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Fulfilling External Stakeholders' Demands—Enhancement Workplace Safety Using Fuzzy MCDM

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Abstract: Sustainable development and project stakeholder management indicate a business practice where an organization strives to fulfil the demands of the important stakeholders for the project's success. If one company relies on subassembly parts from its supplier, then it might be considered that it has high interest for enhancing the business continuity of the supplier. This issue has become more complex during 2020 due to turbulent business conditions where the problem of the safety and health of workers during daily work has become one of main reasons for business vulnerability. Besides the above-mentioned, project stakeholders may have different demands. The implementation of the management actions that lead to the fulfilment of stakeholder demands (SDs), such as addressing ongoing issues, are almost always limited by the available budget. The contribution of this research is providing the input for determining the actions which should address the most important SDs. Those activities may be seen as part of the strategy for external stakeholder management and successful long-term relationship. The determination of the priorities of SDs is based on a fuzzy multicriteria optimization model with type-2 fuzzy sets.

Keywords: stakeholder demands; Delphi technique with IT2TFNs; IT2FTOPSIS

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1. Introduction

One of the activities that support the overall success of a project is stakeholder management. It may be considered as an on-going activity where identifying and prioritizing stakeholders embraces the input for determining the strategy about how to satisfy stakeholders' demands while achieving business goals.

No matter where the company is positioned in the supply chain, the relationship between supplier and customer is crucial for the business and it should be continually improved. It is usual in business practice that a company that is dependent of its suppliers to perform supplier audits periodically [1]. An important task of audits is to assess if suppliers have capability to meet demands over time.

This paper is focused on a model for stakeholder management with the determination of the most important stakeholders' demands and proposing alternatives which should be improved to satisfy their demands. Over the course of pandemic of 2020, business continuity and occupational health and safety have been identified as a major concern of companies and their stakeholders all over the world.

During the planning phase of projects, it is important to evaluate and rank risk factors, especially in the scope of occupational safety and health (OSH). This is also in compliance with other business activities which are not bounded to the projects. In the literature, there are no recommendations or rules on how to define a list of risk factors and scholars provide a variety of these [2]. Risk factors may be defined in a way such as (I) to obtain a list of hazards for subsequent evaluation using other risk assessment techniques, and (II) to perform a qualitative evaluation of the significance of the hazards and the measures for reducing the risks from them [3].

As original equipment manufacturers (OEMs) are more and more demanding regarding their suppliers regarding the capacity to fulfil uncertain demand, the motivation of this research is to increase the effectiveness of the business operations of manufacturing companies in the automotive industry. In the presented case study, increasing the effectiveness is aligned with the requirements of the new comprehensive standard (ISO 45001). The enhancement of occupational safety management in manufacturing companies can be seen as one of main initiatives in stakeholder management. Injuries at work can greatly affect the implementation and normal functioning of the production process [4]. Therefore, the importance of the safety and reliability management of workplaces is recognized [5] by both practitioners and researchers. By the end of the second decade of the 21st century, many challenges had been raised due to the increased level of complexity incurred by the pandemic. As part of the on-going challenges, many companies have raised the issue of business continuity activities of their suppliers.

While assessing the stakeholder demands, it is important to distinguish their relative importance and their real their value since these variables are different for the different branches of industry and for the companies themselves. The relative importance of SDs and their values can be significantly better assessed if natural language words are used than precise numbers. The development of some areas of mathematics, primarily fuzzy set theory, has enabled linguistic expressions to be well presented quantitatively, such as through: type-1 fuzzy numbers [6], type-2 fuzzy numbers [7], hesitant fuzzy numbers [8], intuitionistic fuzzy numbers [9] and linguistic fuzzy sets [10]. Type 2 fuzzy sets have grades of membership that provide new degrees of design freedom for the handling of uncertainties and are more capable of capturing the complexities found in social environments as well as the inherent vagueness of people's preferences. The computational effort with the interval type-2 fuzzy sets is reduced and their use is increased to solve different decision-making problems.

In theory, there are many techniques that may be employed for determining the relative importance criteria that are the topic of interest. In practice, the Delphi technique is very widely used in different areas [11,12]. The major weakness of the Delphi technique is the lack of a theoretical framework. Taking the completeness and consistency of decision-maker's (DMs) opinions, the fuzzy Delphi technique avoids misinterpreting the originality of statements [13]. In this research, the assessment of the relative importance of SDs is stated as a fuzzy group decision-making problem. The modelling of the used linguistic terms is based on using the interval type-2 triangular fuzzy numbers (IT2TFNs) [14]. By the analogy of the conventional Delphi technique, the weights of SDs are given in that iteration in which a consensus of DMs is reached.

The solutions of the complex management tasks are almost impossible to find by respecting only one criterion. Therefore, these problems are set as multicriteria decision-making problems. Numerous multicriteria decision-making methods (MCDM) have been developed in the literature with different mathematical and logical bases. The main characteristics of all MCDM include: (I) the alternatives to be evaluated, (II) the criteria against which the alternatives are evaluated, (III) scores that reflect the value of alternative's expected performance on the criteria, and (IV) criteria weighs that measure the relative importance of each criterion compared with the others [15]. These MCDM could be classified into different groups [16,17]. In engineering management domain [18], the most commonly used MCDM are: the Analytic Hierarchy Process (AHP) [19], the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) [20], the elimination and choice expressing reality (ELECTRE) [21], the multicriteria optimization and compromise solution (VIKOR) [22], Complex Proportional Assessment (COPRAS) [23], etc. The rapid and frequent changes that occur in the environment have led to the need to extend the MCDM methods with the different types of fuzzy numbers [8,9,24–26] in order to determine a more accurate priority.

For the purpose of criteria assessment and ranking, one of the very commonly used methods in different domains is the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) with Interval Type-2 Fuzzy Numbers (IT2TFNs), or in other words IT2FTOPSIS [27]. In general, the IT2FTOPSIS is based on knowledge of the Fuzzy Positive Ideal Solution (FPIS) and Negative Ideal Solution (FNIS), distances of alternatives from FPIS, and FNIS, as well as closeness coefficient, which can exploit the outranking relation, which is specific to a particular choice or a ranking problem. The main limitation of IT2FTOPSIS is a complex account. The purpose of this research is to extend the TOPSIS method [28] to the decision environment of IT2TFNs for the ranking of SDs. The feasibility and applicability of the proposed hybrid method are verified on the real-life data originating from automotive companies.

The wider goal of this research may be seen as providing input for forming the actions addressing the SDs ranked in first place as part of the strategy for external stakeholder management, enabling the fulfilment of stakeholder demands. This wider goal can be deconstructed into the following subgoals: (a) identify and rank project stakeholders, (b) rank the demands of the most important stakeholders, (c) develop a fuzzy two-stage model whose application determines the priority of stakeholder demands in an exact way.

The paper is organized into the following sections: Section 2 presents the literature review. In Section 3 the problem statement is presented. Section 4 presents the proposed model. The verification of the proposed model is performed by real-life data from the automotive industry, which is presented in Section 5. The conclusion is given in Section 6.

2. Literature Review

A number of challenges can arise with suppliers such as lower quality of the ordered products and subassemblies, cost overruns or schedule slippage. The practice indicates that the majority of the named issues may be addressed by implementing better organization and efficiency of workers. In order to implement actions that support business improvements, workers need to work in safe and healthy conditions. In this section the detailed literature review is presented in three domains: (1) stakeholder management in companies, (2) fuzzy Delphi technique with IT2FTNs, and (3) IT2FTOPSIS.

2.1. Stakeholder Management in Companies

Stakeholder analysis and management is a topic of interest to many scholars and practitioners [29]. From the perspective of the company that is engaged in project management, it is crucial to identify its stakeholders. This practice is applicable to any kind of company, especially those that are engaged in innovation [30] or other activities that support company projects.

An important aspect of project management activities is to know who the important stakeholders are and how they value the project goals. The named issues may be analyzed from the perspective of multicriteria analysis [31]. The proposed model takes in account the weights of the stakeholders and also embraces the stakeholder demands as well as the ranking of those demands. In this way, it sets the foundations for defining strategies about how to satisfy stakeholders' demands and how to manage stakeholders in an efficient manner. The demands of the stakeholders may differ, but due to current conditions and conditions in previous periods, many stakeholders stress the importance of human resources and risk management in order to provide business continuity of their operations. Recently, project stakeholders started emphasizing the importance of business continuity in terms of the health and safety policies of their suppliers. This may be recognized as a response to the pandemic crisis all over the world.

The efficiency of the plant can be understood in several ways and depends primarily on the production possibilities of the company. The level of vulnerability depends on productivity, sunk costs, and origin capital, health and safety policy, etc.

The risk level in the workplaces of small and medium production companies may be analyzed in uncertain environments [32]. On the other hand, a risk matrix evaluation can be used in industrial companies [3].

2.2. Fuzzy Delphi Method

The Delphi technique can be defined as a structured process for data collection during successful rounds involving multiple DMs with different specialties—between five and ten members are sufficient. According to the theoretical framework, if there is no consensus, the experts will be provided with the calculated mean as controlled feedback together with the questionnaire. After several rounds, when the consensus was achieved, based on the average of the final round, the items were screened [12].

There are a significant number of papers where the Delphi technique is enhanced with type-1 fuzzy sets [33,34]. The modelling of the linguistic statements using DMs by using IT2TFNs represents the main difference, and the advantage of this research over the analyzed papers. In the analyzed papers, the aggregation of the DM opinions into unique assessment (in the each iteration) can be given by using: (i) the fuzzy geometric operator [33], and (ii) the fuzzy averaging operator, as in the presented research.

In any intuitive method, such as the Delphi technique, the key question is when a consensus can be considered to have been reached. The attitude that the optimal solution is achieved in the second iteration is widely applied by practitioners, although this view has no theoretical basis. In this research, the consensus is considered to be reached when the variance of the aggregate score is less than the cut-off value.

In all of the analyzed papers, the decision-makers' assessment in the last iteration is presented by crisp value. In the presented research, it is described by IT2TFNs, which may be seen as a theoretical contribution.

2.3. Fuzzy MCDM

The analysis of the papers from the relevant literature has shown that the application of the fuzzy MCDM, which is based on the utility function, ix widely used in solving complex management problems in uncertain environments. This is applicable to Fuzzy Simple Additive Weighting (FSAW) [35], the Fuzzy Technique for Order of Preference by Similarity to Ideal Solution (FTOPSIS) [36,37], Multi-criteria optimization and compromise solution (FVIKOR) [38], Fuzzy Complex Proportional Assessment (FCOPRAS) [39] and Fuzzy Characteristic Objects Method (FCOMET) [15,40,41].

In this research, special attention is paid to the proposed IT2FTOPSIS method that can be found in the literature [36,37,42–45]. In all analyzed papers, the construction of the weighted fuzzy decision matrix is based on the fuzzy algebra rules [14].

Wu et al. [36] suggest that the determination of FPIS and FNIS can be based on the results of comparisons of two IT2FNs, which is developed by [46]. In this research, FPIS and FNIS are determined according to the procedure by analogy [47]. The distances from FPIS and FNIS are determined in compliance with: (I) procedure [48] by [36] and (II) Euclidean distance [45,49], which is widely used in the literature as well as in this research. In all analyzed papers the closeness coefficient values are determined according to the procedure proposed in conventional TOPSIS.

It should be highlighted that these methods have different mathematical bases, so they could be classified into different groups [16]. Some authors [50] consider that it is important to compare the results obtained by applying methods belonging to different groups. There are numerous methods in the literature that are used to check the consistency of ranks obtained by applying different methods [51], such as Spearman, Goodman–Kruskal, Kendall coefficient, etc. In this research, the consistency check was performed using the Coefficient of Rankings Similarity, *WS* [51], since it has some advantages in comparison with the other methods that can be found in the literature. Some of advantages are: (i) the value of the Coefficient of Rankings Similarity depends significantly more on alternatives that are placed in higher places in the rankings compared to those that are placed in lower places in the rankings (in practice, problem-solving is based on this principle), and (ii) the value of the Coefficient of Rankings Similarity is limited to a specific interval.

In the literature, there are papers where the results obtained by using FSAW and FTOPSIS [52] are compared, as is proposed in this paper.

3. The Problem Statement

The continuous improvement of products and processes is one of the formal requirements of the ISO 9000 series of standards, which should lead to stable business operations in the long run. The results of good practice show that the set goal can be achieved through the implementation of projects for the development of new and/or improvement of existing products. Numerous stakeholders, who have been recognized by the company's top management, are involved in defining and implementing these projects.

On the other hand, the importance of human resources was also recognized by classical management theories, and they have gained special importance in modern management theories.

The procedure for the problem solving is presented in Figure 1.

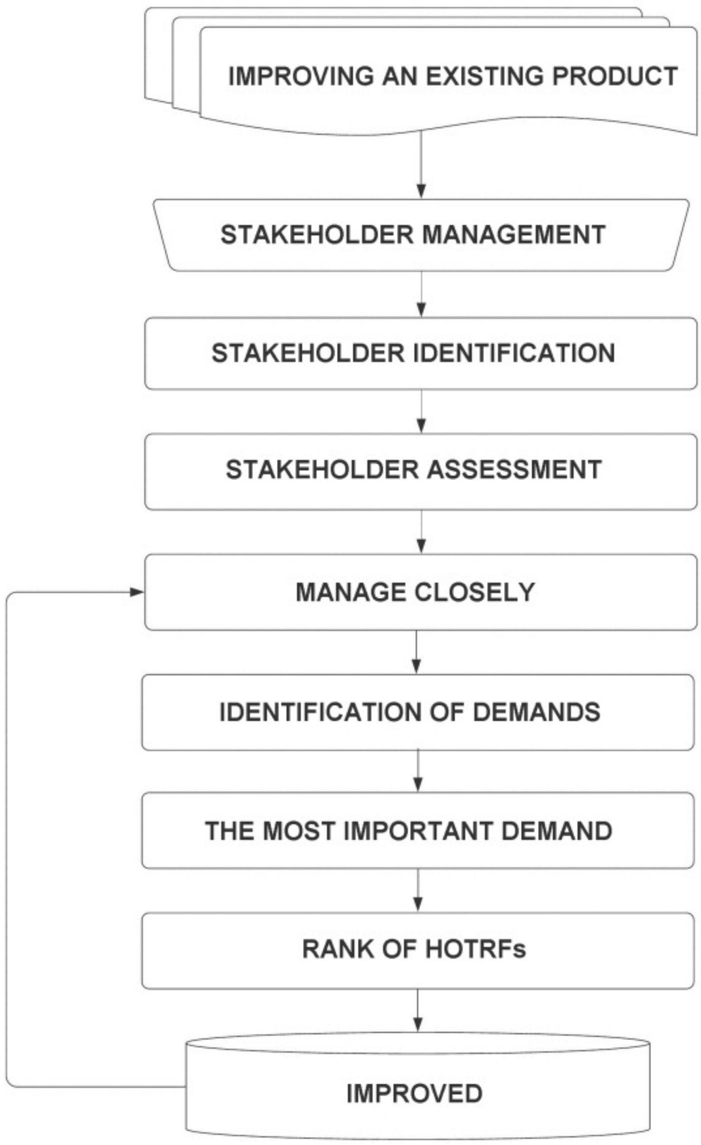

Figure 1. Improving an existing product.

These days, due to numerous changes, both in the field of technology, and above all in the economic and social domain, it can be argued that human resources are the most important resource of a company. With respect to this fact, health and safety at work is one of the most important tasks for management, which is regulated by the ISO 45001 standard.

3.1. Formalization of the Stakeholders

Numerous stakeholders have a significant influence on the development and implementation of projects, and thus on the company's operations. They can be formally represented by a set of indices $\{1, \ldots, s, \ldots, S\}$. The total number of stakeholders is denoted as S and $s = 1, \ldots, S$, is the index of the stakeholder. The list of the stakeholders is defined by the top management of the company.

In this research, the stakeholders are: local government, local community, legislatures, customers, suppliers, financiers, and employees. It is known from the results of good practice that these stakeholders have different importance, which can be assessed by numerous criteria. These criteria may be formally presented as the set $\{1, \ldots, k, \ldots, K\}$. The total number of criteria is denoted as K, and $k = 1, \ldots, K$. The experience of good practice and project management standards indicate that the stakeholders are assessed by applying two criteria: (1) interest in the project, and (2) impact on the project, which is delivered in this research.

3.2. Formalization of the Decision-Making Group

Formally, DMs are represented by a set of indices $\{1, \ldots, e, \ldots, E\}$. The index of DM is denoted as e, $e = 1, \ldots, E$, and E is the total number of DMs. DMs come from different business processes and are also located at different hierarchical management levels. In this research, the relative importance of the SDs is assessed by the following DMs: HR manager, industrial psychologist, production manager, logistic manager, quality manager, safety manager, production supervisor, data analysis manager, professional maintenance manager, and autonomous maintenance manager.

3.3. Definition of a Finite Set of Company Organizational Units

In the scope of the proposed problem, different organizational units of the company may provide an effort in order to satisfy SDs. Production in one manufacturing process can be delivered in different organizational units or workplaces. Formally, these workplaces can be presented by a set of indices $\{1, \ldots, i, \ldots, I\}$. The index of the workplace is denoted as i, $i = 1, \ldots, I$. In some workplaces, manufacturing operations are automated and workers are hired whose knowledge is lower than workers who work in jobs that are not automated. It should be emphasized that the experience of the workers in different jobs is different.

3.4. Definition of a Finite Set of SDs

SDs may be delivered by the most important stakeholder(s) working on on-going project(s) and those are formally represented by the set $\{1, \ldots, r, \ldots, R\}$. The total number of SDs is denoted as R, and r, $r = 1, \ldots, R$ is index of SD.

The most important SD should be deconstructed to SD components (SDCs) which should be assessed and ranked so adequate actions may be defined and incorporated in the stakeholder management strategy. The SDCs formally represented by the set $\{1, \ldots, j, \ldots, J\}$. The total number of SDs is denoted as J, and j, $j = 1, \ldots, J$ is index of SD. In the presented case study, the SDCs are the human, organizational, and technical/technological risk factors (HOTRFs).

4. Methodology

This section first formulates modelling of the existing uncertain and imprecise variables. In the end, the hybrid model that integrates the Delphi technique with IT2TFNs and IT2TOPSIS is presented.

4.1. Modelling of the Uncertainties

In this paper, modelling and handling existing uncertainties into the relative importance of stakeholders, relative importance of SDs and the degree of belief that each SDs is fulfilled is based on IT2TFNs, which presents a special case of type-2 fuzzy sets and their operations [14]. It can be said that all types and types of uncertainties can be described quite well quantitatively by using the IT2TFNs. At the same time, the scope and complexity of the computation are less compared to the use of IT2TrFNs.

Granularity is defined as the number of fuzzy sets assigned to the existing uncertainties where linguistic rating systems include different scales. In this research a nine-point scale is applied. The domains of IT2FNs are defined on the different measurement scales, for instance [0–1], as in this paper. The relative importance of the SDs is described by nine linguistic terms and modelled by corresponding IT2TFNs (Table 1).

Table 1. Pre-defined linguistic expressions for assessment of the Relative Importance of the SDs

The Relative Importance of the SDs	The Corresponding Values of SDs' Relative Importance
Extremely low importance (W1)	((0, 0.1, 0.25; 1), (0, 0.1, 0.2; 0.85))
Very low importance (W2)	((0.05, 0.2, 0.35; 1), (0.1, 0.2, 0.3; 0.85))
Low importance (W3)	((0.15, 0.3, 0.45; 1), (0.2, 0.3, 0.4; 0.85))
Fairly low moderate importance (W4)	((0.25, 0.4, 0.55; 1), (0.3, 0.4, 0.5; 0.85))
Moderate importance (W5)	((0.35, 0.5, 0.65; 1), (0.4, 0.5, 0.6; 0.85))
Fairly high moderate importance (W6)	((0.45, 0.6, 0.75; 1), (0.5, 0.6, 0.7; 0.85))
High moderate importance (W7)	((0.55, 0.7, 0.85; 1), (0.6, 0.7, 0.8; 0.85))
Very high importance (W8)	((0.65, 0.8, 0.95; 1), (0.7, 0.8, 0.9; 0.85))
Extremely high importance (W9)	((0.75, 0.9, 1; 1), (0.8, 0.9, 1; 0.85))

Degrees of the belief that SDs are fulfilled are assessed by the top manager. He may adequately express his assessments by using 7 linguistic expressions modelled by IT2TFNs (Table 2).

Table 2. Pre-defined linguistic expressions for assessment of the Values of SDs

The Values of SDs	The Corresponding Values of SDs
Very low degree of belief (V1)	((1, 1, 3.5; 1), (1, 1,3; 0.9))
Low degree of belief (V2)	((1, 2.5, 4;1), (1.5, 2.5, 3.5; 0.9))
Fairly medium degree of belief (V3)	((2.5, 4, 5.5; 1,), (3, 4, 5; 0.9))
Medium degree of belief (V4)	((3.5, 5, 6.5; 1,), (4, 5, 6; 0.9))
Fairly high degree of belief (V5)	((4.5, 6, 7.5; 1,), (5, 6, 7; 0.9))
High degree of belief (V6)	((6, 7.5, 9; 1,), (6.5, 7.5, 8.5; 0.9))
Very high degree of belief (V7)	((7.5, 9, 9; 1,), (8, 9, 9; 0.9))

The domains of these IT2TFNs are defined on a common measurement scale [1–9].

4.2. The Proposed Algorithm

The proposed algorithm is composed of two parts, which are: (1) the selection of the most important stakeholder and SDs and (2) the ranking of the selected SDCs by applying the proposed IT2FTOPSIS.

4.2.1. The Selection of the Most Important Stakeholder and SDs

The procedure of the most important stakeholder's selection is shown:

Step 1. The relative importance of the stakeholder s, $s = 1, \ldots, S$, according to the criterion k, $k = 1, \ldots, K$ is assessed by the top management:

$$\tilde{\tilde{W}}_s^k \tag{1}$$

Step 2. The aggregated relative importance of the stakeholder s is given by using the geometric mean.

$$\tilde{\tilde{\theta}}_s = \sqrt[k]{\prod_{k=1,\ldots,K} \tilde{\tilde{W}}_s^k} \tag{2}$$

Step 3. Determination of the representative scale of IT2TFN, $\tilde{\tilde{\theta}}_s$, θ_s by using the Defuzzified Triangular Type-2 Fuzzy Sets (DTriT) approach [53]. Let us sort the values θ_s in the descending order. The rank of the stakeholders is based on the obtained order. It may be assumed that the most important stakeholder is ranked as the first in the rank.

Step 4. The definition of the operational management actions is oriented to the demands of the most important stakeholder. The SDs are defined in compliance with the results of good practice, literature recommendations or business evidence. In the scope of this research, the treated demands are defined by existing literature [1]. Those are: costs, product quality, technology capability, delivery reliability, environment management systems, waste management, waste pollution, safety, the rights and health of employees, staff development, and information disclosure. The most important SD should be deconstructed to the SD components (SDCs) which should be assessed and ranked so adequate actions may be defined and incorporated into the stakeholder management strategy.

4.2.2. The Ranking of the Selected SDCs by Applying Proposed IT2FTOPSIS

The proposed algorithm is realized through the following steps.

Step 1. In the first iteration, the relative importance of SDCs j, $j = 1, \ldots, J$ is assessed by DMs, e, $e = 1, \ldots, E$:

$$\tilde{\tilde{W}}_j^e \tag{3}$$

Step 2. The aggregated relative importance of SDCs j, $j = 1, \ldots, J$ with respect to all DMs is given by using the fuzzy averaging operator:

$$\tilde{\tilde{W}}_j = \frac{1}{E} \cdot \sum_{e=1,\ldots,E} \tilde{\tilde{W}}_j^e \tag{4}$$

Step 3. Determine the variance of the aggregated value of the relative importance of SDCs j, $j = 1, \ldots, J$:

$$\frac{1}{E-1} \cdot \sum_{e=1,\ldots,E} \left(\tilde{\tilde{W}}_j - \tilde{\tilde{W}}_j^e \right)^2 = S_j^2 \tag{5}$$

where $(\tilde{\tilde{W}}_j - \tilde{\tilde{W}}_j^e)$ is calculated according to Euclidean distance formula [49].

Step 4. By applying the technique of analysis of variance, we test the hypothesis at the risk level of 5% that the variance of the aggregated assessment of the relative importance of SDCs j, $j = 1, \ldots, J$ less than the assumed value of variance σ_0^2. In case the alternative hypothesis is not correct, we return to Step 1. Otherwise, the weight of the SDs j, $j = 1, \ldots, J$ is the value obtained in Step 3.

Step 5. Let us construct a fuzzy decision matrix:

$$\left[\tilde{\tilde{x}}_{ji}\right]_{JxI} \tag{6}$$

The elements of fuzzy decision matrix are defined as the degree of belief that SDCs j may lead to a fulfilment of SDCs in organizational unit/work place i. The degree of these beliefs is modelled by IT2TFNs: $\tilde{\tilde{x}}_{ji}$, $j = 1, \ldots, J$; $i = 1, \ldots, I$.

Step 6. The weighted fuzzy decision matrix is given:

$$\left[\tilde{\tilde{z}}_{ji}\right]_{JxI} \tag{7}$$

where:

$$\tilde{\tilde{z}}_{ji} = \tilde{\tilde{\omega}}_j \cdot \tilde{\tilde{x}}_{ji} \tag{8}$$

The values of $\tilde{\tilde{z}}_{ji}$ are presented by IT2TFNs according to the fuzzy algebra rules [14].

Step 7. Fuzzy positive ideal solution, $\tilde{\tilde{z}}_k^+$, and fuzzy negative ideal solution, $\tilde{\tilde{z}}_k^-$:

$$(\forall i) : \tilde{\tilde{z}}_j^+ = \left(\left(\max_{j=1,\ldots,J} a_{1i}^U, \max_{i=1,\ldots,I} a_{2i}^U, \max_{i=1,\ldots,I} a_{3i}^U; 1 \right), \left(\max_{i=1,\ldots,I} a_{1i}^L, \max_{i=1,\ldots,I} a_{2i}^L, \max_{i=1,\ldots,I} a_{3i}^L; 0.75 \right) \right) \tag{9}$$

$$(\forall i) : \tilde{\tilde{z}}_j^+ = \left(\left(\min_{i=1,\ldots,I} a_{1i}^U, \min a_{2i}^U, \min_{i=1,\ldots,I} a_{3i}^U; 1 \right), \left(\min_{i=1,\ldots,I} a_{1i}^L, \min_{i=1,\ldots,I} a_{2i}^L, \mathrm{mim}_{i=1,\ldots,I} a_{3i}^L; 0.75 \right) \right) \tag{10}$$

Step 8. Distance from IT2FPIS, d_i^+, and distance from IT2FNIS, d_i^-:

$$d_i^+ = \sum_{i=1,\ldots,I} d\left(d_i^+, \tilde{\tilde{z}}_{ji}\right) \tag{11}$$

$$d_i^- = \sum_{i=1,\ldots,I} d\left(d_i^-, \tilde{\tilde{z}}_{ji}\right) \tag{12}$$

where $d\left(d_i^+, \tilde{\tilde{z}}_{ji}\right)$ and $d\left(d_i^-, \tilde{\tilde{z}}_{ji}\right)$ are the Euclidean distances between the two IT2TFNs [38].

Step 9. The closeness coefficient values can be given:

$$c_j = \frac{d_i^-}{d_i^+ + d_i^-} \tag{13}$$

Step 10. Overall degree of belief that all considered SDCs j may lead to a fulfilment of SDCs in organizational unit/work place i, $\tilde{\tilde{\delta}}_i$ is determined by the simple additive weighing with IT2TFNs (IT2FSAW) method:

$$\tilde{\tilde{\delta}}_j = \sum_{i=1,\ldots,I} \tilde{\tilde{z}}_{ij} \tag{14}$$

Step 11. The coefficient of ranking similarity values, γ_j is based on the comparison of fuzzy numbers [7].

Step 12. The closeness coefficient values, as well as coefficient of ranking similarity values are sorted into decreasing order. The rank of the SDCs is based on the constructed order.

Step 13. Calculate the coefficient of rankings similarity, WS [51]:

$$WS = 1 - \sum_{i}^{I} 2^{-R_{x_i}} \cdot \frac{\left|R_{x_i} - R_{y_i}\right|}{max\{|1 - R_{x_i}|, |I - R_{x_i}|\}} \tag{15}$$

where: R_{x_i} and R_{y_i} are the values in the rank of the alternative i according to the first and second methods, respectively.

5. Case Study

The proposed model was tested on real-life data derived from expertise which is part of the automotive supply chain. The company has been manufacturing molded rubber products, brake hoses, and rubber sealing profiles for many years, of which almost 85% of the products are produced for the automotive industry. The company is based in the Republic of Serbia, and has certificates for a number of international standards, such as: ISO 9001:2015, ISO 16949:2016, and ISO 14001:2015.

5.1. The Application of the Algorithm: The Selection of the Most Important Stakeholder and SDs

The assessment of the stakeholder importance was determined by the following criteria: (1) interest in the project, and (2) impact on the project data. The proposed variables were assessed by company's top management by applying brainstorming technique (Table 3).

Table 3. The assessment of the stakeholders' importance.

Stakeholders	Interest in the Project	Impact on the Project	$\tilde{\tilde{\theta}}_s$	θ_s
Local government (s = 1)	W3	W7	$\begin{pmatrix} (0.29,\ 0.46,\ 0.62;1), \\ (0.24,\ 0.46,\ 0.57;0.85) \end{pmatrix}$	0.408
Local community (s = 2)	W2	W1	$\begin{pmatrix} (0,\ 0.14,\ 0.29;1), \\ (0,\ 0.14,\ 0.24;0.85) \end{pmatrix}$	0.129
Legislatures (s = 3)	W4	W7	$\begin{pmatrix} (0.37,\ 0.53,\ 0.68;1), \\ (0.42,\ 0.53,\ 0.63;0.85) \end{pmatrix}$	0.487
Customers (s = 4)	W9	W8	$\begin{pmatrix} (0.67,\ 0.85,\ 0.97;1), \\ (0.72,\ 0.85,\ 0.95;0.85) \end{pmatrix}$	0.772
Suppliers (s = 5)	W7	W7	$\begin{pmatrix} (0.55,\ 0.7,\ 0.85;1), \\ (0.6,\ 0.7,\ 0.8;0.85) \end{pmatrix}$	0.647
Financiers (s = 6)	W8	W5	$\begin{pmatrix} (0.48,\ 0.63,\ 0.79;1), \\ (0.46,\ 0.63,\ 0.73;0.85) \end{pmatrix}$	0.574
Employees (s = 7)	W3	W3	$\begin{pmatrix} (0.15,\ 0.3,\ 0.45;1), \\ (0.2,\ 0.3,\ 0.4;0.85) \end{pmatrix}$	0.277

In compliance with current research trends [30], business customers as external stakeholders were recognized as highly important. This was confirmed by the calculations in the case study since the company's products are subassemblies that are embedded in the final product of the three original equipment manufacturers (OEMs) that are direct customers of the company.

In compliance with step 4 of the algorithm presented in Section 4.2.1, the decision-making team identified the most important SD. In the presented case study, it was the safety, rights and health of employees. The most important SD was deconstructed to its components (SDCs). Especially during the most recent period, the major customers identified the risk of their business continuity, which is dependent on the input provided from the analyzed company. The situation is even more complex having in mind the business turbulence caused by pandemic, so the health and safety of the workers has been put in the first place. In this research, it is assumed that the safety of workplaces in manufacturing industries is most influenced by SDCs which are appointed as HOTRFs [54] and presented in Appendix A.

The roles within this company that are considered in this research are: (1) crimping machine operator; (2) profile cutting and joining machine operator; (3) flocking machine operator; (4) extrusion machine operator; and (4) press operator. All employees have appropriate formal education and extensive work experience in similar jobs. The principle of continuous education is present in the company.

5.2. The Application of the Algorithm: The Ranking of the Selected SDCs by Applying Proposed IT2FTOPSIS

The procedure was designed to determine the weights of HOTRFs, which is in accordance with the assumptions introduced in the conventional Delphi technique. By e-mail, each DM received a questionnaire to assess the relative importance of HOTRFs. Furthermore, an aggregated estimate of the relative importance for each HOTRF in the previous iteration was sent to each DM using e-mail.

The proposed algorithm (Step 1 to Step 4) is illustrated on the example of determining the relative importance of HOTRF personal characteristics (j = 1). The assessments of the DMs are: W9, W5, W7, W3, W6, W2, W4, W1, W3, W2.

The aggregation of the assessments of the DMs into a single rating is performed by fuzzy averaging method, so that:

$$\tilde{\tilde{W}}_1 = ((0.28,\ 0.42,\ 0.57;1),\ (0.32,\ 0.42,\ 0.52;0.85))$$

The variance of the aggregated the relative importance of HOTRF (j = 1) is:

$$S_1^2 = \frac{1}{9} \cdot \sum_{e=1,\ldots,10} \left(\widetilde{\widetilde{W}}_1 - \widetilde{\widetilde{W}}_1^e \right)^2$$

$$S_1^2 = \frac{1}{9} \cdot \sum_{e=1,\ldots,10} \left(1.156^2 + \ldots + 0.539^2 \right) = 0.376$$

In this research, it is assumed that the maximum allowable value of variance is determined by the condition that 50% of DMs consider that the relative importance is described by the linguistic statement W8 and the other half by the linguistic statement W2. Within this assumption, the assumed value of variance $=$ 0.6. If the variance estimate of the DMs is less than 0.6 it can be considered that the DMs have reached consensus. The reverse is also true.

Let us test the 5% risk hypothesis that a consensus has been reached. The null hypothesis is defined as the DMs not reaching a consensus that is mathematically represented (=0.6). An alternative hypothesis defines that the DMs have reached a consensus that we mathematically represent (σ_1^2 < 0.6). The decision statistics are $\chi_1^2 = \frac{9 \cdot 0.376}{0.6} = 5.64$. The tabular value of the χ^2 distribution for a risk of 5% is $\left(\chi^2_{0.95,9} = 3.33 \right)$. As the calculated value is higher than the tabular value, it can be considered that the null hypothesis is adopted, i.e., that no consensus has been reached.

The distances between the IT2TFN describing the aggregated relative importance of the HOTRF (j = 1) of the predefined linguistic expressions are calculated by using the Euclidean distance. The minimum distance is given:

$$\min_{1,\ldots,9} \left(\left(d\left(\widetilde{\widetilde{W}}_1, W1 \right), \ldots, d\left(\widetilde{\widetilde{W}}_1, W9 \right) \right) \right)$$

$$= \min_{1,\ldots,9} (0.764, 0.539, 0.294, 0.049, 0.196, 0.444, 0.686, 0.391, 1.156) = 0.049$$

The DMs are provided with written information that the aggregate value of the assessment of the relative importance of HOTRF (j = 1) can be described by the linguistic statement W4.

In the second iteration, DMs again assess the relative importance of HOTRF (j = 1) with respect to the result obtained in the first iteration. These assessments are W7, W4, W5, W4, W5, W3, W4, W3, W4, W3.

In the second iteration, the aggregated relative importance of HOTRF (j = 1) is:

$$\widetilde{\widetilde{W}}_1 = ((0.29,\ 0.44,\ 0.59; 1),\ (0.34,\ 0.44,\ 0.54; 0.85))$$

Let us test the hypothesis of the DMs reaching consensus again, using the technique of analysis of variance. The decision statistics are 1.64 and less than the table value. So, it can be considered that a consensus of the DMs has been reached in this iteration.

The weights of the considered HOTRFs (presented in Appendix B) were determined in the same way. The fuzzy decision matrix (Step 5 of the proposed algorithm) is given according to the assessment of the DMs and it is presented in Table 4.

The weighted fuzzy decision matrix, and FPIS and FNIS are presented in Table 5a–c (Step 6 to Step 7 of the proposed algorithm).

By applying the proposed algorithm (Step 8 to Step 10) the rank of the HOTRFs is given and presented in Table 6.

By comparing the results obtained using the proposed IT2FTOPSIS and the IT2FSAW method combined with the fuzzy number comparison method, it can be clearly concluded that the ranking of the HOTRFs is almost stable.

The two HOTRFs that have the greatest impact on the safety of the workers in the workplace are: experience (j = 2) and technical characteristics of equipment (j = 11). The

HOTRFs that have the least impact on the safety of workers at the workplace are: relations (j = 5), organization and schedule of work tasks (j = 7), and personal characteristics (j = 1).

According to step 13 of the proposed algorithm, the coefficient of rankings similarity, WS when using IT2FTOPSIS and IT2FSAW are presented in Table 7.

According to the suggestion of the coefficient of rankings similarity method [51], respecting the obtained value of WS, it can be said that the consistency of the rankings can be described as high.

5.3. The Discussion of the Obtained Results

Starting from the conclusions the previous research [55] that even the establishment of OSH management system cannot achieve the desired results in the field of improving safety and health at work, concrete steps are needed. All companies interested in OSH improvements have to prioritize their actions and get more from less. Many researchers advise that leadership is the main and indispensable element for the success and the functioning of OSH and organization as well [56–60]. Bearing in mind all the mentioned facts, it is very important for the safety manager to determine the order in which appropriate measures are taken. By using the obtained priority, the safety manager may quickly and easily prioritize management initiatives, which at the same time leads to increased efficiency of the manufacturing process in the shortest possible time and at the lowest cost. The results of the proposed model (experience j = 2 and technical characteristics of the equipment j = 11) indicate the most common problems that companies have in the analyzed region. First, the lack of experienced workers in the market requires companies to employ a young workforce directly from high schools/colleges/universities. One of the ways to solve this problem is the establishment of training centers, internships for students in the final years of the study, etc. Another critical aspect for companies is the technological level of equipment, which could be improved, especially in the network domain [61]. The equipment used in the work processes is satisfactory and gives the required results, but it is also considered to be old. This could be solved by the country's external funding or by applying to funds that provide support to the economy. In this way, it could be possible to tackle the highest identified HOTRFs. After detailed cost/benefit analysis and the consideration of the possible management decisions, the effects of the HOTRFs ranked first and second could be minimized to the lowest possible level. This is all in accordance with the work practice, where the process of eliminating hazards or reducing risks is carried out through the redesign of technological processes, and the training and empowerment of the employees.

Table 4. Fuzzy decision matrix.

	$i = 1$	$i = 2$	$i = 3$	$i = 4$	$i = 5$
j = 1	V4	V5	V4	V4	V6
j = 2	V2	V5	V4	V6	V7
j = 3	V1	V6	V4	V6	V7
j = 4	V2	V6	V3	V7	V7
j = 5	V1	V6	V3	V5	V6
j = 6	V4	V7	V4	V6	V7
j = 7	V2	V7	V3	V6	V7
j = 8	V7	V7	V7	V7	V7
j = 9	V7	V7	V5	V5	V6
j = 10	V6	V6	V6	V6	V6
j = 11	V4	V6	V6	V7	V7
j = 12	V6	V5	V5	V5	V3
j = 13	V2	V7	V3	V6	V7
j = 14	V4	V6	V5	V7	V7
j = 15	V2	V6	V7	V5	V2

Table 5. The weighted fuzzy decision matrix, FPIS and FNIS.

(**a**)

	***i* = 1**	***i* = 2**
$j = 1$	((1.02, 2.20, 3.84; 1), (1.36, 2.20, 4.43; 0.85))	((1.31, 2.64, 3.84; 1), (1.70, 2.64, 3.78; 0.85))
$j = 2$	((0.61, 1.90, 3.56; 1), (0.99, 1.90, 3.01; 0.85))	((2.75, 4.56, 6.68; 1), (3.30, 4.56, 6.02; 0.85))
$j = 3$	((0.45, 0.60, 2.63; 1), (0.50, 0.60, 2.10; 0.85))	((2.70, 4.50, 6.75; 1), (3.25, 4.50, 5.95; 0.85))
$j = 4$	((0.42, 1.43, 2.88; 1), (0.71, 1.43, 2.35; 0.85))	((2.52, 4.28, 6.48; 1), (3.06, 4.28, 5.07; 0.85))
$j = 5$	((0.11, 0.23, 1.23; 1), (0.15, 0.23, 0.93; 0.85))	((0.66, 1.73, 3.15; 1), (0.98, 1.73, 2.64; 0.85))
$j = 6$	((1.23, 2.50, 4.23; 1), (1.60, 2.50, 3.60; 0.85))	((2.63, 4.50, 5.85; 1), (3.20, 4.50, 5.40; 0.85))
$j = 7$	((0.19, 0.85, 1.96; 1), (0.36, 0.85, 1.54; 0.85))	((1.43, 3.06, 4.41; 1), (1.92, 3.06, 3.96; 0.85))
$j = 8$	((1.20, 2.76, 4.14; 1), (1.68, 2.76, 3.69; 0.85))	((1.20, 2.76, 4.14; 1), (1.68, 2.76, 3.69; 0.85))
$j = 9$	((2.55, 4.41, 5.76; 1), (3.12, 4.41, 5.31; 0.85))	((2.55, 4.41, 5.76; 1), (3.12, 4.41, 5.31; 0.85))
$j = 10$	((1.26, 2.70, 4.59; 1), (1.69, 2.70, 3.91; 0.85))	((1.26, 2.70, 4.59; 1), (1.69, 2.70, 3.91; 0.85))
$j = 11$	((1.47, 2.85, 4.68; 1), (1.88, 2.85, 4.02; 0.85))	((2.52, 4.28, 6.48; 1), (3.06, 4.28, 5.70; 0.85))
$j = 12$	((2.16, 3.83, 5.94; 1), (2.67, 3.83, 5.19; 0.85))	((1.62, 3.06, 4.95; 1), (2.05, 3.06, 4.27; 0.85))
$j = 13$	((0.33, 0.48, 2.21; 1), (0.38, 0.48, 1.74; 0.85))	((2.48, 4.32, 5.67; 1), (3.04, 4.32, 5.22; 0.85))
$j = 14$	((0.98, 2.15, 3.77; 1), (1.32, 2.15, 3.18; 0.85))	((2.48, 4.32, 5.67; 1), (3.04, 4.32, 5.22; 0.85))
$j = 15$	((0.36, 1.28, 2.64; 1), (0.62, 1.28, 2.14; 0.85))	((1.68, 3.23, 5.22; 1), (2.15, 3.23, 4.51; 0.85))
FPIS	((2.55, 4.41, 5.94; 1), (3.12, 4.41, 5.31; 0.85))	((2.75, 4.56, 6.75; 1), (3.30, 4.56, 6.02; 0.85))
FNIS	((0.11, 0.23, 1.23; 1), (0.15, 0.23, 0.93; 0.85))	((0.66, 1.73, 3.15; 1), (0.98, 1.73, 2.06; 0.85))

(**b**)

	***i* = 3**	***i* = 4**
$j = 1$	((1.02, 2.20, 3.84; 1), (1.36, 2.20, 3.24; 0.85))	((1.02, 2.20, 3.84; 1), (1.36, 2.20, 3.24; 0.85))
$j = 2$	((2.14, 3.80, 5.79; 1), (2.64, 3.80, 5.16; 0.85))	((3.66, 5.70, 8.01; 1), (4.29, 5.70, 7.31; 0.85))
$j = 3$	((3.38, 5.40, 6.75; 1), (4.00, 5.40, 6.30; 0.85))	((2.70, 4.50, 6.75; 1), (3.25, 4.50, 5.95; 0.85))
$j = 4$	((1.05, 2.28, 3.96; 1), (1.41, 2.28, 3.35; 0.85))	((3.15, 5.13, 6.48; 1), (3.76, 5.13, 6.03; 0.85))
$j = 5$	((0.28, 0.92, 1.93; 1), (0.45, 0.92, 1.55; 0.85))	((0.50, 1.38, 2.63; 1), (0.75, 1.38, 2.17; 0.85))
$j = 6$	((1.23, 2.50, 4.23; 1), (1.60, 2.50, 3.60; 0.85))	((2.10, 3.75, 5.85; 1), (2.60, 3.75, 5.41; 0.85))
$j = 7$	((0.48, 1.36, 2.70; 1), (0.72, 1.36, 2.20; 0.85))	((1.14, 2.55, 4.41; 1), (1.56, 2.55, 3.74; 0.85))
$j = 8$	((1.20, 2.76, 4.14; 1), (1.68, 2.76, 3.69; 0.85))	((1.20, 2.76, 4.14; 1), (1.68, 2.76, 3.69; 0.85))
$j = 9$	((1.53, 2.94, 4.80; 1), (1.95, 2.94, 4.13; 0.85))	((1.53, 2.94, 4.80; 1), (1.95, 2.94, 4.13; 0.85))
$j = 10$	((1.26, 2.70, 4.59; 1), (1.69, 2.70, 3.91; 0.85))	((1.26, 2.70, 4.59; 1), (1.69, 2.70, 3.91; 0.85))
$j = 11$	((2.52, 4.28, 6.48; 1), (3.06, 4.28, 5.70; 0.85))	((3.15, 5.13, 6.48; 1), (3.76, 5.13, 6.03; 0.85))
$j = 12$	((1.62, 3.06, 4.95; 1), (2.05, 3.06, 4.27; 0.85))	((1.62, 3.06, 4.95; 1), (2.05, 3.06, 4.27; 0.85))
$j = 13$	((0.83, 1.92, 3.47; 1), (1.14, 1.92, 2.90; 0.85))	((1.98, 3.60, 5.67; 1), (2.47, 3.60, 4.93; 0.85))
$j = 14$	((1.26, 2.58, 4.35; 1), (1.65, 2.58, 3.71; 0.85))	((2.10, 3.87, 5.22; 1), (2.64, 3.87, 4.77; 0.85))
$j = 15$	((2.70, 4.59, 5.94; 1), (3.28, 4.59, 5.49; 0.85))	((1.62, 3.06, 4.95; 1), (2.05, 3.06, 4.27; 0.85))
FPIS	((2.70, 4.59, 6.48; 1), (3.28, 4.59, 5.70; 0.85))	((3.66, 5.70, 8.01; 1), (4.29, 5.70, 7.31; 0.85))
FNIS	((0.28, 0.92, 1.93; 1), (0.45, 0.92, 1.55; 0.85))	((0.50, 1.38, 2.63; 1), (0.75, 1.38, 2.17; 0.85))

(**c**)

	***i* = 5**
$j = 1$	((1.74, 3.30, 5.31; 1), (2.21, 3.30, 4.59; 0.85))
$j = 2$	((4.58, 6.84, 8.01; 1), (5.28, 6.84, 7.79; 0.85))
$j = 3$	((3.38, 5.40, 6.75; 1), (4.00, 5.40, 6.30; 0.85))
$j = 4$	((3.15, 5.13, 6.48; 1), (3.76, 5.13, 6.03; 0.85))
$j = 5$	((0.66, 1.73, 3.15; 1), (0.98, 1.73, 2.64; 0.85))
$j = 6$	((2.63, 4.50, 5.85; 1), (3.20, 4.50, 5.40; 0.85))
$j = 7$	((1.43, 3.06, 4.41; 1), (1.92, 3.06, 3.96; 0.85))
$j = 8$	((1.20, 2.76, 4.14; 1), (1.68, 2.76, 3.69; 0.85))
$j = 9$	((2.04, 3.68, 5.76; 1), (2.54, 3.68, 5.02; 0.85))
$j = 10$	((1.26, 2.70, 4.59; 1), (1.69, 2.70, 3.91; 0.85))
$j = 11$	((3.15, 5.13, 6.48; 1), (3.76, 5.13, 6.03; 0.85))
$j = 12$	((0.90, 2.04, 3.63; 1), (1.23, 2.04, 3.05; 0.85))
$j = 13$	((2.48, 4.32, 5.67; 1), (3.04, 4.32, 5.22; 0.85))
$j = 14$	((2.10, 3.87, 5.22; 1), (2.64, 3.87, 4.77; 0.85))
$j = 15$	((0.36, 1.28, 2.64; 1), (0.62, 1.28, 2.14; 0.85))
FPIS	((4.58, 6.84, 8.01; 1), (5.28, 6.84, 7.74; 0.85))
FNIS	((0.36, 1.28, 2.64; 1), (0.62, 1.28, 2.14; 0.85))

Table 6. Rank of human, organizational, and technical/technological risk factors (HOTRFs).

	c_j	Rank Obtained by IT2FTOPSIS	$\tilde{\tilde{\delta}}_j$	γ_j	Rank Obtained by IT2FSAW
$j = 1$	0.36	13	$\begin{pmatrix} (6.11, 12.54, 20.67; 1), \\ (7.99, 12.54, 19.28; 0.85) \end{pmatrix}$	0.039	14
$j = 2$	0.85	1	$\begin{pmatrix} (13.74, 22.80, 32.05; 1), \\ (16.50, 22.80, 29.29; 0.85) \end{pmatrix}$	0.085	2
$j = 3$	0.64	3	$\begin{pmatrix} (12.61, 20.40, 29.63; 1), \\ (15, 20.40, 26.60; 0.85) \end{pmatrix}$	0.079	5
$j = 4$	0.61	4	$\begin{pmatrix} (10.29, 18.25, 26.28; 1), \\ (12.70, 18.25, 22.83; 0.85) \end{pmatrix}$	0.069	9–10
$j = 5$	0.11	15	$\begin{pmatrix} (2.21, 5.99, 12.09; 1), \\ (3.31, 5.99, 9.93; 0.85) \end{pmatrix}$	0.034	15
$j = 6$	0.59	6	$\begin{pmatrix} (9.82, 17.75, 26.01; 1), \\ (12.20, 17.75, 23.41; 0.85) \end{pmatrix}$	0.071	7–8
$j = 7$	0.25	14	$\begin{pmatrix} (5.87, 12.32, 19.33; 1), \\ (7.76, 12.32, 16.84; 0.85) \end{pmatrix}$	0.043	13
$j = 8$	0.38	12	$\begin{pmatrix} (6, 13.80, 20.70; 1), \\ (8.40, 13.80, 18.45; 0.85) \end{pmatrix}$	0.051	12
$j = 9$	0.60	5	$\begin{pmatrix} (10.20, 18.38, 26.88; 1), \\ (12.68, 18.38, 23.90; 0.85) \end{pmatrix}$	0.080	4
$j = 10$	0.41	10	$\begin{pmatrix} (6.30, 13.50, 22.95; 1), \\ (8.45, 13.50, 19.55; 0.85) \end{pmatrix}$	0.058	11
$j = 11$	0.78	2	$\begin{pmatrix} (12.81, 21.67, 3.96; 1), \\ (15.52, 21.67, 27.48; 0.85) \end{pmatrix}$	0.094	1
$j = 12$	0.48	8	$\begin{pmatrix} (7.92, 15.05, 24.42; 1), \\ (10.05, 15.05, 21.05; 0.85) \end{pmatrix}$	0.069	9–10
$j = 13$	0.45	9	$\begin{pmatrix} (8.10, 14.67, 22.69; 1), \\ (10.07, 14.67, 20.01; 0.85) \end{pmatrix}$	0.072	6
$j = 14$	0.49	7	$\begin{pmatrix} (8.92, 16.79, 24.23; 1), \\ (11.26, 16.79, 21.65; 0.85) \end{pmatrix}$	0.081	3
$j = 15$	0.39	11	$\begin{pmatrix} (6.72, 13.44, 21.39; 1), \\ (8.72, 13.44, 18.55; 0.85) \end{pmatrix}$	0.071	7–8

Table 7. Coefficient of rankings similarity, WS.

	Rank Obtained by IT2FTOPSIS	Rank Obtained by IT2FSAW	Rank Obtained by IT2FSAW	Rank Obtained by IT2FTOPSIS
$j = 1$	13	14	14	13
$j = 2$	1	2	2	1
$j = 3$	3	5	5	3
$j = 4$	4	9.5	9.5	4
$j = 5$	15	15	15	15
$j = 6$	6	7.5	7.5	6
$j = 7$	14	13	13	14
$j = 8$	12	12	12	12
$j = 9$	5	4	4	5
$j = 10$	10	11	11	10
$j = 11$	2	1	1	2
$j = 12$	8	9.5	9.5	8
$j = 13$	9	6	6	9
$j = 14$	7	3	3	7
$j = 15$	11	7.5	7.5	11
WS	0.8815		0.8814	

6. Conclusions

This research presents a model for determining successful stakeholder management actions which are based on satisfying the most important project stakeholders and their SDs. As obtained in the case study, the customers are identified as the most important stakeholders of the treated company with SD for enabling business continuity through the care of employees regarding health and safety issues. This SD is deconstructed to its components (SDCs). Keeping in mind the on-going conditions and the pandemic's effects, it may be concluded that experience (2) has the most important influence. As an action that, different trainings may be proposed and incorporated in the company strategy. This leads to the increased sustainability and competitiveness of the company in the long run. By using risk analysis, health and safety managers can take adequate measures at the right time to reduce the risk factors that affect the safety and health of workers.

The assessment of SDCs is delivered by a fuzzy model for the evaluation and ranking of the SDCs which are denoted in the case study as HOTRFs with respect to their relative importance and values, simultaneously. The relative importance and values of the HOTRFs are assessed by the DMs, who put their assessments through linguistic expressions. These linguistic expressions are modelled by IT2TFNs. The relative importance of the HOTRFs is determined by the proposed fuzzy Delphi technique with IT2TFNs. In this research, a criterion was defined according to which it was assessed whether DMs had reached a consensus, which is the main theoretical contribution of the proposed Delphi technique compared to the extended fuzzy Delphi technique that can be found in the literature. After that, the priority of the HOTRFs was given according to the proposed IT2FTOPSIS.

It can be said that the main advantages of this model are: (I) describing the considered problem by formal language that enables the calculation of a solution in an exact way; (II) the existing uncertainties can be described by IT2TFNs; (III) the whole process of improved risk assessment can be carried out quickly and easily; (IV) the results of the model are understandable to anyone; (V) all the changes, as with the changes in the relative importance and values, can be easily incorporated into the model; and (VI) it can be easily implemented in the workplace, which enables the enhancement of the safety process.

The main limitation of the proposed model may be identified as the choice of the appropriate group of DMs. Their choice affects the reliability of the input data.

Future research should include the benchmarking of the obtained results with results that come from different companies within the automotive industry. Industrial management practice shows that in almost every production organization, maintaining the levels of workplace safety allows for an increase in the efficiency of the manufacturing process. Future research should also cover the consistency of the results, checking if: a) the uncertainties are described by different types of fuzzy numbers, and b) if the MCDMs belonging to different groups (defined in [16]) are applied. It is very important for practitioners to verify the model with data originating from different automotive companies, as well as in comparison to the obtained results.

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Appendix A

Table A1. The human, organizational, and technical/technological risk factors (HOTRFs).

No. of HOTRF	HOTRF	HOTRFs Indicators	No. of HOTRF	HOTRF	HOTRFs Indicators
$j = 1$	Personal characteristics	The percentage value is based on HR department assessment according to profile surveys of the employees. Current value is determined with respect to ideal state (100%) that could be possibly reached in observed company	$j = 9$	Workplace ergonomics	Assessment of employee-workplace interaction (percentage of ergonomics standards implemented)
$j = 2$	Experience	The number of years spent on job with required characteristics with respect to ideal state (in manufacturing sector this period is 5 years), respected to what employee could learn and achieve	$j = 10$	OSH system	State of occupational safety and health in observed company in respect to ideal state (number of injuries, unsafe condition and unsafe acts, number of implemented actions per year for OSH improvement)
$j = 3$	Level of training	The number of finished trainings in company with respect to planned number, for specific work activities (for example 4 finished trainings out of 10)	$j = 11$	Technical characteristics of Equipment	The current characteristics of equipment versus characteristics of equipment needed for easy and quality performing of the work tasks (for example using trolley for transporting parts versus manual handling)
$j = 4$	Behavior	Assessment of employees' attitudes in respect to work obligations and responsibility for work tasks. Ideal state set the company (for example percentage of broken deadlines by worker or getting late for work)	$j = 12$	Level of automatization	Level of current automatization versus level of possible automatization ratio (for example simple automatization versus worker)

Table A1. *Cont.*

No. of HOTRF	HOTRF	HOTRFs Indicators	No. of HOTRF	HOTRF	HOTRFs Indicators
$j = 5$	Relations	The percentage value is based on HR department assessment according to how good or bad are relations between employees (atmosphere in company). Current value is determined with respect to ideal state that could be possibly reached in observed company (for example how many conflicts occurred)	$j = 13$	Characteristics of safety equipment and devices	The level of applicability of current safety equipment and devices (for example percentage of removed safety devices from machines or state-of-the-art level of devices related to existing ones on market)
$j = 6$	Work place	This value depends on occupancy rate in a sense of working hours for observed workplace (for example 100% is working three shifts during six-day week)	$j = 14$	Maintenance level of equipment	The type of maintenance activities conducted regarding detailed yearly
$j = 7$	Organization and schedule of work tasks	The number of successful completed work tasks on time respect to planned (for example 1 finished and 1 is just started out of 5)	$j = 15$	Characteristics of personal protective equipment	The type of PPE used respect to needed PPE
$j = 8$	Information, procedures and documentation	The number of standards, procedures and following documentation implemented versus necessary ones in observed manufacturing sector			

Appendix B

Table A2. The assessment of the relative importance of HOTRFs and their aggregated values are presented in Appendix B.

RFs	Assessment of DMs	Variance/Decision-Making Statistics/Mean Value Estimate	Tabular Value at Risk Level 5%	Consensus	The RF Weights
$j = 1$	W9,W5,W7,W3,W6, W2,W4,W1,W3,W2	0.376/5.63/W4	3.33	No	((0.29, 0.44, 0.59; 1), (0.34, 0.44, 0.54; 0.85))
	W7,W5,W6,W4,W5, W3,W4,W3,W4,W3	0.109/1.64		Yes	

Table A2. *Cont.*

RFs	Assessment of DMs	Variance/Decision-Making Statistics/Mean Value Estimate	Tabular Value at Risk Level 5%	Consensus	The RF Weights
$j = 2$	W6,W6,W9,W7,W8, W9,W8,W5,W9,W9	0.131/1.338	3.33	Yes	((0.61 0.76, 0.89; 1), (0.66, 0.76, 0.86; 0.85))
$j = 3$	W9,W5,W6,W8,W9, W6,W7,W5,W2,W1	0.426/6.38/W6	3.33	No	((0.45, 0.6, 0.75; 1), (0.5, 0.6, 0.7; 0.85))
	W8,W6,W6,W7,W8, W6,W6,W6,W4,W3	0.147/2.20		Yes	
$j = 4$	W4,W6,W8,W7,W8, W6,W6,W5,W4,W3	0.171/2.61	3.33	Yes	((0.42, 0.57, 0.72; 1), (0.47, 0.57, 0.67; 0.85))
$j = 5$	W6,W4,W2,W2,W3, W2,W2,W2,W1,W1	0.134/2.005	3.33	Yes	((0.11, 0.23, 0.35; 1), (0.15, 0.23, 0.31; 0.85))
$j = 6$	W3,W7,W5,W5,W9, W6,W6,W9,W1,W1	0.474/7.11/W5	3.33	No	((0.35, 0.5, 0.65; 1), (0.4, 0.5, 0.6; 0.85))
	W4,W6,W5,W5,W8, W5,W5,W8,W2,W2	0.253/3.80/W5		No	
	W5,W5,W5,W5,W7, W5,W5,W7,W3,W3	0.107/1.60		Yes	
$j = 7$	W3,W2,W3,W7,W3, W5,W5,W2,W2,W2	0.176/2.64	3.33	Yes	((0.19, 0.34, 0.49; 1), (0.24, 0.34, 0.44; 0.85))
$j = 8$	W1,W1,W3,W5,W9, W5,W3,W1,W1,W1	0.408/6.15/W3	3.33	No	((0.16, 0.31, 0.46; 1), (0.21, 0.31, 0.41; 0.85))
	W2,W2,W3,W4,W7, W4,W4,W2,W2,W2	0.158/2.37		Yes	
$j = 9$	W2,W4,W3,W5,W5, W9,W6,W9,W3,W1	0.428/6.42/W5	3.33	No	((0.34, 0.49, 0.64; 1), (0.39, 0.49, 0.59; 0.85))
	W3,W5,W4,W5,W5, W8,W5,W8,W4,W2	0.219/3.28		Yes	
$j = 10$	W2,W1,W3,W3,W8, W9,W3,W1,W2,W2	0.459/6.87/W3	3.33	No	((0.21, 0.36, 0.51; 1), (0.26, 0.36, 0.46; 0.85))
	W3,W2,W3,W3,W7, W8,W3,W2,W3,W3	0.254/3.80/W3		No	
	W3,W3,W3,W3,W6, W6,W3,W3,W3,W3	0.058/0.86		Yes	
$j = 11$	W2,W2,W8,W6,W7, W8,W7,W5,W7,W8	0.320/4.80/W6	3.33	No	((0.42, 0.57, 0.72; 1), (0.47, 0.57, 0.67; 0.85))
	W3,W3,W7,W6,W6, W7,W6,W6,W6,W7	0.134/2.006		Yes	
$j = 12$	W2,W2,W7,W6,W6, W5,W4,W7,W6,W6	0.206/3.08	3.33	Yes	((0.36, 0.51, 0.66; 1), (0.41, 0.51, 0.61; 0.85))
$j = 13$	W2,W2,W5,W4,W4, W8,W7,W5,W7,W8	0.357/5.35/W4	3.33	No	((0.33, 0.48, 0.63; 1), (0.38, 0.48, 0.68; 0.85))
	W3,W3,W4,W4,W4, W7,W6,W4,W6,W7	0.144/2.16			

Table A2. *Cont.*

RFs	Assessment of DMs	Variance/Decision-Making Statistics/Mean Value Estimate	Tabular Value at Risk Level 5%	Consensus	The RF Weights
$j = 14$	W1,W1,W5,W3,W4, W4,W6,W4,W9,W8	0.408/6.07/W4	3.33	No	((0.28, 0.43, 0.58; 1), (0.33, 0.43, 0.53; 0.85))
	W2,W2,W4,W4,W4, W4,W5,W4,W8,W7	0.411/6.17/W4		No	
	W3,W3,W4,W4,W4, W4,W4,W4,W7,W6	0.094/1.41		Yes	
$j = 15$	W3,W3,W4,W4,W4, W8,W7,W5,W6,W7	0.192/2.88	3.33	Yes	((0.36, 0.51, 0.66; 1), (0.41, 0.51, 0.61; 0.85))

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