

Decision-Making for the Supply Chain Management in Conditions of Economic Turbulence

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Abstract— The decision-making process for supply chain management is complex and involves multiple people across multiple teams. This article deals with the problem of choosing an optimal management solution in a turbulent economy. We systematise new management risks in the context of a pandemic are systematized. A method for constructing an integral risk assessment function for managerial decision-making is proposed. We identify a need for an expert community to make more informed decisions has been identified. The research propose a simulation of new management risks in the context of a pandemic is proposed. Specific supply chains are faced with the situation where they have to accept uncertainty but need to develop a strategy that enables them still to match supply and demand. Hence, this research works in this direction and identifies various supply chain strategies to match demand and supply efficiently and effectively.

Keywords— *proactive monitoring, supply chain management, decisions making, integral evaluation function, assessment of new risks.*

1. Introduction

Supply chain spans all movement and storage of raw materials, work-in-process inventory, and finished goods from point of origin to point of consumption. Supply chain performance improvement initiatives strive to match supply and demand, thereby driving down costs and simultaneously improving customer satisfaction. In modern conditions of economic turbulence, the negative impact on the economy of countries and regions of the coronavirus pandemic is obvious. The spring of 2020 was disastrous for the global economy. Measures to protect against the epidemic have led to many countries actually closing their borders, reduced transport links to a minimum, and stopped entire lines of business. The business community is in a situation of the highest uncertainty, there is no opportunity to make any plans. The risks of making management decisions are increasing. According to estimates by the

world's leading economists, Russia's GDP in these conditions may decrease by 10-20%. A modest recovery in global production is expected in the second half of 2020, provided that the spread of the coronavirus is largely contained worldwide and that there is no second or third wave of pandemics. Increasing uncertainty will lead to increased safety savings among people and delay business investment. Some consumers may also continue to isolate themselves even after government bans are lifted for fear of contracting the Coronavirus, which will limit the recovery of private consumption. At worst, if efforts to contain the pandemic cause the depletion of budget revenues and a sharp increase in public spending in developed countries, this could trigger a sovereign debt crisis. This is compounded by the fact that many of the European countries most affected by the pandemic, such as Italy and Spain, already had weak financial positions before the outbreak. A potential debt crisis in any of these countries will quickly spread to other developed countries and emerging markets, leading to another downturn in the global economy. Therefore, in these conditions, issues of timely and effective management decision-making become relevant.

2. Formulation of the Problem

The practice of making managerial decisions is characterized by a set of conditions and circumstances (situation) for supply chain that create certain relationships, conditions, and situations, taking into account the quantitative and qualitative characteristics of the information at the disposal of the decision-maker [1].

When faced with uncertainty, the Manager can use two main options. First, try to get more relevant information and analyze the problem again. This often reduces the novelty and complexity of the problem. The Manager combines this additional information and analysis with accumulated experience, judgment, or intuition to give a number

of results a subjective or assumed probability [2]. The second option is to act in exact accordance with past experience, judgment, or intuition and make an assumption about the probability of events. Time and information constraints are crucial in making management decisions [3,4].

In the conditions set by the current coronavirus pandemic, zones of economic turbulence are characterized by an extremely unstable situation, which, under the influence of the slightest negative change in the external environment, can lose its balance and change the structural characteristics of elements in a negative direction.

The impact of turbulence is becoming more significant, and it is unpredictable and often undiagnosable. If appropriate counter-measures are not taken, chaos ensues, and governments, business communities, markets, and industries are plunged into it [5]. Burdened by the turbulence factor, the current stage of economic development stands out against the background of previous economic cycles, because today we can expect a much greater number of different-scale shocks, which can cause increased risks and uncertainty at both the macro and microeconomic levels.

3. Material and Methods

In this article, we will use a methodology for analyzing hierarchical structures based on a strict mathematical eigenvector method for processing inverse-symmetric matrices to simulate new management risks when making management decisions in supply chain process [5, 6].

Supply Chain Strategy

In this phase, decision is taken by the management mostly. The decision to be made considers the sections like long term prediction and involves price of goods that are very expensive if it goes

wrong. It is very important to study the market conditions at this stage.

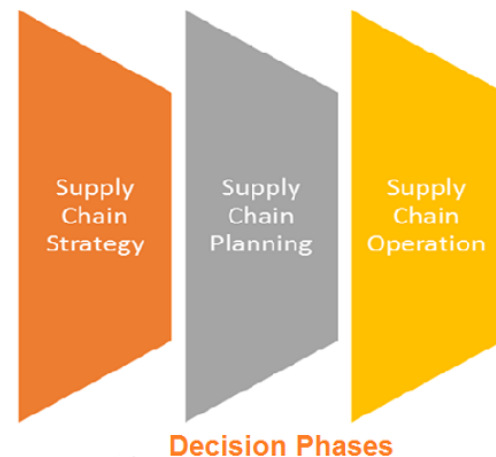


Figure 1: Decision making for SCS

Supply Chain Planning

Supply chain planning should be done according to the demand and supply view. In order to understand customers' demands, a market research should be done. The second thing to consider is awareness and updated information about the competitors and strategies used by them to satisfy their customer demands and requirements. As we know, different markets have different demands and should be dealt with a different approach.

Supply Chain Operations

The third and last decision phase consists of the various functional decisions that are to be made instantly within minutes, hours or days. The objective behind this decisional phase is minimizing uncertainty and performance optimization. Starting from handling the customer order to supplying the customer with that product, everything is included in this phase.

New management risks are being formed in the context of economic turbulence against the background of a coronavirus pandemic (table 1).

Table 1. Risks of management decisions during a pandemic

№	Area of Risk	Effect on the economy of the Russian Federation
1.	Geopolitical	rejection of a number of international and inter-country agreements, price war in the energy market, increased competition in the commodity and financial markets
2.	Systemic	non-compliance of enterprises and organizations with new requirements
3.	Personnel	a complete shutdown of many businesses, especially those engaged in such areas as tourism, hotels, transportation, catering, trade in non-food products, sports and leisure, will lead to the fact that a significant number of employees will be left without work
4.	Managerial	reduced efficiency of management systems, inefficient decision-making mechanisms, the need to switch to new modern tools (digital technologies, big data, etc.)
5.	Demographic	the decrease in the population's income leads to a drop in the purchasing power of the population, in turn, this factor actively affects the decrease in the birth rate. The spread of coronavirus infection and other severe diseases leads to increased mortality
6.	Projective	risk of not having an image of the future and tools for creating such an image

The approach proposed in this article to management decision - making in a turbulent economy will improve the efficiency of decision-making, thereby minimizing new risks during the pandemic.

Management decision-making is based on a

simulation of new management risks. Thanks to this, those charged with making management decisions will be able to most effectively assess existing risks and make a decision.

Simulation of new management risks (figure 2) based on table

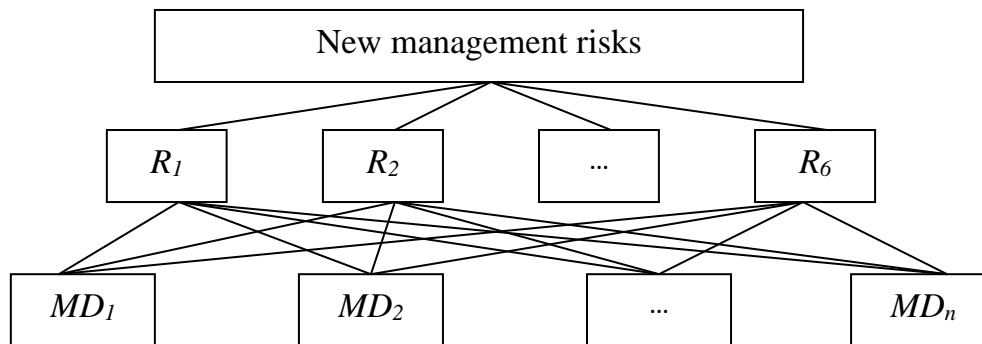


Figure 2. Simulation model of new management risks

where, $R_1...R_6$ -new management risks;

$MD_1 ... MD_n$ -management decisions.

When choosing a management decision from the position of a specific risk, the damage caused is taken into account, and when comparing the risks themselves as evaluation criteria, we take into

account the probability of a specific risk. To assess management risks, it is necessary to build a function for assessing management risks.

The main stages of quantitative assessment of management risks (stages of simulation of management risks) are (table 2) [7,8].

Table 2. Stages of management risk simulation

Stages	Content
1.	Preparing a model that can predict risk;
2.	Determining the probability law of variable distribution;
3.	Removing the boundaries of the range of variable values;
4.	The establishment of relations between the controlled variables;
5.	Generating random estimates based on a set of assumptions;
6.	Statistical analysis of simulation results.

To conduct the construction of the management risk assessment function, the Manager needs to attract experts who are competent in these issues.

The experts involved can relate directly to the employees of this company, as well as third-party experts with experience in crisis management [9,10].

Each expert assesses the risks from the point of view of necessary management decisions. The combination of expert opinions helps the Manager to make a more balanced decision.

4. Results and Discussion

Within decision-making theories, the rational decision-making model is the most commonly used. Let's consider the procedure for constructing the management risk assessment function. Let the criterion "New management risks" be specified by sub-criteria ($R_1, R_2, ...R_n$). In this case, a matrix of paired comparisons of management decisions is constructed for each of them. Table 3 is a matrix of paired comparisons of management decisions for geopolitical risk.

Table 3. Matrix of paired comparisons for geopolitical risk (R_1)

R_1	MD_1	MD_2	MD_3	...	MD_n
MD_1	r_{11}	r_{12}	r_{13}	...	r_{1n}
MD_2	r_{21}	r_{22}	r_{23}	...	r_{2n}
MD_3	r_{31}	r_{32}	r_{33}	...	r_{3n}
...
MD_n	r_{n1}	r_{n2}	r_{n3}	...	r_{nn}

Next, we build a matrix of paired comparisons for the remaining risks.

Table 4 is a matrix of paired comparisons of management decisions for projective risk.

Table 4. Matrix of paired comparisons for projective risk (R_6)

R_6	MD_1	MD_2	MD_3	...	MD_n
MD_1	r_{11}	r_{12}	r_{13}	...	r_{1n}
MD_2	r_{21}	r_{22}	r_{23}	...	r_{2n}
MD_3	r_{31}	r_{32}	r_{33}	...	r_{3n}
...
MD_n	r_{n1}	r_{n2}	r_{n3}	...	r_{nn}

After processing each matrix of paired comparisons of management decisions, we obtain an eigenvector corresponding to the maximum eigenvalue. For example, for R_1 , the eigenvector has the form (1):

$$W(MD/R_1) = (w(MD_1/R_1), w(MD_2/R_1), \dots, w(MD_n/R_1)). \tag{1}$$

The next step is to evaluate the "weights" of the clarifying sub-criteria themselves (table 5).

Table 5. Matrix of paired comparisons of new management risks

New management risks	R_1	R_2	R_3	...	R_n
R_1	$w(MD_1/R_1)$	$w(MD_1/R_2)$	$w(MD_1/R_3)$	...	$w(MD_1/R_n)$
R_2	$w(MD_2/R_1)$	$w(MD_2/R_2)$	$w(MD_2/R_3)$	...	$w(MD_2/R_n)$
R_3	$w(MD_3/R_1)$	$w(MD_3/R_2)$	$w(MD_3/R_3)$	...	$w(MD_3/R_n)$
...
R_n	$w(MD_n/R_1)$	$w(MD_n/R_2)$	$w(MD_n/R_3)$	...	$w(MD_n/R_n)$

After processing this matrix, we get an eigenvector corresponding to the maximum eigenvalue, for example, for R_1 we get a vector (2):
 $W(R) = (w(R_1), \dots, w(R_6)).$

(2)
 Next, based on table 5, we build a matrix, which we multiply by the vector $W(R)$. This procedure is a "hierarchical weighting" (3):

$$\begin{bmatrix} w(MD_1/R_1) & w(MD_1/R_2) & w(MD_1/R_3) & \dots & w(MD_1/R_n) \\ w(MD_2/R_1) & w(MD_2/R_2) & w(MD_2/R_3) & \dots & w(MD_2/R_n) \\ w(MD_3/R_1) & w(MD_3/R_2) & w(MD_3/R_3) & \dots & w(MD_3/R_n) \\ \dots & \dots & \dots & \dots & \dots \\ w(MD_n/R_1) & w(MD_n/R_2) & w(MD_n/R_3) & \dots & w(MD_n/R_n) \end{bmatrix} * \begin{pmatrix} w(R_1) \\ w(R_2) \\ w(R_3) \\ \dots \\ w(R_n) \end{pmatrix} = \begin{pmatrix} w(MD_1/R) \\ w(MD_2/R) \\ w(MD_3/R) \\ \dots \\ w(MD_n/R) \end{pmatrix} \tag{3}$$

Therefore, the function of evaluating a management decision from the perspective of new

management risks, denoted by $\phi R (MD)$, has the following form (table 6):

Table 6. Function for evaluating management decisions from the perspective of new management risks

Argument	MD_1	...	MD_n
Function value $\varphi^R(MD)$	$w(MD_1/R)$	...	$w(MD_n/R)$

5. Conclusion

The topic of supply chain excellence is extremely broad and spans a smorgasbord of topics associated with People, Process and Technology. However, if we focus on key decision-making capabilities that can help companies achieve supply chain excellence, can cause a better performance in efficiency and managing the sever conditions.

The decision-making environment varies depending on the degree of risk. In the current conditions of a turbulent economy, when the coronavirus pandemic has a negative impact on the business environment. The Manager should determine the probability of possible consequences, if possible, making management decisions that allow to level the risks. The new management risks identified in this article reflect the extent of the negative impact of the pandemic on the economies of countries and regions. Simulation modelling in a turbulent economy and assessment of the impact of these risks will allow managers to make more informed, balanced decisions.

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