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Summary

Impact of organizational learning on firm performance: The mediating role of corporate entrepreneurship and the moderating role of environmental condition
Hadj Hassine Abir, Lakhal Lassad 1

The relationship between the Zakat management structure and economic development
Samia Ben Amor, Ghazi Zouari 29

The role of social medias for the success of Moroccan SMEs
Hamour Hasnae, Jabbouri Zakia..... 32

Optimizing resilience strategies to reduce vulnerabilities in the supply chain based on the QFD approach: The case of the clothing company ZENs
Fersi Ghada, Ghorbel Ahmed, Charfi Momtez..... 35

Strategic risk management in international trade operations: case of import operation for a Tunisian companys
ENNOURI Wissem..... 53

Impact of organizational learning on firm performance: The mediating role of corporate entrepreneurship and the moderating role of environmental condition

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Abstract

Purpose: The aim of this paper is to study the mediation effect of corporate entrepreneurship on the relationship between organisational learning and firm performance and to investigate the moderating role of environmental condition.

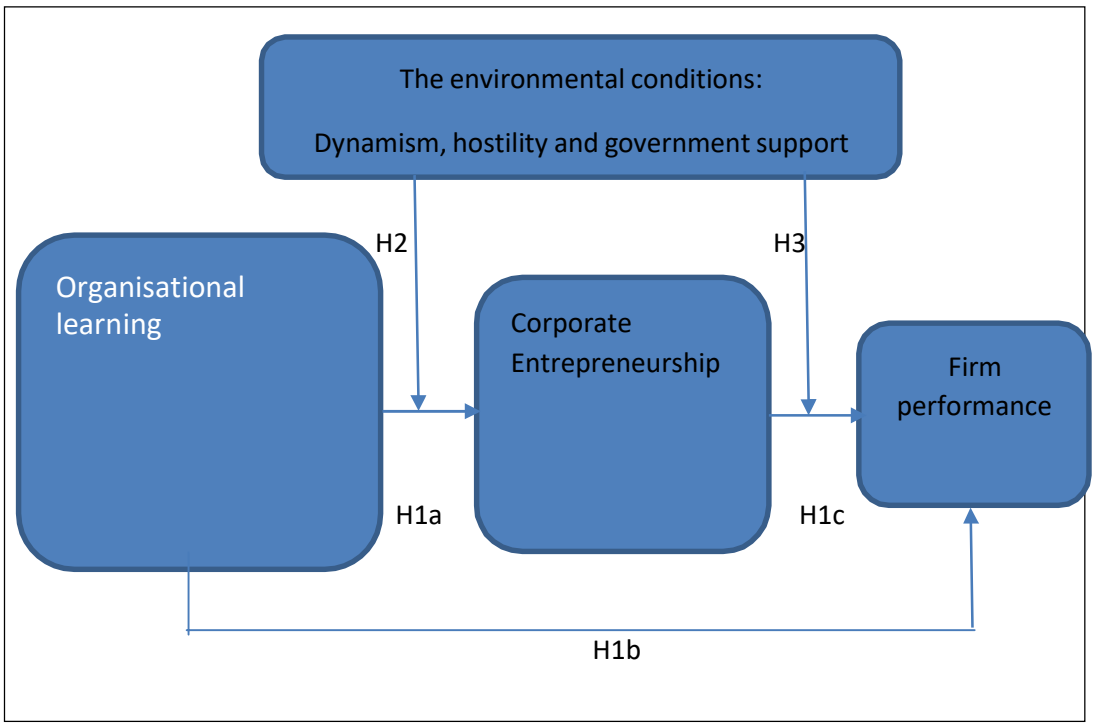
Design/methodology/approach: The paper employs a quantitative methodology based on a sample of 214 middle and top managers of hotels in Tunisia.

Findings: Results demonstrate that organisational learning influences positively corporate entrepreneurship and firm performance. Furthermore, results show that the mediation effect of corporate entrepreneurship is not significant. Also, the results suggest that the moderating effect of environmental condition is significant.

Keywords: organisational learning; corporate entrepreneurship; firm performance; dynamism; hostility; external environment; tourism sector.

***Paper type*:** Research paper.

The research model



ISSN: 1737-9334

Results and discussions

1. CE mediating effect on the relationship Organisational learning oriented context and Firm performance

Before checking the fit of our mediation model and the hypotheses, we check the discriminant validity which is well examined in the Table 2

Table 1: Discriminant validity of the constructs of the mediation model

	Context	**CE**	**Firm performance**
Context	**0.723**		
CE	0.235^2	**0.923**	
Firm performance	0.574^2	0.371^2	**0.888**

Now, to verify our hypothesis on mediation and direct effect represented in our research model Figure 1, we employed a structural equation modelling (SEM) approach. We opted for the 'causal' methods, which remained the most common. They are based on the model of Baron and Kenny (1986) revised and renovated in 1998 by Kenny and al. presented in the work of El Akremi and Roussel (2003) and recommended the Sobel test (1996). This model set out a simple, clear and sufficiently broad approach which integrated the other methods of differences and products of coefficients. This approach presented a series of four successive and necessary tests in testing the mediating effect of a variable M on the relationship between two variables X and Y. The coefficients of such relationships must be significant with Student's test ≥ 1.96; $p = 0.05$. To determine the nature and type of the relationship we referred to the work of Mathieu and Taylor (2006) who developed the mediation decision tree.

But first of all, we have to check the fit of the two models (Table 3): The Direct Model M1 and the Mediation Model M2. We find a good fit goodness, which reflects a good fit to the empirical data. The internal consistency reliability and construct validity can be examined. Indeed, the The Chi-squared test (CMIN), the CMIN/DF, the RMSEA, the AIC and the ECVI show an acceptable fit.

Table 2: Fit of the direct and mediation models.

Adjustment indices of two measurement Models: M1 Direct Model and M2 Mediation Model									
	Absolute				***Incremental***			***Parsimony***	
	CMIN	**DF**	**CMIN/DF**	**RMSEA**	**NFI**	**TLI**	**CFI**	**AIC**	**ECVI**
M1 DIRECT	2198.987	583	3.772	.114	.735	.759	.789	2512.987	11.798
M2 MEDIATION	2108.609	581	3.629	.114	.746	.771	.8	2426.699 >SM 1480	11.393 >SM 6.948

ISSN: 1737-9334

Standards	-	-	[1;5]	<0,08	>0,9	>0,9	>0,9	< MI 8459.981	< MI 93.714

Moving on the validation of CE mediation effect, using the Baron and Kenny's (1986) test of the mediation effect, we proved the significances of the positive and direct effect of context on performance (c) (p=.045<.05) and the positive effect of context on CE (a) (p=.000<.05). However, we failed to prove either the significance of CE on performance (b) (p=.084 >.05) or the significance of the positive effect of context on organisational performance under the control of the mediating variable CE (c'). Thus, we rejected the mediation hypothesis at this level of analysis (Table 4).

Table 3: Baron and Kenny's (1986) test of the CE mediation thesis between organisational learning oriented context and firm performance

Mediator variable: EC					
Dependent variable : Performance					
Independent variables : Context					
Relationship	**c**	**a**	**b**	**c'**	**Result**
Significance	**Sign**	**Sign**	**No Sign**	**No Sign**	**Direct relationship**

To confirm this result, we check the Sobel test (Table 5). This test presents a has a p-value of order 0.087 > 0.05. thus, we confirm the reject of the mediation hypothesis.

Table 4: Sobel test

	Value		***Test statistic***	***Std.Error***	***P value***	***Decision***
a	***0,278***	*Sobel test*	*-1.71217813*	*0.8782392*	*0.086*	*NV*
b	***(-5,409)***					
S_a	***0,022***					
S_b	***3,13***					

Moving on the Student test to check the significance of the CE mediation thesis between organisational learning oriented context and firm performance, we proved that the Mediation hypothesis is not validated and we verified a direct relationship between organisational learning oriented context and firm performance (Table 6 and Table 7).

Table 5: Student test of the mediation effect

Relationship to be tested	***« Stand.Beta »***	***Student T***	***P[1]***	***Decision***
CE ⟸ Context	*0.973*	*12.907*	***	*V*

[1] p < 0.05 *H1: The CE mediates the relationship between organisational learning oriented context and firm performance is not validated*

ISSN: 1737-9334

Performance ⇦ CE	*(-3.565)*	*(-1.728)*	*0.084*	*NV*

Table 6: Recap of hypothesis verification

H1a	*The organisational learning-oriented context (learning orientation, memory orientation and intercommunication & information sharing) has direct influence on the CE*	***V***
H1c	*The organisational learning-oriented context (learning orientation, memory orientation and intercommunication & information sharing) has direct influence on firm performance*	***V***
H1b	*CE has a direct influence on firm performance*	***NV***
H1	*The CE mediates the relationship between the organisational learning oriented context and firm performance*	***NV DR***

- ***H1a is validated***: The significance the positive effect of the organisational learning oriented context on CE (***γ= 0.937; T Student= 12.907; p= 0***). This result confirms that such perceived context is incentive-based and conducive to entrepreneurial activity (Antoncic and Hisrich, 2004; Rutherford and Holt, 2007; Holt and al., 2007; Zampetakis and al., 2009; Ireland and al., 2009; Zahra and Nambisan, 2012). Indeed, according to the managers interviewed, an organisational context characterised by a good communication climate (Gupta and al., 2004; Hornsby and al., 2002; Rutherford and Holt, 2007; Hornsby and al., 2008; Van Wyk and Adonisi, 2011) and oriented towards learning and memorizing (Ghemawat 1991; March 1991; Moorman and Miner 1997; Hanvanich, 2006; Ming-Ta Tsai, 2008; Mol and Birkinshaw, 2009; Camisón and Villar-López, 2011) is significantly promised the exercise of CE in hotels of Djerba island in Tunisia.

Therefore, having a learning orientation especially from their past experiences and crises, drawing the right lessons, creating and sharing new knowledge (Sinkula and al., 1997), information and visions are key factors to drive innovations, CVs and even strategic renewal in hotels.

- ***H1c is validated:*** The significance of the direct effect of such context on hotel performance (***γ= 0.873; T Student= 2.004; p= 0.045<0.05***). In fact, we proved that the performance of hotels in terms of growth and profitability is positively and significantly correlated with the organisational context characterised by a well-established communication climate and a well-perceived organisational learning and memory orientations. Such result has been widely documented in the literature. In fact, an organisational context that promotes learning, memorisation, information sharing and good inter-communication between its different members is a real and unique resource for the hotel to ensure its performance and have a competitive advantage over its

ISSN: 1737-9334

competitors (Zahra, 2012; Eggers and al., 2013; Sakiet al.,2013; Wang and al., 2015; Qi and Chau, 2018; Zuo and Fisher, 2019; Asbari and al, 2020; Hyun eta al, 2020; Nguyen and al., 2020). Indeed, it is very important to adopt organisational learning as a strategic orientation in the hotels to be developed in order to maintain its attractiveness and to face both the competition of the other tourist destinations of the Mediterranean and the numerous successive crises which it has been confronted with and which have made it increasingly fragile. It should be noted that the hotel sector in Tunisia has been in peril since the 1990s: it has experienced less growth and poor performance due mainly to the loss of momentum of its traditional model, the existence of several structural deficiencies and a very high level of debt (4 billion dinars in 2014 according to the Central Bank of Tunisia, including 2.3 billion dinars of classified debts and 1.4 billion dinars of estimated contentious debts).

This situation has been aggravated by the various events experienced by the country since 14 January 2011 and especially during the year of our empirical study 2015 marked by two attacks that directly targeted the sector and made the season catastrophic according to various experts in the field.

Thus, the establishment of a learning-oriented organisational context that creates, stores and shares new knowledge developed from particular phenomena (Moorman and Miner, 1997) and situations (Hargadon and Fanelli 2002) in the hotels' history, can be brought to bear current decisions (Walsh and Ungson, 1991; Camisón and Villar-López, 2011; Houtekier and al. 2013). It allows them to act quickly by anticipating changes (Balmisse and Meingan, 2008), ensuring their existence in a very fragile market and above all improving their performance (Rostini and al, 2021).

- ***H1b is not validated:*** The non-significance of the positive effect of CE on hotel performance (***γ= (-3.565); Student T= (-1.728); p= 0.084 > 0.05 NV***) which still makes our results surprising.

Such result can be explained by at least two reasons:

The first is essentially due to the nature of the economic model of the hotel sector in Tunisia which is traditionally based on the mass beach product and which does not oblige either the managers or the hoteliers to practice and conduct corporate entrepreneurship in a continuous manner. Indeed, to ensure performance in terms of growth and profitability, hotels seek to secure a contract with a tour operator, usually through an incoming agency. It is true that such contract is a form of CV that guarantees them full booking during the season and ensures a certain level of performance. However, once obtained, hotels do not make any further entrepreneurial efforts, they try to work within the standard norms to renew it.

The second reason is that usually there are conflicts of interest between hoteliers as owners of the funds and managers as agents. Thus, the CE may not be targeted by the latter.

ISSN: 1737-9334

Typically, these conflicts originated in differences in planning horizons and risk aversion (Byrd and al, 1998).

Focusing on the planning horizon, hotel managers favoured short-term investment projects in order to quickly reveal their performance and spread uncertainty about their own value in the labour market (Narayanan, 1985). They preferred the short term, during which they ran the hotel, whereas the planning horizon of hoteliers was longer, relating to the indefinite life of their hotel (Mezghanni, 2010).

Focusing on the divergence in terms of risk aversion, we note that fund owners generally had a diversified portfolio. Therefore, they were willing to bear a higher level of risk than the managers. The latter tended to avoid CE projects, by virtue of the unreasonably uncertain nature of their income. Indeed, this type of project is too risky and its consequences on their career can be harmful (Mezghanni, 2010). This may lead to myopic investment behaviour (Porter, 1992).

Thus we reject the hypothesis of CE mediation on the positive and direct relationship between organisational context and performance and we proved the existence of a direct relationship between such variables.

Hence, in this stage, our results are consistent with the Resource-Based Theory, Social Learning and the Social Exchange Theories. Undeniably, working in organisational context that facilitates learning, interaction and communication between employees, is a unique and non-imitable resource to guarantee CE; performance and competitive advantage. Indeed, the managers of the hotels which characterised by a beneficial and supportive learning oriented organisational context, feel obligated to reciprocate these benefits in the form of positive attitude. According to our empirical study, this attitude can be either commitment to CE or improving firm performance.

2. The environment conditions moderating effect on the relationships between organisational learning oriented context and CE; and CE and performance

To verify our hypothesis on moderation effect represented in our research model Figure 1, we employed a structural equation modelling (SEM) approach. In particular, we used Ping's (1995) procedure (Fig. 2). The choice of this procedure was not arbitrary. Indeed, while referring to the work of El Akremi and Roussel (2003), we note that this method has several advantages. Firstly, it restricts the number of parameters evaluated by determining the interaction effect (XP*Z) by a single indicator equal to the product of the sums of the XP and Z indicators. Secondly, it can be used with all structural equation methods software, as it replaces the non-linear constraints with values fixed from the results of the confirmatory factor analysis previously performed. And thirdly, it is characterised by relative simplicity compared to other interaction effect analysis approaches and has the same rigour as them (Cortina and al., 2001).

ISSN: 1737-9334

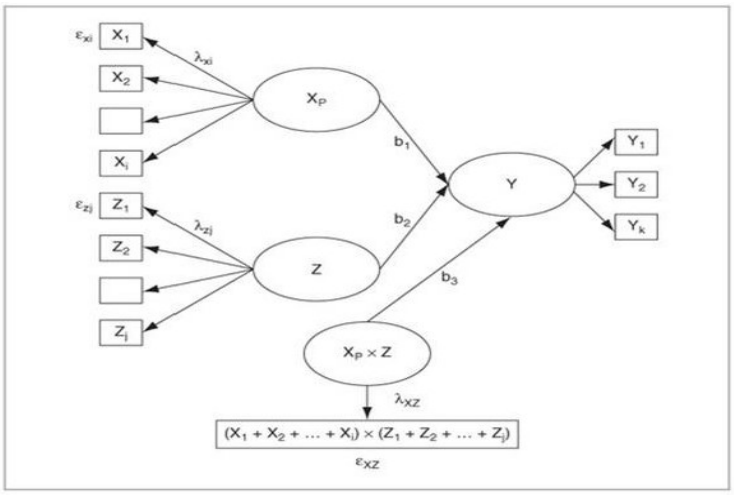


Fig. 2: Ping's (1995) procedure for the analysis of the moderator variable

The environment conditions moderating effect on the relationships between organisational learning oriented context and CE

Firstly, we check the discriminant validity of all the constructs of the mediation model. The results presented in the Table 8 shown the existence of such validity.

Table 7: Discriminant validity of the constructs of the moderation models

	Context	**Envr Cd**	**CE**	**Firm performance**
Context	**0.732**			
Envr Cd	0.563^2	**0.820**		
CE	0.276^2	0.172^2	**0.923**	
Firm Performance	0.542^2	0.145^2	0.847^2	**0.888**

To test this effect, we, firstly, proceeded to check the fit goodness of two structural models.

- M1 consists of studying the causal links between both the organisational learning oriented context and the environmental conditions on the CE. It is a model without moderation.
- M2 includes the interaction variable (Context*environmental conditions) whose significance test allowed us to estimate the degree of significance of the moderating effect of environmental conditions on the causal link between the organisational learning oriented context and CE. It is a model with moderation

The goodness of fit of these two models is presented in the Table 9 which showed a good fit goodness. Indeed, the internal consistency reliability and construct validity can be examined. In fact, the CFI and TLI associated with the two models present very acceptable values in the range of 0.9. The Chi-squared test or CMIN, the CMIN/DF, the RMSEA, the AIC and the ECVI show an acceptable fit.

Table 8: Fit of the moderation model of environment condition on the relationship between the organisational learning oriented context and CE

ISSN: 1737-9334

Adjustment indices of two measurement Models: M1 without moderation effect and M2 with moderation effect									
	Absolute				***Incremental***			***Parsimony***	
	CMIN	**DF**	**CMIN/DF**	**RMSEA**	**NFI**	**TLI**	**CFI**	**AIC**	**ECVI**
M1 without moderation	102.7	36	2.849	0.093	0.871	0.833	0.909	186.568 (156 MS)	0.876 (.732MS)
M2 with moderation	94.22	35	2.692	0.089	0.881	0.847	0.919	180.215	40.846
Standards	-	-	[1;5]	<0,08	>0,9	>0,9	>0,9	< 818.849	< 3.844

Then, we test the different causal links of the two models, the results are presented in the Table 10. We note the significance of the direct and positive causal links between the organisational learning oriented context and CE (***γ= 0.672; Student T= 3.118 > 1.96; p= 0.002 < 0.05***) and between environmental conditions and CE (***γ= 0.735; Student T= 3.858; p= 0***). Furthermore, we reported that the inclusion of a new interaction variable produced by two variables: the independent variable (the organisational learning oriented context) and moderating variable (environmental conditions) produces a positive significant effect on the causal link between such context and CE. Indeed, the standardised Beta of the interaction variable is of order ***0.236*** and has a significant *P* value of order ***0.002 < 0.05.*** Thus, we admit that environmental conditions positively moderate the positive causal link between the organisational learning-oriented context and CE. They act as an accelerator and stimulator of this positive relationship. In this way, ***H2 is validated.***

Table 9: Student tests of the causal links of the two models tested: M1 without moderation effect and M2 with moderation effect of environment condition on Context/CE

Causal Links	**M1 without moderation effect**			**M2 with moderation effect**		
	Stand. Beta	**Student T**	**P**	**Stand. Beta**	**Student T**	**P**
CE ← Context	0.672	3.118	0.002	0.698	3.324	***
CE ← Envr Conditions	0.735	3.838	***	0.676	3.47	***
CE ← Context* Envir Conditions				0.236	3.162	0.002

We can explain the stimulating effect of environmental conditions on the positive relationship between the organizational learning oriented context and CE that when hotels operated in a dynamic, hostile environment in which the government played a supportive role, they became more and more oriented towards the exercise of CE while benefiting from a context oriented towards the creation, memorization and sharing of new knowledge. It should be recalled that we launched our empirical study during a very critical period experienced by the country and

ISSN: 1737-9334

especially by the sector, just after the attack on the Imperial Hotel Sousse which occurred in June 2015, just 3 months after the attack on the Bardo Museum in Tunis. Thus, we could admit that the external environment at that time was very dynamic, very hostile to that is added on the effective level the government contribution which announced a series of exceptional measures to support this sector to pass the crisis. An investigation of managers' perceptions allowed us to conclude that in such environment, hotels have made the most of their crisis management know-how memorised from their past experiences and history to launch new entrepreneurial adventures. Indeed, such an assumption has been proven in reality, as many hotels have conducted new ECV, especially by entering new international markets and seeking new contracts with TOs, such as the Russian market with the tour operator annex tour (in about 121,000 Russians in hotels in 2017) and the Algerian market (14831 Algerians in hotels in 2017). In addition, several hotels have increasingly relied on domestic tourism which has been a saving grace for the sector. According to FTH statistics, the number of overnight stays by Tunisian customers (non-residents and residents abroad) was 6 420 327 at the end of June 2017, against 5 338 375 at the end of June 2016 and 11 052 985 during the same period of 2014, i.e. an increase of 20.3% compared to 2016 and a decrease of 41.9% compared to 2014.

Accordingly, our results are consistent with the contingency perspective and the dynamic capability theory. In fact, under external environment condition characterised by a high level of dynamism, hostility and government support, hotels have responded proactively by exploring and exploiting new opportunities that have arisen in new markets with new TOs. They reconfigured their capabilities and made the most of their organisational learning context to drive CE. Thus, our study contributes to the theory of organizational learning by proving the importance of the creation, memorisation and sharing new knowledge. Indeed, knowledge is the most strategically significant resource of the hotel which is able to generate entrepreneurial activities under high levels of environmental dynamism, hostility and government support.

The environment conditions moderating effect on the relationships between CE and performance

One of the steps to follow in the study of the moderating effect of environmental conditions on the causal link between CE and firm performance is to centre all the indicators of the variables in the model to reduce the multi-collinearity between them. We then proceeded to test two structural models. The first M1 consists of studying the causal links between both the CE and the environmental conditions on the firm performance. The second model, M2, includes the interaction variable CE*environmental conditions, and the test of its significance allowed us to estimate the degree of significance of the moderating effect of environmental conditions on

ISSN: 1737-9334

causal link between CE and performance in terms of growth and profitability. The goodness of fit of these two models is presented in the Table 11 which demonstrates an acceptable and satisfactory fit goodness. Internal consistency reliability and construct validity can be examined. The Chi-squared test or CMIN, CMIN/DF, RMSEA, AIC and ECVI are all within the norms and show a good fit between the data and the theoretical model.

Table 10: Fit of the moderation effect of the environmental conditions on the relationship between CE and firm performance

Adjustment indices of two measurement Models: M1 without moderation effect and M2 with moderation effect									
	Absolute				***Incremental***			***Parsimony***	
	CMIN	**DF**	**CMIN/DF**	**RMSEA**	**NFI**	**TLI**	**CFI**	**AIC**	**ECVI**
M1 without modération	197.2	34	5.801	0.15	0.767	0.67	0.794	261.24 (132 MS)	1.226 (0.62 MS)
M2 with modération	141.1	33	4.277	0.124	0.833	0.77	0.863	207.141	0.972
Standards	-	-	[1;5]	<0,08	>0,9	>0,9	>0,9	< 868.154	(<4.076)

Moving on testing the different causal links of the two models, the results are presented in the Table 12. We note that the simple inclusion of the environmental conditions variable in this model makes the relationship between CE and firm performance significant and positive (γ= 0.674; Student T= 7.484; p= 0). Nevertheless, we observe the non-significance of the direct and positive causal link of environmental conditions on performance (γ= (-0.206); Student T= (-1.356); p= 0.175> 0.05 NV). Working on a second model that takes into account the moderator effect, we find that the integration of a new interaction variable produced by two variables, independent CE and moderator environmental conditions, produces a significant positive modification on the positive causal link between CE and firm performance. Indeed, the interaction variable has both a significant P value and a Beta of orders 0.423. Thus, we admit that environmental conditions have a positive effect on the positive relationship between CE and firm performance. They stimulate this causal link. Thus we validated H3. logical results that have been widely proven in previous literature.

Firstly, we prove that hotels derived CE activities to improve their growth and profitability (Zahra, 1996; Zahra and al., 2009; Goodale and al.,2011; Peltola,2012; Yunis and al., 2018). Generally, the CE is a key factor of the firm performance (Lomberg and al. 2017; Kreiser and al., 2019; Rahaman, 2021).

Secondly, we verify the non-significant direct link between an external environment characterized by a high level of dynamism, hostility and government support and firm performance.

ISSN: 1737-9334

Thirdly, we demonstrate that such external environment act as an accelerator of the positive relationship between CE and firm performance. Indeed, hotels which derived entrepreneurial activities, as a response to the dynamism, hostility and government support presented in their external environment, improve their profitability and growth. In other words, under the pressure from the external environment, the managers of the hotels should identify and neutralize threats and weaknesses (Antoncic and Hisrich, 2001) and seek innovative solutions by fostering their entrepreneurial activities to ensure and improve their survival and performance (Covin and Slevin, 1991; Zahra, 1993). Therefore, our results are consistent with the contingency and institutional perspectives.

Table 11: Student tests of the causal links of the two models tested: M1 without moderation effect and M2 with moderation effect of environment condition on CE/Firm performance

Causal Links	**M1 without moderation effect**			**M2 with moderation effect**		
	Stand. Beta	**Student T**	**P**	**Stand. Beta**	**Student T**	**P**
Performance ← CE	0.674	7.484	***	0.732	9.236	***
Performance← Envr Conditions	-0.206	-1.356	0.175	-0.234	-1.589	0.112
Performance ← CE * Envr Conditions				0.423	8.486	***

Conclusion

The purpose of this study is to understand the role of organisational learning oriented context in driving CE and improving firm performance. Results demonstrate that such context is positively associated CE and firm performance. Furthermore, this work supports the idea that establishing an organisational learning oriented context is a unique resource to drive CE, improve firm performance and to create a sustainable competitive advantage for the hotels. The findings reveal that the managers of the hotels who perceived a beneficial and supportive learning oriented organisational context, feel obligated to reciprocate these benefits in the form of positive attitude which can be either commitment to CE or improving firm performance. However, this study demonstrates that the CE has no significant mediation effect on the relationship between such context and hotels performance.

Focusing on the moderation effect of the external environment, this work validates that working in external environment characterized by the dynamism, hostility and a perceived government support stimulate both the impact of the organisational learning oriented context on CE and the impact of the latest on firm performance. Indeed, the more hotel managers operate under the

ISSN: 1737-9334

pressures of the external environment, the better they exploit the newly acquired stored and shared knowledge to conduct entrepreneurial activities that guarantee growth and profitability;

Thus, this study contributes to the growing stream of research on Corporate Entrepreneurship by integrating several theories. This research enriches our understanding of the role of organisational learning oriented context, as a unique resource, in driving CE and improving growth and profitability.

Furthermore, an important contribution of this study is the impact of the organisational learning oriented context on both CE and firm performance. As the managers feel obligated to reciprocate the benefits of the organisational context where they are operated, in the form of positive attitude toward CE and improving performance. Such result confirms the premises of social learning and social exchange theories.

Another important contribution of this study, the fact that it is consistent with research which suggest the application of institutional (Pinchot, 1985; Aidis and al., 2008; Yiu and al., 2007; Yiu and Lau 2008; Cantwell and al., 2010; Kouame; 2012; Turró and al., 2013) and contingency theories (Sadler, 2000; Kouame 2012; Peltola 2012; Zahra and Nambisan 2012; Hoenen and al. 2013; Turró and al. 2013) is particularly useful in entrepreneurial research. Thus we go beyond the use of the resource-based theory as a foundation in our research and confirm the idea developed in the dynamic capability theory which postulates that firms act in response to the market opportunities, and reconfigure their capabilities to maintain competitiveness and improve firm performance (Teece and al., 1997), in our context the main capabilities are the creation, storing and sharing new knowledge.

The present study has important implications for practitioners. Managers of hotel need to be conscious of their organisational context as a unique and idiosyncratic resource and understand how they should exploit it to launch new entrepreneurial activities and to improve hotel performance. Managers should use this specific resource for strategic decision making to successfully sustain survival in a very turbulent external environment marked by successive crises.

Despite the promising findings of this research, our research is not free from limitations that future studies are called to address. First, as we didn’t utilize control variables; future researches are needed to take into consideration other possible variables which may be affect significantly our models. These variables may include manager level, manager experience in the hotel, hotel categorisation, operating model, type of management contract and governance style etc.

Second, the generalizability of our results is another limitation as this research was conducted only on Hotelier sector in the Djerba island Tunisia. In order to increase generalizability, it may prove helpful to carry out a comparative study between two or more regions in the same country or to

ISSN: 1737-9334

study to study the whole tourism sector in Tunisia with its different components. Furthermore, our data relied on a single respondent, the top and middle manager. Reponses from the owner would provide richness to our findings.

Third, this work has limited itself to use just subjective measures for firm performance. However, it would be relevant to include objective measures. Finally, another limitation is the cross-sectional nature of our research which limits the possibility to provide further conclusions. Longitudinal research could assess causality in the relationships under study.

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The relationship between the Zakat management structure and economic development

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Introduction :

- Ligne 1 This study examines the impact of the management structure of Zakat (Zakat's investment, Zakat collected from enterprises, and the number of Zakat beneficiaries) on Economic development social assistance, official development assistance.

- Ligne 2 A sample of 8 countries from the Middle East and the North Africa (MENA) was examined during the period 2011-2014 to achieve our goal.

- Ligne 3 The study found that there is a significant positive relationship between the social assistance, zakat collected from enterprises, the number of beneficiaries and the Gross Domestic Product.

- Ligne 4 On the other hand, it can be seen that the Investment and Official Development Assistance have no effect on the Gross Domestic Product.

- Ligne 5 **Keywords :** Domestic Product, zakat, Social assistance, MENA, Investment, Economic development, Islamic Financial

Resultats :

Fig 1.

GDP	Coef	Std.Err	T	P>t
AD	0.834	0.315	2.65	0.013**
ZC	0.270	0.023	1.17	0.051***
Nbr B	0.006	0.004	1.54	0.035**
Nbr H	0.003	0.005	0.62	0.042**
Cons	0.759	0.831	0.91	0.069***
Number of observations = 32				
F (4, 27) =11.70				
Prob>F = 0.000				

ISSN: 1737-9334

R^2 = 0.63

Fig 2.

The variables	Assumptions	The results of the regression	Expected sign	Sign observed
I	H1: Investment has a positive effect on GDP	Rejected	(+)	(+)
AS	H2: Social assistance has a positive effect on PB	Accepted	(+)	(+)
APD	H3: Official development assistance has a positive effect on GDP	Rejected	(+)	(+)
ZCE	H4: Zakat collected from businesses has a positive effect on the GDP	Accepted	(+)	(+)
Nbr B	H5: the number of beneficiaries has a positive effect on GDP	Accepted	(+)	(+)

- Mathematical model

$GDP= \beta_1 AS_{it} +_t + \beta ZC_{2it} + \beta_3 Nbr\ B +_{it} \beta Nbr_4\ H +_{it} \mu_{it}$

- Commentaires

- Investment has no effect on gross domestic product, i.e. zakat has no impact on investment.
- Social assistance has a significant positive effect on the gross domestic product, i.e. Zakat represents a determinant of growth of social assistance and also of gross domestic product.
- Official development assistance does not have an effect on the gross domestic product, i.e. the variation of Zakat does not generate a variation of official development assistance and also of the gross domestic product.

Zakat collected from businesses has a significant positive effect on Gross Domestic Product, i.e. growth in Zakat leads to growth in Gross Domestic Product

ISSN: 1737-9334

Conclusion :

- Ligne 1, Every lunar year (Hegira), Muslims are faced with the "obligation" to give alms to the poor to support themselves, even non-Muslims, the rich in a state of financial crisis, and those employed to collect it, can benefit from it. Zakat is not only subject to gold or silver, but also to agricultural crops, livestock, and trade. The benefits of Zakat are not only limited to the purification of man from greed, or as a sacred bond between man and God, but it is also a factor of economic development.

- Ligne 2, In the first place, Zakat combats hoarding (the excessive accumulation of money and goods), which is a fundamental aspect of capitalism. Hoarding means that money and natural resources remain limited to a social class, which enjoys wealth and well-being, while the poor are marginalized and impoverished, and labor is excessively exploited. Zakat came to fight against hoarding and poverty. By giving annual alms to the poor, the latter can consume more, and even acquire the tools of work.

- Ligne 3, God says in the Holy Quran: "Announce a painful punishment to those who hoard gold and silver without spending anything in the way of Allah; the day when these metals will be brought to incandescence in the fire of Gehenna and will serve to mark their foreheads, their francs and their backs: "This is what you hoarded; taste what you hoarded! (Surah al-Tawbah, verse 34-35).

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The role of social medias for the success of Moroccan SMEs

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Introduction :

In a rapidly digitizing global landscape, social media has emerged as a crucial factor in the commercial success of businesses. This holds especially true for Moroccan small and medium-sizedenterprises (SMEs) seeking to capitalize on digital opportunities to enhance their market positions. The surge of social media has created a virtual space intertwining social interactions, information dissemination, and commerce, enabling SMEs to compete with larger counterparts. Morocco stands out in Africa for its digital intensity and connectivity, prompting businesses to acknowledge the profound impact of social media on operations. The study explores how Moroccan SMEs leverage social media, going beyond the advantages to critically assess the challenges faced in establishing a significant online presence. With virtual communities boasting large followings, the study delves into the transformative potential of social media for Moroccan SMEs, shedding light on their role in shaping the country's economic future. The research recognizes the evolving nature of commerce where everything is "social" and every one is "media," emphasizing the strong influence of social media on purchasing decisions. The article aims to demonstrate the relationship between social media use and SME success through an exploratory study, providing tangible insights for entrepreneurs and decision-makers. Ultimately, the research seeks to simplify the understanding of this concept and contribute to an overarching theoretical frame work, addressing the research question: How do social media influence the visibility of SMEs in Morocco?

Résultats :

The transformative power of social media is evident in the evolution of small and medium- sized enterprises (SMEs) in Morocco, as explored in this study. The research focuses on a Moroccan company's experience during two distinct phases: a period of low sales following the suspension of advertising (ADS) and email marketing, and a subsequent recovery phase where these strategies were reactivated, resulting in a substantial increase in sales and inquiries.

In the initial phase of ADS and emailing cessation, the company experienced a decline in online visibility and engagement, underscoring the importance of maintaining an active social media presence for audience retention and continuous customer relationships. The second phase, marked by the reactivation of ADS and emailing, showcased impressive results, with significant sales

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growth and increased customer inquiries. This phase emphasizes social media's ability to create a dynamic business ecosystem, capturing opportunities and reigniting public interest in the brand.

The success drivers of social media during the reactivation phase include improved visibility through targeted messages and enhanced engagement facilitated by active communication channels. The study emphasizes that while social media amplifies product visibility, the level of customer interaction and attention, measured by views, ultimately determines effective visibility and influence on consumer behavior.

The concept of engagement is pivotal, measured through indicators like interactions (likes, comments, shares), time spent on content, and emotional resonance. Active engagement contributes to a positive perception of products or services, potentially influencing purchasing decisions and consumer behavior.

The study also highlights the cross-border nature of social media, playing a crucial role in the company's success by regaining local audiences and establishing connections with potential global customers. This underscores the importance of social media in expanding a company's geographical reach and adapting to diverse markets and cultures

Conclusion :

In the dynamic digital landscape, this exploratory study emphasizes the pivotal role of social media in shaping the success of Moroccan SMEs. Through a compelling journey that encompasses the suspension and strategic reactivation of advertising and email marketing, the study illustrates a broader narrative applicable to SMEs throughout Morocco. The profound impact of social media on visibility, engagement, and overall success becomes evident, showcasing its unique advantages in connecting with a targeted audience, narrating brand stories, and fostering genuine customer relationships through real-time interactions.

The study further reveals the interconnected nature of digital strategies. The revitalization of the company's visibility through the integration of ADS and email marketing highlights that social media is not an isolated tool but a crucial player in a holistic business approach. The synergy between these elements underscores the potential for exponential growth when effectively harnessed.

As Moroccan SMEs navigate the complexities of the modern business landscape, integrating social media into their strategy can lead to remarkable outcomes. However, success on these platforms demands consistent effort, adaptability, and a deep understanding of the target audience. The journey of the studied company serves as a compelling case, showcasing the potential of social media in reshaping the trajectory of business endeavors.

In conclusion, the study underscores the imperative for Moroccan SMEs to embrace the power of social media as a catalyst for growth, innovation, and resilience. By strategically leveraging these platforms, SMEs can enhance visibility, forge lasting connections with customers, expand market reach, and pave a path toward sustained success in the ever-changing business landscape.

ISSN: 1737-9334

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Optimizing resilience strategies to reduce vulnerabilities in the supply chain based on theQFD approach: The case of the clothing company ZEN

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Abstract: With the growth of frequent disruptive events, organizations have become more vulnerable to the consequences undergone by them. As a result, the need for a more resilient supply chain (SC) to mitigate vulnerabilities has become intrinsic.

Our central objective in this research work is to examine the degree of vulnerability and resilience of the supply chain in Tunisian companies and to identify the optimal portfolio of effective resilience strategies to mitigate thesevulnerabilities.

Firstly, we will apply the QFD and then investigate the efficiency of the different strategies proposed for the resolution of the problems linked to the supply chain and for the minimization of the risks to which it is exposed.

Our methodology relies on applying the adjusted QFD to identify different resiliencies and vulnerabilities as well developing a multi-objective nonlinear binary program to determine the optimal portfolio of resilience strategies.

Keywords: SCRM, Vulnerability, Resilience, QFD, Multi-objective nonlinear binary model

I. INTRODUCTION

Tunisia's current socio-political situation has created enormous management and development difficulties for most Tunisian companies, preventing their managers from improving their supply chain risk management concepts.

Indeed, every organization seeks to be resilient, and to achieve this facet of resilience, the organization must manage its vulnerabilities well. To this end, a number of researchers have studied vulnerability factors and the different resilience capabilities for adopting and overcoming supply chain disruptions in various industrial sectors, based on different supply chain risk management practices and tools.

According to [1] supply chain resilience is "The adaptive capacity of a supply chain to reduce theprobability to protect itself against unforeseen disruptions and counter to their spread while keeping track of functions and structures, defend itself through instantaneous and effective reactive plans in order to overcome the disruption and restore the supply chain's robustness."

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In the next several sections we have developed effective resilience capabilities for the ZEN supply chain in SFAX to mitigate vulnerabilities. We assign weights to the different vulnerabilities by applying the AHP method. We then develop a multi-objective program to determine the portfolio of effective resilience strategies to mitigate vulnerabilities. We will use a modified version of the Quality Function Deployment (QFD) tool to find vulnerabilities and their resilience strategies. Thistool enabled us to assess the effectiveness of each resilience strategy in reducing individual risks, to formulate the problem as a non-linear binary program and determine the optimal strategies for maximizing the degree of resilience.

II. DEPLOYMENT OF THE QUALITY FUNCTION (QFD)

Quality function deployment (QFD) stands for a planning tool used to meet customer expectations. It was created in 1972 in Japan as a product quality improvement methodology implemented in organizations such as Mitsubishi, Toyota and their suppliers. Indeed, it proves to be an effective tool to help product developers systematically integrate customer requirements into product and process development [2].

Quality function deployment (QFD) corresponds to a technique for translating customer needs into practical action. This approach allows companies to become proactive in terms of addressingquality issues rather than reactive at the level of responding to customer complaints.

In addition, QFD refers to a holistic concept that translates customer requirements into appropriate technical ones for each stage of product development and production (i.e. marketingstrategies, planning, product design and engineering, process development).

This method displays multiple advantages such as high customer satisfaction, potential for breakthrough innovation, low production costs, shorter turnaround times, better communication through teamwork and preservation of knowledge [3].

A. *The Graphic Tool: THE HOUSE OF QUALITY*

Fig. 1 exhibits the basic graphical tool of the QFD, often called the "house of quality".

The house of quality translates the customer's expectations (the WHAT), written in rows, into product specifications (the HOW), written in columns. The basic principle of the passage from one to the other is the answer to the WHAT/HOW question while ensuring that the essential WHY and HOW questions are answered.

ISSN: 1737-9334

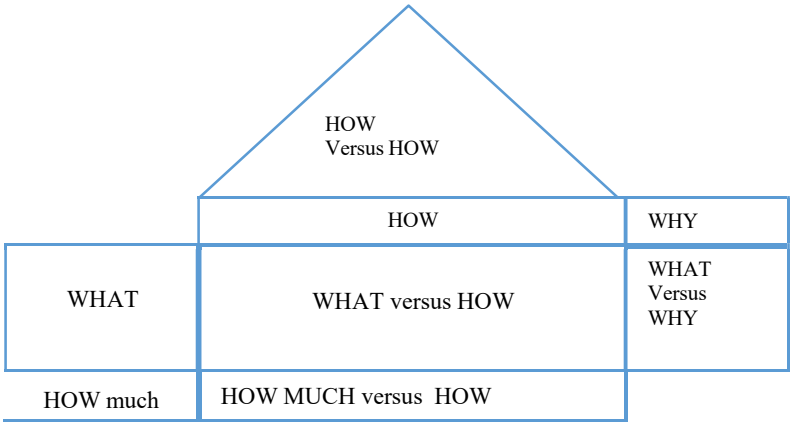

Fig 1 : La maison de la qualité [4]

However, participants in quality house building sessions tend to provide information about their individual judgments in several formats such as numerically or linguistically depending on their different knowledge,experiences, cultures, and circumstances.

Several authors emphasized that the basic format of the House of Quality (HOQ) comprises six sections: (1) Obtaining customer attributes and their relative importance; (2) Developing design requirements tailoredto customer attributes; (3) Planning matrix; (4) Relationships between customer requirements and design requirements; (5) Correlation of design requirements; (6) Action plan.

II. The different uses of QFD in the literature

Quality function deployment (QFD) is considered as an effective tool for systematic planning of new product development. It incorporates customer requirements into every aspect of product design throughhighlighting customer needs and translating them into technical requirements so that the final product meets customers' expectations (Liu and Wang, 2010).

TABLE I: The different uses of QFD in literature

Authors	The different uses of QFD in literature
[5]	They applied the FQFD for risk prioritization and the cause-and-effect diagram to define actions directed towards risk mitigation or elimination in a pharmaceutical company in Colombia.
[6]	They developed a new collaborative quality design framework for complex products using a FQFD approach.

ISSN: 1737-9334

[7]	They identified and prioritized optimal strategies for supply chain sustainability in a dynamic environment using FQFD.
[8]	They presented the different applications of the QFD method in the fields of energy and environment.
[9]	They established the selection of suppliers and the impact of internal dependency between them using a fuzzy multi-criteria group decision approach based on the quality function deployment (QFD) methodology.
[10]	They set forward the AHP-QFD methodology to help decision makers make informed decisions about energy efficiency solutions.
[11]	They applied ANFIS (Adaptive Neuro-fuzzy Inference Systems) and FQFD to enact a relationship between strategic planning and operational budgeting
[12]	They proposed a hybrid model implementing AHP and QFDF methods to provide an intelligent solution for vendor evaluation
[13]	They created a combined QFD and AHP approach to measure the performance of alternative suppliers.

III. Assessing the impact of resilience strategies on vulnerabilities

The Case of ZEN (Before Coronavirus)

1. Introduction to ZEN

Zen corresponds to a family business created by the Zouari family, which has been working in the textile sector since 1978. This small company, founded in Sfax in 2003, has proved to be a huge success. The reputation of Zen then exceeded the borders of its city, to give birth to several stores spread in several citiesof Tunisia. In the textile and clothing sector, Zen has won the bet to maintain a Tunisian production of quality and to defend a unique know-how. It is a 100% Tunisian brand dedicated to the whole family (men, women, teenagers and children) and leader in the ready-to-wear market. Customer loyalty is one of the major concerns of the company ZEN.

ZEN knows an exponential expansion thanks to its new idea and its quality products and services. It enjoysa good brand image and is increasing its presence thanks to its quality/price ratio as well as the availabilityand variety of products.

2. Methodology

In this chapter, we adapted the QFD methodology to identify vulnerabilities and resilience strategies. Subsequently, we elaborated a multi-objective methodology to find the portfolio of effective resilience strategies to mitigate the vulnerabilities.

ISSN: 1737-9334

We applied our methodology in a garment company. Our study rests upon three steps: identification of vulnerabilities and resilience strategies, integration with the analytical hierarchy process (AHP), and finally determining effective resilience capabilities (a binary nonlinear mathematical program with program).

Our basic objective is to select the set of strategies that maximize the supply chain resilience indicators while respecting the available financial and budgetary constraints. To achieve such an objective, we investedthe responses of the company's managers in order to establish in a first step a modified QFD allowing to analyze the effectiveness of different actions that can be taken to enhance resilience and mitigate resilienceand reduce vulnerability the different stages of the supply chain.

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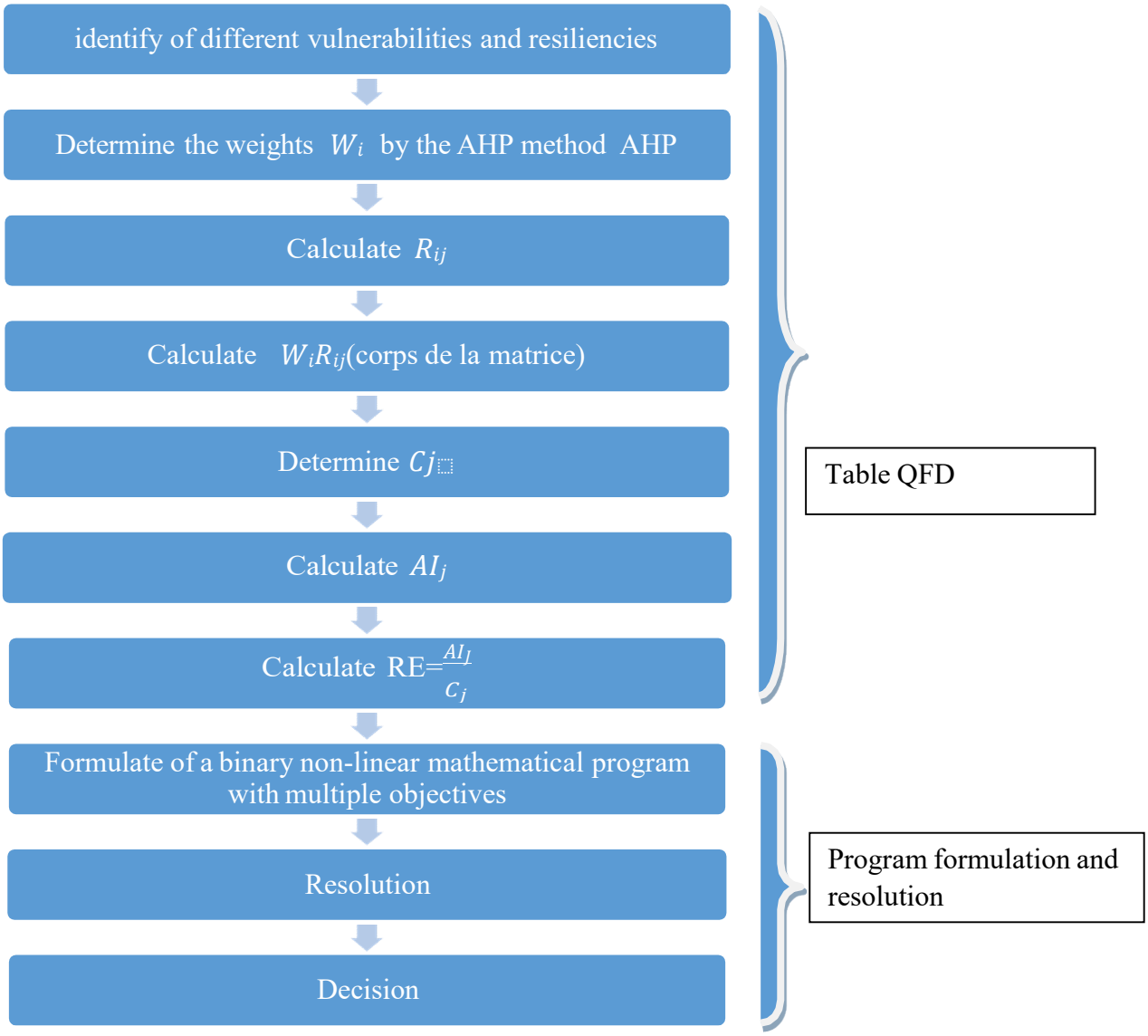


Fig 2: Methodology for selecting an optimal portfolio of resilience strategies.

Step 1: Identification of vulnerabilities and resilience strategies

Grounded on literature reviews and interviews, we managed to identify the different vulnerabilities and resiliencies of the textile sector to start filling in the QFD table.

. There are 33 vulnerabilities. Among them, 22 vulnerabilities were selected and 13 resilience strategies were chosen to mitigate the vulnerabilities.

In Step 1, we defined the items in the**CRi** (what) row that represent the vulnerabilities ZEN's supply chain currently faces and the items in the **DRj** (how) that represent resilience strategies or capabilities to mitigatevulnerabilities (Fig 3).

ISSN: 1737-9334

The vulnerabilities and resiliencies were collected from the literature review and interviews with officials.

To find **Rij** responses, we asked respondents to indicate "the extent of vulnerability reduction i as a result of implementing resilience j" applying the widely used scale of 9 (strong mitigation), 3 (moderate mitigation), 1 (weak mitigation), and 0 (no mitigation). [14]; [15]; [16].

Step 2: Integration with the hierarchical analysis process (AHP).

In step 2, we applied Saaty's AHP method to estimate the values of **wi** (importance of each vulnerability).

The hierarchical analysis process is a structured technique for organizing and analyzing of complex decisions, based on mathematics and psychology. It was developed by Thomas L. Saaty in the 1980's. It aims to refine the decision process throng examining the by examining the consistency and logic of the decision maker's preferences.

The overall weight of each vulnerability reflects to a great extent its importance of

vulnerability.To apply the AHP method we used the Super Decisions software.

Fig 3 illustrates the **wiRij** values (in the main body of the matrix) and the AIj values for different resiliencestrategies.

The **AIj** are the absolute importance of the resilience strategies

Example: the magnitude of DV3 vulnerability reduction by the ST2 resilience strategy is equal to 3, so **wiRij** =3*0.009=0.027

The magnitude of DV4 vulnerability reduction by the ST3 resilience strategy is equal to 9, so **wiRij** =9*0.026=0.234

Note that in our case, **AIj** is interpreted as "full resilience" of the resilience strategy to mitigate vulnerabilities.

$$\mathbf{AI_j} = \sum_{\mathbf{i=1}}^{\mathbf{n}} \mathbf{w_i R_{ij}} \quad \forall \ \mathbf{j} \quad \mathbf{j = 1, \ldots \ldots, n} \qquad \mathbf{(1)}$$

For example, for the ST1 strategy: ST1 : $\mathbf{AI_1}= W_1R_{11} + W_2R_{21} + W_3R_{31} + W_4R_{41} + \ldots\ldots\ldots =$

$0 + 0 + 0 + 0.081 + 0.246 + \cdots \ldots\ldots + 0 + 0.144 = 2.3\mathbf{79}$

The relative importance (resilience) of resilience strategy j is determined by:

$$\mathbf{RI_j} = \frac{\mathbf{AI_j}}{\sum_{\mathbf{j=1}}^{\mathbf{n}} \mathbf{AI_j}} \qquad \mathbf{(2)}$$

For example : $\mathbf{RI_1} = \frac{\mathbf{AI_1}}{\sum_{\mathbf{j=1}}^{\mathbf{n}} \mathbf{AI_j}}$ =2.379/33.174=0.071

Economy: Actions and steps are common to both strategies so that the application of one strategy can reducethe effort and cost to apply the other. Some actions and steps or tools are already implemented.

ISSN: 1737-9334

In step 2, we collected the quantitative data ($\mathbf{w_i R_{ij}}$) to find the $\mathbf{AI_j}$and $\mathbf{RI_j}$ values (see equations (1) and (2)). We also collected data on the costs $\mathbf{C_j}$ of implementing resilience strategies to find the resilience efficiency $\mathbf{RE_j}$ and cost savings when two resilience strategies i and j are implemented simultaneously.

According to [17] the resilience efficiency **REj** is calculated as follows:

$$\boldsymbol{REj = AIj/cj}$$

where **RE ij**= measures the effectiveness of strategy j in addressing the problem related to vulnerability i,and

C j indicates the cost of implementing the resilience

strategy.As an example, $\boldsymbol{RE1 = 2.379/10 = 0.2379}$

It is noteworthy that resilience strategies ST6 (Skills and efficiency development through training and consulting), ST7 (Product and process improvement for efficiency and waste reduction), ST5 (Quality control and reduction of defective products), ST4 (Backup capacity), and ST2(Multiple sources of supply) display the highest IAs (3.822, 3.643,3.63,3.117, and 3.027 respectively)

It remains to be noted that resilience strategy ST6 (Skills and Efficiency Development through Training and Consulting) exhibits the highest ER value of 1.911 followed by resilience strategy ST11 (Social and Environmental Compliance) with 0.826 and strategy ST2 (Multiple Sourcing) of 0.756.

The cost **Cj** of implementing the resilience strategies is found in a more elaborated manner. Each respondentis asked to provide his most likely, optimistic, and pessimistic estimates of **Cj**.

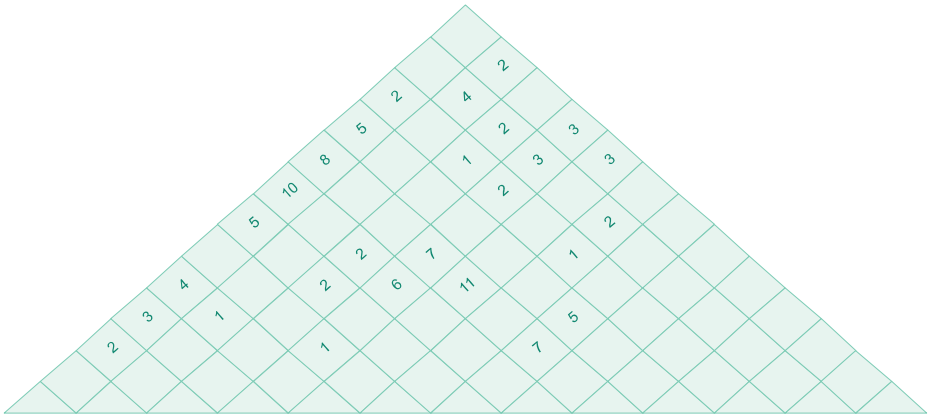
To find the savings, respondents were asked to indicate whether there are savings from implementing two strategies simultaneously and with what amounts to be implemented simultaneously and what the estimatedsavings might be.

The triangle in Fig 3 reveals these savings data. For example, resilience strategies 1 and 3 can beimplemented simultaneously.

The triangle at the top of the house represents the savings **Sij** from the simultaneous application of strategies **STi**and **STj** or the degree of correlation between both of them. An empty square indicates zero correlation between the two strategies i.e., there are no savings and the total cost of implementing the both of them is the sum of **Ci** + **Cj**.

On the other side, a non-zero correlation indicates that implementing both strategies will result in a saving cost of an amount **Sij** such that the cost of implementing simultaneous implementation of both strategies isequal to **Ci** + **Cj**-**Sij**.

ISSN: 1737-9334



	ST1	ST2	ST3	ST4	ST5	ST6	ST7	ST8	ST9	ST10	ST11	ST12	ST13	weights
DV2	0	0	0	0	0	0.129	0	0	0	0	0.387	0	0	0.129
DV3	0	0.027	0.027	0	0.081	0.081	0.027	0	0	0	0	0.027	0	0.009
DV4	0	0.234	0.234	0	0.234	0.234	0.078	0.078	0.078	0	0.078	0.078	0.078	0.026
SV1	0.081	0.081	0.027	0.027	0.081	0.081	0.081	0.027	0.027	0.081	0.027	0.081	0.081	0.009
SV2	0.246	0	0.246	0.246	0.738	0.738	0.738	0.246	0.246	0.246	0.738	0	0.246	0.082
SV3	0141	0.423	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.423	0.047
SV5	0.243	0	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.243	0.027
FV1	0.099	0.033	0	0.033	0	0	0	0	0	0	0	0	0	0.011
FV2	0.201	0.201	0	0.201	0	0	0	0	0	0	0	0	0	0.067
FV3	0.126	0.126	0	0.126	0.378	0.126	0	0	0.378	0	0.126	0	0	0.042
FV4	0.243	0.027	0	0	0.081	0	0	0	0.081	0.081	0	0	0	0.027
FV5	0.051	0.051	0	0	0.051	0.051	0	0	0.051	0.051	0	0	0.017	0.017
OV1	0.111	0	0.111	0	0.111	0.333	0.111	0	0	0	0.037	0	0	0.037
OV2	0.063	0	0.063	0.063	0.063	0.189	0.063	0	0	0	0.021	0	0	0.021
OV3	0.324	0.972	0.324	0.972	0.972	0.972	0.972	0.324	0.324	0	0	0.972	0	0.108
IV1	0	0.375	0	0.375	0	0	0.375	0.375	0.375	0	0	0.125	0.375	0.125
IV2	0	0.123	0	0	0.123	0	0.123	0.123	0.123	0	0	0.041	0.123	0.041
DO1	0.195	0.195	0.195	0.585	0.195	0.585	0.585	0.195	0.195	0.195	0	0.195	0.585	0.065
DO2	0.078	0.078	0.078	0.234	0.078	0	0.078	0.078	0.078	0.078	0	0.234	0.078	0.026
DO3	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0	0.033	0.033	0.011
DO6	0	0	0	0	0.141	0	0.141	0.141	0.141	0.141	0	0.047	0.141	0.047
DO7	0.144	0.048	0.048	0	0.048	0.048	0.016	0.144	0.048	0.144	0.016	0.016	0.144	0.016
AI	2.379	3.027	1.608	3.117	3.63	3.822	3.643	1.986	2.4	1.272	1.652	2.071	2.567	
Coût	10	4	3	8	8	2	25	20	9	5	2	15	5	
RE	0.2379	0.7567	0.536	0.3896	0.4537	1.911	0.1457	0.0993	0.267	0.2544	0.826	0.1380	0.513	

Fig 3: Supply chain resilience model before COVID -19: AI=absolute importance; 〖ST〗_j=Resiliencestrategy j; DV, SV, FV, OV, IV, DO =various vulnerabilities; RE=Resilience effectiveness.

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Using the QFD stepwise procedure, we identified vulnerabilities and corresponding resilience strategies.

In terms of the importance of these vulnerabilities, four principles of vulnerabilities were identified: failure in production planning and stock management (OV3), delay in customs clearance (IV1), non-compliance with social and environmental standards (SV2) and political instability (DV2).

Step 3: Proposed methodology for determining effective resilience capabilities in QFD

The concept of effectiveness and generating effective solutions prevails in a multi-objective decision domain [18]. A general multi-objective decision problem is expressed as follows:

$$\begin{matrix} Max(min) f_i(X) = C^i(X)\ i = 1, \dots, p \\ g_j(X) \le b_j \quad j = 1 \dots \dots \dots, q \end{matrix} \} \quad (3$$

where $X = (x_1, \dots \dots \dots, x_n)$ denote n-dimensional decision variables ;

$f_i()$ indicates P contradictory and linear objective functions p i=1,2,..., p

$g_j()$ refers to the constraint j, j=1,2,..., q.

A feasible solution X^* to problem (3) is said to be efficient (for a maximisation problem) if there is noother feasible solution X such that for all i=1,...,p , $f_i(X) \ge f_i(X^*)$ et $f_i(X) > f_i(X^*)$ for at least one i.

In other words, X^* is not dominated by any other solution in terms of fulfilling the objective function.

According to [19] the following formulation can be used to maximise supply chain resilience.

$$\begin{matrix} Max f_1(X) = \sum_{j\in n}^{n} RE_j x_j \\ Max f_2(X) = \sum_{k\in n\ ,k\neq j} RE_k x_k \\ \dots \dots . \\ Max f_p(X) = \sum_{i\in n, i\neq k\neq j} RE_i x_i \end{matrix} \quad (4)$$

$$\text{constrained}: \sum_{j=1}^{n} c_j x_j - \sum_{i=1}^{n} \sum_{j>i}^{n} S_{ij} x_i x_j \le B$$

$$x \in X$$

$$x_i \in \{0,1\},$$

where n is the number of resilience strategies.

$\boldsymbol{RE_j}$: is the effectiveness of resilience strategy j ;

$\boldsymbol{x_j}$ is equal to one or zero, depending on whether the corresponding resilience strategy j is selected ornot ;(decision variable)

$\boldsymbol{C_j}$ is the cost of implementing resilience strategy j ;

$\boldsymbol{S_{ij}}$ is the savings made if resilience strategies i and j are implemented

simultaneously;B is the budget available to manage supply chain risk.

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It is worth noting that there are different conflicting objectives that need to be optimised simultaneously. It is therefore necessary to find an effective and satisfactory solution to problem (4) through interacting with the decision-maker.

Note that any solution to problem (4) will offer a portfolio of resilience strategies so as to mitigate vulnerabilities.

To find the optimal portfolio of strategies, we need to reformulate problem (4) as follows:

$$Max \sum_{i=1}^{p} \lambda_i f_i(X)$$

$$sous\ contrainte\ : \sum_{j=1}^{n} C_j x_j - \sum_{i=1}^{n} \sum_{j>i}^{n} S_{ij} x_i x_j \leq B \qquad (5)$$

$$x \in X$$

p is the number of objective functions in the program

where λ_i($i = 1, \dots, p$) are positive values representing the weights (importance) given by the decision maker to the different objective functions Multi-objective optimisation domain theorems indicate that anysolution to problem (5) stated above is an efficient (non-dominated) solution to problem (4) [20].

Note that the large weights λ_i are only needed to find the first efficient solution to problem (4)

We therefore set forward an interactive procedure that finds a satisfactory portfolio, to explore othereffective solutions through modifying the decision-makers' weights.

We shall now introduce an interactive procedure to identify a satisfactory portfolio of effective resiliencestrategies in order to mitigate vulnerabilities.

Step 1: Optimise each objective function in problem (4).

p optimal solutions are obtained. Decision-makers will act according to the maximum value of each individual objective. An efficient solution may be a compromise of the solutions.

Step 2: Formulate problem (5) where each $\lambda_i = \mathbf{1}$ ($i = 1, \dots, p$).Solve problem (5). The solution will beefficient (non-dominated) for problem (4). Offer it to the decision maker.

Step 3: If the decision-maker is satisfied with this solution (after comparing it with the solutions found in step 1), it will be retained. This solution offers the satisfactory portfolio of resilience strategies to mitigate vulnerabilities. If the decision-maker is not satisfied, go on to step 4.

Step 4: Discuss with the decision maker to adjust the values of λ_i and find new values representing their preferences for the objective functions.

Step 5: Formulate and solve problem (5) with the new values of λ_i . Proceed to step 3.

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In Step 3, we developed a multi-objective binary program and applied the stepwise procedure to find the satisfactory portfolio of effective resilience strategies. We defined three objectives to maximise:

- Maximise the resilience of "Supply" processes by applying at least one of the strategies ST2, ST4,ST9 and ST13.
- Maximise the resilience of "Processing" processes by applying at least one of the strategies ST5,ST6, ST7, ST11 and ST12.
- Maximise the resilience of "Distribution" processes by applying at least one of the strategies ST1,ST3, ST8 and ST10.

The existence of a budget constraint makes it impossible to apply all the strategies at once and achieve a maximum level of resilience for the 3 processes at the same time. According to the manager, the B budget can be set at 80 million dinars.

The total cost of implementing the strategies is equal to the sum of the costs of the different strategies to be implemented minus the savings made as a result of the simultaneous application of both interrelated strategies. This cost must not exceed the budget B allocated by the company to improve the resilience of thesupply chain.

$$Max\ f_1(X) = RE_2x_2 + RE_4x_4 + RE_9x_9 + RE_{13}x_{13}$$

$$Max\ f_2(X) = RE_5x_5 + RE_6x_6 + RE_7x_7 + RE_{11}x_{11} + RE_{12}x_{12}$$

$$Max\ f_3(X) = RE_1x_1 + RE_3x_3 + RE_8x_8 + RE_{10}x_{10}$$

Subject to:

$$\begin{aligned} c_1x_1 + c_2x_2 + c_3x_3 + c_4x_4 + c_5x_5 + c_6x_6 + c_7x_7 + c_8x_8 + c_9x_9 + c_{10}x_{10} + c_{11}x_{11} + c_{12}x_{12} + c_{13}x_{13} \\ - S_{1.3}x_1x_3 - S_{1.4}x_1x_4 - S_{1.3}x_1x_3 - S_{1.5}x_1x_5 - S_{1.7}x_1x_7 - S_{1.8}x_1x_8 - S_{1.9}x_1x_9 \\ - S_{1.10}x_1x_{10} - S_{1.11}x_1x_{11} - S_{2.5}x_2x_5 - S_{2.12}x_2x_{12} - S_{2.13}x_2x_{13} - S_{3.7}x_3x_7 \\ - S_{3.8}x_3x_8 - S_{3.11}x_3x_{11} - S_{3.12}x_3x_{12} - S_{4.6}x_4x_6 - S_{4.8}x_4x_8 - S_{4.9}x_4x_9 \\ - S_{4.11}x_4x_{11} - S_{4.12}x_4x_{12} - S_{4.13}x_4x_{13} - S_{5.9}x_5x_9 - S_{5.13}x_5x_{13} - S_{6.11}x_6x_{11} \\ - S_{6.12}x_6x_{12} - S_{7.9}x_7x_9 - S_{7.10}x_7x_{10} \leq B \qquad \forall J = 1 \text{ ou } 0 \end{aligned}$$

$$Max\ f_1(X) = 0.756x_2 + 0.389x_4 + 0.267x_9 + 0.513x_{13}$$

$$Max\ f_2(X) = 0.453x_5 + 1.911x_6 + 0.145x_7 + 0.826x_{11} + 0.138x_{12}$$

$$Max\ f_3(X) = 0.237x_1 + 0.536x_3 + 0.099x_8 + 0.254x_{10}$$

Subject to:

$$\begin{aligned} &10x_1+4x_2+3x_3+8x_4+8x_5+2x_6+25x_7+20x_8+9x_9+5x_{10}+2x_{11}+15x_{12}+5x_{13} \\ &-0.2x_1x_3-0.3x_1x_4-0.4x_1x_5-0.5x_1x_7-1x_1x_8-0.8x_1x_9-0.5x_1x_{10}-0.2x_1x_{11}-0.1x_2x_5-0.4x_2x_{12}- \\ &0.2x_2x_{13}-0.2x_3x_7-0.2x_3x_8-0.1x_3x_{11}-0.2x_3x_{12}-0.1x_4x_6-0.6x_4x_8-0.7x_4x_9-0.2x_4x_{11}-0.3x_4x_{12}- \\ &0.3x_4x_{13}-1{,}1x_5x_9-0.3x_5x_{13}-0.1x_6x_{11}-0.2x_6x_{12}-0.7x_7x_9-0.5x_7x_{10}<=80 \end{aligned}$$

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We followed a step-by-step procedure to find a satisfactory portfolio of effective resilience strategies. We used LINGO as the optimization software. The optimal solutions yielding the optimal portfolio of resiliencestrategies are outlined in Table 4

To solve the program, we used LINGO program writing:

TABLE 4 : OPTIMAL PORTFOLIO OF RESILIENCE STRATEGIES (BEFORE COVID-19)

Programme ($\lambda_1, \lambda_2, \lambda_3$)	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**X7**	**X8**	**X9**	**X10**	**X11**	**X12**	**X13**	Z_1	Z_2	Z_3	Z_4	Z_5
P1 (1, 0,0)	1	1	1	1	1	1	0	1	1	0	1	1	1	**1.925**				
P2 (0, 1,0)	1	1	0	1	1	1	1	0	0	1	1	1	1		**3.473**			
P3 (0, 0,1)	1	0	1	1	1	1	0	1	1	1	1	1	1			**1.126**		
P4 (1/3,1/3,1/3)	1	1	1	1	1	1	1	0	1	1	1	0	1				**2.095**	
P5 (0.35, 0.55, 0.1)	0	1	1	1	1	1	1	0	1	0	1	1	1					**2.637**

If the company's objective is to maximise the degree of resilience of the procurement process independentlyof the resilience of other processes, it should opt to implement all the strategies except ST7 and ST10. This would result in an optimal level of resilience Z_1=1.925. In this case, the resilience indicators for the processing and distribution processes are equal to 3.328 and 0.872 respectively.

On the other side, if the company's objective is to maximise the degree of resilience of the treatment process independently of the resilience of the other processes, it should opt to implement all the strategies except ST3, ST8 and ST9. This achieves an optimal level of resilience Z_2=3.473. In this case, the resilience indicators for the supply and distribution processes are equal to 1.658 and 0.491, respectively.

This provides an optimum overall resilience level of 2.095 (i.e. a resilience level of 1.925 for the supply process, 3.335 for the treatment process and 1.027 for the distribution process).

Similarly, if the objective is to simultaneously maximise the resilience of the three processes with the same budgetary constraints and with different emphases on each process (0.35 for the supply process, 0.55 for thetreatment process, 0.1 for the distribution process), the optimal solution is to implement all the strategies

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except ST1, ST8 and ST10. This achieves an optimal overall resilience level of 2.637 (i.e. a resilience level of 1.925 for the supply process, 3.473 for the treatment process, 0.536 for the distribution process).

eventually, we can infer that the optimal portfolio of strategies depends largely on the process for which we are aiming to maximise the degree of resilience and basically on the importance ascribed to each process interms of maximising its level of resilience.

Assessing the impact of resilience strategies on vulnerability: the case of ZEN (Durant COVID-19)

We adapted the same QFD methodology (vulnerabilities and resiliencies are similar to study 1). Next, we elaborated the same multi-objective methodology approach to find the portfolio of effective resilience strategies during covid-19.

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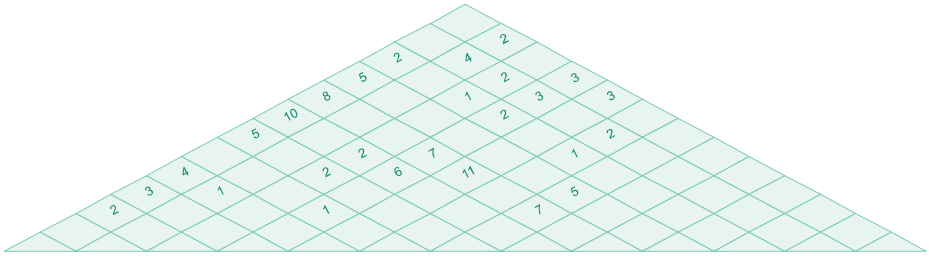

	ST1	ST2	ST3	ST4	ST5	ST6	ST7	ST8	ST9	ST10	ST11	ST12	ST13	weights
DV2	0	0	0	0	0	0	0	0	0	0	0.129	0	0	0.129
DV3	0	0.009	0.009	0	0.027	0.009	0.027	0	0	0	0	0.027	0	0.009
DV4	0	0.026	0.026	0	0.026	0.026	0.078	0.078	0.026	0	0.026	0.078	0.078	0.026
SV1	0.081	0.081	0.027	0	0.009	0.009	0.027	0.027	0	0.009	0.009	0.081	0.009	0.009
SV2	0.082	0	0.082	0.082	0.246	0	0.246	0.246	0.082	0.082	0.246	0	0.082	0.082
SV3	0.047	0.141	0.141	0.047	0.047	0.047	0.141	0.141	0.047	0.047	0.141	0.047	0.047	0.047
SV5	0.027	0	0.027	0.027	0.027	0.027	0.027	0.081	0.027	0.027	0.027	0.027	0.027	0.027
FV1	0.033	0.011	0	0.011	0	0	0	0	0	0	0	0	0	0.011
FV2	0.134	0.067	0	0.067	0	0	0	0	0	0	0	0	0	0.067
FV3	0.042	0.042	0	0.042	0.126	0.126	0	0	0.126	0	0.042	0	0	0.042
FV4	0.081	0.027	0	0	0.027	0	0	0	0.027	0.027	0	0	0	0.027
FV5	0.017	0.017	0	0	0.017	0.017	0	0	0.017	0.017	0	0	0.017	0.017
OV1	0.037	0	0.037	0	0.037	0.111	0.037	0	0	0	0.037	0	0	0.037
OV2	0.021	0	0.021	0.021	0.021	0.021	0.021	0	0	0	0.021	0	0	0.021
OV3	0.108	0.324	0.108	0.324	0.324	0.324	0.324	0.324	0.108	0	0	0.972	0	0.108
IV1	0	0.125	0	0.125	0	0	0.125	0.375	0.125	0	0	0.125	0.125	0.125
IV2	0	0.041	0	0	0.041	0	0.041	0.123	0.041	0	0	0.041	0.041	0.041
DO1	0.065	0.065	0.065	0.195	0.065	0.195	0.195	0.195	0.065	0.065	0	0.195	0.195	0.065
DO2	0.026	0.026	0.026	0.078	0.026	0	0.026	0.078	0.026	0.026	0	0.234	0.026	0.026
DO3	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.033	0.011	0.011	0	0.033	0.011	0.011
DO6	0	0	0	0	0.047	0	0.047	0.141	0.047	0.047	0	0.047	0.047	0.047
DO7	0.016	0.016	0.016	0	0.016	0.016	0.016	0.144	0.016	0.048	0.016	0.016	0.048	0.016
AI	0.828	1.029	0.596	1.03	1.14	0.939	1.389	1.986	0.791	0.406	0.694	1.923	0.753	
Coût	10	4	3	8	8	2	25	20	9	5	2	15	5	
RE	0.0828	0.2572	0.1987	0.1287	0.1425	0.4695	0.0555	0.099	0.08789	0.0812	0.347	0.1282	0.1506	

Fig 5: Supply chain resilience model (Durant covid-19): AI=absolute importance; 〖ST〗_j=resiliencestrategy j; DV, SV, FV, OV, IV, DO =various vulnerabilities; RE=resilience effectiveness.

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TABLE 5: EFFECTIVE PORTFOLIO OF RESILIENCE STRATEGIES (DURING COVID-19)

Programme($\lambda_1, \lambda_2, \lambda_3$)	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**X7**	**X8**	**X9**	**X10**	**X11**	**X12**	**X13**	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**
P1 (1, 0,0)	1	1	1	1	1	1	0	1	1	0	1	1	1	**0.622**	1.086	0.329		
P2 (0, 1,0)	1	1	0	1	1	1	1	0	0	1	1	1	1	0.535	**1.141**	0.163		
P3 (0, 0,1)	1	1	1	0	1	1	0	1	1	1	1	1	1	0.494	1.086	**0.460**		
P4 (1/3,1/3,1/3)	1	1	1	1	1	1	0	1	1	0	1	1	1	0.622	1.086	0.379	**0.695**	
P5 (0.35, 0.55, 0.1)	0	1	1	1	1	1	1	0	1	0	1	1	1	0.622	1.141	0.198		**0.865**

We followed the stepwise procedure to find the satisfactory portfolio of effective resilience strategies during Covid-19. We used LINGO as the optimization software. The optimal solutions and the portfolio of resilience strategies are depicted in Table 5.

Conclusion

In this research work, we developed effective resilience capabilities of the ZEN supply chain in SFAX in order to mitigate vulnerabilities.

It is noteworthy that the most prominent vulnerabilities can be summarized as follows: problem in production planning and inventory management (OV3), delay in customs clearance (IV1), non-compliancewith social standards and environmental factors (SV2) and political instability (DV2).

We can conclude that during covid-19, the company needed to opt for the same portfolios to optimize the resilience of the supply and production processes separately. In this respect, maximizing the total resilienceof the three processes simultaneously with the same emphasis on the processes will grant us new solutions.

The results reveal that resilience levels deteriorated during covid-19 compared to the covid-19 period.

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Strategic risk management in international trade operations: case of import operation for a Tunisian company

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Abstract- **This research explores the intricate landscape of strategic risk management within the realm of international trade operations, with a specific focus on the import activities of a Tunisian company. In an era characterized by global economic interdependence, businesses engaging in cross-border transactions face a myriad of challenges that necessitate a comprehensive understanding and strategic approach to risk management. The study delves into the multifaceted dimensions of risk inherent in international trade, emphasizing the unique context of import operations for a Tunisian company. By employing a case study methodology, the research aims to elucidate the practical implications and strategic decisions made by the company to navigate the complexities of the global marketplace.**

***Key words*- Risk management, Methodology, FMEA, Prioritization, Risks mitigation strategies**

1. I. INTRODUCTION

The intricate web of international relations introduces a plethora of inherent risks that intricately weave into the operational fabric of businesses involved in global commerce. For Tunisian enterprises, the pursuit of customer satisfaction amid fierce competition with international counterparts underscores the imperative to evolve conventional management strategies. In response to the dynamic nature of the global business landscape, there is a discernible trend towards incorporating risk considerations into the core of the management process. This paradigm shift recognizes the need for proactive measures to navigate the complexities and uncertainties associated with cross-border trade. Our focus in this study is directed towards unraveling the intricacies of risk management strategies within the framework of a Tunisian company, with a specific lens on the importation process. As globalization continues to reshape business dynamics, the importation operations of Tunisian companies become pivotal arenas where strategic decisions must be made to not only optimize efficiency and profitability but also to safeguard against an array of potential risks. This research embarks on an exploration of how a Tunisian company strategically manages risks in its importation process, delving into the nuanced interplay between global market dynamics, regulatory frameworks, and the company's operational imperatives. By scrutinizing the multifaceted dimensions of risk within this context, we aim to contribute valuable insights that can inform both academia and practitioners about effective risk management approaches tailored to the challenges faced by Tunisian enterprises in the realm of international trade. Through a comprehensive analysis of the importation process, we seek to illuminate the practical implications of risk management strategies, thereby fostering a deeper understanding of how businesses can fortify themselves against the uncertainties inherent in the global trade arena.

2. II. LITERATURE REVIEW

In this section, we embark on an exploration of the fundamental concepts underpinning risk management, aiming to provide a comprehensive understanding of risk and its intricate management processes. The significance of risk has become increasingly pronounced in the contemporary business landscape, particularly in logistics, where its growing influence disrupts entire networks. Managers are compelled to proactively identify and navigate these hazards, a task made complex by the subjective nature of risk, varying across individuals based on perspectives, attitudes, and experiences. Aven's (2012) foundational risk theory is pivotal in comprehending this complexity, tracing the evolution of risk concepts and their ties to environmental shifts since 1679. Veland and Ave (2015) further delve into the divergent perspectives on risk, examining how these perspectives influence communication among decision-makers, analysts, and the general populace. Professional viewpoints add another layer of complexity, as engineers, designers, and contractors interpret risk through a technological lens, while lenders and developers perceive it

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economically and financially. The diverse definitions of risk, despite their variations, converge in defining it as an unforeseen event impeding smooth operational continuity. The BS OHSAS 18001 framework refines this definition, encapsulating risk as the likelihood of hazardous events or exposure coupled with the severity of resulting incidents. Risk, in its inherent probabilistic nature, categorizes into distinct types such as strategic, operations, supply, customer, asset impairment, competitive, reputation, financial, and fiscal risks. All these risks can be classified as internal (organizational), endogenous, and exogenous (Ennouri, 2023). Moving to the domain of risk management, this exploration has gained significant traction as a prominent area of research. While various studies, such as those by Bai et al. (2022) and Rodriguez-Espindola et al. (2022), have delved into this domain, a comprehensive understanding of its intricacies is crucial. The risk management process, as outlined by Ennouri (2023), involves four key steps:

- Risk Identification.
- Risk Assessment.
- Risk Management.
- Risk Monitoring.

3. III. METHODOLOGY

In the pursuit of comprehensively examining and managing strategic risks within the importation process of the Tunisian company under investigation, a meticulously designed methodology is imperative. The study design is anchored in a case study approach, allowing for an in-depth exploration of the specific risk management strategies employed by the company. This qualitative research design enables a nuanced understanding of the complexities inherent in the import operations, fostering insights into decision-making processes, risk identification, and mitigation strategies. The team nomination process involves the selection of a multidisciplinary team comprising individuals with expertise in logistics, supply chain management, finance, and risk management. The diverse skill set within the team ensures a holistic evaluation of risk factors associated with international trade operations, enhancing the reliability and validity of the study. Various data sources are systematically selected and processes are established to gather pertinent information. This includes archival records, company documentation, and interviews with key personnel involved in the importation process. The combination of these data sources allows for a triangulation of information, offering a comprehensive view of the risk landscape. The Failure Mode and Effect Analysis (FMEA) method is selected as the primary analytical framework for risk assessment. This method provides a systematic approach to identifying, prioritizing, and mitigating risks within the importation process (Gokus and Arslan 2022, Minguito and Banluta 2023). Risk identification involves a thorough examination of potential failure modes at each stage of the import operations, considering factors such as customs clearance, transportation, and supplier relationships. Following risk identification, a rigorous risk prioritization process is undertaken (ElLithy et al 2023). This involves assigning numerical values to factors such as severity, occurrence, and detection, facilitating the establishment of a risk priority number (RPN). The RPN serves as a quantitative metric to prioritize risks based on their potential impact and likelihood. For undesirable or unacceptable risks identified through the FMEA process, corrective actions are proposed. These actions aim to mitigate the identified risks and enhance the overall resilience of the importation process. The proposed corrective actions are grounded in best practices, industry standards, and the expertise of the multidisciplinary team. The findings of the risk assessment and proposed corrective actions are consolidated into a comprehensive FMEA report. This report serves as a valuable tool for the Tunisian company, offering a clear roadmap for strategic risk management within its import operations. The FMEA report encapsulates the entire methodology, providing a holistic view of the risk assessment process and offering actionable insights for optimizing the importation process while minimizing potential disruptions. The following figure represents our developed methodology.

ISSN: 1737-9334

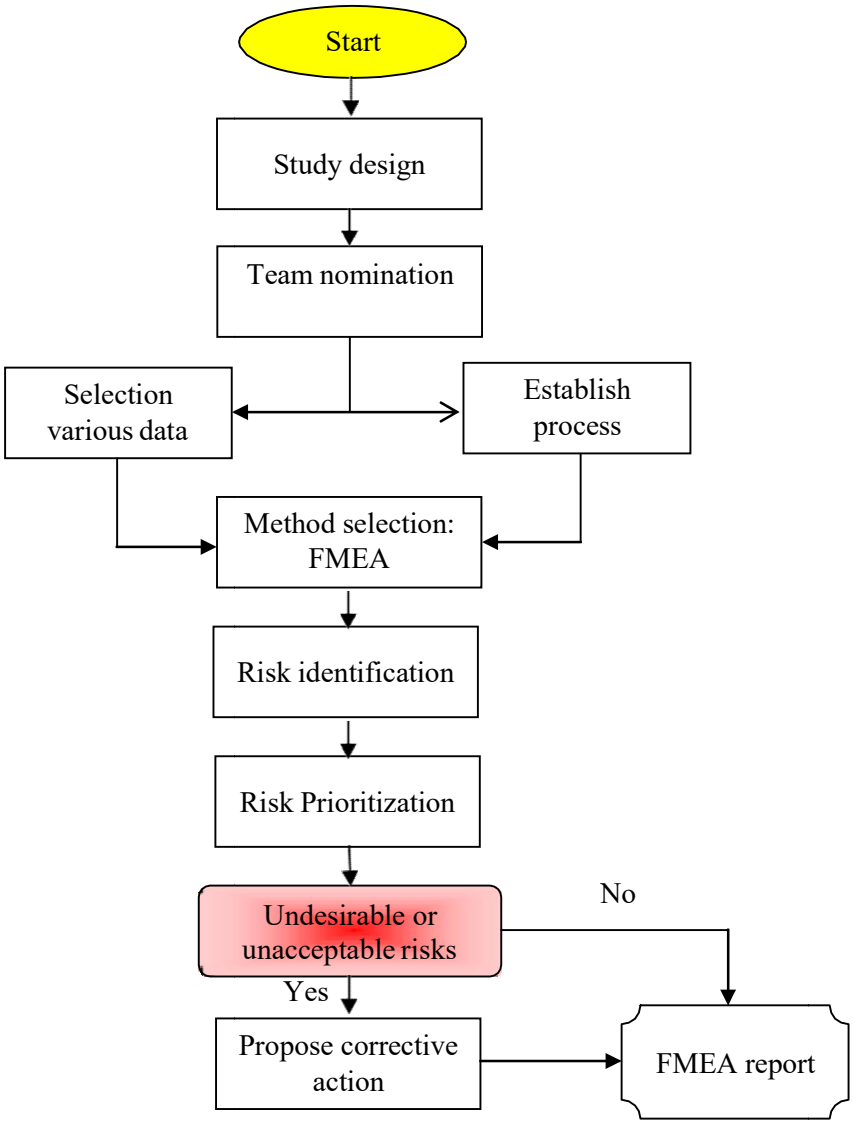

Fig. 1: proposed methodology

4. IV. RESULTS

Globe International Business, in its perpetual pursuit of elevating customer satisfaction, remains steadfast in its commitment to minimizing potential risks that may arise throughout its operations. The company has instituted robust security systems aimed at mitigating risks inherent in the execution of its business activities, acknowledging the inevitability of encountering risks of diverse natures. Our focus centers on the critical theme of risk management within the framework of Globe International Business, with a particular emphasis on the unloading and transportation process of containers during import operations. Recognizing the intricacies involved in these stages, the company has implemented comprehensive measures to ensure the security and efficiency of these operations, thereby safeguarding against potential disruptions and enhancing overall customer satisfaction. The processed procedure involves stringent protocols for the handling of hazardous goods within Globe International Business. Each hazardous commodity is obligated to undergo a specific declaration process with the maritime company, ensuring compliance with international regulations and safety standards. Notably, the containers themselves are subject to distinct markings, which are imperative for the identification and categorization of the contained hazardous materials. It is emphasized that these markings must be removed following each export of dangerous goods. A strict policy dictates that no residues of any kind should persist within the container post-unloading, as the personnel responsible for container maintenance and cleaning could be

ISSN: 1737-9334

adversely affected. In a concerted effort to minimize potential risks, the company strategically limits its involvement in the transportation of hazardous goods to specific stages of the process. These key stages include the unloading of containers, customs verification, transportation to the storage hold, and the subsequent handling of the merchandise within the storage facility. By adhering to this delineated set of steps, Globe International Business aims to curtail exposure to potential risks associated with the transportation of hazardous materials. The nature of the goods and their associated risks at each stage of the process is succinctly represented in the accompanying figure, providing a visual guide to the outlined steps and their strategic sequence.

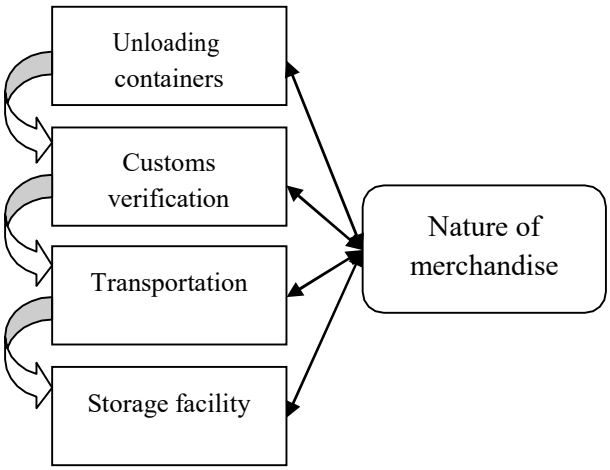

Fig. 2: The processes of the dangerous product transport operation

Before embarking on the actual implementation of FMEA, a thorough understanding of the system and its environment is paramount. This knowledge is typically derived from functional analysis, risk analysis, and, if available, lessons learned from past experiences. In the initial phase, it is imperative to determine how and for what purpose the FMEA will be utilized. This involves defining the necessary means, organizational structure, and associated responsibilities. Subsequently, in the second phase, the effects of failure modes must be evaluated. The effects of failure modes on a specific entity are scrutinized within the system (local effect) and its broader environment (global effect). This step involves a comprehensive examination to identify potential impacts and consequences that may arise from the failure modes. In the third phase, a systematic classification of the effects of failure modes by their level of criticality is undertaken. This classification is relative to predefined system safety criteria aligned with the established objectives, particularly those pertaining to safety. The failure modes of individual components are grouped and hierarchically organized based on the criticality of their effects. This typology facilitates the identification of the most critical components, paving the way for the formulation of targeted actions and procedures to address and mitigate the associated risks. The conclusive phase of FMEA involves interpreting the results and implementing recommendations. This critical activity marks the culmination of the FMEA process, where the insights garnered from the analysis are transformed into actionable strategies. The identification of critical components and the subsequent proposal of remedial actions contribute to enhancing the overall reliability and safety of the system, reinforcing its resilience against potential failures. We present the FMEA table to analyze the risks that may arise in our studied process. G: Severity of the effect (scale of 1 to 10), O: Occurrence, the probability of occurrence (scale of 1 to 10), D: Detection risk (scale of 1 to 10), and RPN: Risk Priority Number (RPN = G * O * D).

Occurrence (O)	1	2	3	4	5	6	7	8	9	10
	Nearly impossible						Risk almost inevitable			
Servity (S)	1	2	3	4	5	6	7	8	9	10
	No effect							Hazardous effect		
Detectability (D)	1	2	3	4	5	6	7	8	9	10
	Almost certain						Absolute uncertainly			

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TABLE 1: FMEA RESULTS

GIB process	Risks	Possible cause	Effect	G	O	D	RPN	Rank
Unloading containers	Container fall	Improper stacking of containers. improper weight distribution	Operation delay. loss of merchandise. Explosion. container deformation. loss of life	9	2	4	72	6
	Crane rope failure	Improper handling, lack of equipment control, container overload.	Defective goods, loss of life, explosion, container deterioration.	9	2	2	36	13
	Truck instability on the dock	Poor layout of the unloading area, personnel irresponsibility, inadequate lighting.	Truck overturn, casualties, defective rolling equipment.	9	5	1	45	10
	Unnecessary movement of goods inside the container during unloading.	Poor load distribution in the container, weather conditions, improper securing of goods.	Product deterioration, explosion.	7	3	6	126	4
Customs inspection	Merchandise return	Non-conformity between the goods and the declaration, lack of SE declaration	Goods will be returned to the supplier on the same vessel, penalty for the client, loss of clients, misallocation of the company.	5	2	1	10	18
	Significant wait time at the dock	Customs inspection delay	Delay for the client, time loss, misallocation.	3	4	6	72	7
	Goods seizure	Prohibited goods, exceeding the authorized quantity, non-compliance with import authorization clauses	Company fine, loss of client, loss of merchandise, damaged reputation, legal proceedings.	7	4	1	28	15
Transport to the warehouse hold	Human errors in driving	Stress, lack of experience, excessive working hours, speeding, lack of supervision.	Accidents, damage to intervention equipment or the vehicle, casualties.	7	5	6	210	1
	Container instability on the rolling equipment	Poor attachment, poor adaptation between the truck and the container.	Container and/or truck overturn, fatal accidents.	7	2	1	14	17
	Road accident.	Technical failures, mechanical breakdowns (axles, brakes, etc.), improper maneuvers, brake failures, tire blowouts, speeding.	Serious accidents, fatalities, explosions, defective rolling equipment, human injuries, property damage.	7	5	5	175	3
	Technical problems related to transport vehicles.	Neglect of maintenance, fleet of old vehicles.	Vehicle damage, delay in activity completion, accidents, casualties.	6	6	2	72	7

Handling of goods within the warehouse.	Lack of equipment for job completion.	Heavy workload, poor layout, malfunctioning handling equipment.	Renting machinery, delayed destination of goods, additional operation costs.	2	5	4	40	11
	Accidents within the warehouse.	Non-compliance with safety standards, stress, excessive working hours, lack of responsibility, improper handling, container overload.	Personnel fatalities, explosions, fires, burns, impacts, human injuries.	8	5	5	200	2
	Improper handling of goods during container unloading operations.	Non-compliance with work regulations, workload overload, human errors, mismatch between handling equipment and goods.	Spillage with the possibility of ignition/explosion, soil pollution, contamination of other goods.	5	2	4	40	12
Nature of merchandise.	Customs inspection delay.	Workload overload, poor choice of freight forwarder, administrative issues.	Delay in delivering goods to customers, negative company reputation, penalties.	6	2	2	24	16
	Fire.	Spark, heat, improper handling of goods.	fatalities, loss of goods, intoxication, damage and destruction of tools.	7	3	5	105	5
	Explosion.	Chemical reaction, heat, fire.	Fatalities, loss of goods, intoxication.	8	2	4	64	9
	Pollution.	Liquid leakage, radioactivity.	Containment, negative impact on humans.	6	2	3	36	14

5. V. DISCUSSION

Based on the above table, it is evident that the work involved in the hazardous product transportation process carries a considerable level of danger, given its inherent risks. The application of the FMEA method, coupled with insights from the company's leadership, has facilitated the categorization of these risks into four classes based on the Risk Priority Number (RPN).

The first class encompasses unacceptable risks (RPN ≥ 141): these are the most severe risks that pose potential threats to the life of the worker and may result in other highly dangerous consequences. Possible causes of these risks include container stacking conditions, human errors, lack of supervision, and non-compliance with safety standards.

The second class involves undesirable risks (91 ≤ RPN ≤ 140): these risks are hazardous but do not lead to fatalities. They may arise from mishandling of goods, poor quality of materials and equipment, typically associated with working conditions.

The third class consists of risks deemed acceptable (41 ≤ RPN ≤ 90): these are risks considered tolerable by Globe International Business management concerning their occupational safety policy, as they are often detected before their potential realization.

The fourth class comprises negligible risks (RPN ≤ 40): these risks have minimal impact on occupational safety, causing no serious accidents or occurring very rarely. Examples include equipment shortages or delays in customs verification, attributed to the company's overarching policy utilizing project planning based on MS Project software.

For risk classes 1 (unacceptable risks) and 2 (undesirable risks), we suggest the following risk mitigation strategies:

TABLE 2: PROPOSED MITIGATION STRATEGIES

Risk	Mitigation strategies
Human errors in driving	Training for drivers, Awareness, Respect safety standards, Adequate time interval and study well
Accidents within the warehouse	Respect the safety instructions, Improvement of the conditions of work. Planning work schedules
Road accident	Material handling, Compliance with safety instructions, Staff accountability, Maintenance, Renewal of the vehicle fleet
Unnecessary movement of goods inside the container during unloading	Respect standards when securing goods, Optimization of loads in the container, Respect safety standards in unfavorable climatic conditions
Fire	Comply with safety standards, raise awareness of the human factor

In addressing the risks associated with human errors in driving, a comprehensive approach to risk mitigation is imperative. This involves implementing rigorous training programs for drivers, emphasizing awareness of road safety principles, and instilling a culture of respect for safety standards among all personnel. Additionally, ensuring an adequate time interval for journeys and conducting thorough studies of routes contribute significantly to minimizing the likelihood of accidents.

Within the warehouse environment, the risk of accidents can be mitigated through a combination of measures. This includes strict adherence to safety instructions by all staff members, continual improvement of working conditions to eliminate hazards, and meticulous planning of work schedules to prevent overcrowding and rush situations.

Mitigating the risk of road accidents requires a multifaceted approach that encompasses various aspects of vehicle operation and maintenance. Measures such as proper material handling techniques, strict compliance with safety instructions during transportation, holding staff accountable for their actions,

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regular maintenance checks, and timely renewal of the vehicle fleet are essential components of this strategy.

Efforts to prevent unnecessary movement of goods inside containers during unloading must prioritize adherence to established standards for securing goods, optimizing loads to minimize shifting during transit, and maintaining strict compliance with safety protocols, especially in adverse climatic conditions.

Finally, the risk of fire demands stringent adherence to safety standards across all operational facets, coupled with efforts to raise awareness among personnel regarding the human factors that can contribute to fire incidents. By implementing these comprehensive risk mitigation strategies, organizations can significantly enhance safety protocols and minimize the occurrence of potential hazards.

These recommendations aim to enhance the overall safety and efficiency of the transportation process for hazardous goods within Globe International Business. By implementing the proposed risk mitigation strategies, the organization can significantly reduce the likelihood of accidents and mitigate the potential consequences of human errors, accidents within the warehouse, road accidents, unnecessary movement of goods during unloading, and fire incidents. These measures underscore our commitment to prioritizing safety across all operational facets and ensuring compliance with regulatory standards. Moreover, it is crucial to underscore that these recommendations will undergo thorough economic analysis to determine their feasibility and cost-effectiveness. This analysis will involve evaluating the potential impact of each proposed strategy on operational costs, resource allocation, and overall risk reduction. Subsequently, based on this economic assessment, a tailored strategy will be selected for addressing each risk associated with class 1 and 2 hazardous goods transportation. This systematic approach ensures that the chosen risk mitigation measures not only prioritize safety but also align with the organization's financial objectives and long-term sustainability goals.

6. VI. Conclusion

In conclusion, our examination delved into the realm of risk management within the scope of import activities, employing the FMEA methodology as a systematic approach to identify and prioritize potential risks. The rigorous application of this method allowed us to successfully pinpoint various risk factors intrinsic to the importation process. Through a meticulous prioritization strategy, we were able to propose targeted corrective actions designed to mitigate the identified risks effectively. This proactive stance in risk management not only contributes to the fortification of management processes but also serves as a catalyst for the elevation of overall satisfaction levels. The proposed corrective actions, grounded in the FMEA findings, are instrumental in fostering an improved operational framework. By addressing potential vulnerabilities, adhering to best practices, and incorporating continuous improvement initiatives, our risk management approach is poised to enhance the resilience of import activities, instilling a culture of safety and efficiency within the organization. One limitation of this study is the reliance solely on the FMEA methodology for risk assessment. While FMEA is a valuable tool for identifying and prioritizing potential risks, it may not capture all aspects of risk inherent in import activities. Other complementary risk assessment methodologies or perspectives, such as scenario analysis, historical data analysis, or expert judgment, could provide additional insights and enhance the comprehensiveness of risk identification. Incorporating multiple approaches to risk assessment would offer a more holistic understanding of potential vulnerabilities and strengthen the effectiveness of risk management strategies.

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