Breaking Risk the Integration Links Between the Participants of Transport and Logistic Infrastructure Projects

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Abstract

The object of the study is the risk of breaking the integration ties between the participants, which arises in the projects of transport and logistics infrastructure. The specific features of the concept of "integration project risks" are defined, which include the risks that may affect the integration in the project and lead to disruption of the project as a system by breaking the integration links between its participants.

One of the most problematic places is to identify integration risks in the pre-investment phase of the project, in the process of qualitative and quantitative risk analysis. However, integration risks are hardly taken into account when designing transport and logistics infrastructure facilities. Particular attention is paid to logistical and project risks. Integration risks combine the features of both logistics and project risks and can lead to negative consequences for a project.

The study used qualitative risk analysis methods, namely Pareto analysis and ABC analysis, which allowed the project participants to be divided into groups with large, medium and low integration ties. Taking into account the number of transactions performed between the participants made it possible to determine the power of integration links. The combination of the results of the ABC analysis and the determination of the integration capacity is the basis for the creation of a matrix of integration capacity of the project participants.

In the course of the work, a qualitative risk analysis was carried out according to the proposed sequence of the project of creating a transport and logistics center. The use of quality management tools and the integration capacity matrix developed by the authors made it possible to identify the many project participants who have the greatest impact on project integration.

The use of the proposed approach to qualitative risk analysis of the integration gap between project participants at the beginning of the project will allow the identification of participants with high integration capacity. The integration of these participants should be further carefully analyzed, as the withdrawal of such a participant from the project can lead to extremely negative consequences.

Keywords 1

project of transport and logistic infrastructure, integration of project participants, integration risks, qualitative risk analysis, matrix of integration capacity of participants.

1. Introduction

The development of the world economy is characterized by the constant expansion of economic ties and international trade, which determines the priority of integration processes, first of all, in the sphere of transport. The level of development of the transport industry of the country testifies to the general state of its economy, since the transport-logistics system performs an integrative function for other industries. It must meet the requirements of social production and national security, have an

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extensive infrastructure to provide the entire complex of transport and logistics services. This can be achieved through the development of the country's transport and logistics infrastructure and the creation of a network of modern transport and logistics centers (TLCs). The solution to this practical problem requires the availability of modern methodological support, which will use modern management methods, including tools for project management, risk management and quality management. In addition, it is necessary to consider the features of the transport and logistic infrastructure as a management object. A modern look at the process of creating a TLC is to present it as a project, one of the specific features of which is the large number of participants involved in integration ties. Analyzing these relationships will allow you to respond in a timely manner in the event of a risk situation and to prevent negative consequences, almost until the project is terminated. Therefore, the topical issue is to determine the features and develop a sequence of analysis of integration risks in transport and logistics infrastructure projects.

2. The object and purpose of the study

The object of the study is the risk of a break in the integration ties between the participants arising in TLC creation projects. This risk relates to the integration risks of the project and may occur in projects of transport and logistic infrastructure. The TLC creation projects are characterized by a large number of participants and a high degree of integration. Not all project participants have an equal impact on the project. The degree of influence of the participant on the integrity of the project depends on the number and capacity of its integration links with other participants, that is, its integration capacity. The main distinguishing feature of the risk of rupture of integration ties between project participants is their impact on integration ties in the project, which can lead to negative consequences, as well as to destruction of the system and termination of its existence. One of the most problematic places is the lack of methodological support for the analysis of this risk category in TLC projects. Scientists pay particular attention to project or logistical risks, without considering their integrative nature.

The purpose of the study is to determine the features and consistency of qualitative analysis of the risk of integration ties between the participants of transport and logistic infrastructure. To achieve this goal requires the following tasks:

1. Identify the specific features of the risk of rupture of integration ties between the participants of the project.
2. Develop a sequence of qualitative risk analysis of the gap in integration ties between the participants of the project.
3. Carry out experimental calculations to determine the integration capacity of the participants in the project.

3. Existing methods and solutions of the problem

The study of integration risk management issues in TLC creation projects is based on the analysis of previous research by scientists. Thus, the research of authors [1] is devoted to the management of risks of functioning of transport and logistics systems, which belong to the category of logistical risks, but they do not consider the risks specific to the objects of transport and logistics infrastructure. The impact of logistical risks on improving the efficiency of enterprises, but without taking into account industry affiliation, is investigated in [2]. The conceptual principles of logistics risk management at the enterprise are explored in [3]. The authors highlight the risks of the enterprise logistics system, but do not take into account the integration of its elements. Therefore, the above studies of logistics risks do not take into account their integrative nature, do not study the design risks of creating logistics systems. Design risks are considered and their classification is made in [4]. Among the large number of project risks, the authors do not single out integration risks in a separate group, which reduces the completeness of identification of the possible risks in the project. the issues of risk management are studied with emphasis on the field of project activity implementation. The issues of project risk analysis are highlighted in [10], which identifies the advantages and disadvantages of existing methods of risk analysis and assessment. Emphasis is placed on quantitative risk analysis, the issues

of qualitative analysis of project risks are not considered. Therefore, it can be concluded that the issue of studying integration risks in projects, taking into account the features of transport and logistics infrastructure objects, is almost ignored. Successful implementation of such large-scale and complex projects as the TLC creation project requires the availability of appropriate methodological support, which will allow to take into account the features of the created objects. The large number of TLC project participants causes integration project risks, which can lead to very negative consequences, even if the project is completely closed. In [11] the authors distinguished the project integration risks into a separate category, in [12] proposed a methodological approach to integrating risk analysis in the TLC creation project, and in [13] emphasized on a qualitative risk analysis. Therefore, this issue needs further study, taking into account aspects of current management methodologies [14,15] and the specific features of the research object - the TLC project.

4. The results of the study

Integration risks fall into the category of risks that can be catastrophic for the project - a break in integration links can lead to the destruction of the entire system. the focus on them is justified as they affect the viability of the project. When considering integration risks through the lens of integration in a TLC project, one of the most important integration risks of the project is the risk of a break in integration ties between project participants. The classification features of this type of risk according to the existing categories of classification of objects from the biological approach (class, type, type) are presented in fig. 1.

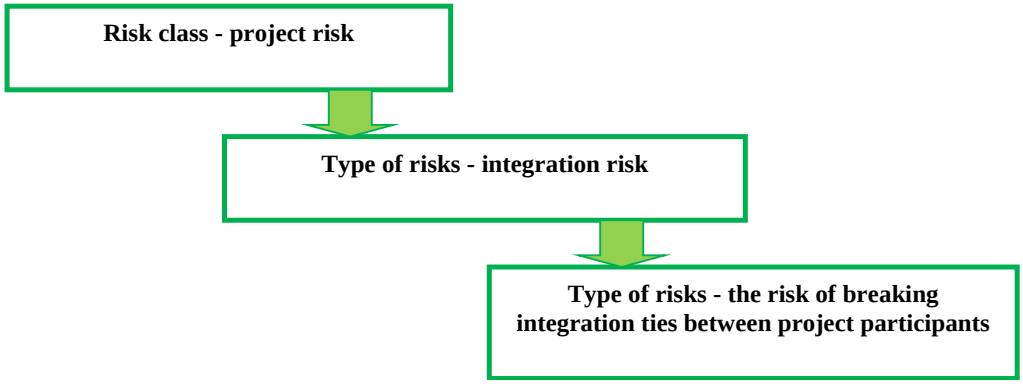

Figure 1: Classification signs of risk of rupture of integration ties between project participants

This type of risk is inherent in all project participants, but its implications for the project depend on which group the participants belong to - major or minor. Catastrophic consequences can occur if the integration links between the main participant (investor, customer, general contractor, etc.) and other project participants till the termination of the project [2]. When it comes to minor participants, the consequences of integration risks may not be as significant for the project. In this case, a preliminary risk analysis helps to influence the situation and preserve the integrity of the project as a system. Integration in creation of TLC projects also has an appropriate classification (system, design, transport and logistics), which is described in detail in [4]. Combining the peculiarities of the project integration of project participants, the selection of secondary project participants gives rise to the concept of risk of rupture of integration links between project participants (Fig. 2).

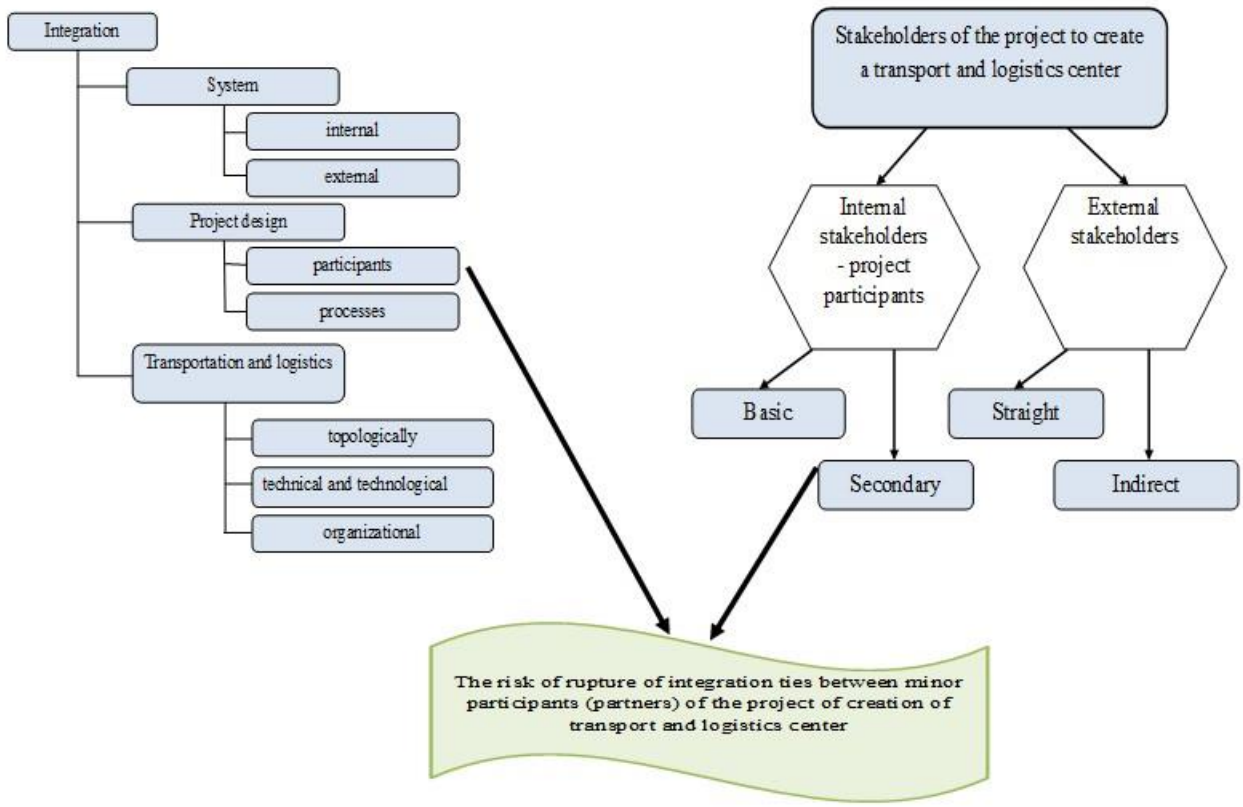

Figure 2: The risk of a break of integration links

Integration risk management involves such processes as: risk management planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning, risk response implementation, risk monitoring [16–29].

Particular attention should be paid to risk analysis. At the stage of qualitative analysis, it is necessary to identify the sources of possible integration risks of the project, that is, to identify those project participants, whose actions may lead to disruption of integration ties in the project. For this purpose it is proposed to use quality management methods, namely: Pareto analysis, ABC analysis, as well as the matrix of integration capacity. A qualitative analysis of integration risks, which is to determine the integration capacity of project participants, is proposed in three steps:

First step. Separation of minor project participants into groups according to the number of their integration ties with other partners.

Second step. Determine the integration capabilities of the project participants.

Third step. Determine the integration capacity of project participants.

The proposed sequence of analysis of the integration risks of the TLTC project allows, in the absence of reliable information about the project implementation conditions:

- identify the elements of the project participants most prone to integration risks;
- determine the integration capacity of project participant;
- the degree of impact on the sustainability of the project system.

The study of the proposed sequence of qualitative analysis will be carried out on the example of a project for the creation of a TLC, which includes 30 minor participants (partners) in the operational phase.

First step. Separation of minor project participants into groups according to the number of their integration ties with other partners.

The Pareto analysis is proposed to identify participants' propensity to integrate risks. The input for the analysis is the set of integration links between the project participants, and the output is a Pareto diagram.

A qualitative analysis of project integration risks using a Pareto diagram consists of the following

steps:

- creating a contiguity matrix that reflects the presence (1) or the absence (0) of integration relations between the elements;
- analysis of the significance of the obtained results, which is reflected in the table of aggregated data;
- construction of the Pareto diagram;
- carrying out the ABC analysis of project participants.

Participants have integration links as shown in Fig. 3.

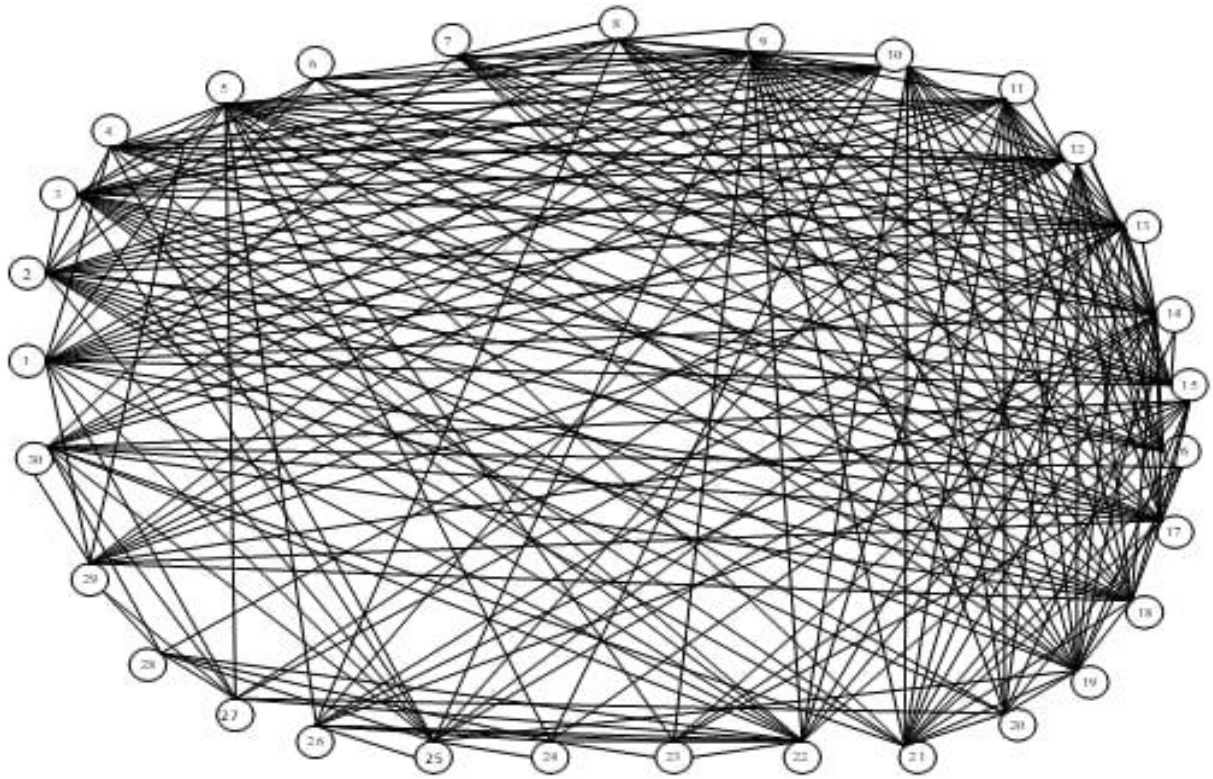

Figure 3: Integration links of the participants

Analysis of integration links between project participants is possible to carry out the following indicators:

- the number of connections of this element with other elements of the system;
- % of the connections of this element with other elements in the total number of integration links between system elements, which is presented in Table 1.

Table 1

Aggregated data for element integration links (partners, project participants)

Project participant	Number of integration links	The cumulative sum of the number of integration links	% of integration links in total	Cumulative %
10	25	25	5,18 %	5,18 %
9	24	49	4,97 %	10,14 %
15	24	73	4,97 %	15,11 %
14	23	96	4,76 %	19,88 %
11	21	117	4,35 %	24,22 %
12	21	138	4,35 %	28,57 %

13	21	159	4,35 %	32,92 %
17	21	180	4,35 %	37,27 %
5	20	200	4,14 %	41,41 %
19	19	219	3,93 %	45,34 %
3	18	237	3,73 %	49,07 %
1	18	255	3,73 %	52,80 %
18	18	273	3,73 %	56,52 %
2	17	290	3,52 %	60,04 %
16	17	307	3,52 %	63,56 %
4	16	323	3,31 %	66,87 %
21	16	339	3,31 %	70,19 %
22	16	355	3,31 %	73,50 %
30	15	370	3,11 %	76,60 %
8	14	384	2,90 %	79,50 %
25	13	397	2,69 %	82,19 %
29	13	410	2,69 %	84,89 %
7	11	421	2,28 %	87,16 %
20	11	432	2,28 %	89,44 %
26	10	442	2,07 %	91,51 %
6	9	451	1,86 %	93,37 %
27	9	460	1,86 %	95,24 %
23	8	468	1,66 %	96,89 %
24	8	476	1,66 %	98,55 %
28	7	483	1,45 %	100,00 %

We build a Pareto diagram of partner integration relationships. On the abscissa axis, we place the elements according to the degree of integration integration, and along the ordinate axis - the percentage of integration relations of the elements in the total and the cumulative percentage of integration relations (Fig. 4).

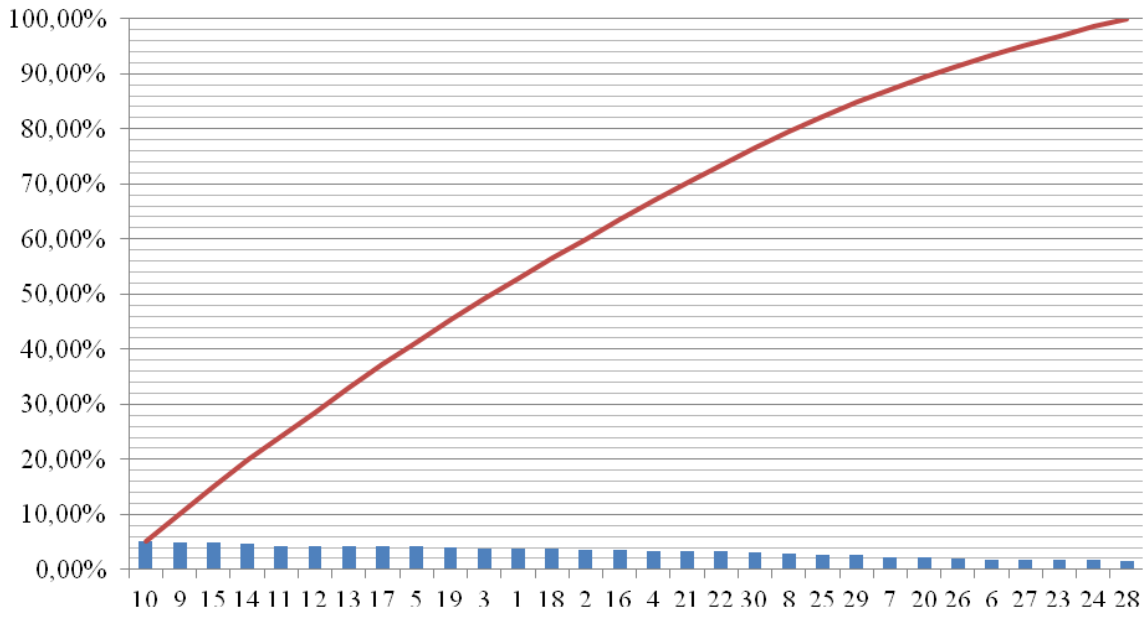

Figure 4: Pareto diagram of the integration links of the project participants

The use of ABC analysis allows to identify the project participants who have the highest number of integration ties (Fig. 5).

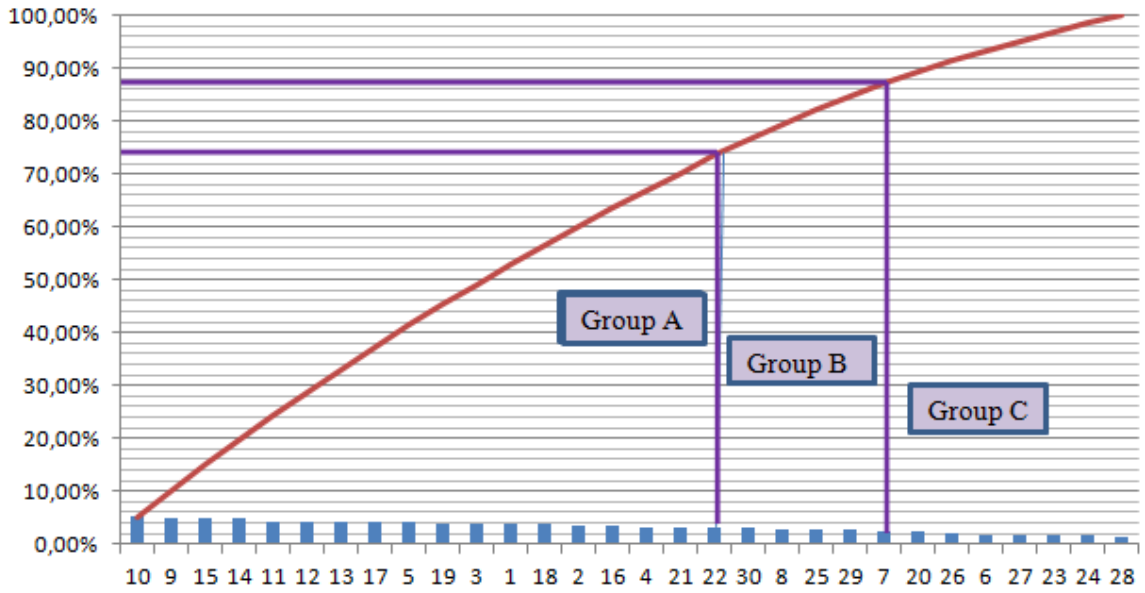

Figure 5: ABC analysis of project participants

It is determined that the group "A" with the largest number of integration links includes elements: "10", "9", "15", "14", "11", "12", "13", "17" , "5", "19", "3", "1", "18", "2", "16", "4", "21", "22". The largest number of integration links (25) is observed in the element "10" - 3PL operator. But this kind of estimation is not enough because the system element can have a large number of integration links, and the power of these connections may be negligible.

The second step. *Determining the integration capacities of project participants.*

We propose to determine the power of the integration link taking into account the number of realized relationships (transactions) using this connection and the cash flow (cost) of the respective operations. An example of calculating the value of the number of operations for 6 months for the element "10" is presented in Table 2.

Table 2

Number of integration operations of element "10" – 3PL operator

Connection	Time period, month						Total units
	1	2	3	4	5	6	
10–1	3	5	7	9	10	14	48
10–2	2	4	3	6	5	8	28
10–3	3	5	6	8	9	11	42
10–4	4	6	8	10	9	6	43
10–5	8	9	12	10	11	12	62
10–6	10	9	12	15	14	14	74
10–7	11	14	15	14	15	15	84
10–8	11	14	15	10	12	14	76
10–9	12	10	13	15	14	13	77
10–11	3	2	2	4	6	5	22
10–12	2	3	1	4	2	2	14
10–13	4	6	8	7	5	7	37
10–14	5	8	10	12	10	13	58
10–15	7	9	9	10	12	14	61

10–16	4	3	6	5	4	4	26
10–17	3	5	4	2	3	4	21
10–18	2	1	3	2	4	3	15
10–19	9	10	11	10	9	12	61
10–20	2	1	4	3	5	4	19
10–21	8	10	12	11	10	13	64
10–22	3	2	5	4	3	3	20
10–24	2	1	3	4	3	4	17
10–26	4	3	5	4	3	6	25
10–29	3	2	1	2	3	4	15
10–30	1	2	1	3	4	3	14

But for the sake of completeness of the importance of this or that integration connection we suggest to consider not only the number but also the cost of the performed operations. Their output will determine the cash flows between the elements of the system that create the integration link. This will allow you to determine the amount of work done on a system that matches a particular integration link:

$$CF_{ij} = q_{ij} \cdot c_{ij}, \quad (1)$$

where CF_{ij}- cash flows moving from the i-th to the j-th element between which the integration link is established;

q_{ij} – number of operations between i-th and j-th elements;

c_{ij}– the average cost of one operation between the i-th and j-th elements.

To determine the power of the integration link between system elements - TCP project participants - we apply the formula:

$$N_{ij} = \frac{CF_{ij}}{t_{ij}}, \quad (2)$$

where t_{ij}– time spent performing operations between i-th and j-th elements.

Based on the obtained values of the power of integration links, it is possible to determine their rating (Table 3).

Table 3

Power of integration links of element "10" - 3PL operator

Connection	Number of operations, units	The average cost of one operation, usd	Cash flow, usd	Connection power, usd/month
10–1	48	1800	86400	14400
10–2	28	5280	147840	24640
10–3	42	2200	92400	15400
10–4	43	3600	154800	25800
10–5	62	10000	620000	103333
10–6	74	1500	111000	18500
10–7	84	13000	1092000	182000
10–8	76	3700	281200	46867
10–9	77	1000	77000	12833
10–11	22	1500	33000	5500
10–12	14	5000	70000	11667
10–13	37	84000	3108000	518000
10–14	58	100000	5800000	966667
10–15	61	200	12200	2033
10–16	26	2000	52000	8667

10–17	21	400	8400	1400
10–18	15	1000	15000	2500
10–19	61	4000	244000	40667
10–20	19	350	6650	1108
10–21	64	1000	64000	10667
10–22	20	600	12000	2000
10–24	17	120	2040	340
10–26	25	200	5000	833
10–29	15	1000	15000	2500
10–30	14	700	9800	1633

The most powerful link is the "10" and "14" elements (3PL Operator - Cargo Terminal). It is possible to determine the total power of all element integration links by the formula:

$$N_i = \sum_{j=1}^{m} N_{ij} \left(i = \overline{1,n} \right). \quad (3)$$

Thus, the total integration power of element "10" is 2019955 usd / month. If you carry out a similar assessment for other elements of the system, it is possible to determine the rating and the total integration power for each project participant and to determine the integration capacity of the project participants (Table 4).

Table 4

Power of integration links of project participants

Element (project participant)	Total power connection of element	Rating ofpower connection of element
10	2019955	5
9	2155880	4
15	7500	27
14	809390	10
11	1781067	20
12	363641	16
13	23364348	1
17	282073	17
5	2669525	3
19	491350	12
3	1060741	7
1	412646	14
18	59480	24
2	376049	15
16	212883	19
4	1017380	8
21	12085147	2
22	9763	26
30	687000	11
8	129748	21
25	942717	9
29	1757727	6
7	453683	13
20	1808	30
26	2400	29
6	226423	18

27	86595	23
23	18175	25
24	6927,5	28
28	108230	22

Based on the results obtained, a management decision should be made to manage the integration risks in the project.

Third step. Assessment of integration capacity of project participants. To determine the integration capacity of project participants, it is proposed to use an integration capacity matrix. The ordinates of the ordinates determine the power rating of the integration links of elements (1–10 - significant power, 11–20 - average power, 21–30 - insignificant power). The ordinate axis defines the zones of ABC analysis that reflect the number of integration links of participants (group A is large, group B is medium, group C is insignificant) (Table 5).

Table 5

Matrix of integration capacity

Connection power	The importance of project participants (by number of integration links)		
	Group A	Group B	Group C
significant	high	high	high
average	high	average	low
insignificant	average	low	low

For an example of a TLC project, the integration capacity matrix is presented in Fig. 6.

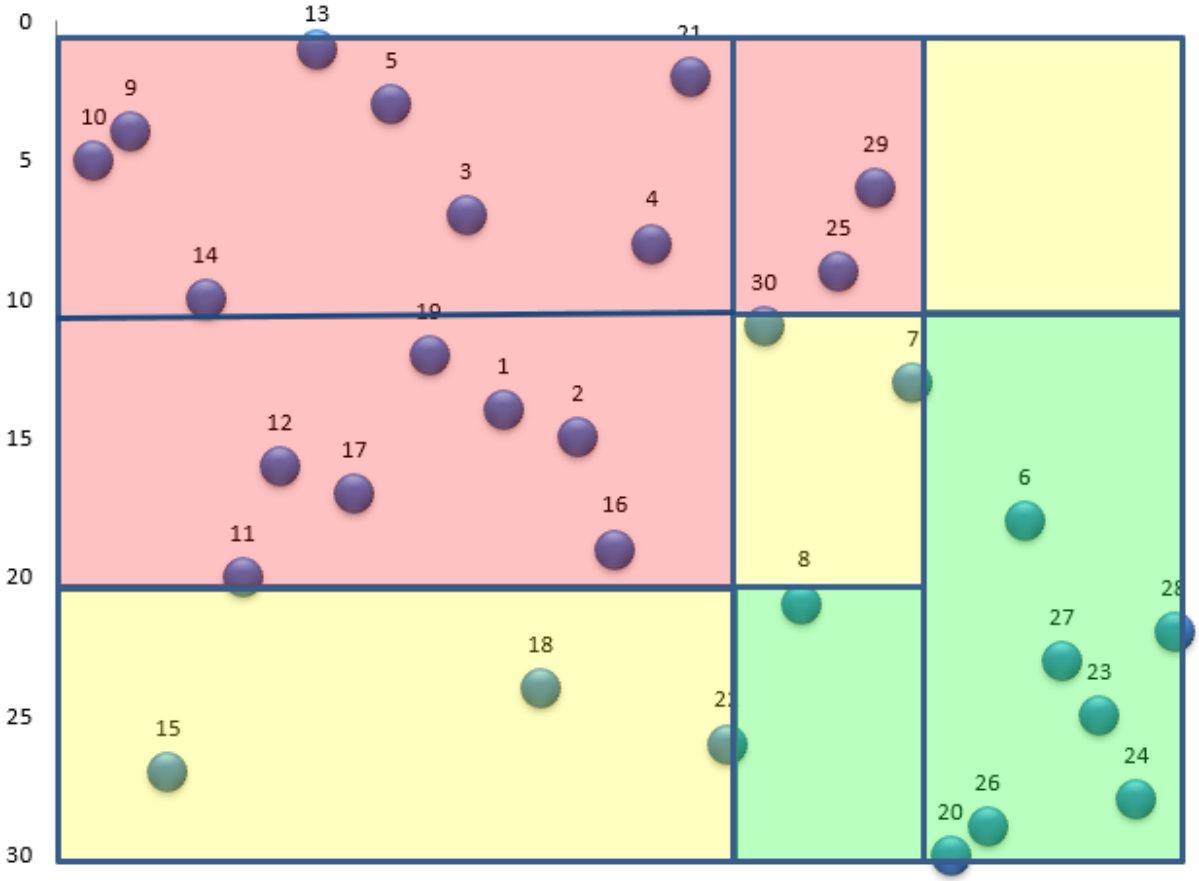

Figure 6: Matrix of integration capacity of participants of the project of transport and logistics center

The Integration capacity matrix allows the project participants to be divided into areas of high,

medium and low integration capacity of the participant. Depending on which area of the matrix a particular project participant falls in, it is possible to determine its integration capacity, that is, the degree of influence on the stability of integration ties between project participants.

5. Conclusions

The specific features of the risk of the break of integration ties between TCP participants are identified, which include the risks that may affect the integration in the project and lead to disruption of the project as a system. That is, this category of risks arose at the intersection of concepts such as project integration and project participants. The classification features of this type of risk are determined according to the existing categories of classification of objects from the biological approach (class, type, type). A sequence of qualitative risk analysis of the TLC creation project has been developed, which includes three steps. A matrix of integration capacity of project participants was created using the results obtained in the previous stages of risk analysis. Based on the data obtained from the ABC analysis and determination of the integration capacity of the project participants, the matrix is divided into three zones of integration capacity: high, medium and low. Experimental calculations of a qualitative analysis of the risks of the break of integration ties between project participants were carried out using the example of a TLC, consisting of 30 participants. The participants of the project of creation of TLCs by zones of matrix of integration capacity are distributed and their tendency to influence of integration risks is determined. The area of high integration capacity has been reached participants, who should be further analyzed for individual integration links and identify the causes of the risks of their break.

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