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Resilience strategies for risk environments in the foreign trade logistics operations of SMEs

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Abstract: Foreign trade fosters a country's economic growth and ensures that consumers can satisfy their needs and that SMEs can compete in other markets, both domestic and international. International negotiations require multiple strategic decisions between buyer and seller, such as the location of the supplier of inputs or raw materials, price, quality, management of information, the contracting of logistics operators, the terms of international negotiation, and in addition, compliance with international regulations and the legalization of the goods established in trade agreements or free trade agreements between countries. However, multiple internal and external variables in foreign trade logistics processes jeopardize the optimal flow of the chain. In consideration, SMEs are more affected. This research, in addition to identifying and studying, through principal component analysis, the different variables that pose a risk of disruption in the foreign trade logistics operations of SMEs, allows for the alignment of strategic decisions to minimize risk and increase the resilience of SMEs. It should be noted that, in the study, a 26-question survey was designed and applied to a sample of 63 Colombian SMEs, and SPSS version 25 software was used.

1 Introduction

In recent years, organizations have faced multiple external conditions, most recently the SARS-CoV-2 pandemic, which has jeopardized their permanence in the markets. However, the immense complexity of supply chain structures makes them vulnerable to risks and, consequently, to disruptions. It is important to mention that risk always exists, but the capacity to respond must be developed based on resilience strategies. In order to mitigate risks in foreign trade operations, information technologies should be used so that there is fast and timely communication between intermediaries in a chain, and also to facilitate real-time risk monitoring, so that actors identify and respond to risks collaboratively; this will allow agility and adaptation to different situations, such as supplier delays or political instability in one or more countries.

It should be noted that, through free trade agreements, companies can control the costs of international trade, have access to more suppliers located in different countries and enjoy benefits in the payment of tariffs or taxes for the legalization of cargo coming from countries with trade agreements [1]. In this sense, it is necessary to properly control the activities of mobilizing goods from one place to another and properly manage costs [2]. A country's logistics costs feed the logistics performance indexes established by the World Bank, which directly affects the competitiveness and confidence index. It is worth mentioning that foreign trade generates economic stability for the trade balance of countries [3]. Hence, the World Bank measures the logistics performance of countries through different indicators, all focused on international trade.

Due to their size, preparedness, and responsiveness, SMEs are the most vulnerable to the risks of foreign trade operations. In a changing world, risks exist in macro and micro contexts due to the very political, social, and economic nature of each country, which creates instability in international business, international currency fluctuations, and uncertainty between supply and demand, all of which directly affect the final price of the product. Therefore, it is necessary to prepare SMEs to design resilience strategies and venture into international markets. Resilience is the willingness to identify, accommodate, and absorb fluctuations, disturbances, disruptions, and surprises [4].

The objective of the paper is to identify the risks in the foreign trade operations of SMEs based on an exhaustive bibliographic review. Subsequently, to group the risks (variables) identified, a survey was designed with closed questions

and response options on a Likert scale. The survey was sent to 100 employees of SMEs in charge of foreign trade, international business, supply chain, and internationalization operations, and 63 of them responded. It should be noted that the information collected through the surveys is statistically reliable. For this purpose, Cronbach's Alpha was used, and to group the risks by affinity, principal component analysis was applied, which resulted in resilience strategies for risk environments in the foreign trade logistics operations of SMEs.

2 Literature review

A supply chain is a set of actors that mobilize goods and services from the origin of raw materials to the final consumer. This involves integrating human and monetary resources, which brings privileges to the parties involved. However, supply chains are also exposed to various risks, such as delays [5], failures [6] and disruptions [7], demand and supply uncertainty, changes in cost rates, quality issues, business performance [8] and price fluctuation [9].

Risk management in the supply chain allows to typify them, analyze them and make decisions to control them [10] but also improves the flexibility and agility of actors [11], the traceability of operations [12] and the efficient flow of information [13], which reduces the impact of risks. Risks are events with negative or positive effects on people and organizations, so it is necessary to correct them, maintain them, and propose continuous improvements in risk management. The goal is to strengthen the structure of the supply chain to combat risks and uncertainties [14]. On the other hand, risk management requires the involvement of the customer, marketing, operations, technology, and customer service [15], as these actors are interrelated to enable the efficient flow of goods, services, and information [16].

Most SMEs have complications in international negotiation processes, especially in finance. Therefore, these firms need intermediaries in foreign trade operations that provide value between buyers and sellers [17], generate knowledge, manage risks, and develop effective resilience strategies to stay in markets [18]. On the other hand, cumbersome paperwork or the centralization and bureaucracy of some countries in the international environment can cause cost overruns and affect international trade [19]. Risk management enhances business competitiveness based on four fundamental principles: identifying, assessing, mitigating, and controlling risks [20]. However, strategy development begins when organizations assimilate the impact of risk [21].

SMEs with foreign trade operations must be prepared to deal with internal and external crises, provide effective, timely, and rapid response to strategic supply chain partners, measure recovery time in the face of atypical situations, and have the ability to share risks with different intermediaries [22]. However, all this requires professional human capital with experience, attitude, and risk perception. It is important to note that man-made events create a domino effect in the supply chain, require the most effort and dedication, and take longer to recover from [23].

According to [24], six supply chain risks are identified: supply risk, process risk, demand risk, logistics risk, collaboration risk, and environmental risk. In turn, [25] identify four risks: supply risk, financial risk, information risk, and manufacturing risk. This leads to the identification of risk environments in this research. It should be noted that the study was conducted in Colombian SMEs, which are classified according to the number of employees and their level of annual turnover, according to Decree 957 of 2019 [26], and according to their participation in the GDP, with a contribution of 35% and 65% of employment [27].

3 Methodology

This research begins with the identification of risk environments and continues with the design of a survey to analyze and identify the risks of these environments. The information obtained from the survey is statistically validated. On the other hand, Principal Component Analysis (PCA) is applied to group the risks by environment and, in this way, design resilience strategies for risk environments in foreign trade logistics operations for SMEs (Figure 1).

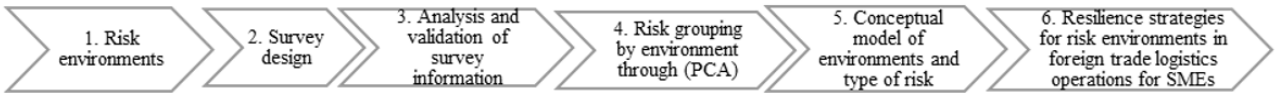

Figure 1 Research methodology
Source: Own elaboration (2024)

3.1 Risk enviroments

From a comprehensive review of the literature, the four environments that generate different risks (Figure 2) in the foreign trade logistics operations of SMEs were identified: the political environment, the economic environment, the social environment, and the legal environment.

Each risk is associated with different environments involved in the movement of goods from origin to destination, specifically in the logistics process of international trade.

3.2 Survey design

A survey was designed and applied to SMEs that carry out foreign trade operations in Medellín (Colombia) to identify the risks of each environment. The sampling was done by convenience and the result is a sample of 63 SMEs that had to meet two main requirements. First, they had to be classified as small or medium-sized companies based on the number of employees or turnover. The second requirement is that these companies have carried out foreign trade operations in one of the business internationalization strategies [28].

The survey consists of 26 questions with response options on a Likert scale of 5 to 1, where 5 is "very important," 4 is "important," 3 is "not very important," 2 is "somewhat important," and 1 is "not at all important. The questions are divided into four sections, each focusing on a different environment (Figure 1). This survey was sent to foreign trade professionals and SME managers. The data were collected between February and April 2024 and analyzed using SPSS statistical software, version 25 for Windows.

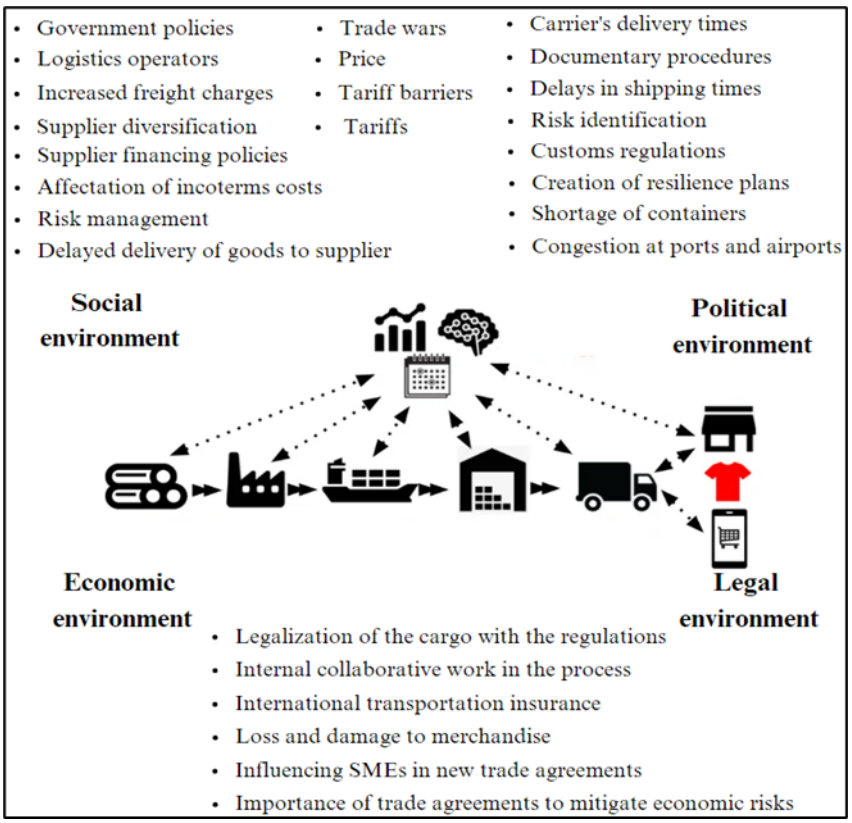

Figure 2 Risk environments
Source: Own elaboration (2024)

3.3 Analysis and validation of survey information

The reliability of the survey is validated by Cronbach's alpha, where a value below 0.70 is considered low and unreliable, from 0.70 to 0.80 reliable, and above 0.80 very reliable [29]. According to the above criteria, the survey is considered reliable, with a reliability index of 0.863 (Table 1).

Table 1 Reliability statistics

Cronbach's alpha	N of elements
0.863	26

3.4 Principal Component Analysis (PCA)

Statistical models interpret the correlation that may exist between a group of variables that must be classified by affinity into components (risk environments) [30]. In this research, principal component analysis has been applied, which makes it possible to use most of the information obtained from the data and to identify the correlation between variables. In addition, it identifies the variables that explain the most significant proportion of the total variance. The result of this statistical technique is the regrouping of the variables into factors.

Before performing the principal components analysis, it is necessary to perform the Kaiser-Meyer-Olkin (KMO) statistical measure to determine whether the data are suitable for factor analysis. This statistic is distributed in values between 0 and 1, and the higher the value, the more related the variables are to each other. It recommends not accepting a factorial model if the KMO is less than 0.5; between 0.5 and 0.7, the quality of the sample is mediocre; between 0.7 and 0.8, the quality is good; between 0.8 and 0.9, the quality is very good; and above 0.9, it is excellent [31]. Bartlett's sphericity test analyzes whether or not the variables are correlated. If the value of the null hypothesis is zero, there is a correlation; that is, the correlation matrix is identity. This statistic is asymptotically distributed according to a chi-squared distribution with (p-1) /2 degrees of freedom; high values of the statistic associated with small significance values allow us to reject the null hypothesis and conclude that the variables in the sample are sufficiently correlated with each other to perform factor analysis. If Bartlett's test of sphericity does not allow the null hypothesis to be rejected, the factors in which the original variables are included could be calculated, although these would be wholly spurious and would not correspond to the correlations that exist between the variables; to conclude that there is a correlation between variables, the value of the correlation matrix must be zero [32].

In this study, the KMO value is 0.788; therefore, the data matrix is appropriate for applying principal component analysis and is further confirmed by the significance associated with Bartlett's sphericity test, which is 0.000 (Table 2).

Table 2 KMO and Bartlett's test

Statistic		Value
Kaiser-Meyer-Olkin measure of sampling adequacy		0.788
Bartlett's sphericity test	Approx. chi-squared	870.950
	gl	325
	Sig.	0.000

The objective of Principal Component Analysis (PCA) is to reduce the dimensionality of the data. When evaluating the proportion of the accumulated variance explained, the minimum number of components is selected, after which the increase is no longer significant. Table 3 shows that 7 components have a total value greater than 1 and explain 69.14% of the total variance.

Table 3 Total variance explained

Component	Initial eigenvalues			Sums of squared extraction loadings			Sums of squared sortation loadings		
	Total	% variance	% cumulative	Total	% de variance	% cumulative	Total	% de variance	% cumulative
1	8.263	31.782	31.782	8.263	31.782	31.782	7.214	27.746	27.746
2	2.803	10.782	42.564	2.803	10.782	42.564	2.170	8.345	36.092
3	1.884	7.244	49.808	1.884	7.244	49.808	1.982	7.623	43.715
4	1.456	5.601	55.410	1.456	5.601	55.410	1.846	7.100	50.815
5	1.332	5.124	60.534	1.332	5.124	60.534	1.790	6.883	57.697
6	1.161	4.464	64.997	1.161	4.464	64.997	1.489	5.728	63.425
7	1.077	4.144	69.141	1.077	4.144	69.141	1.486	5.716	69.141
8	0.937	3.606	72.747						
9	0.862	3.317	76.064						
10	0.801	3.082	79.146						
11	0.743	2.856	82.002						
12	0.619	2.382	84.384						
13	0.595	2.290	86.674						
14	0.555	2.133	88.807						
15	0.428	1.648	90.455						
16	0.418	1.606	92.061						
17	0.363	1.396	93.457						
18	0.312	1.199	94.656						
19	0.276	1.060	95.716						
20	0.259	0.995	96.711						
21	0.227	0.871	97.582						
22	0.191	0.734	98.316						
23	0.182	0.699	99.016						
24	0.120	0.461	99.477						
25	0.083	0.318	99.795						
26	0.053	0.205	100.000						

Extraction method: Principal Component Analysis

Table 4 shows the rotated component matrix obtained using the varimax rotation method, which converges to 7 interactions. It should be noted that this method groups the variables into different components and that each variable is grouped into the component where the correlation is significant.

Table 4 Rotated component matrix

		Component						
		1	2	3	4	5	6	7
1.	Logistics operators	-0.048	0.302	-0.252	-0.093	0.666	0.232	-0.075
2.	Supplier diversification	0.077	0.346	-0.235	0.636	-0.212	0.273	-0.068
3.	Supplier financing policies	-0.035	0.117	0.051	-0.059	-0.062	0.142	0.791
4.	Risk identification	0.278	0.703	0.283	0.057	-0.044	-0.004	-0.037
5.	Creation of resilience plans	0.270	0.149	0.763	0.170	0.022	0.022	0.077
6.	Influencing SMEs in new trade agreements	0.059	0.111	0.203	0.160	0.322	-0.260	0.588
7.	Tariff barriers	-0.006	0.177	0.140	0.727	0.042	-0.057	0.119
8.	Importance of trade agreements to mitigate economic risks	0.091	-0.080	0.194	0.823	0.187	-0.119	-0.065
9.	Internal collaborative work in the process	0.135	0.654	0.298	0.078	0.205	0.154	0.291
10.	Customs regulations	0.215	0.327	0.733	0.067	0.017	0.128	0.171
11.	Legalization of the cargo with the regulations	0.059	0.789	0.014	0.143	0.030	-0.081	0.094
12.	Loss and damage to merchandise	0.796	0.024	0.074	0.093	-0.116	0.026	0.120
13.	Delayed delivery of goods to supplier	0.760	0.219	-0.288	0.044	0.074	-0.038	0.120
14.	Increased freight charges	0.828	0.123	0.021	0.082	-0.121	-0.171	0.052
15.	Documentary procedures	0.757	0.029	0.378	0.102	-0.107	0.070	-0.122
16.	Trade wars	0.568	0.061	0.130	-0.077	0.436	0.124	0.140
17.	Shortage of containers	0.703	0.008	0.210	0.087	0.129	0.113	-0.089
18.	Congestion at ports and airports	0.843	0.181	0.150	-0.108	0.097	-0.141	-0.142
19.	Delays in shipping times	0.824	0.076	0.141	-0.068	0.145	-0.186	-0.248
20.	Carrier's delivery times	0.803	0.184	0.169	0.031	0.180	-0.156	-0.214
21.	Tariffs	0.724	0.070	0.160	0.059	0.075	-0.057	0.121
22.	Government policies	0.697	0.018	0.081	0.044	0.338	0.173	0.214
23.	Risk management	0.186	0.236	0.242	0.136	0.305	0.578	0.242
24.	Affectation of incoterms costs	0.209	-0.117	0.134	0.202	0.756	0.068	0.083
25.	International transportation insurance	-0.138	-0.078	0.030	-0.099	0.110	0.785	-0.044
26.	Price	0.736	-0.009	-0.014	0.035	0.012	0.278	0.161

Extraction method: Principal Component Analysis
Rotation method: Varimax with Kaiser normalization

A reliability analysis was also applied with the split-half method, in which the total variables are divided into two halves. The result for part 1 has a Cronbach's alpha of 0.68, while part 2 has 0.87, which is considered acceptable for both parts (Table 5).

Table 5 Split-half method

Reliability statistics			
Cronbach's Alpha	Part 1	Value	0.681
		N of element	13[a]
	Part 2	Value	0.879
		N of element	13[b]
	N total number of elements		26
Correlation between forms			0.502
Spearman-Brown Coefficient	Equal length		0.669
	Unequal length		0.669
Guttman two-half coefficient			0.644

a. The variables are: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13.
b. The variables are: 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26.

Split-half method obtained from SPSS

Finally, the variables are then grouped in the component (risk environment), where they have a significant correlation. In this research, seven components were obtained, which are strategically named according to the affinity of the variables, and which group the 26 variables (Figure 3).

4 Results and discussion

Conceptual model of risk environments in foreign trade logistics operations for SMEs. Based on the results of the PCA, the conceptual model of risk environments in foreign trade logistics operations for SMEs is obtained. This model is represented by seven risk environments of foreign trade operations in SMEs, each environment grouping several variables (Figure 3).

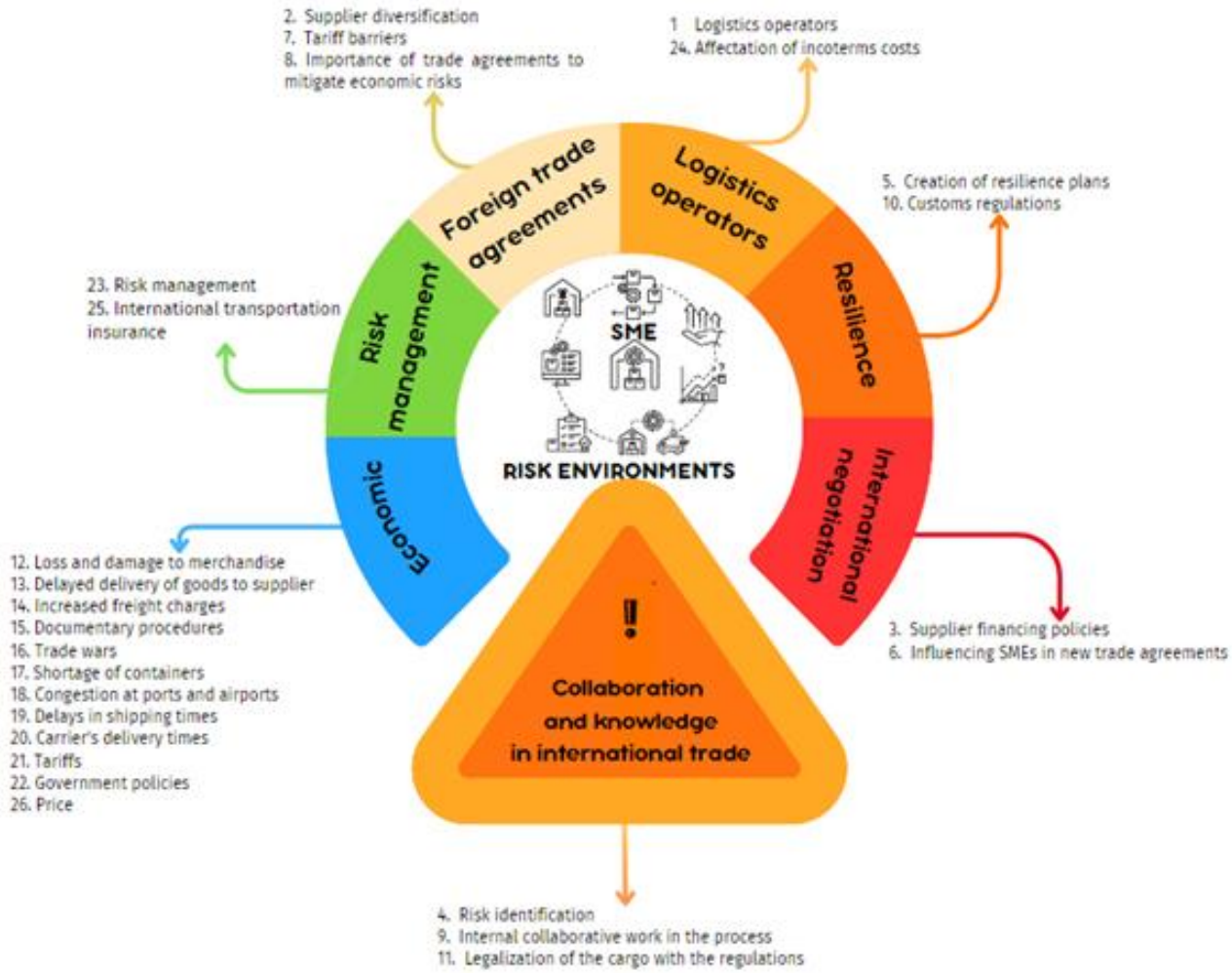

Figure 3 Conceptual model of risk environments in foreign trade logistics operations for SMEs
Source: Own elaboration (2024)

Robustness is defined as proactivity, while they understand flexibility and agility as reactivity. robustness as the ability to withstand and respond to an impact, which implies defining resilience strategies as the normalization of operations after a disruption [33].

Resilience strategies for SMEs with foreign trade operations must be unified not only with planning and execution but also with knowledge, flexibility, strategic allies, negotiations, and political, economic, social, technological, environmental, and legal uncertainties. The results obtained in this research allow designing resilience strategies oriented to the selection and evaluation of raw material and input suppliers (a), selection and evaluation of logistics operators (b), information systems and collaborative communication (c), organizational structure (d) and human capital expert in foreign trade operations (e). These resilience strategies will have an impact on the different risk environments (Figure 4), which will allow SMEs with foreign trade operations to be robust and flexible in order to increase their capacity for agility and adaptability.

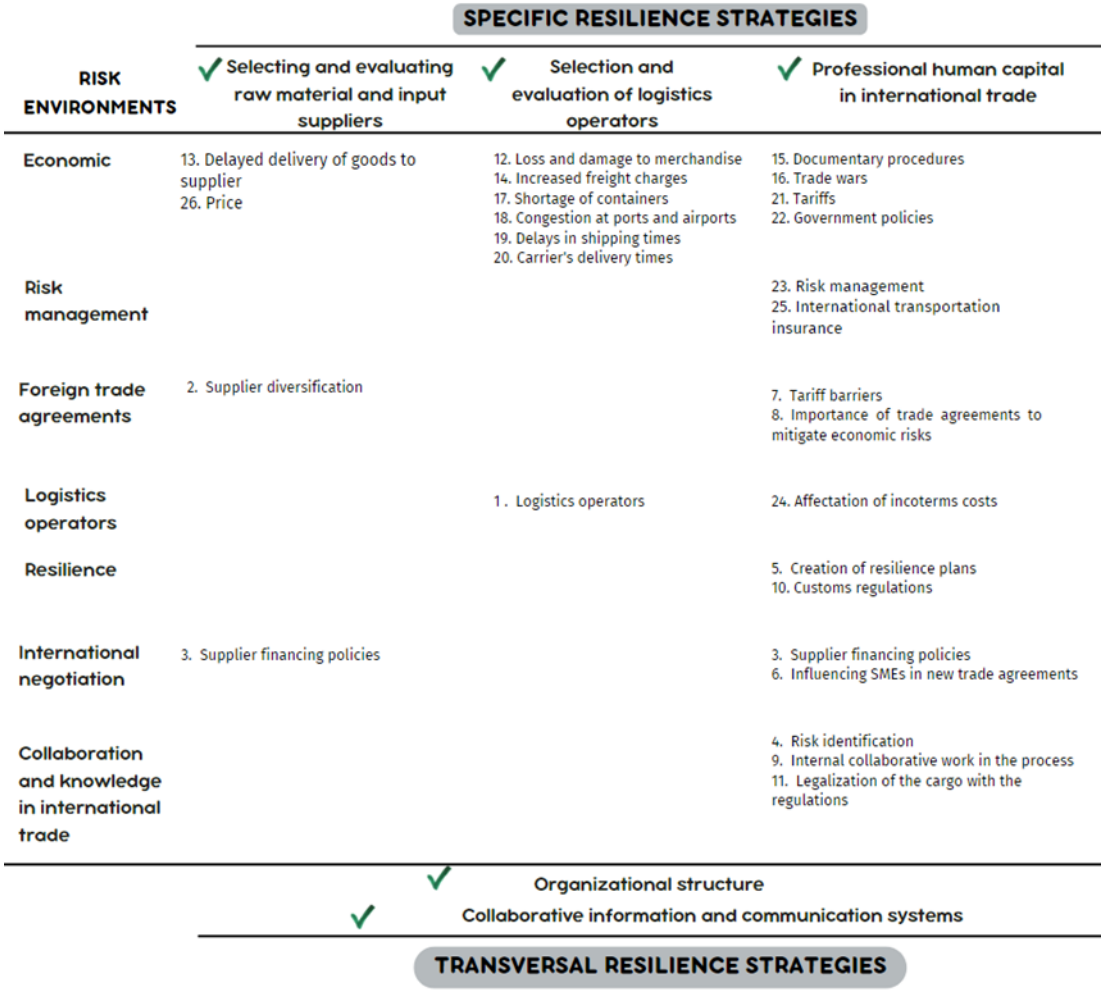

Figure 4 Resilience strategies for SMEs with foreign trade operations
Source: Own elaboration (2024)

The objective of the strategy for selecting and evaluating suppliers of raw materials and inputs is to select reliable suppliers that offer good value for money, with whom a solid business relationship can be established that reduces both prices and uncertainty between supply and demand. Suppliers that can adapt to changing needs and provide accurate and timely deliveries will help improve customer service levels and competitive positioning. In addition, an advantage should be gained from suppliers located in other countries with which there is a trade agreement or free trade agreement in force. On the other hand, it is important to emphasize that the evaluation and selection of suppliers are essential processes to prevent risks related to third parties.

A logistics network is a system that must efficiently connect production and consumption activities (sales to the end customer). Its main objective is transportation and warehousing, and although it seems simple, it is a complex planning that requires a large number of resources. For this reason, it is better to outsource it through logistics operators (OPL) since many variables must be considered, such as procurement policy, volume of goods, transportation systems, available warehouses, racking configuration, and forecasts, among others. In this sense, the selection and evaluation strategy of the OPL must be based on the evaluation of transportation costs, the level of customer service, and the fulfilment of delivery promises.

The strategy of professional human capital in international trade is essential for decision-making in various scenarios of foreign trade operations. Professionals must have specialized knowledge of trade agreements, customs regulations, and tariff barriers established by the World Trade Organization. It is necessary to have a broad understanding of the laws related to the import of goods into the country since the related guidelines are very dynamic and affect the flow of goods, causing significant delays and customs expenses. On the other hand, it is much more beneficial to know the incentive programs that a government creates to reduce taxes for exporting companies. The field of international trade is a crucial point, so the selection and maximization of each human resource is the most critical factor to being successful at the

organizational level. It should be noted that the professionalization and experience of human capital also allow the creation of resilience plans.

In the competitive business world, SMEs face a number of challenges to achieve success. However, organizational structure is crucial yet constantly overlooked. The relationship between a well-defined organizational structure and the success of an SME is profound and multifaceted. A well-designed organizational structure strategy should clearly distribute the roles and responsibilities of each member of the company to create effective communication channels, enable quick and efficient decision-making, and avoid duplication of tasks. On the other hand, the organizational structure allows flexibility and adaptability to market changes and new opportunities. Flexibility facilitates innovation, as ideas flow without too many bureaucratic obstacles. It also fosters employee motivation and commitment by providing a clear and organized work environment that improves productivity, which is essential for sustainable growth.

The strategy of collaborative information and communication systems (internal and external) enables agile management in the review of documentation by all stakeholders and compliance with regulatory and legal processes. It offers greater traceability of operations throughout a supply chain. It should be noted that technological tools are necessary to identify, quantify, and mitigate risks [34]. Companies will have greater visibility to act faster on risks. In this sense, the risks inherent in foreign trade logistics operations can be minimized through three specific strategies and two cross-cutting strategies, which increase responsiveness and flexibility (Figure 5).

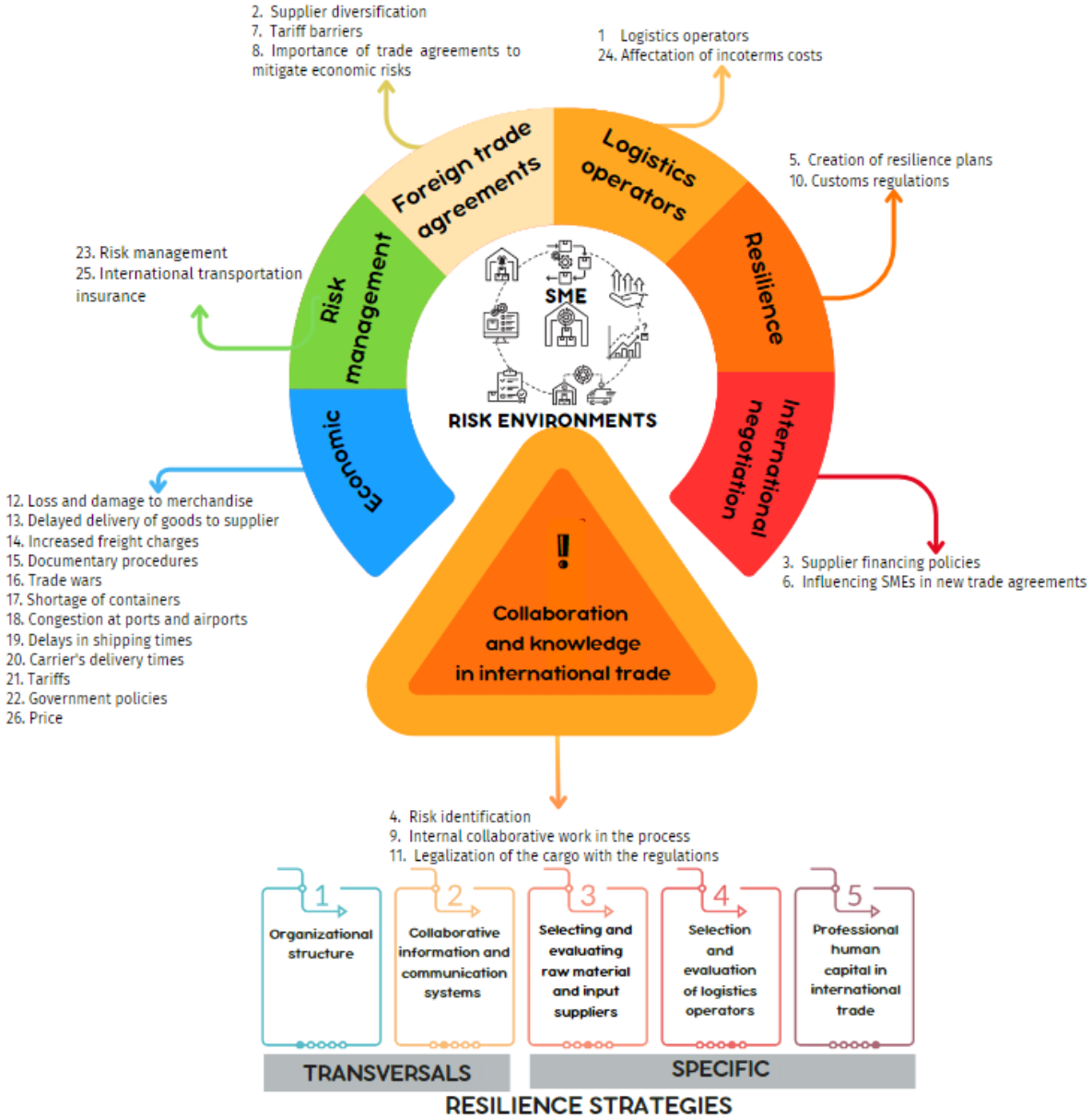

Figure 5 Resilience strategies for risk environments in the foreign trade logistics operations of SMEs
Source: Own elaboration (2024)

5 Conclusions

Among the findings of research, that economic risk is the most important for SMEs. However, they also mention some sub-criteria with a high level of importance, such as work environment, human error, and supplier quality. These findings show that the economic environment is the one with the highest number of risks (12 variables). In addition, the environment of collaboration and knowledge of SMEs in international trade processes is essential within SMEs. The educational profile or training of personnel in areas such as supply chain and logistics operations within an organization is closely related to the attitude to detect and perceive risk; this implies that it is necessary to have qualified personnel with knowledge of foreign trade and international regulations, with adequate preparation and experience. This requires an exchange between educational institutions and SMEs.

SMEs have limited financial capacity, which prevents them from implementing resilience strategies beyond their means. However, in the medium and long term, they should include in their projections technological tools that support the information overload along a supply chain for their strategies, such as data mining, artificial intelligence, and blockchain in logistics, the implementation of resilience indicators and thus be able to improve decision making and increase their level of competitiveness in international trade, without losing sight of the fact that technological development can attract new risks, such as computer or cyber risk. The correlation of the supply chain with technological tools enables a compact base in the short, medium and long term for organizations to be more resilient [35]. The technology called blockchain is essential for the analysis and minimization of risks in the different logistics services in a company.

In this research, information has been obtained on SMEs, which play a significant role in the world economy. However, it is essential to clarify that SMEs have low cash flow and few assets. This situation does not occur in large companies, whose cash flow is significant and whose assets have increased dramatically in value, which helps to mitigate the impact of risks and may spark future research to compare the risks of SMEs and large companies. This research may have a second stage where we can include a factor with environmental, technological, sustainability, and sustainability risks for SMEs and identify the impact of climate change on supply chain performance.

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