies	Organizational risk
0.02187	1.66	2.067	2.733	1.467	Government policy	
0.02675	2.03	2.467	2.533	1.933	human mistake	
0.02754	2.09	2.800	1.867	2.733	Poor communication between supply chain partners	
0.02806	2.13	2.133	2.667	2.533	Non-commitment in the Green Supply Chain	
0.02516	1.91	2.400	1.800	2.533	Capacity constraint	supply risk
0.02213	1.68	2.467	1.667	2.133	Key supplier failure	
0.02675	2.03	1.933	2.467	2.667	Low quality supplier	
0.02240	1.7	2.800	2.000	1.867	Material Risks	

0.01489	1.13	2.200	1.400	1.400	Inventory risks	
0.02306	1.75	2.067	2.867	1.400	Supplier Financial Instability	
0.02253	1.71	1.467	2.133	2.733	Product Design Risk	Production Risk
0.02964	2.25	2.533	2.667	2.800	Production capacity risk	
0.01370	1.04	1.400	1.333	1.400	Demand risk	
0.02951	2.24	2.667	2.467	2.667	Production quality risk	
0.02991	2.27	2.667	2.667	2.667	Improper planning	
0.02899	2.2	2.400	2.600	2.800	Prediction error	
0.02516	1.91	2.133	2.267	2.000	Worker Strike	
0.02925	2.22	2.600	2.533	2.667	Risk of machinery and equipment	
0.02806	2.13	2.467	2.333	2.533	Long time between start and finish of the production process	
0.01937	1.47	1.800	1.800	2.067	Risk of change in technology	
0.01818	1.38	1.867	2.067	1.467	Close to airport	distribution risk
0.02530	1.92	2.133	2.200	2.133	Road quality	
0.01765	1.34	1.867	1.867	1.400	Demand fluctuations	
0.02951	2.24	2.667	2.467	2.667	Demand Forecast Risk	
0.01805	1.37	1.933	1.667	1.733	Market Related Risks	
0.01568	1.19	1.800	1.400	1.600	Inability to use green fuel	
0.02793	2.12	2.267	2.667	2.467	Risk of damage to the product	
0.02503	1.9	2.200	1.933	2.267	Political instability	Environmental risk
0.02451	1.86	2.067	2.000	2.200	Economic risks	
0.02319	1.76	2.067	2.067	1.867	Natural disasters occur during project execution	
0.02964	2.25	2.533	2.667	2.667	war	
0.02451	1.86	2.133	2.067	2.000	terrorism	

According to the calculations, we can conclude that:
Inappropriate planning with a weight of 0.02991 is the second priority.
The risk of production capacity and the risk of war with a weight of 0.02964 are jointly top priority.
Demand forecast risk and production quality risk with a weight of 0.02951 is jointly the fourth priority.

5. Conclusion

The purpose of this study is to analyze the risks of supply chain outsourcing in the automotive industry using a fuzzy inference system. For this purpose, first by studying the research background, the risks of outsourcing in the supply chain were identified and then, in order to summarize and filter, with expert opinion the components were summarized. Then, in order to weigh the research sub-criteria, the main components of the research must first be weighted and ranked. The three main components included probability, severity and risk seriousness. By

combining these three components on the basis of the normal weight obtained for each of them (probability with a normal weight of 0.410, the severity with a normal weight of 0.377, and the seriousness with a normal weight of 0.212), the weight of each sub-criterion was obtained.

Now, by normalizing the weights, each risk can be prioritized according to the degree of importance. As shown in the tables, none of the risks were in the very high (3) and high (2.50-2.99) range. The 3 sub-criteria of the total sub-criteria are in the medium upward risk range (2-2.49).18 sub-criterion is in the medium-low risk range (1.5-1.99) and 12 sub-criterion is in the low-risk range, and no sub-criteria are in the very low-risk range (1).

Accordingly, first of all, there is no high-risk priority in Saipa Automotive Organization. But among the criteria reviewed, inadequate planning with a weight of 0.02991 is the top priority. There are also human error risks, poor communication between supply chain partners, non-commitment in the green supply chain, poor supplier quality, production capacity risk, inadequate planning, machinery and equipment risk, excessive time between start and finish of production process, demand forecast risk, risk of product damage and war are in the medium upward range (1-2%) of outsourcing risks, this indicates that they should be prioritized in the supply chain in Saipa Automotive Company. Also among these 13 identified risks, 6 items are related to production risks, which represent the priority of this field over other criteria in the first priority range of outsourcing risks namely organizational risk, supply risk, distribution risk and environmental risk. Finally, among the reviewed mentioned risks, the criterion of "inability to use green fuels" from the criterion of "distribution risk" has the lowest priority in Saipa Automotive Outsourcing Risks.

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