Research Article

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Applying the Heuristic to the Risk Assessment within the Automotive Industry Supply Chain

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Abstract: Risk management facilitates risk identification, evaluation, control, and by means of appropriate set of measures, risk reduction or complete elimination. Therefore, the risk management becomes a strategic factor for a company’s success. Properly implemented risk management system does not represent a tool to avoid the risk; it is used to understand the risk and provide the bases for strategic decision-making.

Risk management represents a key factor for the supply chain operations. Managing the risks is crucial for achieving the customer satisfaction and thus also a company’s success. The subject-matter of the article is the assessment of the supply chain in the automobile industry, in terms of risks. The topicality of this problem is even higher, as after the economic crisis it is necessary to revaluate the readiness of the supply chain for prospective risk conditions. One advantage of this article is the use of the Saaty method as a tool for the risk management within the supply chain.

Keywords: risk, supply chain, automotive industry, Saaty method

1 Introduction

Dynamcity and high competitive in the automotive industry influences Original Equipment Manufacturers (OEMs). Thus, they constantly introduce innovations aimed at maintaining, or, ideally, improving their position on the market [1] while implementing managerial practices.

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These practices include lean production, excellent production, intelligent manufacturing, sustainable manufacturing, learning organization, Just in time (JIT) inventory and e-commerce. One of the stock management strategies is the JIT. Just in time (JIT) inventory is a management system in which materials or products are produced or acquired only as demand requires [2, 3]. Leskova presents this concept in the process of supplying materials to an automotive assembly plant [4]. These “best practices” support agility, thus must be applied also by second-grade and third-grade suppliers. These suppliers are on lower positions within the supply network structure. The aim is to reduce the costs by elimination of wasting resources (the lean approaches) and increase the production efficiency [5].

Efficiency and functionality of the supply chain is negatively affected by many factors that must be identified, managed, and eliminated. These risk factors may be in mutual interactions and may result in undesired chain reactions and situations at each level of the supply chain (SC) [6, 7]. Hartel [8] points on the big financial losses caused by disruptions in various supply chains. Suppliers operating in the automotive industry are aware of the flat-rate penalty amount for the production downtimes attributed to manufacturing delay. Therefore, the stock amounts are subjected to analyses, optimisation, and strategic management.

Risks within supply chains may be classified using various methods and considering several aspects (economic, natural, policy, etc.). Manuj and Mentzer state [9] eight possible risks, which they divided into four categories of risks related to the supply chain, whereas the remaining four are the risks related to the environment. They are supply risks, operational risks, demand risks, security risks, policy risks, competitive risks, and resource risks. Chopra and Sodhi identify nine risk categories, particularly disruptions, delays, systems, forecast, intellectual property, procurement, receivables, inventory, and capacity [10]. For these categories, they also define the drivers. Jüttner, Peck, and Christopher distinguish three types of risks affecting the SCM (risks related to the company, risks related to the supply chain, risks related to the supply chain environment) and they use four
basic pillars of the risk management issues, in particular the risk sources, unfavourable consequences, risk drivers, and mitigation strategies [11].

In practice, it may frequently be the case that a situation occurs, resulting in undesired conditions, risky situations. It is very difficult to prevent such situations; that is why the risks and risky situations must be detected, analysed, and specifically managed. Ziegenbein presents three phases of risk management within supply chains (risk identification, evaluation, and management) [12].

With regard to the assessed company, it is appropriate to apply the 4-step risk management strategy, as defined by Hartel [8], with the aim to identify, evaluate, and manage risks and risky situations in the existing supply chain serving to automobile manufacturers and thus ensure the proper operation of this chain. This article only presents, with regard to the limited extent hereof, the results of risk identification, analysis, and evaluation, applying the Saaty method.

2 Methods

According to [13], the decision-making process is a non-random choice of one of the set of possible solutions on the basis of certain well-thought reason, in terms of fulfilment of the determined objective. Depending on the application of particular scientific procedures when formulating a decision, these methods are divided into three basic groups:

- Empiric decision-making methods, e.g., the Trial and Error method, brainstorming, and others.
- Exact decision-making methods, including mainly the basic methods of the Operational Analysis.
- Heuristic (mixed) decision-making methods, decision-making analysis methods, decision tree method, decision-making tables, simulated annealing method, genetic algorithms, neural networks, etc.

One of the methods of the comprehensive evaluation of risks within the supply chain is the multiple criteria decision-making method that is currently becoming more and more important in common decision-making situations [14]. When facing decision-making problems, it is necessary to consider all elements affecting the analysis result, their mutual relations, and intensity of their mutual impacts. One of the methods how to depict these facts is to create certain hierarchical structure (determination of the objective, appointing assessment experts, defining criteria and dividing them into subcriteria, assessment of variants). One of the methods of the decision-making problem analysis using the hierarchical structure is the Analytic Hierarchy Process (AHP), proposed by prof. Saaty in 1980 [15]. The Saaty Analytic Hierarchy Process belongs to the frequently used multiple criteria methods and is used in more complex decision-making tasks. The AHP method uses the pairwise comparison method, at which preferential relations of individual criteria pairs are identified. The pairwise comparison is carried out according to the recommended basic point scale (Table 1).

Rohacova and Markova present advantages and disadvantages of using the AHP method and its potential use in logistics [16]. Duc states that in comparison with other methods used to determine the weights, the Saaty method is better, as it also solves making even repugnant decisions and determines the measures when respondents’ decisions are inconsistent [17].

Table 1: Saaty point scale.

<table>
<thead>
<tr>
<th>Number of points</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Criteria are equally important.</td>
</tr>
<tr>
<td>3</td>
<td>The first criterion is slightly more important than the second one.</td>
</tr>
<tr>
<td>5</td>
<td>The first criterion is significantly more important than the second one.</td>
</tr>
<tr>
<td>7</td>
<td>The first criterion is demonstrably more important than the second one.</td>
</tr>
<tr>
<td>9</td>
<td>The first criterion is absolutely more important than the second one.</td>
</tr>
</tbody>
</table>

Values 2, 4, 6, and 8 may be used for more accurate differentiation of intensity of preferences of criteria pairs. The application of the Saaty method is based on the structure of the so-called Saaty matrix \( S \), containing elements \( s_{ij} \), representing the estimates of criteria weights proportions (how many times one criterion is more important than the other one). If the \( i^{th} \) and the \( j^{th} \) criteria are equal, then \( s_{ij} = 1 \). If the \( i^{th} \) criterion is slightly preferred to the \( j^{th} \) criterion, then \( s_{ij} = 3 \). Values on the Saaty matrix diagonal always equal 1:

\[
S = \begin{pmatrix}
1 & s_{12} & \cdots & s_{1n} \\
1/s_{12} & 1 & & \\
& \ddots & \ddots & \\
1/s_{1n} & 1/s_{2n} & 1
\end{pmatrix}.
\]

Weights of individual groups of criteria may be identified using the exact approach based on the calculation of eigenvalues and eigenvectors of the Saaty matrix.
In order to determine the weights of the examined criteria, we need to know the eigenvector $w$, corresponding to the maximum eigenvalue $\lambda_{\text{max}}$ of the Saaty matrix, which is calculated by solving the set of equations

$$(S - \lambda_{\text{max}}I)w = 0. \quad (2)$$

Weights of criteria are then identified using the standardised eigenvector $v$, where

$$v = (v_1, v_2, \ldots, v_n), \quad v_i = \frac{w_i}{\|w\|}, \quad i = 1, 2, \ldots, n,$$

$$\|w\| = \sum_{i=1}^{n} w_i. \quad (3)$$

Another method how to determine the weights of criteria from the assigned matrix is the calculation of geometric mean of each line of the Saaty matrix.

The precondition of a correct decision is adherence to the consistency rule when assigning importance to individual criteria - the risks. In case the consistency requirement is not met, the assessing person should reevaluate their assessment. Analysis of the criteria consistency is carried out using the consistency index $CI$ and using the so-called consistency ratio $CR$, for which it applies that

$$CI = \frac{\lambda_{\text{max}} - n}{n - 1}, \quad CR = \frac{CI}{RI}, \quad (4)$$

where $\lambda_{\text{max}}$ is the highest eigenvalue of the Saaty matrix, $n$ is the number of criteria, and $RI$ (Random Index) is the average consistency index. The matrix is sufficiently consistent, if $CI < 0.1$, or if $CR < 0.1$.

This article presents the weights of individual risks (criteria) groups, calculated using the exact approach based on the calculation of eigenvalues and eigenvectors of the Saaty matrix.

### 3 Results and discussion

The solution procedure consisted in the collection of information, selection of appropriate solving methods, brainstorming for the identification of risks within the supply chains, selection of a risk evaluation tool, creation of the Process Failure Mode and Effect Analysis (PFMEA), and evaluation of identified risks.

A case study of the SCM function was studied in a selected company, a subsidiary of the large Automotive concern, operating in sixteen countries and forty-three plants. The company’s product portfolio includes components for cars and trucks, e.g. transverse frames, front or back constructions of a vehicle. Until recently, the company was only focused on a single OEM. This single-customer focus strategy appeared to be inefficient and risky, and currently the company’s product portfolio is distributed to more than 10 customers.

#### 3.1 Risk identification

The risks were identified applying the brainstorming carried out by 3 experts. Brainstorming resulted in the list of significant 37 risks and risky situations, whereas the highest amount of risks were identified in the Supply Risks category and the lowest amount in the Security Risks category.

**Identified risk in the SC:**

**Supply Risks (SUP)**
- inability to meet the requirements (SUP1)
- price increase (SUP2)
- lack of raw materials and semi-finished products (SUP3)
- production equipment breakdown (SUP4)
- transporting equipment breakdown (SUP5)
- high quantity of suppliers (SUP6)

**Operational Risks (OPE)**
- capacity overload (OPE1)
- costs of quality (OPE2)
- technological innovations (OPE3)
- increased operational costs (OPE4)
- equipment and machinery breakdown (OPE5)
- strike of employees (OPE6)

**Demand Risks (DEM)**
- errors in prognostics (DEM1)
- reducing volumes of orders (DEM2)

**Security Risks (SEC)**
- theft (SEC1)
- sabotage (SEC2)

**Macro Risks (MAC)**
- unstable exchange rate (MAC1)
- increased tax rates (MAC2)
- changes in international trade conditions (MAC3)
- increased road toll (MAC4)
- deterioration of economic situation in the country (MAC5)

**Policy Risks (POL)**
- foreign policy risks (POL1)
- changes in social policy (POL2)
change of government (POL3)

Competitive Risks (COM)
- uncertainty about steps taken by competitors (COM1)
- lower prices (COM2)
- more advanced technology (COM3)
- higher production capacities (COM4)
- more reliable production (COM5)

Resource Risks (RES)
- costs of three-day emergency stock (RES1)
- limited financial resources in the company KHKft (RES2)
- limited budget from the headquarters Kirchhoff (RES3)
- necessity to take a bank loan (RES4)

Other Risks (OTH)
- natural disasters (OTH1)
- collapse of the information system (OTH2)
- social problems (OTH3)
- employee education level (OTH4)

3.2 Risk analysis

Risk analysis and evaluation was carried out while using the PFMEA comprehensive tool [18] and identifying the Risk Priority Number (RPN) for individual risks [19].

Out of identified Supply risky situations was observed the highest RPN value for the risk of cooperation with high quantity of suppliers. The following evaluated risks included Security and Macro Risks. Using the security service represents a risky situation of theft and sabotage. Operational Risks include risky situations which might disturb the company’s operations. The highest risk value within this category was assigned to the capacity overload due to improper planning. Demand Risks are evaluated as highly important, but their occurrence and the forecast-assisted detectability are not high. Policy Risks may cause disturbances in business conditions of the supply chain, but the probability of their detection is very low. Competitive Risks should be understood for the preparation stage of cooperation between individual units within the supply chain. This category of risks does not have, within the production state, a strong impact on the company’s position in the well-functioning chain. In the Other Risks category, natural disasters were assigned high importance, as the automotive industry in Japan was paralysed due to the destructive earthquake.

3.3 Identification of resulting standardised risk weights

In order to assess the supply chain in the automotive industry, the following basic risks were considered: Supply (SUP), Operational (OPE), Demand (DEM), Security (SEC), Macro (MAC), Policy (POL), Competitive (COM), Resource (RES), Other (OTH).

The resulting Saaty matrix $S$ for assessments made by experts is

$$S = \begin{pmatrix}
1 & 3 & 1 & 5 & 3 & 7 & 5 & 5 & 5 & 5 \\
1/3 & 1 & 1/3 & 5 & 5 & 7 & 5 & 5 & 3 & 5 \\
1 & 3 & 1 & 5 & 3 & 7 & 7 & 5 & 5 & 5 \\
1/5 & 1/5 & 1/5 & 1 & 1/3 & 5 & 5 & 3 & 3 & 1 \\
1/3 & 1/5 & 1/3 & 3 & 1 & 5 & 3 & 3 & 3 & 3 \\
1/7 & 1/7 & 1/7 & 1/5 & 1/5 & 1/3 & 1/3 & 1/3 & 1 & 1 \\
1/5 & 1/5 & 1/5 & 1/3 & 3 & 3 & 1 & 1 & 1 & 1 \\
1/5 & 1/5 & 1/5 & 1/3 & 3 & 1 & 1 & 1 & 1 & 1
\end{pmatrix}$$

Eigenvalues of the Saaty matrix $S$ were obtained by solving the equation

$$1 - \lambda \begin{pmatrix}
1 & 3 & 1 & 5 & 3 & 7 & 5 & 5 & 5 & 5 \\
1/3 & 1 - \lambda & 1/3 & 5 & 5 & 7 & 5 & 5 & 3 & 5 \\
1 & 3 & 1 - \lambda & 5 & 3 & 7 & 7 & 5 & 5 & 5 \\
1/5 & 1/5 & 1/5 & 1 - \lambda & 1/3 & 5 & 5 & 3 & 3 & 1 \\
1/3 & 1/5 & 1/3 & 3 & 1 - \lambda & 5 & 3 & 3 & 3 & 3 \\
1/7 & 1/7 & 1/7 & 1/5 & 1/5 & 1 - \lambda & 1/3 & 1/3 & 1/3 & 1/3 \\
1/5 & 1/5 & 1/5 & 1/3 & 3 & 1 - \lambda & 1/3 & 1/3 & 1 & 1 \\
1/5 & 1/3 & 1/5 & 1/3 & 3 & 3 & 1 - \lambda & 1 & 1 & 1 \\
1/5 & 1/5 & 1/5 & 1 & 1/3 & 3 & 1 & 1 & 1 & 1 - \lambda
\end{pmatrix} = 0.$$ 

The maximum eigenvalue corresponding to the Saaty matrix $S$ is $\lambda_{max} = 9.8727$. The eigenvector $w$ (2) corresponding to the maximum value $\lambda_{max}$ is

$$w = (0.5828; 0.4388; 0.5982; 0.1623; 0.2316; 0.0457; 0.0759; 0.1103; 0.0999)^T.$$

By transforming the eigenvector of the $S$ matrix into a standardised eigenvector $v$ (3), we obtained the vector containing the components determining the weights of individual criteria

$$v = (0.2485; 0.1871; 0.2550; 0.0692; 0.0987; 0.0195; 0.0324; 0.0470; 0.0426)^T.$$

The results indicate that the Demand Risks has the highest weight of 0.2550 and the second one in this order is the...
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Table 2: Resulting Risks Weights.

<table>
<thead>
<tr>
<th>Risks</th>
<th>SUP</th>
<th>OPE</th>
<th>DEM</th>
<th>SEC</th>
<th>MAC</th>
<th>POL</th>
<th>COM</th>
<th>RES</th>
<th>OTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (%)</td>
<td>24.85</td>
<td>18.71</td>
<td>25.50</td>
<td>6.92</td>
<td>9.87</td>
<td>1.95</td>
<td>3.24</td>
<td>4.70</td>
<td>4.26</td>
</tr>
<tr>
<td>Order</td>
<td>2.</td>
<td>3.</td>
<td>1.</td>
<td>5.</td>
<td>4.</td>
<td>9.</td>
<td>8.</td>
<td>6.</td>
<td>7.</td>
</tr>
</tbody>
</table>

Supply Risks with the weight of 0.2485. The lowest weight is assigned to the Policy Risks. Results of risks weights are presented in Table 2.

Analysis of criteria consistency will be carried out using the consistency index CI (4) and using the so-called consistency ratio CR (4), for which it applies that

\[ CI = \frac{\lambda_{\text{max}} - n}{n - 1} = 0.109, \quad CR = \frac{CI}{RI} = 0.075, \]

where \( \lambda_{\text{max}} = 9.8727 \) is the highest eigenvalue of the Saaty matrix, \( n \) is the number of criteria, and RI (Random Index) is the average consistency index, the value of which for \( n = 9 \) is 1.45. The values of consistency indexes indicate that the Saaty matrix may be regarded as sufficiently consistent and the evaluations of individual risks are not in mutual conflict.

The results indicate that the highest weight is assigned to the Demand Risks (25.5%) and the lowest one to the Policy Risks (1.95%). Resulting order is as follows: DEM > SUP > OPE > MAC > SEC > RES > OTH > COM > POL.

3.4 Identification of resulting standardised subrisk weights

In the following step we calculated the weights of risk in individual groups. In the Supply Risks group, the highest weight was observed for the inability to meet the requirements subrisk (40.8%), followed by the price increase subrisk (22.6%), lack of raw materials and semi-finished products (17.1%), and production equipment breakdown (10.9%).

In the Operational Risks group, the increased operational costs subrisk (33.5%) was identified as the subrisk with the highest weight. It was followed by the costs of quality (24.7%) and obsolete technology (19.6%). In the Demand Risks group, the reduction of volume of orders subrisk was assigned the highest weight (75%). In the Security Risks group, the sabotage subrisk was assigned the highest weight (75%). The highest weight (65.9%) in the Policy Risks group was assigned to the changes in social policy subrisk. In the Macro Risks group, the highest weight was calculated for the deterioration of the economic situation subrisk (37.5%). It was followed by the unstable exchange rate (30.5%) and the increased road toll (13.3%) subrisks, together with the increased tax rates subrisk (13.2%). The highest weights in the Competitive Risks group were assigned to more reliable production (31.3%), higher production capacities (29.0%), and more advanced technology (26.3%) subrisks. In the Resource Risks group, the highest weights were assigned to the limited budget from the Kirchhoff headquarters subrisk (37.1%) and the necessity to take a bank loan (34.1%) subrisk. In the Other Risks group, the most important risks were natural disasters (64.7%) and collapse of the information system (24.3%).

In all cases, the consistency requirement was met. Obtained subrisk weights were multiplied with the weights of respective group risks, with the result being the resulting weights of all considered risks (Table 3 – Table 7).

Analysis and evaluation of risks and subrisks indicate that the highest weight (preference) is held by the reduction of the volume of orders risk (19.13%) and the inability to meet the requirements risk (10.15%). Order of first five risks with the highest weights: reduction of the volume of orders (DEM2, 19.13%), inability to meet the requirement (SUP1, 10.15%), errors in prognostics (DEM1, 6.38%), increased operational costs (OPE4, 6.269%), and price increase (SUP2, 5.61%).

Subrisks on the lowest positions include lower prices (COM2, 0.20%), employee education level (OTH4, 0.22%), uncertainty about steps taken by competitors (COM1, 0.24%), social problems (OTH3, 0.25%), and change of government (POL3, 0.30%).

4 Conclusion

It is not easy for any production organisation to ensure competitiveness and stability on the market. This situation is even more difficult, if an organisation belongs to a chain and if previous as well as following chain units depend on the organisation’s operations.

The article identified the risky situations affecting the original equipment manufacturer operations and the implementation of the PFMEA. This serves as an appropriate tool for quality departments of production plants operating in the automotive industry. Creation of the PFMEA brings several benefits:
Table 3: Resulting values of subrisks weights – Part I.

<table>
<thead>
<tr>
<th>Subrisks</th>
<th>SUP1</th>
<th>SUP2</th>
<th>SUP3</th>
<th>SUP4</th>
<th>SUP5</th>
<th>SUP6</th>
<th>DEM1</th>
<th>DEM2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (%)</td>
<td>10.15</td>
<td>5.61</td>
<td>4.25</td>
<td>2.71</td>
<td>0.58</td>
<td>1.55</td>
<td>6.38</td>
<td>19.13</td>
</tr>
<tr>
<td>Order</td>
<td>2.</td>
<td>5.</td>
<td>8.</td>
<td>13.</td>
<td>28.</td>
<td>18.</td>
<td>3.</td>
<td>1.</td>
</tr>
</tbody>
</table>

Table 4: Resulting values of subrisks weights – Part II.

<table>
<thead>
<tr>
<th>Subrisks</th>
<th>OPE1</th>
<th>OPE2</th>
<th>OPE3</th>
<th>OPE4</th>
<th>OPE5</th>
<th>OPE6</th>
<th>SEC1</th>
<th>SEC2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (%)</td>
<td>2.17</td>
<td>4.62</td>
<td>3.67</td>
<td>6.27</td>
<td>1.47</td>
<td>0.50</td>
<td>1.73</td>
<td>5.19</td>
</tr>
<tr>
<td>Order</td>
<td>14.</td>
<td>7.</td>
<td>10.</td>
<td>4.</td>
<td>19.</td>
<td>30.</td>
<td>16.</td>
<td>6.</td>
</tr>
</tbody>
</table>

Table 5: Resulting values of subrisks weights – Part III.

<table>
<thead>
<tr>
<th>Subrisks</th>
<th>MAC1</th>
<th>MAC2</th>
<th>MAC3</th>
<th>MAC4</th>
<th>MAC5</th>
<th>POL1</th>
<th>POL2</th>
<th>POL3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (%)</td>
<td>3.02</td>
<td>1.30</td>
<td>0.54</td>
<td>1.31</td>
<td>3.71</td>
<td>0.36</td>
<td>1.28</td>
<td>0.30</td>
</tr>
<tr>
<td>Order</td>
<td>11.</td>
<td>21.</td>
<td>29.</td>
<td>20.</td>
<td>9.</td>
<td>31.</td>
<td>22.</td>
<td>33.</td>
</tr>
</tbody>
</table>

Table 6: Resulting values of subrisks weights – Part IV.

<table>
<thead>
<tr>
<th>Subrisks</th>
<th>RES1</th>
<th>RES2</th>
<th>RES3</th>
<th>RES4</th>
<th>OTH1</th>
<th>OTH2</th>
<th>OTH3</th>
<th>OTH4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (%)</td>
<td>0.35</td>
<td>1.00</td>
<td>1.74</td>
<td>1.61</td>
<td>2.75</td>
<td>1.03</td>
<td>0.25</td>
<td>0.22</td>
</tr>
<tr>
<td>Order</td>
<td>32.</td>
<td>25.</td>
<td>15.</td>
<td>17.</td>
<td>12.</td>
<td>23.</td>
<td>34.</td>
<td>36.</td>
</tr>
</tbody>
</table>

Table 7: Resulting values of subrisks weights – Part V.

<table>
<thead>
<tr>
<th>Subrisks</th>
<th>COM1</th>
<th>COM2</th>
<th>COM3</th>
<th>COM4</th>
<th>COM5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (%)</td>
<td>0.24</td>
<td>0.20</td>
<td>0.85</td>
<td>0.94</td>
<td>1.01</td>
</tr>
<tr>
<td>Order</td>
<td>35.</td>
<td>37.</td>
<td>27.</td>
<td>26.</td>
<td>24.</td>
</tr>
</tbody>
</table>

Identification and evaluation of risk events within a particular supply chain management,

- suggested measures to reduce the risk indicators and contains recommendations for further use of the FMEA results in a particular supply chain management.

The PFMEA tool for the risk management within the supply chain was applied to suggest the measures aimed at improving the chain’s resistance to situations that might disturb the supply chain functionality and cause thus inability to meet the requirements of the compiling company.

In this stage of research, authors wish to point out that in the decision-making process there are several risks affected by the appropriateness of the formulation of a particular problem, by the selection of methods, and the decision-making method. The group of risks also includes the risk related to quality of assessment of risks weights and preferences carried out by individual assessing persons, that is affected not only by the number of such persons, but also by their experience and accuracy of their estimates.

A case study of the SCM function is an example of a selected company, a subsidiary of the large Automotive company, operating in sixteen countries and forty-three plants. Practically, this case study is a proposed general solution of the procedure focused on the supply chain management in the automotive industry, in terms of risk management.

Early identification of risks and selection of a proper management strategy facilitate stable operation of companies integrated in the supply chain and lead thus to the elimination of risky situations in the entire supply chain. However, importance of reverse examination of revealed risks and reassessment should not be underestimated.
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