جهوزية المصانع لتفادي مخاطر الهزات الأرضية

The Readiness of Factories to Avoid Earthquake Risks

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الملخص:

تهدف الدراسة إلى التعرف على مدى مقاومة المصانع السعودية للأخطار البيئية الطبيعية وتوضيح إجراءات الأمن والسلامة التي تتبعها الشركات السعودية لمقاومة مخاطر الزلازل. إلى جانب تحديد الإجراءات التي تتبعها الشركة السعودية للكهرباء من حيث الأمن والسلامة واستعداد الشركة لاتباع مقاييس مقاومة مخاطر الزلازل. اعتمدت الدراسة على المنهج الوصفي التحليلي بالإضافة إلى مناهج إدارة الأزمات وإدارة الجودة الشاملة لتحقيق هدف الأساسي للدراسة. تتمحور أهمية هذه الدراسة في ضرورة أخذ نتائجها بعين الاعتبار في تحديد مدى استعداد الشركة السعودية للكهرباء لمقاومة مخاطر الزلازل وتجنبها بقدر الإمكان. بناءً على ذلك تضمنت الدراسة أربعةمحاور. المحور الأول تناول الإطار المنهجي للدراسة، بينما تناول المحور الثاني الإطار المفاهيمي للدراسة، وركز المحور الثالث على الإجراءات المنهجية، وأخيرا تناول المحور الرابع نتائج الدراسة الميدانية.

الكلمات المفتاحية: الزلازل، المخاطر، الشركات، الشركة السعودية للكهرباء.

Abstract:

The study aims to identify the magnitude of Saudi factories' resistance to natural environmental hazards, and to clarify security and safety procedures followed by Saudi companies to resist the risk of earthquakes. Besides, identifying the procedures followed by the Saudi Electricity Company in terms of security and safety and the readiness of the Saudi Electricity Company for measures to resist earthquake risks. To achieve the aim of the study, it relied on the descriptive analytical method, in addition to approaches of Crisis management and total quality management. The importance of this study that its results ought to be taken into consideration in identifying the readiness of the Saudi Electricity Company to resist the risk of earthquakes, to avoid them if possible. Therefore, the study includes four chapters, the first is the methodological framework of the study. And also, the second chapter dealt with the conceptual framework of the study. According to the third chapter, it focused on methodological procedures. At last, the fourth chapter dealt with results of the field study.

Keywords: Earthquakes, Risks, Companies, Saudi Electricity Company

1. Public framework of the study

1.1. Introduction

Earthquakes are a natural phenomenon spread in many countries around the world, and abounding in certain countries like Turkey, Japan and others **[**Badran, 2023**]**. These earthquakes cause earth cracks, changes in the heights and depressions of the earth's crust and rising sea and ocean waves **[**Al-Dubaik, 2009: 5**]**. Whereas the results are catastrophe according to its rate.

The catastrophes reach to a wide range, destroy buildings with their different types, affect negatively on infrastructure and roads, and damage to water, internet and electricity networks.

As long as the earthquakes affect in the people's life completely, the manufactures also affected and stopped working partially or completely, and also collapsed. This matter definitely effects on the economic sector as a result of blockage of the damaged factories, and it has other repercussions, such as the cessation of work by the workforce and the interruption of their livelihoods, or the decline in their job competencies in the event of a significant cessation of work **[**Ramadan, 2023**]**.

Most factories take into consideration prevention and safety measures, includes earthquakes, volcanos, and natural disasters. Else, it imposes on its employees a code of conduct that contributes to minimizing risks to the greatest extent. Especially that factories are more damaged and influenced by natural disasters because they have heavy machines and massive electricity line. In order to avoid risks, the factories organize training programs to face the risk through identifying the best ways to evacuation, going to safe place for protection, shutting off gas, install the fuel tank and heating, the presence of a fire extinguisher, keep away from heavy objects,

keep the necessary materials in tightly closed tanks, and keep food supplies **[**Skynews, 2023**]**.

Talking about the Saudi Company for Electricity, is a joint stock company specialized in the production, transmission and distribution of electricity. Also, it is the biggest company in the field of electricity power in the middle east and north Africa. According to the report of doing businesses issued by the World Bank in 2022, the company has made Saudi Arabia ranked 18^{th} out of 190 countries in getting electricity for business. Since this company is one of the most important companies in the KSA, it is paramount to avoid the risks during natural disasters. For this reason, the company always seeks to reduce environmental impacts and their factors to reduce pollution and support public health and sustainable development due to the increasing demand for electricity. Thus, the greater the demand, the greater the challenge to provide the utmost safety for citizens in the face of environmental changes, including earthquakes, hurricanes and other fluctuations **[**Saudi Electricity Company: Website**]**.

1.2. Research Problem

The problem of the study lies in identifying the readiness of the Saudi Company for Electricity to resist the dangers of earthquakes and to follow safety and protection measures when they occur, as it serves thousands of regions and citizens around the Kingdom and distributes electric power to many networks that may be affected in the event of danger and lack of readiness to resist it. Hence, the main study question is derived:

What is the extent of the Saudi Electricity Company's resistance to avoid the risk of earthquakes?

From the main question, the following sub-questions branch out:

1. What is the extent of Saudi factories' resistance to natural environmental dangers?

2. What are the security and safety measures followed by Saudi companies to resist the risk of earthquakes?
3. What are the safety and security procedures followed by the Saudi Electricity Company?
4. Are there procedures prepared for the Saudi Electricity Company to resist the risk of earthquakes?

1.3. Objectives of the Study:

The objectives of the study are as follows:

1. Knowing the magnitude of Saudi factories' resistance to natural environmental hazards.
2. Clarification of security and safety procedures followed by Saudi companies to resist the risk of earthquakes.
3. Knowledge of the procedures followed by the Saudi Electricity Company in terms of security and safety.
4. Identifying the readiness of the Saudi Electricity Company for measures to resist earthquake risks.

1.4. The Importance of the Study

The importance of the study lies in the following points:

1. The study is a qualitative addition to the scientific research units in Saudi companies and factories to follow the highest standards of safety and security for them in the face of the danger of earthquakes.
2. Its results are taken into consideration in knowing the readiness of the Saudi Electricity Company to resist the risk of earthquakes, to avoid them if possible.

1.5. The limits of the study

- **Spatial limit:** (Saudi Arabia) – the Saudi Electricity Company, located in the city of Riyadh in the Kingdom of Saudi Arabia.
- **Time limit:** The study will be applied according to the latest developments of the company for the academic year 2023.

1.6. Previous studies:

Atiyah Study (2022): The study aims to identify the impact relationship between both personal traits, teamwork skills, and management skills of officials on the one hand as dimensions of the independent variable of charismatic leadership and crisis management on the other as a variable of a sample of economic institutions in Umm El-Bouaghi Province. In order to achieve the objectives of the study: the researcher used the analytical descriptive method to familiarize himself with various aspects of the topic. 65 forms were collected as a purposive sample from several economic institutions. The study reached a series of results, notably that all dimensions of charismatic leadership from personality features, teamwork skills, and management skills impact crisis management, even to varying degrees in the institutions under study.

Al Ifa Study (2022): The study aimed to identify the structure of the crisis management team in conjunction with the organization's management team crisis and the effectiveness of the crisis management team. the study recommended that the only standard to be invoked was the interest of the enterprise, and the need to act quickly to save what could be saved, as one of the most important characteristics of the crisis was lack of time and information, which were fatal combination if not controlled by the crisis management team, to overcome them and return the institution to normal functionality.

Saloula & Barah Study (2021): The study aimed to highlight crises and their communication management strategies and models, known as crisis communication. To achieve the goal: the study relied on the descriptive approach and found some results. The most notably that crisis management is no longer in such a random and improvised manner, but rather with rules and foundations that a successful course of action must be aware of as literature and rules and then used in its management of the

crisis. The study recommended that institutions should be careful in developing advance plans to manage the crisis, especially with regard to the communication gap, and periodic evaluation of the institution's strategies as well as its environment, in order to activate early warning of crises before they occur.

Saheli et. al Study (2021): The study aimed to shed light on the reality of Saudi Electricity Company's social responsibility since its critical importance where the social responsibility is one of the most visible features of the social realities of entities and organizations. To achieve the objectives of the study: the researchers used the descriptive and analytical method. The study found a series of results and the most notably is that the Saudi Electricity Company through its efforts and ambitious programs was able to enter an intense competition with many companies known for their expertise in customer service and won all the merits. Moreover, in a short period of time, it was able to launch a new system of customer service which contributed to the reliability of the electrical system in Saudi Arabia. The study recommended a number of recommendations, one of the most prominent is the need to customers, consumers, those with rights, and the environment care which will enable the enterprises to achieve leadership and more competitiveness in the field.

Salem Study (2020): Salem Study (2020): The study aimed to identify the impact of the application of total quality management principles on the new product development strategy, as well as the level of adoption by industrial enterprises of the Setif Province of the total quality management principles. To achieve the objectives of the study: the researcher designed a questionnaire that was directed to a group of staff working in some of industrial enterprises in Setif Province. 86 questionnaires were distributed and 68 forms were retained for statistical analysis. The study found a series of results, the most important of which: there is a difference in the level of adoption of the principles of total quality

management and the level of application of the new product development strategy depending on the duration and size of the enterprise's activity. Moreover, there is a statistically significant correlation relation between the application of TQM principles and the product development strategy.

2. Methodological framework of the study

2.1. The analytical descriptive approach

The study relies on the analytical descriptive approach, which is based on careful monitoring and follow-up of a specific phenomenon or event in a quantitative or qualitative manner in a limited period of time or several periods, in order to identify the phenomenon or event in terms of content, and to reach results and generalizations that help in understanding and developing reality (Al-Mashhadani, 2017: 162). The analytical descriptive approach is an investigation that focuses on one of the phenomena as it exists in the present, with the aim of diagnosing it, revealing its aspects, and determining the relationships between its elements or between it and other phenomena (Al-Azzawi, 2008:97).

The analytical descriptive approach relies on the statistical package in the social sciences SPSS, by depending on the questionnaire tool for collecting the data from the study sample.

2.2. The crisis management approach:

Crisis management is a purposeful activity based on searching and obtaining the necessary information that enables the management to predict the locations and trends of the expected crisis, and create the appropriate climate to deal with it, by taking measures to control the expected crisis and eliminate it or change its course for the benefit of the organization. Some researchers believe that crisis management is a distinct administrative process because it is exposed to a sudden event, and because it needs quick and decisive actions that match with the developments of the crisis;

Thus, the crisis management has the initiative to lead events, influence them, and direct them according to the requirements of matters (Tareef, 2017: 7-8).

2.3. Sources of data collection

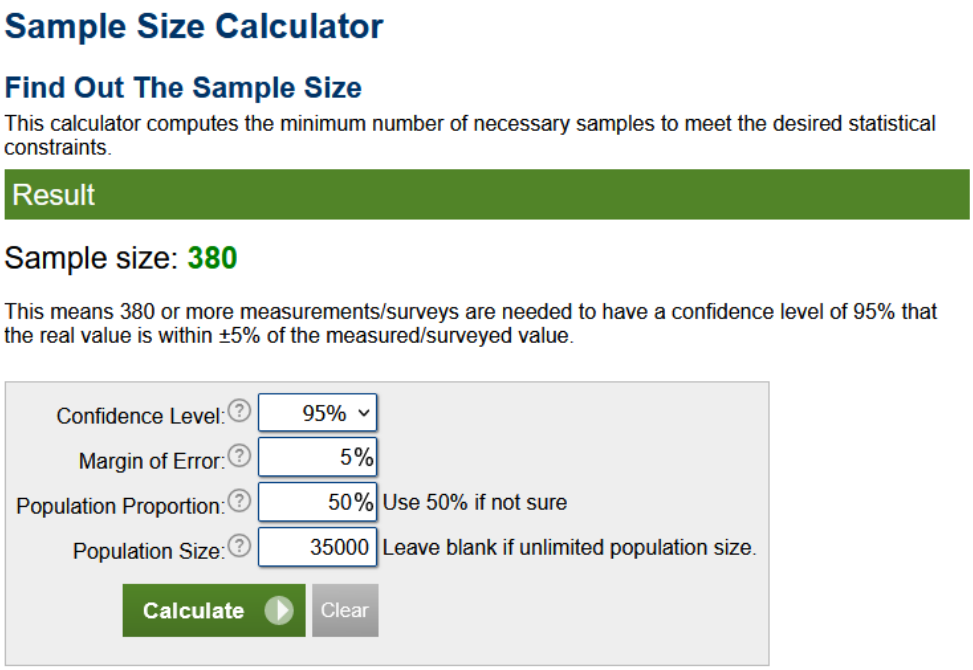
The study relies on two of the data collections tools, namely:

1. Questionnaire: The researcher is going to prepare a questionnaire containing main axes; The first deals with the personal characteristics of the respondents, and the second deals with the sub-axis of the study variables, that each sub-axis includes 10 questions, and the questionnaire is going to be distributed to a sample of employees in the same company.
2. Interview: The researcher will conduct a series of personal interviews with the aim of supporting the results of the field study with the opinions of a group of workers in the same company, academics or experts, especially when the researcher is unable to compare the results of the field study with any previous study.

2.4. Study sample population:

The study population is represented by the Saudi Electricity Company, which includes about 35 thousand workers, according to the official reports issued by it, while the sample size is 380 individuals, as the sample was calculated through the website:

https://www.calculator.net/sample-size-calculator



3. *Field study*

3.1. Reliability test

Table 1 shows the reliability test analysis of the study variables, including Readiness of Factories, Earthquake Risks, and total score degree.

Table 1. The reliability analysis of the study variables

Variables	no of items	Alpha Cronbach
Readiness of Factories	8	0.723
Earthquake Risks	6	0.812
Total degree	14	0.804

As shown in Table 1, The Alpha Cronbach coefficient of the study variables was 0.723 and 0.812 for Readiness of Factories and Earthquake Risks, respectively. These values suggest moderate to high internal consistency or reliability levels among these items. In other words, the items in this variable tend to measure the same underlying construct with a reasonable degree of consistency.

In addition, The Alpha Cronbach coefficient of the total degree was 0.804 reflecting a good level of internal consistency or reliability among all study items. It implies that the items in this variable measure the same underlying construct consistently and reliably.

3.2. Readiness of Factories statistics

The descriptive statistics of the independent variable in the study (Readiness of Factories), including frequency, percentage, mean, and standard deviation, are shown in Table 2.

Table 2. Readiness of Factories (independent variable) statistics

Items		strongly disagree	disagree	neutral	agree	strongly agree	mean	standard deviation	Response	Rank
Small businesses have a risk-proof system	Frequency	17	36	56	19	10	2.78	1.067	neutral	8
	Percent	12.1	25.7	40.0	13.6	7.1				
Saudi factories resist the dangers of the natural environment	Frequency	13	14	47	49	16	3.29	1.100	neutral	6
	Percent	9.3	10.0	33.6	35.0	11.4				
There are procedures prepared for Saudi companies to resist the risks of earthquakes	Frequency	11	31	46	36	15	3.09	1.109	neutral	7
	Percent	7.9	22.1	32.9	25.7	10.7				
The Saudi Electricity Company is one of the largest companies in the field of electric energy in	Frequency	3	4	16	47	69	4.26	0.927	agree	1

the Middle East and North Africa										
	Percent	2.1	2.9	11.4	33.6	49.3				
The company always strives to reduce environmental impacts and their factors to reduce pollution and support public health and sustainable development	Frequency	6	6	25	63	38	3.88	1.007	agree	2
	Percent	4.3	4.3	17.9	45.0	27.1				
The Saudi Electricity Company resists the dangers of the natural environment	Frequency	9	12	31	60	27	3.60	1.094	neutral	4
	Percent	6.4	8.6	22.1	42.9	19.3				
There are procedures prepared for the Saudi Electricity Company to combat the risks of earthquakes	Frequency	10	11	35	54	29	3.58	1.122	neutral	5

	Percent	7.1	7.9	25.0	38.6	20.7				
There are training programs prepared for the Saudi Electricity Company to face risks by determining the best evacuation methods	Frequency	4	9	33	60	32	3.78	0.974	agree	3
	Percent	2.9	6.4	23.6	42.9	22.9				
	The overall mean of the variable						3.53	0.688	neutral	

Note; response from 1−2.33 disagrees, 2.34−3.66 is neutral, and 3.67−5.0 agree.

For item 1, Participants' responses indicate a neutral opinion regarding the presence of a risk-proof system in small businesses. The relatively low mean and the moderate standard deviation suggest that the opinions on this item are varied. This item was the lowest on the scale.

Also, Participants expressed a neutral stance regarding the ability of Saudi factories to withstand natural environmental risks. The mean score suggests a slightly more positive perception compared to the previous item; however, the standard deviation indicates a wide range of opinions.

Further, Participants' responses indicate a neutral perspective on the preparedness of Saudi companies in dealing with earthquake risks. The mean score is relatively lower, indicating a more neutral view and the standard deviation implies a diverse range of opinions.

On the other hand, Participants strongly agreed that the Saudi Electricity Company is one of the largest companies in the Middle East and North Africa's electric energy sector. This item was the first item in the rank. The high mean score and low standard deviation indicate widespread agreement among the respondents.

In addition, Respondents generally agreed that the company makes consistent efforts to mitigate environmental impacts, reduce pollution, and support public health and sustainable development. This item was the second item in the rank. The mean score suggests a positive perception, although the standard deviation indicates some opinion variability.

On the contrary, Participants expressed a neutral opinion regarding the Saudi Electricity Company's ability to withstand natural environmental dangers. The mean score suggests a slightly positive view, while the standard deviation indicates a range of responses.

Similarly, Participants held a neutral perspective on the existence of procedures for the Saudi Electricity Company to address earthquake risks.

The mean score suggests a neutral opinion, while the standard deviation indicates a variety of responses.

Finally, The last item in the scale suggested that respondents generally agree that the Saudi Electricity Company has training programs to deal with risks by identifying optimal evacuation methods. The relatively high mean score indicates a positive perception among the participants.

Overall, The total degree score of the scale was 3.53, suggesting a slightly positive leaning towards the neutral response category. However, it is important to note that the specific nature of the response options for this total degree score is not provided. The standard deviation of 0.688 indicates a relatively low variability among the responses, suggesting moderate agreement or consistency among the participants.

3.3. Avoid Earthquake Risks statistics

The descriptive statistics of the dependent variable in the study (Earthquake Risks), including frequency, percentage, mean, and standard deviation, are shown in Table

Table 3. Earthquake Risks (dependent variable) statistics

Items		strongly disagree	disagree	neutral	agree	strongly agree	mean	standard deviation	Response	Rank
Risks of various types affect companies	Frequency	2	1	3	64	69	4.42	0.711	agree	1
	Percent	1.4	0.7	2.1	45.7	49.3				
The impact of risks on companies reduces the company's reputation	Frequency	3	6	16	53	61	4.17	0.947	agree	4
	Percent	2.1	4.3	11.4	37.9	43.6				
Earthquakes are a natural phenomenon that destroys buildings of various kinds	Frequency	4	15	16	49	55	3.98	1.100	agree	5
	Percent	2.9	10.7	11.4	35.0	39.3				
Earthquakes affect infrastructure, water, internet and electricity networks.	Frequency	3	6	8	47	75	4.33	0.928	agree	2
	Percent	2.1	4.3	5.7	33.6	53.6				

Earthquakes affect the corporate economy	Frequency	1	7	13	49	69	4.28	0.885	agree	3
	Percent	0.7	5.0	9.3	35.0	49.3				
Earthquakes affect the economy of the Saudi Electricity Company	Frequency	4	10	25	51	49	3.94	1.041	agree	6
	Percent	2.9	7.1	17.9	36.4	35.0				
	The overall mean of the variable						4.19	0.611	agree	

Note; response from 1−2.33 disagrees, 2.34−3.66 is neutral, and 3.67−5.0 agree.

As shown in Table 3, all the Earthquake Risks avoiding variable items showed a strong agreement from the respondents. The majority of respondents agreed that various types of risks have an impact on companies. The high mean score of 4.42 suggests a strong level of agreement among participants, and the low standard deviation of 0.711 indicates a relatively consistent opinion.

Additionally, Participants agreed that risks have a negative impact on a company's reputation. The mean score of 4.17 indicates a high level of agreement, while the standard deviation of 0.947 suggests some response variability.

Further, Respondents generally agreed that earthquakes are natural phenomena that can destroy different types of buildings. The mean score of 3.98 suggested a high level of agreement; however, the standard deviation of 1.1 indicated a wide range of opinions.

Moreover, Participants strongly agreed that earthquakes impact infrastructure, water, internet, and electricity networks. The high mean score of 4.33 indicates a strong level of agreement, and the relatively low standard deviation of 0.928 suggests a degree of consensus among respondents.

Similarly, Respondents agreed that earthquakes have an impact on the corporate economy. The mean score of 4.28 suggests a high level of agreement, and the standard deviation of 0.885 indicates a relatively consistent opinion.

Finally, Participants agreed that earthquakes have an impact on the economy of the Saudi Electricity Company. The mean score of 3.94 suggests a high level of agreement, and the standard deviation of 1.041 indicates some variability in responses.

In addition, The Total degree score represents the overall score obtained by aggregating responses across all items in the scale. In this

case, the mean score of 4.19 suggests a high level of agreement, and the low standard deviation of 0.611 indicates a consistent opinion among the respondents.

Overall, these results indicate a consensus among the participants regarding the impact of risks, particularly earthquakes, on companies and the economy. Most respondents agreed with the statements presented, highlighting the perceived significance of these factors.

3.4. Regression analysis statistics

The simple linear regression analysis was conducted to detect the impact of the Readiness of Factories in avoiding Earthquake Risks (Table 4).

Table 4. Linear regression analysis model

	Model Summary			ANOVA				Coefficients		
independent variable	R	R^2	Adjusted R^2	F	df		P–value	β	T	P–value
Readiness of Factories	.273	0.074	0.068	11.02	Regression	1	0.001**	0.273	3.320	0.001**
					Residual	137				
					Total	138				

** highly significant at P–value <0.01

The simple linear regression analysis model examines the relationship between the independent variable (Readiness of Factories) and the dependent variable "Avoid Earthquake Risk" and. The R–value of 0.273 indicates a positive correlation between the Readiness of Factories and Earthquake risk avoidance. However, since the R^2 value is only 0.074, it suggests that the Readiness of Factories explains only a small portion (7.4%) of the variation in Earthquake risk avoidance. Further, the adjusted R–squared value of 0.068 suggests that the model accounts for the

correlation between variables while considering the number of predictors in the model.

In addition, The ANOVA results assess the overall significance of the regression model. The F-value of 11.02 suggests that the model is statistically significant, indicating that the independent variable, "Readiness of Factories" significantly impacts the dependent variable, “Avoid Earthquake Risk”. The associated p-value of 0.001^{**} confirms this significance.

Lastly, the coefficient (β) of 0.273 represents the estimated slope of the regression line, indicating the strength and direction of the relationship between the independent variable "Readiness of Factories" and the dependent variable “Avoid Earthquake Risk”. The positive coefficient suggests a positive relationship. These β values mean that increasing one unit of Readiness of Factories raises Earthquake Risk avoidance by 27.3%. The t-value of 3.320 and the associated p-value of 0.001^{**} indicate that the coefficient is statistically significant.

In summary, the linear regression analysis model shows a statistically significant positive relationship between the independent variable "Earthquake Risk" and the dependent variable “Avoid Earthquake Risk”. However, the model has limited predictive power, as the R-squared value is relatively low, indicating that other factors not included in the model may also influence the dependent variable.

4. Conclusion:

At the end of the research, earthquakes are considered natural disasters with destructive effects that leave many negative effects on humans, the environment and the economy. necessary protection methods, Therefore, the researcher recommends the following:

Through this research and study, the researcher recommends future studies to include all problems and their solutions, including the following:

- A study on protection measures in factories and companies against earthquake risks.
- A special study of the structural design work of buildings, factories and companies that are compatible with earthquakes.
- A special study of the procedures that must be taken when an earthquake is felt.

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