PARETO Analysis of the Supplier’s Risk

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Abstract: - Modern industry requires a careful planning and management of all the steps. Distribution of goods is an important part of a production flow because it is responsible for a rhythmic production (the raw materials arrive to the manufacturers based on the provider’s distribution) and for the product’s valorization, towards the beneficiaries. The suppliers are thus important parts of the production chain and their activities are key issues in the management of the full, complex process. The paper presents a risk analysis model as management instrument for any industrial company.

Key-Words: - risk analysis, supply distribution chain

1 Introduction
Distribution is a sector with a quite considerable size (15% of the total occupied population in EU), characterized by density and dynamism. Very few producers distribute directly to their final customers, in general they use specialised distributors. In some industries reasonable savings were possible due to the introduction of information technologies and modern „just in time” techniques.

The product/service distribution concept, through its place and role in the sphere of social reproduction, belongs in the third phase of reproduction: the change. Distribution covers the total of the operations which a product / service out of fabrication is made available to the consumer or user.

In modern marketing vision, distribution is a complex concept reflecting: physical circuit of merchandise, market relations and the total of the activities which mark the pass from the producer to the product consumer, including:

• the path of the merchandise to the final consumer;
• distribution channel;
• economic operations marking the successive passing till going into consume;
• physical or logistical distribution;
• technical infrastructure realizing operations (unit network, infrastructure, personnel).

In the after war period, the rapid evolution of distribution was marked by the reconstitution in economic theory and practice of the report production – consume, and by the technical and managerial transformations of this field. The most important factors pushing this evolution are: series production development and their diversification, leading to an increase of consume, and also the product evolution in terms of quality and technical aspects. So, distribution has the decisive role in insuring the flow of economic processes, as it finishes the activity of a producer, ending the production cycle and insuring financial resources for restarting economic activity.

Developing the company distribution policy, contributing to fulfilment of marketing objectives means not only to establish the distribution channels, but also to formulate the strategy and tactics of the physical distribution, respectively the merchandise logistics.

Valorification of the market opportunities and effective ending of the activities of companies producing goods and services are conditioned by products reaching consumers and final users, by satisfying needs for which they have been developed.

Between ending production and entering products / services in consume there is an assembly of operations and economic processes whose efficient orientation is the object of one marketing mix component – the distribution policy.

The quality – risk integrated management system can be considered an organizational and managerial concept oriented towards the future. This fact needs the approach of a qualified and concrete management at all responsibility levels.

In the modelling process of the integrated quality-risk management at the level of distribution systems, the risk manager must insure the optimization of identified costs and a structure of quality and risks costs, as a premise of optimal
developments of objectives established by effective management of the link risk – quality.

2. ABC (Pareto) Analysis of Suppliers risks

The paper proposes an algorithm for ABC analysis (Pareto analysis) of suppliers’ risks. Previously defined instruments will be used, especially the priority – risk matrix [1], as well as the ABC method, which classifies entities, on different criteria, in three classes [2]:

- **C Class**: interval 0 – 80%;
- **B Class**: interval 81 – 95%;
- **A Class**: interval 96 – 100%.

The algorithm for ABC analysis (Pareto analysis) of suppliers’ risks consists of the following steps:

**Step 1**: Establish the suppliers’ risks, noted \( R_1, R_2, R_m \).

**Step 2**: Evaluation of each risk \( R_i \) and establish \( IPR_i, i = 1, 2, ..., m \).

**Step 3**: Development of suppliers risk matrix is presented in Table 1.

<table>
<thead>
<tr>
<th>Risk</th>
<th>Probability</th>
<th>Impact</th>
<th>IPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>( R_1 )</td>
<td>X</td>
<td>X</td>
<td>IPR_1</td>
</tr>
<tr>
<td>( R_2 )</td>
<td>X</td>
<td>X</td>
<td>IPR_2</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>( R_k )</td>
<td>X</td>
<td>X</td>
<td>IPR_k</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>( R_m )</td>
<td>X</td>
<td>X</td>
<td>IPR_m</td>
</tr>
</tbody>
</table>

**IPR = IPR_k**

where the X-es represent the probability and impact scores.

**Step 4**: Sum of the priority – risk indicators:

\[
\sum IPR = \sum_{k=1}^{m} IPR_k ,
\]

(1)

**Step 5**: Sorting in descending order the supplier risks matrix, depending on the calculated values of \( IPR_k \).

**Step 6**: The calculation of the relative frequency of each risk \( (frel_i)\):

\[
frel_i = \frac{IPR_i}{\sum_{k=1}^{m} IPR_k} ,
\]

(2)

And of the cumulated relative frequency of each risk \( (frelcum_i)\):

\[
frelcum_i = frel_1 ,
\]

(3)

\[
frel_{cum_{k+1}} = frel_{cum_{k}} + frel_{k+1} .
\]

**Step 7**: ABC classification of suppliers’ risks and development of the Pareto diagram.

The previously proposed algorithm will be exemplified, considering a generic list of risks, coded \( R_1, R_2, ..., R_{15} \) (\( m = 15 \)).

The supplier’s risk matrix in Figure 1 is the result of the evaluation of probability and impact scores.

By ordering the risk matrix and then calculating the relative and cumulated relative frequencies, the results in figure 2 were obtained.

![Fig.1 Supplier’s risks matrix](image1.png)

![Fig.2 Ordered supplier’s risks matrix](image2.png)
An ABC classification of suppliers’ risks is in order. In figure 2, it can be noticed that the first six risks, R13, R11, R4, R5, R15 and R6 have a weight of 0.78 or 78% and they will be classified in class A. The following five risks R9, R12, R1, R10 and R14 reach a cumulated weight of 95%, and are classified in class B, while the last four will be classified in class C. The graphic representation of the Pareto diagram for suppliers’ risks is shown in figure 3.

The use of this classification and risk prioritizing method, allows a better approach of the supplier’s risks management. As noticed in the above Pareto diagram, for the proposed example, in class A are situated risks with a very high and high risk level. The actions for risks reduction / elimination / diminution must be oriented on these particular risks.

The proposed method can be integrated in the organization risks procedures. The Risk Registry, The Risk Card, as the main documents frequently used for recording and monitoring risks, can be completed with the proposed quantification elements, such as priority risk indexes, as well as the necessary elements establishing the relative and cumulated frequencies, allowing the development of the Pareto diagram.

On the other hand, the Pareto 80% – 20% method extended through the adoption of the 80% – 15% – 5% classes, offers an efficient management way to focus the action on a small number of risks, but with a weight of 80%.

3 ABC (Pareto) Classification of the suppliers based on medium risk

The ABC analysis will be extended on the classification of the suppliers from the supply and distribution chain. The proposed model will be used together with the metrics. The algorithm for the ABC (Pareto) analysis of the suppliers consists of the following steps:

Step 1: Establishing the Priority Medium Risk Index \((IPRM_j)\) of each supplier, based on the equation:

\[
IPRM_j = \frac{\sum_{k=1}^{m_j} IPR_k}{m_j},
\]

where \(j\) is the supplier index \(F_j, j = 1, 2, ..., n\).

Step 2: Establishing the Priority Value Risk Index \((IPRV_j)\) of each supplier, based on the equation:

\[
IPRV_j = IPRM_j \cdot \frac{V_j}{\sum_{k=1}^{n} V_k},
\]

where \(V_j\) is the supplier’s risk value \(F_j, k = 1, ..., n\), \((n\) being the total number of suppliers in the distribution chain), calculated by cumulating the number of supplied products \(p_{kj}\) multiplied with the loss value \(v_{kj}\) as a consequence of the appearance of that risk and the break in the distribution chain:

\[
V_k = \sum_{j=1}^{n} p_{kj} \cdot v_{kj}
\]

Step 3: Ordering descending the suppliers’ matrix, depending on the priority value risk index \((IPRV_j)\) of each supplier.

Step 4: ABC Classification of the suppliers and the development of the Pareto diagram.

An example for 12 suppliers is given in figure 4.

<table>
<thead>
<tr>
<th>Supplier</th>
<th>IPRM</th>
<th>V(u.m.)</th>
<th>V/ V</th>
<th>IPRV</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>40,5</td>
<td>105</td>
<td>0,10</td>
<td>4,0</td>
</tr>
<tr>
<td>F2</td>
<td>12,5</td>
<td>90</td>
<td>0,08</td>
<td>1,1</td>
</tr>
<tr>
<td>F3</td>
<td>20,5</td>
<td>120</td>
<td>0,11</td>
<td>2,3</td>
</tr>
<tr>
<td>F4</td>
<td>25</td>
<td>60</td>
<td>0,06</td>
<td>1,4</td>
</tr>
<tr>
<td>F5</td>
<td>35</td>
<td>80</td>
<td>0,07</td>
<td>2,6</td>
</tr>
<tr>
<td>F6</td>
<td>40</td>
<td>75</td>
<td>0,07</td>
<td>2,8</td>
</tr>
<tr>
<td>F7</td>
<td>15</td>
<td>80</td>
<td>0,07</td>
<td>1,1</td>
</tr>
<tr>
<td>F8</td>
<td>24,3</td>
<td>110</td>
<td>0,10</td>
<td>2,3</td>
</tr>
<tr>
<td>F9</td>
<td>24</td>
<td>150</td>
<td>0,14</td>
<td>3,4</td>
</tr>
<tr>
<td>F10</td>
<td>34</td>
<td>85</td>
<td>0,08</td>
<td>2,7</td>
</tr>
<tr>
<td>F11</td>
<td>12</td>
<td>60</td>
<td>0,06</td>
<td>0,7</td>
</tr>
<tr>
<td>F12</td>
<td>10</td>
<td>55</td>
<td>0,05</td>
<td>0,5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1070</td>
</tr>
</tbody>
</table>

Fig.4 Suppliers risks matrix
The first column of the table in figure 4 contains the values of the medium priority risk indexes for the selected suppliers, and the following the risk value of the supplier, calculated by cumulating the supplied number of products \( p_{ij} \) multiplied with the loss value \( v_{ij} \) as a consequence of the appearance of that risk and the break in the distribution chain. In figure 5, after the suppliers have been ordered depending on the priority value risk index and the relative and cumulated frequencies have been calculated, the ABC classification is performed.

- „Red suppliers”, with a very high level of value risk (higher then 4);
- „Orange suppliers”, ”, with a high level of value risk (between 3 and 4);
- „Yellow suppliers”, ”, with a medium level of value risk (between 2 and 3);
- „Green suppliers”,” with a low level of value risk (smaller then 2).

The mentioned colours can be marked on the accompanying documents of the products coming from those suppliers.

<table>
<thead>
<tr>
<th>Class</th>
<th>Supplier</th>
<th>IPRV</th>
<th>Frel</th>
<th>Frel cum</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>F1</td>
<td>4.0</td>
<td>0.16</td>
<td>0.16</td>
</tr>
<tr>
<td></td>
<td>F9</td>
<td>3.4</td>
<td>0.14</td>
<td>0.30</td>
</tr>
<tr>
<td></td>
<td>F6</td>
<td>2.8</td>
<td>0.11</td>
<td>0.41</td>
</tr>
<tr>
<td></td>
<td>F10</td>
<td>2.7</td>
<td>0.11</td>
<td>0.52</td>
</tr>
<tr>
<td></td>
<td>F5</td>
<td>2.6</td>
<td>0.11</td>
<td>0.62</td>
</tr>
<tr>
<td></td>
<td>F8</td>
<td>2.3</td>
<td>0.09</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>F3</td>
<td>2.3</td>
<td>0.09</td>
<td>0.81</td>
</tr>
<tr>
<td>B</td>
<td>F4</td>
<td>1.4</td>
<td>0.06</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td>F7</td>
<td>1.1</td>
<td>0.05</td>
<td>0.91</td>
</tr>
<tr>
<td></td>
<td>F2</td>
<td>1.1</td>
<td>0.04</td>
<td>0.95</td>
</tr>
<tr>
<td>C</td>
<td>F11</td>
<td>0.7</td>
<td>0.03</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>F12</td>
<td>0.5</td>
<td>0.02</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Fig. 5 Ordered suppliers risk matrix

Pareto diagram regarding ABC classification of suppliers is presented in Figure 6.

Fig. 6 Pareto diagram of suppliers

4 Conclusions

Based on the priority – risk matrix the global quantitative evaluation of the suppliers’ risk level was developed. The evaluation was based also on the IPR score, together with a qualitative evaluation, usually associated with colours, represented in the risk analysis and evaluation documentation. The paper describes an algorithm for the ABC (Pareto) analysis of the supplier’s risks. The use of this classification and risk prioritizing method allows a better approach of the supplier’s risk management. The proposed method for the analysis of the supplier’s risks allows the direct integration in the organization’s risk procedures.

References: