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Combining of quantitative and qualitative analysis in risk management using Pareto distribution: A case study of an insurance company

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Abstract---The study aims to create a probability distribution that seeks to analyze and assess the main risks faced by the company. To this end, Pareto Distribution was used in risk management, which provides a useful analytical framework for many risks through its probabilistic distributions, ranking risks from the most impactful to the least impactful, achieving the principle of symmetry (80% of effects come from 20% of causes). This allows for the organization of risk mitigation measures at points of weakness. The results obtained through Pareto Distribution indicated that a small portion of the risks explain a large part of the potential losses for the company's portfolio in the future. Additionally, we found a relationship between the main risks and the strategic response adopted by the company, along with effect size from those risk-driving variables.

Keywords---risk, quantitative and qualitative risk analysis, Pareto Distribution, insurance company.

1. Introduction

Companies are exposed to various risk that can lead to losses affecting future of revenues, cash flow, and owned assets. In an uncertain environment and with the ongoing technological development, the risk diversified, and increased the need of

searching for new means to manage these risks. Therefore, the combining of quantitative and qualitative risk analysis has become an urgent necessity for decision-makers, to reduce the occurrence of these risk or to limit their frequency or the losses resulting from their occurrence. In such cases, the use of Pareto Distribution can be resorted to. which can be applied when there is a need to prioritize risk and help identify the most significant causes to address the most threatening risk treatments to the company's activities. Pareto Distribution has been used to model many phenomena, being one of the most important probability distributions in various fields such as economics, finance, business management, investment opportunities, and more, in addition to its ability to analyze risk that help in identifying and visualizing events in a cause-and-effect relationship. Based on the above, the following issue can be raised:

How can Pareto Distribution be used to estimate risk probabilities and develop a strategic response to control and mitigate them?

To gain a better understanding of the research topic, the following sub-questions can be posed:

- 1- What are the main significant risk faced by the insurance company?
- 2- What does the combining between quantitative and qualitative risk analysis mean?
- 3- What is meant by the Pareto Distribution method?

To answer the sub-questions and address the research variables, we formulated the **study hypotheses** as follows:

- 1- The Pareto Distribution provides a combination of probability distributions to estimate the likelihood of the most impactful risk.
- 2- There is a statistically significant relationship between the effect size of risk variable and the strategic response adopted for risk management in the company.

The **importance** of the study lies in enriching the knowledge aspect of researchers in the field of risk and crisis management, through the use of the Pareto Distribution, enabling the organization to identify the few causes that have a significant impact on its activities. It is one of the methods of quantitative and qualitative risk analysis.

This study **aims** to review the Pareto Distribution and its applicability in diagnosing and analyzing risk and mitigating their negative effects, as well as emphasizing the importance of combining qualitative and quantitative analysis in the risk management process, as it provides more reliable results.

Methodology and Study Tool

In order to achieve the objectives of the study, a quantitative and qualitative analysis methodology was used due to the multiplicity of variables, through the collection of data from a large number of respondents represented in the study sample (senior and middle management within the company). We aimed to select them because they are the most capable of providing information, in addition to their involvement in the decision-making process within the company. To this end, a questionnaire was constructed with the aim of obtaining the largest volume of data and information about the company under study, in addition to using the

Pareto Distribution, which is considered as one of the most important techniques and methods that can be used in the quantitative and qualitative analysis of risk, which in turn helps in building the company's strategy to face risk.

Study variables: The study variables related to the insurance industry are illustrated as follows:

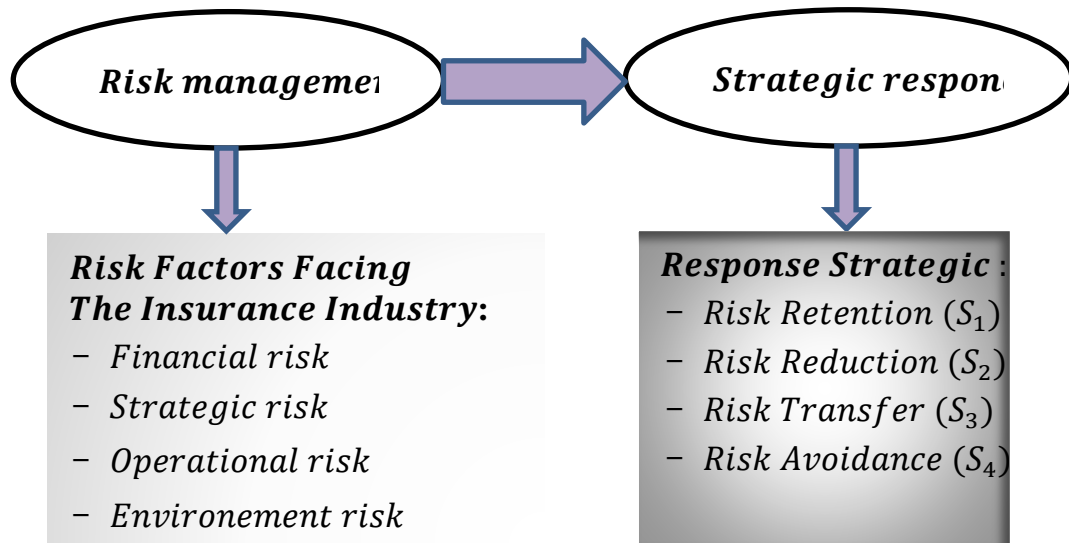


Figure1- The study variables

2. Theoretical Framework of the Study

2.1 Risk Analysis

Risk analysis includes steps to identify the risk, describe the it, and finally assess the it, which can be done using a quantitative, semi-quantitative, or qualitative approach, in terms of the likelihood of the risk occurring and the potential outcomes. The results regarding threats or opportunities for success may be high, medium, or low, and the probabilities may also be high, medium, or low (AIRMIC, 2002, p. 6). Conducting risk analysis involves the following criteria and techniques:

Table1- Criterias and techniques used in risk analysis

Risk analysis techniques			
Techniques that provide a measure of risk	Techniques analyzing dependencies and interactions	Techniques for understanding consequence and likelihood	Techniques for analyzing controls
<ul style="list-style-type: none"> • Toxicological risk assessment • Data protection impact analysis • Value at risk (VaR) • Conditional (CVaR) 	<ul style="list-style-type: none"> • Causal mapping • Cross impact analysis 	<ul style="list-style-type: none"> • Markov analysis • Pareto Analysis • Monte Carlo simulation • Bayesian analysis • Bayesian network • Business impact analysis • Event tree analysis • Fault tree analysis • Cause-consequence analysis 	<ul style="list-style-type: none"> • Bow tie analysis • HACCP • LOPA • Pareto Analysis

Source: (IEC , 2019, p. 37)

2.2 Quantitative and Qualitative Risk Analysis

Quantitative and qualitative risk analysis is used within steps to understand risk on one hand, and various stages of the risk management process on the other. In other words, it is resorted to whenever there is a need to understand uncertainty and its impacts. This is done through the use of quantitative and qualitative analysis methods in a wide range of risk situations in risk management steps and beyond their original application. Some methods are similar in concept but have different names and methodologies that reflect their historical development in various sectors. These methods have evolved over time and continue to develop, and they can be adapted, integrated, and applied in new ways or expanded to meet current and future needs.

Quantitative and qualitative risk analysis is also used to identify the overall risk to objectives when they all operate simultaneously. The techniques used appropriately for quantitative risk analysis have many characteristics such as: comprehensive representation of risk, calculation of overall risk impacts, probability models, data collection capabilities, effective presentation of quantitative analysis results, and repeatability capabilities. Quantitative analysis techniques allow the representation of both opportunities and threats that impact objectives (PMIP, 2022, p. 120).

2.3 Combining Risk Analyses

Again, both qualitative and quantitative analysis generally have inherent challenges related to the information and resource requirements for data and/or analytical models. So it only makes sense that if you want to maximize the accuracy of your

risk and opportunity predictions, you should look to combine the two. This combination can come in the form of two separate analyses or the possibility of a hybrid approach that combines attributes from both types during the analysis process.

Regardless of how you choose to analyze, achieving maximum value requires that your risk analysis methods are commensurate with the risk areas and business lines you are analyzing within the organization. In some areas of your business, a qualitative analysis may suffice; in others, you may need to quantify your analysis as well.

In either case, once you have this compounded view across the organization, senior management can begin to determine with greater accuracy whether the organization's overall risk is within its risk appetite and begin to create appropriate risk responses as required (Quantivate.com, 2017). The following figure illustrates how to integrate quantitative and qualitative risk analysis:

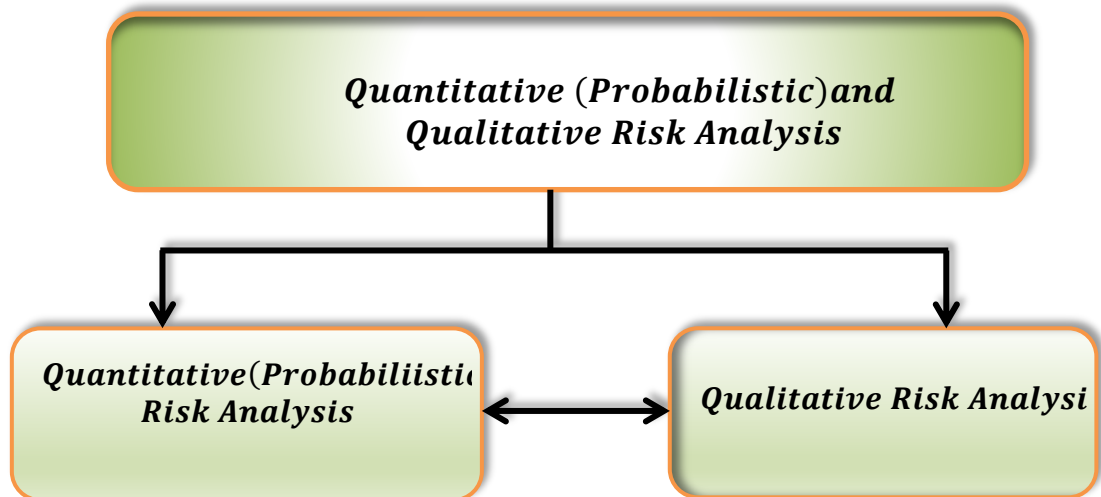


Figure2- Combining Risk quantitative (probabilistic) analysis and qualitative analysis

3. Pareto Distribution 20/80

The Pareto distribution is one of the techniques for analyzing and assessing risk, as it is used to highlight the most important problems whose solutions are key to solving a large number of other issues. It is named after the Italian philosopher, engineer, economist, and politician Vilfredo Federico Pareto. The Pareto distribution is a systematic approach and plays an important role in decision-making for risk managers. The idea is that the vast majority of problems (80%) arise from a few main causes (20%), and this theory is one of the means of quality improvement in Six Sigma. The Pareto distribution is a statistical tool that helps identify priorities in overcoming a major issue and prevents the diversion of resources to less significant causes. In risk management, the Pareto distribution can be applied by focusing on the risk that have the greatest impact on the organization (Sayed Abdul Nabi, 2019, p. 97).

The steps of Pareto analysis proceed through the following stages:

3.1 Stages of the 80/20 Pareto distribution in risk analysis and assessment

by identifying the significant causes according to the following steps (Sayed Abdul Nabi, 2019, p. 101):

1. Collect data on the frequency of occurrence of each cause.
2. Rank the causes in descending order (starting from the most frequent) and calculate the frequency percentage of each. Where:

$$\text{Frequency percentage} = \frac{\text{Number of occurrences of the alternative}}{\text{Total occurrences}}$$
3. Calculate the cumulative percentages for each cause.
4. Represent the results graphically, with the horizontal axis representing the factors being studied, while the vertical axis represents the percentage ranging from zero to 100%.
5. Represent the frequency of occurrence of each cause as a bar in the chart, and represent the cumulative percentage line on the same chart.
6. Draw a line parallel to the horizontal axis starting from the 80% point on the vertical axis.
7. Drop a line from the intersection point of the 80% line with the cumulative percentage line, which separates the significant factors/alternatives from the less important factors/alternatives.











3.2 The relationship between risk management and Pareto distribution

The researcher believes that in light of the openness of global markets and the rapid changes that companies are experiencing, risk have increasingly surrounded economic companies compared to the past. It may be possible to predict most internal risk, while predicting external risk is more difficult. Therefore, the company must follow all possible methods and techniques to identify and address risk before they occur. One of the most important of these methods is the Pareto Distribution, which states the 80/20 principle. This research focused on this concept related to arising risk, which states that 80% of all effects can be explained by 20% of the causes. The main goal of economic companies operating in the markets is profit, value creation, and loss avoidance. If the company can manage the small percentage of causes, which is 20%, then from the Pareto perspective, it can be said that the company has succeeded in managing its risk by 80%.

4. Practical Study

We conducted an internal and external survey on a special team that includes key users of the process or experts, and employees related to the methods and techniques used in the selected process, regarding a set of key variables driving potential risk faced by Salama Insurance Company- algeria, which are (financial risk, strategic risk, operational risk, environmental risk). The results for the various categories of risk and their frequency of occurrence according to the company's team data were as follows:

Table 2- Types of risk and their frequency of occurrence for insurance company

<i>rank</i>	<i>Risk</i>	<i>Period septembre 2023 to avril 2024 Frequency (numbre occurrence of risk)</i>	<i>Change 2024</i> Increased decline fixed  - 
1	<i>Competition risk</i>	4	
2	<i>Liquidity risk</i>	13	
3	<i>Technological risk</i>	3	-
4	<i>Market risk</i>	4	
5	<i>Credit insurance risk</i>	9	
6	<i>Product concentration risk</i>	2	-
7	<i>Profit margin risk</i>	10	
8	<i>Research and development risk</i>	2	
9	<i>Reputation risk</i>	2	
10	<i>Human resources risk</i>	1	

Notes: The data was compiled based on the Company's risk register for the period September 2023 to Avril 2024. The final column shows the ncreased or decline or Fixed from the previous year.

Source: (SALAMA ASSURANCE , 2024).

4.1 Risk analysis and assessment according to Pareto Distribution

After collecting data on the frequency of occurrence of each risk, we classified the risk by types, then arranged them in descending order (starting from the most frequent), and calculate the frequency percentage of each, along with the cumulative percentages for each of the risk faced by the company (www.statvision.com, 2013, pp. 3-4), according to the Pareto distribution, as shown in the following table:

Table 3- Pareto Distribution of risk.

Rank <i>k</i>	Risk class <i>j</i>	Type of risk	Descending frequency <i>f_j</i>	weight <i>w_j</i>	Weighted	Cumulative	Percent <i>P_j</i>	Cumulative
					Score <i>S_j</i>	Score cumulative <i>F_j</i>		Percentage <i>F_j, (%)</i>
1	<i>j₁</i>		<i>f₁</i>	1	<i>S₁</i>	<i>F₁</i>	<i>P₁</i>	<i>F₁, (%)</i>
.	.	.	.	1	.	.	.	.
.	.	.	.	1	.	.	.	.
.	.	.	.	1	.	.	.	.
.	.	.	.	1	.	.	.	.
.	.	.	.	1	.	.	.	.
.	.	.	.	1	.	.	.	.
.	.	.	.	1	.	.	.	.
<i>k</i>	<i>k</i>	.	<i>f_j</i>	1	<i>S_j</i>	$\sum F_j$	100%	.
Σ			Σf_j		ΣS_j			100%

The table displays the following information for each type of class Risk.

Where :

Rank (*k*) : the ranking of each Risk class *j* from 1 through *k* .

Risk class (*j*) : different types of risk. *j* = 1,2, ... *k*.

Frequency (*f_j*): the number of occurrences of each type of risk .

Weight (*w_j*): the weight *w_j* associated with risk type *j*. If weights were not specified on the data input dialog box, then *w_j* = 1 for all *j*.

Weighted score (*S_j*): the score associated with risk type.

$$S_j = w_j f_j \dots\dots\dots (1)$$

Cumulative score (*F_j*): the sum of all weighted scores from risk class 1 through the last risk class.

Percent (*P_j*): the percentage of the total weighted score represented by each risk:

$$P_j = \frac{S_j}{W} 100\% \dots\dots\dots (2)$$

Where:

$$W = \sum_{j=1}^k w_j f_j \dots\dots\dots (3)$$

Cumulative percent (*F_j,%*): the sum of the percentages from class 1 through the last risk class.

4.2 Creating a Pareto distribution of the risk of the insurance company

After gathering data on the frequency of occurrence of each risk, we arrange the risk in descending order (starting from the most frequent), and calculate the frequency percentage of each, along with the cumulative percentages for each of the risk faced by the company, according to the Pareto distribution, as shown in the following table:

Table4- Pareto distribution of the risk of the insurance company

Rank <i>k</i>	Risk <i>j</i>	Type of risk	Desce.	weig	weig. Score	Score. cum	perc	Cum. Perc (%)
			freq <i>f_j</i>	<i>w_j</i>	<i>S_j</i>	<i>F_j</i>	<i>P_j</i>	<i>F_j.%</i>
1	Liquidity	Financial risk	13	1	13	13	26%	26%
2	Profit margin		10	1	10	23	46%	20%
3	Credit insurance		9	1	9	32	64%	18%
4	Competition	Strategic risk	4	1	4	36	72%	8%
5	Market		4	1	4	40	80%	8%
6	Technological	Operational risk	3	1	3	43	86%	6%
7	Product concentration	Environment risk	2	1	2	45	90%	4%
8	Research& development	Strategic risk	2	1	2	47	94%	4%
9	Reputation	Environment risk	2	1	2	49	98%	4%
10	Human resources	Operational risk	1	1	1	50	100%	2%
Σ			50	/	50	/	/	100 %

Where: $n = 50$:frequency of risk (sample size) of $k = 10$ different types of risk.

4.3 Designing a Pareto chart for risk

From the outputs of the above table, a Pareto chart can be designed as follows:

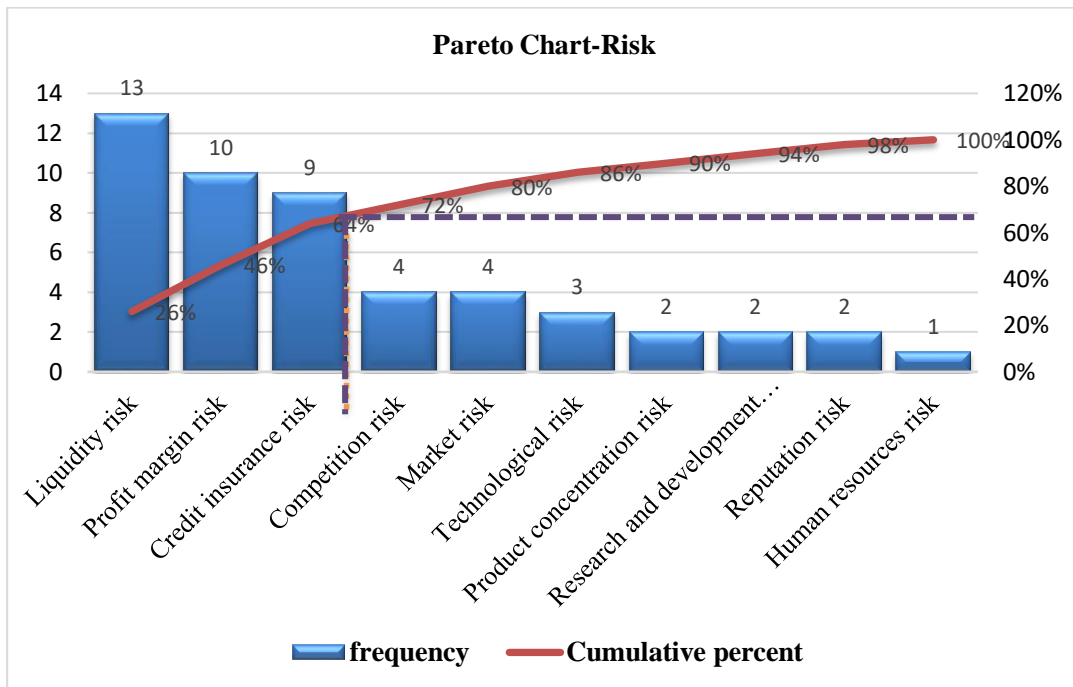


Figure 3-Pareto Chart-Risk

In this case, the three most common types of risk were liquidity risk, profit margin risk, and credit insurance risk. These three types of risk represent 72% of all risk. These risks fall under the category of financial risk.

We can see from the results in the above figure that nearly two-thirds ($2/3$) of these risks, which account for 72%, are due to liquidity risk, profit margin risk, and credit insurance risk, which are classified as financial risk. That is, 3 risk out of 10 are responsible for 72% of the results, while the remaining 7 risk account for 28% of the results.

Considering that it is easier to reduce high-frequency occurrences rather than low-frequency ones, the chart illustrates that it would be more beneficial to focus on addressing the top three causes (few and high-frequency) instead of concentrating on the low causes (many and low-frequency). Here, the principle of symmetry and inverse proportion can be seen through the Pareto chart, where the smaller part representing 28% increases to the larger part representing 72%, as shown in the chart.

Thus, the Pareto diagram clearly indicates that risk can be managed and mitigated. To achieve this, it is essential to start by addressing the high-frequency risk, which occur frequently, and then tackle the less frequent risk, thereby prioritizing the significant risk.

The company cannot eliminate all risk at once, as this takes time and cost to address. Therefore, the company can eliminate one-third ($1/3$) of the types of risk, which are (liquidity risk, profit margin risk, credit insurance risk), thereby reducing

the risk percentage by 72%. This also reduces a lot of time and cost, while at the same time, the company's insurance products, which could hinder its future goals, are not disrupted.

5. Statistical analysis of the sample opinions

To analyze the significant aspects of these impactful risk, data was collected on the frequently occurring financial risk that significantly affect the company's activities and account for more than 72% of the results. Data was also gathered regarding the strategic response employed by the company to confront those risk, through directed questions in the form of a questionnaire for the study sample of the company, (Appendices), aimed at helping us interpret the results obtained through the Pareto distribution.

A five-point Likert scale was used as a tool to analyze the financial risk questionnaire, as it is considered one of the best measures for describing and analyzing the responses of the study sample individuals. A severity score (response score) can be assigned to the corresponding degree on the scoring scale according to the following table:

Table 5- Five-Point Likert scale

<i>agreement (Sample direction)</i>	<i>strongly agree</i>	<i>Agree</i>	<i>Neutral</i>	<i>Disagree</i>	<i>Strongly Disagree</i>
<i>Degree</i>	5	4	3	2	1

5.1 Sample Direction/ agreement:

Since the variable that expresses the options or direction (*Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree*) are an ordinal scale, and the numbers entered into the program (*Degree*) represent the weights, we can calculate **Scale Interval (Impact)** for the Likert scale by determining the direction of the sample.

To determine the general direction of the sample, it is necessary to specify *Interval level* as follows:

$$\text{Interval level} = \frac{\text{greatest value} - \text{smallest value}}{\text{number of points}}$$

$$\text{Interval level} = \frac{5 - 1}{5} = 0.8$$

I measured agreement from *Strongly agree* to *strongly Disagree* based on Table:

Table 6- Values of the *Scale Interval (Impact)* for the 5-point Likert scale

<i>agreement</i>	<i>strongly agree</i>	<i>Agree</i>	<i>Neutral/ uncertain</i>	<i>Disagree</i>	<i>Strongly Disagree</i>
<i>Scale Interval (Impact)</i>	5 - 4.2	- 3.4 4.2	3.4 - 2.6	2.6 - 1.8	1.8 - 1

Since the Likert scale is five-point, the average of the scale can be calculated as follows:

$$\text{Average scale}(\mu) = \frac{\text{greatest value} + \text{smallest value}}{2} = \frac{5 + 1}{2} = 3$$

The results of the opinions of the study sample regarding financial risk can be clarified as follows:

5.2 Variable of potential financial risk affecting the company

By creating the probability distribution of the financial risk affecting the company according to the following table:

Table 7-The probability distribution of financial risk affecting the company

Degree of agreement D_i	phrase number (frequency f_i)								Σ	P_i
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8		
strongly agree (5)	2	1	7	3	4	6	10	8	41	41/400= 0,10
Agree (4)	12	10	18	19	25	12	19	22	137	137/400= 0,34
Neutral (3)	6	15	10	6	9	7	8	6	67	67/400= 0,17
Disagree (2)	17	21	8	13	6	16	10	12	103	103/400= 0,26
strongly Disagree (1)	13	3	7	9	6	9	3	2	52	52/400= 0,13
Σ	50	50	50	50	50	50	50	50	400	400/400= 1.00

The results of the distribution of the financial risk variable can be analyzed, which are the actual values of this probability distribution, and the average agreement on financial risk (**AAFr**) can be calculated from Table 6, as follows:

$$\text{AAFr} = \sum_{i=1}^k (P_i) \times (D_i)$$

Where:

P_i : Probability.

D_i : Degree of agreement.

$k = 5$; numbre of Degree.

i : numbre of variable ; where $i = 1,2, \dots k$.

$$\text{AAFr} = (0,10)(5) + (0,34)(4) + (0,17)(3) + (0,26)(2) + (0,13)(1) = 3,02$$

This result indicates that the average agreement for all statements regarding the probability distribution of financial risk is 3,02 , which falls into Scale Interval to the sample's tendency towards a "Neutral" degree, as previously explained in table5.The response degree for this variable is in the same category as Average scale(μ) =3, indicating a state of uncertainty regarding the opinions of the surveyed sample about the level of severity concerning the financial risk faced by

the company. We seek to find the appropriate strategy for the severity of this type of risk.

5.3 Variable strategic response adopted by the company

By creating the probability distribution of the strategic response adopted by the company according to the following table:

Table 8- Probability Distribution of the Response Strategy Adopted by the Company

Degree of agreement D_i	phrase number (frequency f_i)					Σ	P_i
	Q9	Q10	Q11	Q12	Q13		
strongly agree (5)	11	7	10	3	4	35	35/250= 0,14
Agree (4)	25	18	25	28	19	115	115/250= 0,46
Neutral (3)	9	20	11	14	9	63	63/250= 0,25
Disagree (2)	5	4	3	5	15	32	32/250= 0,13
strongly Disagree (1)	0	1	1	0	3	5	5/250= 0,02
Σ	50	50	50	50	50	250	250/250= 1.00

The results of the probability distribution concerning the response strategies adopted by the company for risk management can be analyzed, which are considered the actual values for this probability distribution. The average agreement for the strategic response (**AAsr**) from table 7 , can be calculated as follows:

$$\begin{aligned}
 AAsr &= \sum_{i=1}^5 (P_i) \times (D_i) \\
 &= (0,14)(5) + (0,46)(4) + (0,25)(3) + (0,13)(2) + (0,02)(1) \\
 &= 3,57
 \end{aligned}$$

This result indicates that the average agreement for the probability distribution of the strategic response adopted by the company for risk management is 3,57, which is greater than Average scale(μ) =3, and falls into the Scale Interval corresponding to the sample's tendency towards a "Agree" degree. This means that there is a positive consensus regarding the opinions of the sample on the statements of this distribution, highlighting the importance of determining the appropriate strategic response by the company for the financial risk it faces, as illustrated through the Pareto distribution.

6. Applying the appropriate strategy for managing financial risk

The Pareto chart shows that risk can be managed and their severity reduced. To achieve this, it is essential to start addressing the high-frequency risk, that is, those that occur frequently, followed by addressing the less frequent risk. Thus, priority is given to significant risk that could hinder the organization's objectives. Large companies often use a Risk Matrix as a means to summarize the risk associated with them. The Risk Matrix is extremely useful and can be employed for a variety of applications, as well as to determine the type of risk strategic response that is likely to be implemented. It illustrates the most suitable method for managing the risk that is expected to be used. The following table shows the results of the financial risk variable and the strategic response:

Table 9- Outputs of the financial risk variable and the response strategy

<i>Impact</i>		strongly agree	Agree	Neutral	Disagree	Strongly Disagree
		(5)	(4)	(3)	(2)	(1)
<i>Variables</i>		5 – 4.2	4.2 – 3.4	3.4 – 2.6	2.6 – 1.8	1.8 – 1
<i>Average agreement</i>	<i>Financial risk</i>			3.02 > $\mu = 3$		
	<i>strategic response</i>		3.57 > $\mu = 3$			
<i>Probability</i>		Very High	High	Medium	Low	Very Low

To apply the appropriate strategy, we plot the outputs of the financial risk results and the strategic response on the **Risk Matrix** (Hopkin, 2010, p. 141)), as illustrated in the following figure 3:

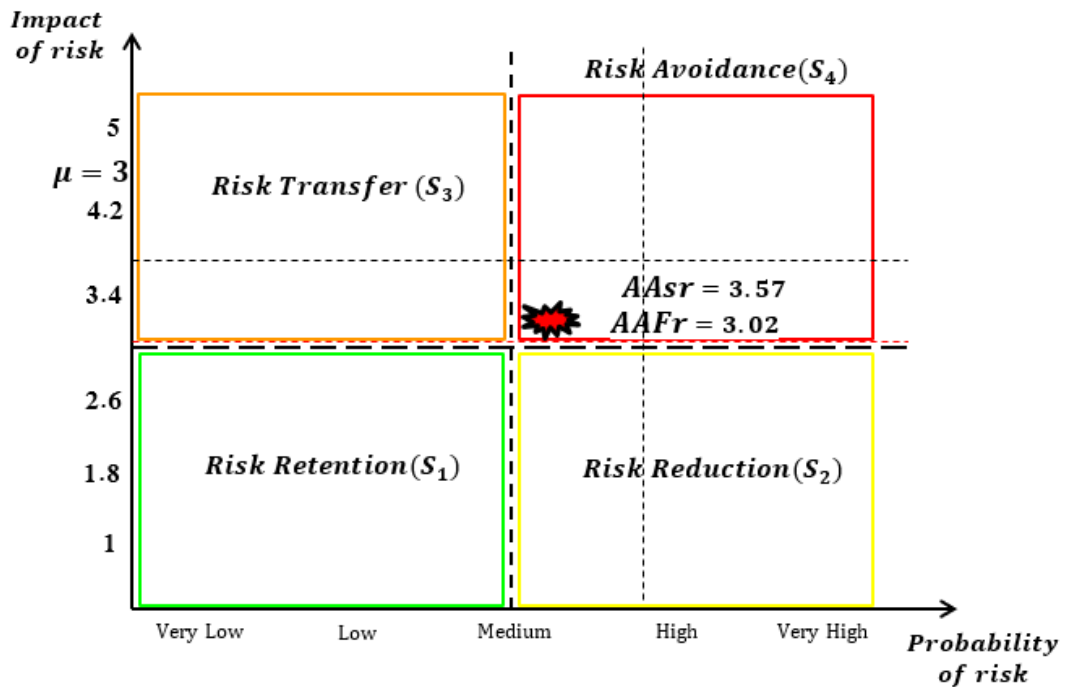


Figure 4- Risk Matrix

Since:

$$AAFr = 3.02 > \mu = 3 \quad \text{And} \quad AAsr = 3.57 > \mu = 3$$

The Average agreement Financial risk ($AAFr$) and the Average Agreement strategic response ($AAsr$), fall within the risk avoidance strategy quadrant according to the *Risk Matrix*. Therefore, the strategic response that the insurance company should implement is: **Risk Avoidance Strategy (S_4)**, This strategy aims to deflect as many threats as possible to avoid their costly consequences. by avoiding the activity that generates the risk or transferring the risk to another party, such as reinsurance, and compensating for that with less risky activities. Risk avoidance is a deliberate tactic. Like any other risk management strategy, it requires a systematic approach; and consists of the following steps:

- Identify risk.
- Analysis and Assess the probability and potential impact of each risk.
- Calculate risk exposure by quantifying the potential losses that may result if the risk is realized.
- Take steps to eliminate the risk.

7. Analysis of the relationship between financial risk variable and the strategic response variable adopted by the insurance company

We will test the relationship using the chi – square test (X^2), which is among the tests used in analyzing nominal and ordinal data, by studying the relationship between the variables driving financial risk and the company's strategic response, at a significance level of $\alpha = 0.05$, as illustrated below:

Null hypothesis H_0 : There is no statistically significant relationship at the significance level of $\alpha = 0.05$ between the financial risk variable and the risk management strategic response adopted by the company.

Alternative hypothesis H_1 : There is a statistically significant relationship at the significance level of $\alpha = 0.05$ between the financial risk variable and the company's risk management strategic response.

The test statistic X^2 can be calculated according to the following formula (Romeu, 2022, p. 2):

$$X^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

where:

O_i : Observed frequency.

E_i : expected frequency.

We have : $E_i = \frac{\text{row sum} \times \text{column sum}}{\text{table sum}}$

To ensure the quality of using the chi – square test, the expected frequency for any cell must not be less than 5 for at least 80% of the cells. To measure the relationship between financial risk and the strategic response, we follow as shown in the following table:

Table 10- X^2 Test for Analyzing the Relationship Between Financial Risk and strategic response

<i>frequency</i> \ <i>Degree</i>	<i>strongly agree</i> (5)	<i>Agree</i> (4)	<i>Neutral</i> (3)	<i>Disagree</i> (2)	<i>Strongly Disagree</i> (1)	Σ
<i>Observed frequency of financial risks O_i</i>	41	137	67	103	52	400
<i>Expected frequency of financial risks E_i</i>	$\frac{76 \times 400}{650}$ = 46,76	$\frac{252 \times 400}{650}$ = 153,84	$\frac{130 \times 400}{650}$ = 80	$\frac{135 \times 400}{650}$ = 83	$\frac{57 \times 400}{650}$ = 35,07	/
<i>Observed frequency of strategic response O_i</i>	35	115	63	32	5	250
<i>Expected frequency of strategic response E_i</i>	$\frac{76 \times 250}{650}$ = 29,23	$\frac{252 \times 250}{650}$ = 96,92	$\frac{130 \times 250}{650}$ = 50	$\frac{135 \times 250}{650}$ = 51,92	$\frac{57 \times 250}{650}$ = 21,92	/
$\Sigma (O_i \text{ financial} + O_i \text{ strategic})$	76	252	130	135	57	650

- Calculate the value of X^2_{cal} :

$$X^2_{cal} = \sum \frac{(O_i - E_i)^2}{E_i} = \frac{(46,76 - 41)^2}{46,76} + \frac{(153,84 - 137)^2}{153,84} + \frac{(80 - 67)^2}{80} + \frac{(83 - 103)^2}{83} + \frac{(35,07 - 52)^2}{35,07} + \frac{(29,23 - 35)^2}{29,23} + \frac{(96,92 - 115)^2}{96,92} + \frac{(50 - 63)^2}{50} + \frac{(51,92 - 32)^2}{51,92} + \frac{(21,92 - 5)^2}{21,92} = 42,21$$

- Determining the tabulated value of X^2_{tab}

Since we have a 4×5 matrix.

As disclosed in Table X^2 and with degrees of freedom:

$$dF = (r - 1)(c - 1) = (4 - 1)(5 - 1) = 12$$

At a significance level of $\alpha = 0,05$. where:

r : number of rows, c : number of columns, The tabular value is $X^2_{tab} = 21,03$

Decision: $X^2_{cal} = 42,21 > X^2_{tab} = 21,03$

Since the calculated value of X^2_{cal} is greater than the value of X^2_{tab} , we reject the null hypothesis and accept the alternative hypothesis.

Result: There is a statistically significant relationship at the significance level of $\alpha = 0.05$ between the financial risk variable and the response strategy adopted for risk management by the company.

8. The Effect size of financial risk variable on the strategic response variable using Cramer's V coefficient

Cramer's coefficient is one of the non-parametric statistical tests that is considered the appropriate statistical measure to calculate the effect size between two groups of characteristics or variables for the *Chi – square test*. The *V* coefficient can be used when we have a matrix of the form 3 x 3 or greater.

The value of *Cramer's V* can be obtained using the following formula (GIANNELLONI & VERNETTE, 1995, p. 294):

$$V = \sqrt{\frac{X^2}{n \cdot \min[(r - 1)(c - 1)]}}$$

In which

V : takes values in $[0,1]$.

X^2 : the chi square Calculated value X^2_{cal} .

n : the sample size.

r : number of rows, c : number of columns.

The value of *Cramer's V* is referenced from Cohen, who is one of the most important references in interpreting effect size and relationships in general. To interpret the obtained value, it must be compared with Cohen's reference as shown in the following table:

Table 11- Cohen's reference for effect size

<i>Effect size</i>	<i>Small</i>	<i>Medium</i>	<i>Large</i>
<i>dF</i>			
1	0.10: < 0.30	0.30: < 0.50	≥ 0,50
2	0.07: < 0.21	0.21: < 0.35	≥ 0,35
3	0.06: < 0.17	0.17: < 0.29	≥ 0,29
4	0.05: < 0.15	0.15: < 0.25	≥ 0,25
5	0.04: < 0.13	0.13: < 0.22	≥ 0,22

Source: (Cohen , 1988, p. 80).

The effect size of financial risk on the response strategy can be calculated by applying *Cramer's V*, at the lowest number of rows or columns, as follows:

$$Cramer's V = \sqrt{\frac{42,21}{50 \cdot \min[(4 - 1)(5 - 1)]}} = \sqrt{\frac{42,21}{50 \times 3}} = 0.53$$

the *Cramer value* for the financial risk affecting the company is:

Cramer's V = 0.53 > 0.29 *Large Effect*, at degree $dF = 3$. According to Cohen's reference for effect size in Table 10.

It is evident from the value of Cramer for financial risk *Cramer's V* = **0.53 > 0.29** that it has a significant effect size on the variable of the strategic response in risk management. This effect size is attributed to the components of financial risk (liquidity risk, profit margin risk, and credit insurance risk), which is **confirmed** by the Pareto distribution that 3 risks out of 10, accounting of 28%, are responsible for 72% of the results.

9. Conclusions

By integrating quantitative and qualitative risk analysis we will get good standards for predicting risks and minimizing their negative impacts. By estimating the probabilities of each type of potential risk, Help anticipate what might happen in the future by dealing with the risks that could occur. Optimal decision-making through strategic response to changes in the company's internal and external environment.

The Pareto Distribution method is important in risk discovery cases as an excellent opportunity to understand the essence of risks analysis and its connections to implementing risk mitigation measures and the dynamic evolution of risk probabilities based on the application of these methods. As a result, this approach is particularly recommended for preliminary or comparative risks analyses. The Pareto Distribution is significant in the following uses:

- We use the Pareto Distribution to identify and separate significant risk/problems from others and focus on solving them (since 80% of problems arise from 20% of the main causes), achieving the principle of symmetry.
- The Pareto Distribution is effective when there is a need to prioritize work and define and distinguish the most impactful factors/risks in order to resolve them.
- The Pareto Distribution should also be combined with other analytical tools to understand the relationship and the extent of the impact of those risk on the company's activities, in order to solve the majority of problems or risk and identify their root causes.

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APPENDICES :**Variable1: financial risk of the company**

Questions	agreement				
	5	4	3	2	1
1. The driving variables for the potential risk of the company					
2. Your company faces risk related to diversifying funding sources and the inability to innovate sources for future cash flows.					
3. Your company faces risk related to diversifying funding sources and the inability to innovate sources for future cash flows.					
4. The company faces credit insurance risk (in that the other party may fail to fulfill its obligations on time and according to the agreed terms).					
5. Your company is affected by increasing inflation risk that lead to a decline in the real value of money.					
6. Your company is exposed to exchange rate fluctuation risk, resulting in losses for its investments in hard currencies.					
7. Your company has resorted to changing the risk classification by adding pandemic risk such as the (COVID-19) crisis, considering them as recurring risk and setting aside financial reserves to deal with such risk.					
8. Your company has resorted to digitizing financial transaction systems to bridge the digital gap as occurred during the (COVID-19) crisis and thereafter.					

Variable2: Strategic response of the company

Questions	agreement				
	5	4	3	2	1
9. The company works on a risk avoidance strategy by avoiding activities that may lead to any risk.					
10. The company resorts to a risk transfer strategy for identified risk, but without completely eliminating them, such as insurance and reinsurance contracts, etc.					
11. The company adopts a risk reduction strategy, which means methods to lessen the severity of losses resulting from the risk.					
12. The company resorts to a risk retention (acceptance) strategy if: the level of risk is very low, the cost of treatment far exceeds the benefit, or there is no available treatment.					
13. Your company has developed emergency plans by adopting a forward-looking methodology for managing risk that will arise from crises, such as the (COVID-19) crisis.					

Where:

<i>agreement</i>	<i>strongly agree</i>	<i>Agree</i>	<i>Neutral</i>	<i>Disagree</i>	<i>Strongly Disagree</i>
<i>Degree</i>	5	4	3	2	1