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MEASURING AND MANAGING GEOPOLITICAL RISK

A Thesis

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By

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Konstantina Melina Nomikou

Abstract

Management and Measurement of Geopolitical Risk

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In light of the changing geopolitical situation and the emergence of new risks, it is crucial for decision makers to actively detect and tackle possible threats to the system. Regularly monitoring, evaluating, and enhancing risk management procedures is crucial to guarantee the system's ability to withstand and endure geopolitical crises.To understand how to measure and manage geopolitical risk, it is first necessary to define the control elements of the system that we want to control if and how it is affected. For this particular process, we should have a detailed and in-depth understanding of how the system works, its vulnerabilities and strengths. With an in-depth examination of the complexities of the system, decision makers can get a deep understanding of its functioning and identify potential

dangers that could jeopardize its stability. Next, we need to classify and assess the potential Geopolitical risks that could impact our system, employing the methodology that we deem most likely to yield accurate outcomes. This involves examining variables such as political and economic volatility, societal turmoil, and ecological hazards. Various techniques, such as scenario analysis or risk tables, can be employed to evaluate the probability and consequences of various risks. The subsequent phase entails addressing significant risks that may impede the seamless operation of our system, implementing strategies to either prevent geopolitical threats or, if prevention is not feasible, minimize their impact. After identifying potential risks, strategies should be designed by implementing preventive measures, hedging risks or even exiting high-risk areas or markets. Finally, the feedback process is required where it is checked whether the measures taken worked and whether the geopolitical risks did not affect or affected our system at tolerable levels. If we do not have the desired results, we repeat the process from the beginning or from the point where the deviation was observed. Managing geopolitical risk is an ongoing process that requires constant vigilance and adaptation. The thesis following this systematic approach, proposes processes that can measure, and effectively manage, geopolitical risks in an increasingly complex and interconnected world.

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Chapter 1:Foundations of Geopolitical Risk Analysis

1.1 Introduction

Geopolitical risk can be understood as the risks arising out of interactions between countries, which include trade relationships, security partnerships, alliances, multinational climate initiatives, supply chains, and territorial disputes. It includes various hazards that may arise as a result of a nation's involvement in international affairs, including political, economic, military, and social risks. Geopolitical risk pertains to conflicts, acts of terrorism, and tensions among nations that disrupt the usual state of peace and stability. The existence of foreign interactions and conflicts presents a significant risk to enterprises.

Additionally, it is defined as the risk associated with terror threats and war threats. Geopolitical risk, which refers to the broad range of risks related to conflicts or tensions between states, has a clear impact on various aspects including innovation. Nevertheless, the information provided does not explicitly address the influence of geopolitical risk on investment decisions or economic stability.

Geopolitical risk can be measured using methods such as textual measurements and news-based metrics. An instance of a textual metric is the GPR Index, which quantifies the proportion of articles in prominent English newspapers that center on perilous geopolitical matters and occurrences. This index offers a quantitative assessment of geopolitical risk through the analysis of news content. News-based metrics, such as the geopolitical risk (GPR) index, employ news sources to detect unfavorable global developments and the corresponding hazards. An alternative method involves creating country-specific indicators of geopolitical risk by quantifying the number of times certain events are reported in newspapers. Furthermore, it is possible to generate a monthly geopolitical risk assessment by utilizing news sources from various countries. These strategies offer valuable perspectives on geopolitical risk by utilizing diverse data sources and methodologies.

The significance of effectively managing geopolitical risk is underscored by multiple sources. Global firms have the ability to actively and strategically handle the risks presented by increasing political tensions, both on an international and domestic level, in order to protect their operations. Companies encounter specific strategic demands depending on their level of political risk exposure and the effectiveness of their political risk management.

Understanding how to effectively handle geopolitical risk is crucial since it can greatly impact the performance, reputation, and well-being of a worldwide company. It is crucial to establish risk tolerance and create measurements and key risk indicators in order to identify and respond promptly when exposures beyond the ability and willingness to take risks. Risk entrepreneurs also employ a comprehensive strategy to manage geopolitical risks, however in a less organized and centralized manner. In an ever-evolving global environment, it is imperative for organizations to effectively manage geopolitical risk in order to protect their operations, reputation, and personnel. Strategies for controlling geopolitical risk can involve adopting a multi-country approach and safeguarding the balance.

The board's role in managing geopolitical risk is also emphasized, using a multifocal lens to assess potential risks. In addition, the importance of developing metrics and key risk indicators, providing frequent updates to stakeholders, increasing geopolitical expertise, asking the right questions and accepting policy impact is mentioned. The insights also highlight the need to integrate geopolitical risk management into broader strategic planning and risk management, as well as a renewed approach to political risk management for companies. However, specific details of each strategy are not provided, or their implementation specified.

1.2 Structure of the Thesis

The thesis is structured with a clear progression from the explanation of the fundamental concepts to the development of specific methodologies, to understand the measurement and then the management of the geopolitical risk that will lead to comprehensive conclusions.

The thesis is structured into two main chapters, each contributing to a comprehensive understanding of geopolitical risk analysis. The first section, Chapter 1, titled "Foundations of Geopolitical Risk Analysis," serves as the foundational segment, laying the groundwork for the entire thesis. Chapter 1 begins with a background section, highlighting the significance and context of geopolitical risk analysis. It is followed by an outline of the thesis's structure, providing an overview of what the reader can expect. Subsequently, the second Chapter delves into a thorough literature review, offering insights from prior research and scholarly work in the field.

Chapter 2 continues with, "Comprehensive Understanding of Geopolitical Risk and Risk Analysis Methods", which is the core of the thesis. It starts with an introduction, setting the stage for a deeper exploration of risk, risk assessment, and the broader context of geopolitical risk. This chapter progresses by dissecting various aspects of risk, including risk management processes, risk concepts, risk attitudes, and risk appetites. Following this extensive examination, it delves into the realm of geopolitical risk. It addresses contemporary geopolitical scenarios, the interplay between geopolitics and risk society, and finally provides a precise definition of geopolitical risk. The chapter then transitions into a discussion of risk analysis methods, covering topics such as coarse risk analysis, examination of failure modes and consequences, risk and functionality assessments, SWIFT, analysis of fault trees, event trees, Bayesian networks, and Monte Carlo simulation. A comprehensive discussion segment concludes the chapter.

In sum, the structure of the thesis is designed to equip the reader with a strong foundational understanding of geopolitical risk analysis in Chapter 2 and at the same time delves into the intricacies of geopolitical risk, its implications, and various risk analysis. This framework allows for a methodical exploration of the subject matter and provides a holistic perspective on assessing and managing geopolitical risk.

Chapter 2:Literature Review of Geopolitical Risk and Risk Analysis Methods

There is a wealth of research in contemporary literature on geopolitical risk and how it affects the economy. These studies examine how geopolitical risk affects economic growth, investment behavior, trade, financial markets and other economic activities. Specifically, the time-varying effect of the oil price in relation to geopolitical risk is examined by Ivanovski Kris and Abebe Hailemariam, (2022) who, using monthly data from 16 countries for the years 1997 to 2020 and a non-parametric variable coefficient data model, they find that the price of oil is related to geopolitical risk. Furthermore, they find a fairly large amount of heterogeneity in the time-varying trend functions of geopolitical uncertainty for each nation. For market participants and policymakers involved in geopolitical risk management, their findings have important [1]implications.[2] The same conclusion is reached by Yang et al. (2023) who examine the dynamic effects of geopolitical risks, oil price shocks and inflationary pressure in various countries from January 2000 to July 2022. The study uses an advanced model to examine the dynamic relationships between of these factors at the global level concluding that geopolitical risks affect oil prices through their effect on supply and demand, thereby affecting inflationary pressure, and that these effects change dynamically over time.

The oil market and geopolitical developments interact significantly, which is reflected in the structure of world politics. A large body of studies focuses on the relationship between eopolitical risks and political security, and how political decisions can affect the economy. For example, Su, Chi-Wei, etc. (2021) examine the political implications of oil from a geopolitical risk (GPR) perspective in order to assess the oil-geopolitical risk relationship. They investigate the link between GPR and the price of oil (OP) and find that while wars will increase OP, a drop in GPR caused by a remote possibility of geopolitical risk will not lead to a sudden drop in price. Financial crises can cause OP to soar while GPR remains low, and we

[2] Ivanovski,,Hailemariam (2022) "Time-varying geopolitical risk and oil prices." *International Review of Economics & Finance* 77 (2022): 206-221.

can see the same thing in these situations. GPR can help with accurate forecasting of OP and steps to reduce the negative impact of major fluctuations in the oil market in the context of a controversial and complex global relationship.[3]

Another category of approach to geopolitical risk assessment includes studies that examine the various methodologies and tools for measuring and managing geopolitical risk. Karagozoglu et al. (2022) use state-of-the-art techniques to measure geopolitical risk, despite the fact that it has usually been considered from a qualitative perspective. The three main methodologies used by the authors to construct measures of geopolitical risk are news text analysis, analyst/expert ratings, and empirical models. Asset price-based measures reflect changes in geopolitical risk more quickly than those based on textual analysis, and model-based measures based on analysis incorporate new geopolitical risk information more quickly than those based on estimates , according to the authors, who also examine how well these approaches can capture changes in geopolitical risks in time.[4] Additionally, an intriguing methodology is added to the body of literature by Caldara, Dario, and Iacoviello (2022), who present a monthly geopolitical risk index based on the number of newspaper articles covering geopolitical tensions and analyzing the development and its effects since 1985 in an effort to measure geopolitical risk. The geopolitical risk index (GPR) peaks during the Gulf War, after 9/11, the 2003 Iraq invasion, the 2014 Russia-Ukraine crisis, and the Paris terrorist attacks. Real economic activity is declining, stock returns are declining, and capital flows are shifting from emerging economies to advanced economies as a result of high geopolitical risk. Geopolitical risk's detrimental effects are primarily brought on by the possibility of unfavorable geopolitical events. They observe that when the index is extended back to 1900, geopolitical risk increased significantly during World Wars I and II, during the Cold War in the 1980s, and has been steadily rising since the start of the twenty-first century.[5]

[3] Su, Chi-Wei, et al. (2021) "Is oil political? From the perspective of geopolitical risk." *Defense and Peace Economics* 32.4: 451-467.

[4] Karagozoglu, Ahmet K., Wang, and Zhou. (2022) "Comparing Geopolitical Risk Measures." *The Journal of Portfolio Management* 48.10: 226-257.

[5] Caldara, Dario, and Matteo Iacoviello (2022). "Measuring geopolitical risk." *American Economic Review* 112.4 (2022): 1194-1225.

Another large category of studies is that which examines how geopolitical risk affects different industries and sectors of the economy, such as energy, tourism, agriculture, technology and others. Research interest in the factors that will determine the success of the green energy transition project has increased as a result of the emergence of numerous initiatives around the world. Flouros, et al. (2022) examine 171 economies in order to measure the impact of geopolitical risk on "green" investments, as represented by geopolitical risk indices, while controlling for all key factors reported in the literature. According to their adaptive model, geopolitical risk has both short- and long-term, significant impacts on green investment. They conclude that taking into account how renewable energy sources are linked to geopolitical tensions is the only way it can play a significant role in the energy mix.[6]

Finally, there is another category of studies that focus on governance and international relations. This category focuses on the role of states, international organizations and multinational corporations in managing and negotiating geopolitical risks. Allen, (2019) examines the geopolitical risk management approach to judging border and customs enforcement procedures against their economic impact. It focuses on how the international community could manage migration, to reduce irregular mass migration and to achieve development and take action against collective exploitation using current practice and examples. It also looks at how the UK and EU can handle the enforcement of customs controls after Brexit.[7]

2.1 Comprehensive Understanding of Geopolitical Risk and Risk Analysis Methods

2.2 Introduction

Geopolitical risks are considered a major influence on investment choices and stock market dynamics by business owners, traders and bank executives. A large percentage of

[6] Flouros, Floros, Pistikou Plakandaras (2022). "Geopolitical risk as a determinant of renewable energy investments." *Energies* 15: 1498.

[7] Allen (2019). "Managing Geopolitical Risk: Repurposing Human Systems and Re-Establishing Sovereignty Over Them".

investors in international markets express greater concern about the economic impact of the various military and diplomatic conflicts taking place around the world, ranking geopolitical risk above political and economic uncertainty.[Wells Fargo/Gallup Survey: Geopolitical Risks Greater Threat to Investments Than the Economy, Investors Say | Business Wire] Geopolitical risk along with economic and political uncertainty ranks among the three most serious risks that could have significant negative economic impacts.[8]

However, the role that geopolitical risks play in determining macroeconomic and financial cycles has not been thoroughly analyzed. The main shortcoming of the monitoring of economic quantities has been the absence of a reliable geopolitical risk indicator that measures this risk in real time and is taken into account by international investors and decision makers. A monthly geopolitical risk index (GPR) could show investors' entry and exit signals from markets depending on geopolitical risk, depending on the factors influencing it, and could reduce investment uncertainty by observing its course. In addition, by looking at how geopolitical risk affects the economy, we would have a picture of stock returns, how much economic growth is slowing down, and track the flow of capital from developing to developed countries. Such a GPR Index is attempted by Caldara, Dario, and Iacoviello.[9]

Geopolitics is the activity of states and organizations that includes the competition and the attempt to control the territory as well as the survival of the states as well as the various entities in the international system and their emergence in a better position compared to their competitors. Geopolitical risk which affects the markets is caused when territorial or other disputes cannot be settled, and the risk of an armed conflict is visible. As a result, we define geopolitical risk as the risk posed by armed conflicts, terrorist attacks and interstate hostilities that have an impact on the peaceful development of international relations as well as the smooth and orderly functioning of international markets. Geopolitical risk includes both the likelihood of these events occurring and the additional risks arising from the escalation of conflicting parties' differences.

[8] Morris, (2018). Securing finance, mobilizing risk: money cultures at the Bank of England. Routledge,

[9] Caldara, Dario, Iacoviello. (2022) "Measuring geopolitical risk." *American Economic Review* 112.4: 1194-1225.

The impact that geopolitical risks have on macroeconomics focuses on the fact that an increase in geopolitical risk causes persistent declines in industrial production, employment, and international trade. We also find that both economic policy uncertainty and consumer confidence help spread geopolitical risk shocks more widely. Additionally, higher geopolitical risk results in a short but significant drop in stock returns. Stock market reaction varies significantly by sector, with the defense sector having positive excess returns and sectors exposed to the general economy—such as steel and mining—having negative returns. The possibility of increased geopolitical risk causes a prolonged increase in uncertainty and a sustained decrease in real activity, while the occurrence of adverse geopolitical events results in the resolution of uncertainty and therefore has little economic impact.

After major political and economic shocks such as the 9/11 terrorist attacks, the OPEC oil price shock, the JFK assassination, the Cuban Missile Crisis, etc., uncertainty seems to rise sharply. Stock market volatility, which can be used as a proxy for uncertainty, shows up as large bursts of price volatility that typically temporarily double volatility after major disruptions. These volatility shocks are strongly correlated with other measures of uncertainty, such as firm- and industry-level productivity declines.

Advanced economies are experiencing a decline in activity as a result of increased geopolitical risk. In addition, geopolitical risks cause stock prices to fall. Finally, significant changes in global capital flows are affected by geopolitical tensions. When geopolitical risk rises, investors pull money out of emerging economies and into safe havens like the United States.

To measure Geopolitical risk first, we should define what we consider geopolitical risk but also the range of events that give us an indication of the level of risk we are investigating, such as wars, severe economic crises, terrorism, whether nations are politically stable, climate change etc.[10] In order to achieve an approach in trying to record the events that change economic stability at a geopolitical level, in the first chapter of the paper we present the definition of Geopolitical risk and the theoretical approach to the subject. We should then determine whether the uncertainty is a result of adverse macroeconomic and financial

[10] Caldara, Dario, et al. (2016) "The macroeconomic impact of financial and uncertainty shocks." *European Economic Review* ,185-207.

conditions or whether it is one of the causes of the financial crisis. Geopolitical risk certainly has recessionary effects, and these recessions and financial crises are directly accompanied by an increase in several indicators of macroeconomic uncertainty.[11] For this reason, in the next chapter of the work, we try to approach the subject through the historical observation of the changes that took place at the economic level, both in the short term and in the long term, due to the most important geopolitical events. In the third chapter, specializing, we will try to decipher the transitions of the energy market in relation to geopolitical events. Finally, the paper records the conclusions reached during the research on how to measure geopolitical risk, but also the management that should be done when signs of such risk are presented.

2.3 Risk and Risk Assessment

In this section, we delve into risk management in the context of project management, emphasizing the importance of understanding and effectively managing risk. The management process begins with the recognition of the fundamental role of success criteria in decision-making, which guides project managers in discerning which risks are worth taking. The six-step risk management process, as established by the Project Management Institute (PMI), serves as a cornerstone for assessing and managing risk during project execution. It begins with risk identification, followed by risk assessment through non-numerical assessment protocols. Calculating impacts and assessing the most significant risks based on probability and impact is also essential. The process proceeds to develop and communicate risk mitigation and prevention strategies. Risk monitoring and management tops the cycle, where implemented risk responses and management strategies are strictly followed.

Concepts of risk are examined, distinguishing risk from uncertainty and emphasizing the importance of evaluating risk events based on their likelihood and impact. The analysis shows how risk quantification depends on a comprehensive understanding of risk events, and probability and impact calculations require both statistical analysis and domain-specific knowledge. Risk tolerance reflects the organization's willingness to take or avoid certain risks, while risk attitude determines the actual decision-making about those risks. The risk

[11] Bloom, (2009). "The impact of uncertainty shocks.", 623-685.

categorization structure serves as a framework for classifying risks, allowing project managers to systematically identify, assess and manage risks, enabling a tailored approach to risk management. Examining risk management perspectives, the module contrasts short-term and long-term views in project management. It presents the challenges posed by the trade-off between immediate project needs and long-term project success, emphasizing the need for informed decisions that take both perspectives into account. The impact of personnel changes on turnover risk management is examined, highlighting the importance of maintaining a coherent risk monitoring and response system. The complex interplay between short-term needs and long-term consequences is explored, where quick decisions must adapt to changing organizational priorities, making long-term outcomes difficult to predict.

2.2.1 Management Process

Even the simplest business choice carries some risks. Because every project involves some level of risk, project success criteria are often used to determine which risks are worth taking and which are not. Decision making becomes more difficult and requires more judgment as more success criteria are added. Project managers will not be able to identify risks that may stand in the way of their success if they do not know the success criteria that guide the project.

Increasing technical complexity increases risk. However, most organizations prioritize cost and schedule objectives because they are simple to understand. However, it is often unclear how cost and schedule choices will affect technical performance risk. Consequently, a formal methodology is necessary to evaluate the outcomes of decisions and potential issues. This methodology should also support the discovery of useful and effective solutions to achieve project objectives.

Every project does not need a formal risk management strategy, but for best results, risk management should develop into a systematic process used in a disciplined manner. Many project managers begin the decision-making process with intuitive reasoning (guessing). When making decisions involving a high level of risk, however, truly effective managers must go beyond simple logic and prior knowledge. Even experienced project managers have not addressed every risk. Others may seem unpredictable, while others either cannot imagine or do not fit their paradigm. Some risks may not be considered without external input because they are so far outside of any individual's expectations or experience.

Six steps have been established by the Project Management Institute, Inc. (PMI). Project risk management is a component of PMI's risk management strategy. For a project specific risk management plan involves developing tolerances and limits for project implementation.[12]

The risk management process should begin with the identification of potential risks. That is, we look for possible events that could possibly have positive or negative effects on the projects, along with information about the likely occurrence of the event and its exact effects. The next stage is risk assessment. Using non-numerical assessment protocols, we assess risk. Afterwards, we proceed to calculate the impact of the risks. According to their probability and impact, we assess the most significant risks and/or the project as a whole and prepare for risk elimination responses. We design, evaluate, and communicate risk mitigation and prevention strategies. Finally, we monitor and manage risks. We implement our risk response and management strategies.

The six-step process is not identical to any other process used by any organization. However, the differences are minimal. Risk management was a four-step process in previous editions of PMI's A Guide to the Project Management Body of Knowledge (PMBOK® Guide, second edition).[13] The United States military follows a six-step process that includes planning, reconnaissance, analysis, handling, monitoring, and implementation. The Australian Government's Department of Commerce follows a six-step process that includes setting the context, defining risks, performing analyses, performing assessments, developing and implementing remedies, and monitoring, reporting, reporting and managing risks. Regardless of the labels used, all processes created appear to encourage more adaptive, flexible approaches to an organization's project methodology and simplify the implementation of risk management.

[12] Wideman, (2002). Project and program risk management a guide to managing project risks and opportunities. Project Management Institute, Inc.,

[13] Gasik, Stanisław. (2015) "An analysis of knowledge management in PMBOK® guide." *PM World Journal* 4 1-13.

All project managers should conduct some type of formal risk management process, whether qualitative or quantitative. Smaller, less important projects may need only a limited risk management effort. However, all major projects should include formal, intensive risk management activities. As a result, the project manager is responsible for monitoring risk and must make decisions based on the project's cost, schedule, and performance challenges.

2.2.2 Risk Concepts

Although the words risk and uncertainty are often used interchangeably, they are not the same. Risk is defined as "the cumulative effect of the possibility of uncertain events that may have a positive or negative impact on project objectives".[14] This is in contrast to uncertainty, which considers only the fact and in which the probability is completely unknown. According to the conventional view, a hazardous situation is one in which an event can occur, and the probability of its occurrence can be estimated using data from previous incidents or environmental factors. This observation differentiates between risk and uncertainty, despite its limited application in project management. Risk gives one a sense of the relative level of probability of an event. This possibility, however, is completely unknown when there is uncertainty.

The project manager must be aware of the potential consequences of an event occurring or not occurring in order to determine whether it is truly "dangerous". For example, even if an event has a small chance of occurring, the results could be catastrophic if it occurs. An example of this type of situation is a flight on a commercial airliner: Despite the low probability of a crash, the consequences are severe. Most people do not think of flying as high risk, even though many people feel uncomfortable about it because of the possible consequences of failure. This individual's perception of risk plays an important role. Occurrence, probability, and severity (or impact) are the three fundamental elements that make up the nature of any given hazard.

The incident reveals to us the danger as it may happen. Descriptions of events are essential. The probability and consequences of a plane crash in a densely populated area are

[14] Ward (2008). Respectably queer: Diversity culture in LGBT activist organizations. Vanderbilt University Press, p. 353

very different from those of a plane crash over the sea. To begin analyzing risk probability and impact, risk managers must first investigate the nature of the risk event itself. Probability and impact calculations become much more challenging without a precise definition of the risk event. Risk events should usually be described in complete sentences. The rest of the risk process is significantly simpler in decision making when the definition of risk is approached consistently.[15]

After defining the risk event, we need to determine the potential severity of its effect. How much damage can it do? Probability can only be estimated when we have a sense of the size of the effect under consideration. This variable is heavily influenced by statistics and probability theory. However, because each project in the conventional project environment is unique, it can be difficult to determine if there is no suitable historical precedent to which current projects can be compared.

The level of risk in most projects and organizations is typically determined by systematic arrangement of variables. Risks are categorized based on their impact and likelihood: risks with minimal impact and probability are deemed as low, while risks with substantial impact and high probability are classified as high. A project is also considered to be at a low overall chance of success if there is a significant chance of it occurring but with few implications. Adopting a methodical approach to evaluating risks enables the creation of consistent and standardized risk management strategies for various projects.

Calculating the level of risk becomes more difficult and requires further analysis as we approach the low probability/high impact quadrant as shown in Figure 1. A project with a vast number of moderate risk elements can be considered high risk, while a project with a small number of high-risk elements may have a lower overall risk score. To determine the risk level of the project, these circumstances usually require some kind of modeling. As a result, numerous attempts have been made to mathematically model this subjective assessment of risk.

Disagreements can arise when stakeholders assess risks. Project managers must be prepared to make the final decision themselves, although technical experts may occasionally

[15] Pritchard, Carl, and PMI-RMP PMP (2014). *Risk management: concepts and guidance*.

need to be consulted as part of the risk management process. While it is important to look at measurable probabilities of loss, opportunities should also be considered. There is no justification for engaging in a dangerous activity if there is no real opportunity. However, the threshold for taking risk increases as the potential reward increases.

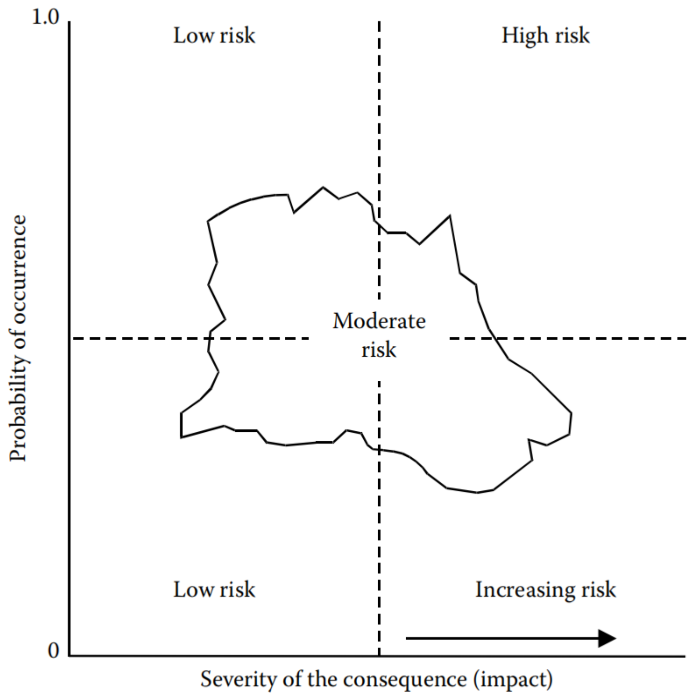

Figure 1: Risk assessment (Source: Pritchard, Carl, et. al., 2014)

2.2.3 Risk Attitudes and Appetites

Recent years have seen an increase in the importance of attitude and risk appetite in many projects. These two factors serve as the basis for many stakeholder risk assessments. Risk tolerance is a measure of how willing the environment is to take certain risks (or not face them). The ability to tolerate specific types or levels of risk depends on an organization, project team, or individual.

While behavior and the general willingness to accept certain risks may be influenced by the attitude towards risk it is ultimately what determines whether these risks are taken or not. Every person has a risk attitude. Some people would never consider skydiving. Others see it as an exciting opportunity. Individual risk attitudes and organizational risk tolerances for project implementation should be synchronized.

The process of delivering a specific good or service at a specific time for a specific price is the area where risks are primarily identified, according to the project manager. A properly planned project will allow the project manager to have some reserve funds and time to deal with unforeseen issues while still meeting the original cost, schedule, and performance goals.

However, a wide range of issues can prevent the manager from achieving project goals. For example, the product may not perform to the specified quality, the actual cost may be too high, or delivery may be delayed. Risk must be classified to be manageable. A risk analysis structure is included in the fifth edition of the PMBOK® Guide to highlight this classification.[16] Risk has also been classified into classes and subclasses by the Software Engineering Institute's Risk Classification-Based Classification.[17] In addition, the original publication of the book by the Defense Systems Management College (DSMC), which focused on five main aspects of risk. Choosing approaches that reflect an organization's risk requirements is more critical than choosing a specific scheme.[18]

The fifth edition of the PMBOK® Guide (2013)[19] explores not only the value of risk categorization but also the idea that risks can be project and organization specific depending on context and culture. The risk allocation structure is crucial because it illustrates a shift in risk management practice from general categories to a set of categories that are relevant to a specific project. These categories become essential to effective risk management because, ultimately, they represent the sources of risk in a project or project organization.

Carr et al. created a risk hierarchy for the software development industry that is a pioneering taxonomy-based risk identification. Their analysis not only includes a list of the risk categories they discovered while working on numerous software projects, but also goes into great detail to explain the meaning of each category and the environmental factors at play when an organization experiences problems in a given category.

[16] Stackpole, Snyder. (2013) *A User's Manual to the PMBOK Guide*. John Wiley & Sons. 317

[17] Carr, Marvin, et al. (1993) Taxonomy-based risk identification.

[18] Defense Systems Management College. (1990) Technical Management Department. *Systems Engineering Management Guide*.

[19] Stackpole, Snyder. (2013) *A User's Manual to the PMBOK Guide*. John Wiley & Sons

Project managers can use this work as a benchmark for how these goals can be more successfully achieved if they want to develop a more thorough understanding of the nature of risk in their organizations and create categories that are beneficial and supporting efforts to identify and identify risks. To help project managers determine the likelihood that a particular area, subset, or category is endemic to their projects, the taxonomy categorizes specific binary questions (yes/no) in addition to categorizing risk categories and their subsets.

2.2.4 Risk Management Perspectives

When managing project risks it is necessary to consider two perspectives. On the one hand a short-term perspective looks at the current stage of the project and the near future. While from a long-term perspective, everything is considered in the long term. The distinction between the two perspectives, like many other aspects of risk management, is somewhat ambiguous and more explanation is needed to define and justify the distinction. The short-term perspective usually refers to risk management related to meeting the immediate needs of the project. However, the long-term perspective asks, "What can I do now to make sure the project will be successful in the end?" This view may include, but is not limited to, incorporating engineering considerations related to project support and production.

The ability to perform at the desired level in the short term requires both short-term and long-term perspectives, but the project manager may be forced to compromise the long-term perspective of the project to achieve short-term success. While new approaches or tools may cause short-term problems for a project, overall productivity and performance may increase over time. However, as with any wise management choice, both short-term and long-term impacts must be thoroughly considered. Only when these effects are known can the project manager respond quickly to a risk.

Figure 2 shows an overall design chosen for a project with specific risk elements, the two perspectives are again presented from a different perspective. It is clear that this choice will have long-term effects. The current task of the project manager is to complete this planning within the limits of available resources. To manage risk on an operational, day-to-day basis, the project manager has chosen some technical, financial and planning parameters (short-term risk management). The project manager must keep an eye on long-term impacts while concentrating on short-term results.

Every day, computer buyers face the same dilemma. If a cheap option may be attractive because of its price, but it may not have the same level of support as an expensive unit. A mid-range computer may have the technical capability but not the support to run recently released software versions. Although an expensive unit may have all the features and support users want, management may not support it in the long term. Therefore, it is difficult to strike a balance between short-term and long-term views.

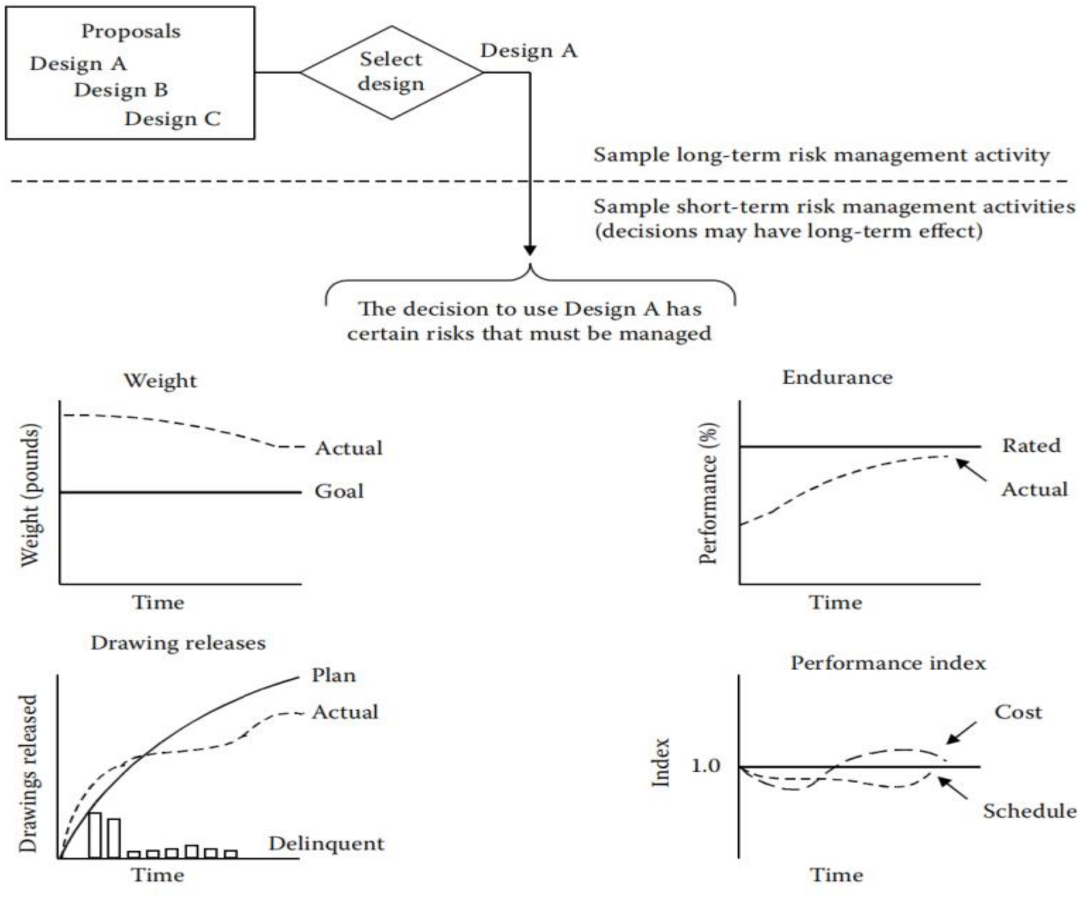

Figure 2: Project management (Source: Pritchard, et. al., 2014)

A project should ideally be overseen by the same management team from start to finish. However, because ideal conditions are unusual, a given project will likely make use of multiple management teams and personnel. Because of this, the risk management process often has gaps due to personnel changes in project management. These gaps in knowledge, in turn, lead to the loss of important data gathered earlier in the project. As a result, valuable time must be spent getting to know the project, often at the expense of long-term planning and risk management. The transition process is facilitated by a formal project risk monitoring, evaluation and response system. When properly implemented, this system also enforces long-term risk management.

Although ideal, it is not always practical to make decisions with long-term results. The project manager is often forced to make decisions based on immediate needs. One reason for this is staff turnover. Defending the project is another matter. Plans for the future can be seriously affected by sudden changes in the organization's priorities (an area of risk in itself). As a result, quick decisions are made to adapt to the new priorities. These decisions are often made before the long-term consequences can be thoroughly assessed. And finally, there are times when it is difficult to predict the long-term consequences when making a decision.

To complete the given phase of a project, operational risks that arise on a daily basis must be addressed. The solutions created to manage these risks must, to the greatest extent possible, be considered from a long-term perspective and must provide the project manager with a solid, well-organized case to support his position. Numerous studies have shown decisions made early in a project's development have a significant impact on overall project performance and cost. Figure 3 illustrates such an example(DSMC 1985)

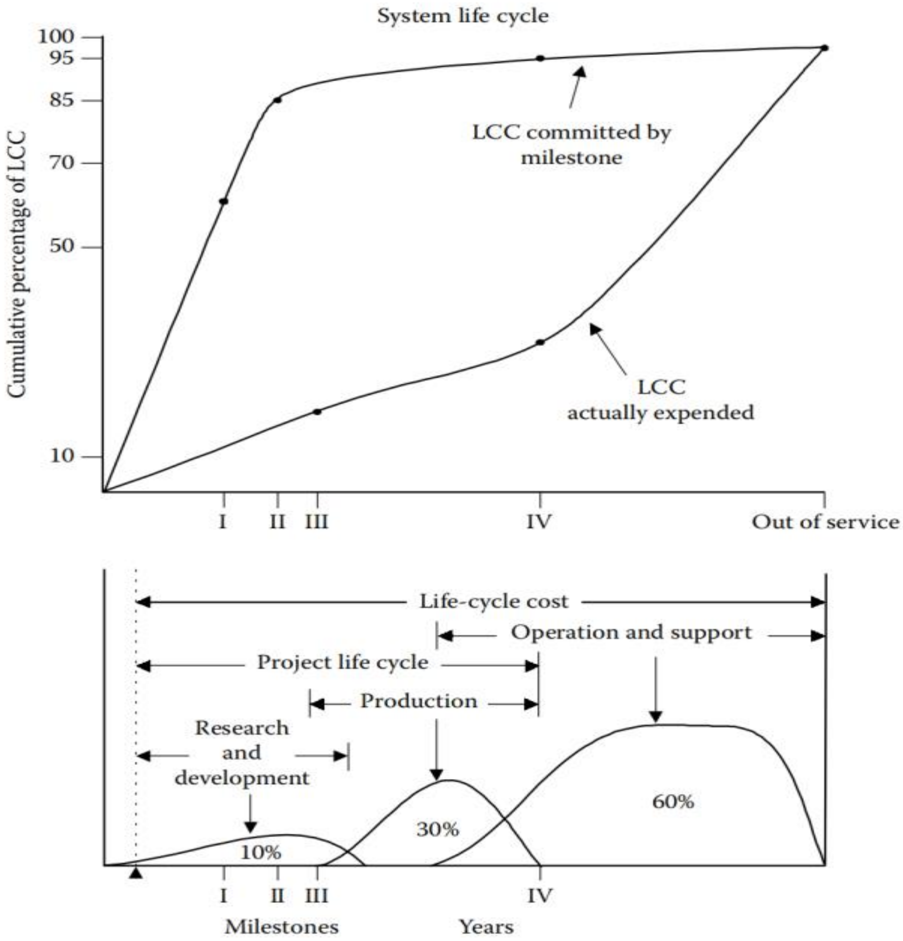

Figure 3: The performance of a project (Source: Pritchard, et. al., 2014)

2.3 Geopolitical Risk

The chapter explores the complex interplay of global forces, events, and trends that have far-reaching implications for nations, businesses, and individuals. It delves into the concept of globalization and how it has transformed traditional notions of national security, turning regional threats into global challenges. Geopolitical risk is examined from multiple perspectives, covering political, economic, military and environmental dimensions. It also highlights the inadequacy of existing institutions and frameworks to address the widening range of risks in today's interconnected world. Geopolitical risk is not limited by geographic proximity and can have an impact across borders, often affecting nations far from the source of the risk. The importance of understanding and quantifying geopolitical risk using financial market data and risk management methodologies is also highlighted.

2.3.1 Understanding Contemporary Geopolitical Scene

The term "globalization" refers to a wide range of various cultural and economic trends that bind the world's most developed economies and impair each state's ability to fully control and manage its economic situation. The effects of globalization are most obvious in the financial markets, where anarchic transnational finance has unleashed significant instability in the global system.[20]

In the name of globalization, Cold War geopolitical rhetoric is resurfacing in a new financial form. Globalization-related crises start out as economic but quickly shift to geopolitical issues. Frequently, the media's lightning-quick information dissemination makes it possible for these crises to develop at a breakneck pace. The development of virtual built environments, international telecommunications systems, and information technologies are now driving the transformation of the manufacturing and service sectors.[21]

It has been obvious since the detonation of the atomic bomb at the conclusion of World War II that humanity could create technologies that could fundamentally alter the circumstances of human life on the planet. The emergence of nuclear energy, the widespread use of chemicals in all facets of life following World War II, and the most recent advancements in genetic engineering have opened up a brand-new realm of risks for the human race. Among the more blatant "side effects" are global warming, ozone depletion, and environmental poisoning. These risks, which permeate daily life, are pervasive and difficult to detect. The dangers of modern techno-scientific civilization are man-made, as opposed to the "natural" dangers of the past, and they could have disastrous effects-. Many of these consequences, though rarely taken into account, go beyond the realms of conventional rational analysis, the local and the individual, and even human lives and the human species. Additionally, catastrophic events like pandemics or nuclear disasters like COVID-19, Chernobyl in 1986, the earthquake and tsunami in Japan in 2011, or the nuclear accident in

[20] Aligica, Dragos. (2001): "Paul Hirst and Grahame Thompson: Globalization in question: the international economy and the possibilities of governance." *Journal of international relations and development* 4.2: 180-182.

[21] Tuathail, Gearóid. (2002)"Postmodern Geopolitics: The modern geopolitical imagination and beyond." *Rethinking geopolitics*. 28-50.

Fukushima in 2011 are no longer just possible; they also have unavoidable, predictable "unexpected consequences."[22]

This new society is one where technological risks are generalized and globalized. Uncertainties that are challenging to predict are caused by the fact that the full dimensions of this new global risk condition have not been precisely calculated. Three crucial geopolitical characteristics can be used to effectively address the various risks and challenges of the current geopolitical situation.

The first trait is that, in the modern era, "national security" has a global reach. While regional and state-centric threats continue to be major security concerns, the most pressing security challenges, ranging from terrorism to international organized crime and weapons of mass destruction proliferation, are now global. The international geopolitical environment is being shaped by coordinated international diplomatic efforts, international aid, arms control, and non-proliferation initiatives, which is something the Western community is aware of and strongly supports. However, two trends tend to undermine such efforts: the first is a unilateral and neo-isolationist reflex in states such as the United States that devalues international cooperative initiatives, and the second is a reluctance on the part of Western states, alliances, and economies to think about how they can contribute to global security.

A second feature of the current geopolitical situation is a crisis of competence and rationality in institutions such as the free market, the welfare state, multiparty democracy, national sovereignty, and "national security" bureaucracies. According to Beck, “we frequently find ourselves in circumstances that the dominant institutions and concepts of politics cannot comprehend or adequately address”.[23] The institutions of contemporary society are unable to address the risk issues facing society or manage them. The global abundance of expanding risks is too great for regulatory institutions to handle. Risks that could be catastrophic have been normalized, but acceptable risks have not been considered. "The inherent diversity of risks... raises doubts about the accuracy of risk assessment."[24]

[22] Beck, Ulrich, Lash, Wynne. (1992) *Risk society: Towards a new modernity*. Vol. 17.

[23] Ibid p. 7

[24] Ibid p. 32

Special "national security" organizations created to counter one kind of threat are still in operation today. In a world of international risks and transnational threats, security institutions are seen as an unsatisfactory existence. They promise protection from territorial threats but find it difficult to deal with "non-traditional" threats, which are frequently imperceptible and lack a recognized territorial origin. The new pattern of global risks confronting "national security" institutions is a result of their success. Threats that the West developed within its universities, transnational chemical companies, biological research laboratories, and information services include the threat of weapons of mass destruction and the terrorism of fundamentalists, two of the most pressing issues the West is facing at the moment. The "boomerang effects" of many institutions that are supposed to produce "security" but actually have the opposite effect characterize contemporary geopolitics.[25]

This aspect of the global risk society has political ramifications in that it highlights the need for radical institutional change in order to establish global systems of governance and regulation. With the G7 initiative to review the institutions that regulate the global financial system, steps to address threats to the use of systemic institutions were first taken. However, more drastic structural changes are required, such as the establishment of a large European security institution, a restructured UN Security Council, strengthened Chemical Non-Proliferation Treaty and Biological Weapons Conventions, and the creation of a permanent rapid response force. The United Nations' reaction.

The third feature of the contemporary geopolitical situation is its attempt to control the turbulence and upheaval brought on by modernization by suppressing it. It does so by turning to the resurgent nationalism, religious fundamentalism, and abrasive unilateralism of the modern era. This is an aggressive attempt to simplify, a political attempt to control the confusion and unpredictability of life in a globalized world with "timeless truths." Such antiquated tendencies and inclinations were given voice by orthodox geopolitical discourse. This antiquated tendency can be seen in some current geopolitical crises where threats from abroad are territorialized as threats from "rogue states."[26] For instance, when it comes to the

[25] Athanasiou, (1996). "The age of greenwashing. Divided planet: The ecology of rich and poor. Athens, GA.": 227-297. p. 120

[26] Hoyt, Paul. (2000) "" Rogue States" and International Relations Theory." *Journal of Conflict studies* 20.2: 68-79.

issue of WMD (weapons of mass destruction), Iraq and Saddam Hussein become the issue. Iran, Iraq, North Korea, and China are all dealing with ballistic missile issues. Terrorism has become a problem for "rogue states" like Sudan and Afghanistan. A more general geopolitical question—how the West reacts to the inevitable spread of WMD and ballistic missiles—lies behind the territorialization of international threats to "rogue states" and is likely to remain so throughout the twenty-first century. Reason and common sense are not the exclusive domain of the state or the national security complex.

In summary, for the assessment of the Geopolitical risk, the risks derived from the geopolitical assessments should be analyzed and evaluated not only of the geopolitical threats, such as the power of the states and the balance in the international system, but also those elements that are not conservative elements of the geopolitical analysis which is performed depending on the system we want to examine. Such elements can constitute threats such as terrorist attacks, threats against human rights, the development of fundamentalist movements, environmental threats, etc. which may not be threats to states but can affect the system we are considering. By following one of the methods analyzed in the next chapter and which fits according to our system, we will be able to record the degree of its influence and draw up the necessary strategy either by ignoring the risk, or by taking measures to avoid or mitigate the geopolitical risk.

2.3.2 Geopolitics and Risk Society

Geopolitics is a knowledge and rationality-based practical discipline. It takes the existing power structures for granted while attempting to explain how the world system of countries functions, how their interactive relationships are formed, and how they work to maintain their position in the global ranking, which is based on the strength of each state. The constant shifting of the variables and correlations that make up the world's power structure, as well as efforts to gain a competitive advantage in a world that is largely ungoverned and therefore regarded as anarchic, frequently lead to tensions and conflicts that increase the geopolitical risk. Therefore, having a understanding of the geopolitical environment can help decision-makers create an effective foreign policy.

On the other hand, critical geopolitics is a theoretical project that challenges current power and knowledge structures. In order to "read the world political map" and project its own strategy, orthodox geopolitics engages in superficial and self-serving behavior that is criticized by critical geopolitics. In an effort to advance, critical geopolitics seeks to make power politics open to examination and public discussion. The idea of the current geopolitical situation is constantly contested in critical geopolitics, which also sees international relations as being about a transnational community of citizens with a skepticism toward power concentrated in state and military bureaucracies. Critical geopolitics also supports an open democratic debate about the definition and politics of "security."

Between orthodox geopolitics in both the East and the West and critical geopolitics, there was a clear and stark contrast during the Cold War. In addition to encouraging risky global political simplifications, orthodox Cold War geopolitics also supported the potentially disastrous militarization of the European continent and other regions. The European environmental and peace movements fought against the Manichean thinking of both the East and the West with practical, critical geopolitics.

The irremediable complexity that critical geopolitics has always defended but that orthodox geopolitics has sought to suppress has only grown more apparent since the end of the Cold War. The dynamics of globalization, information, and the "risk society" have long been taken seriously by critical geopolitics, who understand that they have enriched the international system of states with additional values beyond those that orthodox geopolitical thought holds as the only criteria for establishing relationships between states. These values include things like economic growth, environmental protection, and others that bring nations together in their pursuit of advancing their shared ideologies. Critical geopolitics, as opposed to orthodox geopolitics, has a much deeper conceptual grasp of problematic "geopolitics" and the issues that states face in the context of advanced modernity.[27]

Critical geopolitics is a method that starts with the claim that the concept of "geopolitics" covers a much wider range of issues than is generally acknowledged. Geographical boundaries define all states, and they also influence every foreign policy strategy and practice. A historical and social form of regional knowledge, geography is not a fixed substrate. Geography is the social and political portrayal of a geographical area. Similarly, geopolitics reflects states' geographical meanings and policies.[28]

[27] Kaldor (1990). The imaginary war: understanding the East-West conflict. Oxford: Basil Blackwell,

[28] Gregory (1994). "Geographical Imaginations Oxford." *UK: Blackwell*.

According to how it examines events, geopolitical science can be divided into three categories. Practical geopolitics focuses on the geographic politics entailed in the routine execution of foreign policy. It looks at how common geographic perceptions influence how foreign policy is conceived of and decided.[29] How the geographical idea of the "Balkans" influenced US foreign policymakers' perceptions of the Bosnian civil war and had negative effects on the region and European security is an illustration of how to understand practical geopolitics. Various mass media outlets that influence popular culture create and discuss geographic politics, which is referred to as popular geopolitics. It addresses how particular collective national and international perceptions of places and people are created and maintained by society, or what Dijkink terms "national identity and geopolitical visions."[30] The study of structural trends and processes, which assumes how all states conduct foreign policy, is included in structural geopolitics. Today, these processes include globalization, information, and the growing dangers that our technoscientific civilization's global successes have unleashed.[31]

2.3.3 Definition of Geopolitical Risk

Risk analysis concerns the exposure of one or more nations to geopolitical events occurring in the same nation or in other, related nations. Geopolitical events are considered events such as the Brexit vote in 2016. Many other events, such as military or terrorist acts, as well as central bank or regulatory actions, can also be interpreted as geopolitical. Local economic events, cyber-attacks, trade conflicts and climate change can all have an impact on the global economy. Defining geopolitical risk as a standard shock to the volatility of a very broad class of financial assets, we create an empirical measure of it in this paper. All nations, asset classes and industry sectors are considered to be affected by geopolitical events. These crises can be classified as political, governmental, military, terrorist, or natural disasters, but

[29] Tuathail, Gearóid (1999) "Understanding critical geopolitics: Geopolitics and risk society." *The Journal of Strategic Studies* 22.2-3: 107-124.

[30] Garman, Dijkink,(1998) National Identity and Geopolitical Visions: Maps of Pride and Pain." *NATIONS AND NATIONALISM* 4.1: 121-123.

[31] Sharp, (1996). "Hegemony, popular culture and geopolitics: the Reader's Digest and the construction of danger." *Political Geography* 15.6-7: 557-570.

their most important characteristic is that they affect the economic prices of a very broad class of assets.

Today's geopolitical landscape is not just about neighboring countries, although proximity is still a critical factor. An event or trend originating in one country often has far-reaching effects, and often, those effects can be much more pronounced in a country on the other side of the world than in neighbors. The Cold War between the two geographically distant superpowers, and the resulting physical and ideological proxy war, is the most obvious example of this. Geopolitics, the study of international security and relations, is not limited by proximity but examines forces on a fundamentally global scale, especially with the spread of fast and easy communication and travel, as well as transnational ballistic capability. Geopolitical risk can be said to be the possibility that social, economic, and cultural factors (events, trends and developments) will have an impact on the sustainability (stability, health/well-being) of businesses. A good way to think about geopolitical risk is the potential for events, trends, and developments in politics, socioeconomics, and culture to have an impact on the stability, health, and well-being of businesses. Responsible leaders want to know what potential effects there may be from events or trends occurring within and between nations or the institutions they represent.

To quantify geopolitical risk, we use financial market prices, which are presumptively based on all available information. Risk management helps businesses and investors make decisions, plan for potential issues, create strategies, and create backup plans for the strategies they plan. A risk formula for quantifying risk is the formula shown below while there are different ways of measuring risk.

$$Risk = \frac{Threat\ x\ Impact\ x\ Likelihood}{CC}$$

Geopolitical risk and political risk are roughly synonymous but differ slightly. Political risk usually refers to factors (especially change or instability) within a country. In emerging markets, analysts often refer to country risk depending on the situation. Political risk analysis involves delving into the country's microeconomics, specific government or regulatory decisions, and historical, socioeconomic, and cultural factors that may or may not be favorable to a foreign entity's involvement in that country's local environment. Geopolitical risk on the other hand includes all of the above, but generally takes a broader perspective through cross-border macroeconomics, transnational relations and movements, and great power politics. Great Power Politics is a theory of international relations that examines the relative influence of "hegemons," or powerful countries, and the basic power dynamics that shape the world.

It is imperative that we recognize both the benefits of global political activity and any potential drawbacks. This concept is often referred to as an afterthought, despite the fact that opportunity must be an integral part of effective geopolitical risk analysis. To address this difference, analyst and author Rodban coined and popularized the term Geopolitical Flow, which reflects both the risks and opportunities that come with it. Socio-economic and political activity, as well as large-scale global trends, should be considered in analysis and decision-making to have a complete picture of the risk posture.

2.3.4 Risk Analysis Methods

2.3.4.1 Coarse risk analysis

A common technique for developing a rough picture of risk with little effort is coarse risk analysis, also known as preliminary risk analysis. The analysis focuses on specific aspects (Figure 4), including initiating events, cause analysis, and consequence analysis. The analysis team is usually made up of 3-10 people.

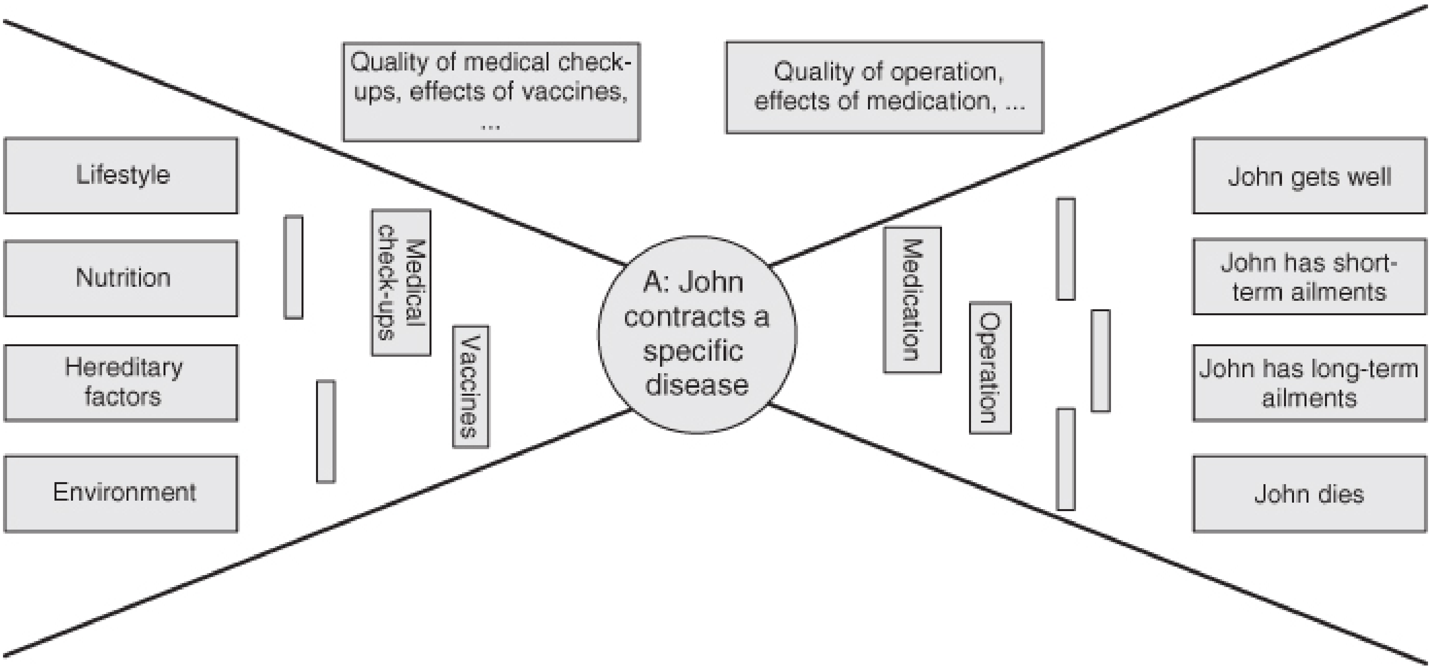

Figure 4: A risk picture's key components.

The triggering event is at the center of the diagram (the risk, the threat, the opportunity). In the given example, a person named John actually has a specific disease. Finding these triggering events is a crucial step in risk analysis. In our illustration, we might be worried about a number of illnesses that could harm the person. The causal scenario that could have caused the event is shown on the figure's left side. The right side discusses the possible outcomes of the event. (Source: Aven, Terje, 2015).

A common method for performing coarse risk analysis is to break the subject of the analysis down into smaller components, and then analyze the risks associated with each one separately. This holds true regardless of whether the analysis is focused on a production system, an offshore facility, a section of a highway, or another analysis subject. Checklists can be a useful tool for locating and assessing risks and threats for each distinct item that needs to be examined.

Frequently, standardized forms are used to record risk analysis. Table 1 displays an illustration of a risk analysis form for a road tunnel. The table shows that categories are used to describe the risk. The categories include possible unfavorable outcomes, their likelihood, and the expected effects should they occur. The table shows that we should anticipate 10 fatalities in the event of a bus fire. The number could be 0, 1, or 30, but 10 is what is anticipated.

Table 1: Example of an analysis form for a coarse risk analysis of a road tunnel (Source: Aven, Terje, 2015).

Sub-element	Hazards/causes			Probabilities and consequences		Comments	Risk	Possible measures	Comments
		Undesirablel events	Causes	Consequence analysis	Probability analysis			To avoid the event or reduce the consequences	Measures taken, ongoing assessments, · ·
Between entry points	Traffic accidents	Head-on crash	Turn-around in tunnel because of long queue, smoke, exhaust, etc. Wrong-way entry	1–3 killed	1–10% prob. in 1 year	Can also result in serious injury	High	Signage for wrong-way driving	
Between entry points	Traffic accidents	Rear-end crash	Slow-moving vehicles	Less serious injuries	Several times per year		Low	Detection of slow-moving vehicles	
Passing lane	Traffic accidents	Lane-changing accidents	Breakdown, speed variation, light conditions, road marking	Serious injuries	10–50% prob. in 1 year		Mode-rate	Detection of slow-moving vehicles	
Entire tunnel	Fire	Bus fire	Technical failure, collision, ignition	10 killed	Below 1% prob. in 1 year	Outcome uncer-tainties	Mode-rate	Fire-extinguish. equipment, ventilation	To be assessed in the detailed analysis

Terms like "often" and "rarely" should be avoided when expressing probabilities as they are subject to various interpretations. A better option is to state our meaning clearly, for instance by using the percentage chance that an event will occur. However, the analysis team may find it challenging to state that there is a particular % probability. Furthermore, rather than using terms like high, low, and so forth, categories of consequences should be clearly defined. Other analysis techniques are frequently combined with a rough risk analysis. The most significant risk factors are identified through coarse analysis, and the causal and/or consequence picture is then thoroughly evaluated through more in-depth analyses.[32]

[32]Aven (2015). *Risk analysis*. John Wiley & Sons

The method can be applied for example in the case of the sudden conflict in the Middle East between Israel and Hamas (Palestinians) to assess the geopolitical risk in energy supply chains:

Cause Analysis, (Table 2): In the Middle East, the start of hostilities between Israel and Hamas may disrupt oil production. For example, the civil war in Syria has led to the shutdown of oil fields and pipelines, affecting global oil supply chains. In the event of conflict in major oil producing areas, oil production can be severely disrupted. This can lead to a decrease in global oil reserves, affecting energy security and causing supply shortages. Any significant geopolitical risk that threatens oil supplies can send prices soaring in global oil markets. For example, the Arab Spring in 2011 sent oil prices soaring due to concerns about supply disruptions in the Middle East. Higher oil prices can have a ripple effect on economies, leading to increased energy costs for consumers and businesses. Inflation, trade balances and economic growth may also be affected. For example, the OPEC oil embargo in 1973 and the subsequent oil price shocks had significant economic effects. The risk analysis would include further investigation, assessment of the likelihood and severity of consequences, and consideration of potential risk mitigation strategies. The results of such an analysis can inform energy policies, investment decisions and strategic planning.

Table 2: The method Coarse risk analysis applied in the case of the sudden conflict in the Middle East between Israel and Hamas

Event	Cause	Potential Consequences
Sudden conflict in the Middle East (Israel-Hamas)	Disruption of oil production	Decrease in global oil reserves Energy security threats Supply shortages Soaring oil prices
Soaring oil prices	Supply disruptions	Increased energy costs for consumers and businesses Inflation Trade balance issues Economic growth impacts

Table 3: Analysis of Consequences for Disruption to Global Supply

Description of Risk	**Risk Category**	**Likelihood Rating**	**Severity Rating**	**Consequences**
Disruptions to Global Oil Supply	Political	**HIGH**: given the region's past history of conflict affecting oil production	(1) with potential disruptions to oil production and shipments from major oil-producing countries in the Middle East (e.g. Saudi Arabia, Iraq, Iran).	This could lead to a significant reduction in global oil reserves.
	Economic	**HIGH**: The possibility of price increases in global oil markets, as geopolitical tensions and conflicts usually push oil prices higher.	(1-3): The severity of economic impacts can range, depending on the scale and duration of the conflict.	May include increased energy costs for consumers and businesses to broader effects on inflation, trade imbalances and economic growth, depending on the duration and intensity of the conflict.

Table 4: Risk Mitigation Strategies

Risk Mitigation Strategies			
Diversification of Energy Sources	Strategic Oil Reserves	Diplomacy and Conflict Resolution	Energy efficiency and conservation

This risk analysis helps identify potential risks associated with conflict in the Middle East, assess their likelihood and severity, and suggest risk mitigation strategies that governments, businesses, and organizations can consider managing geopolitical danger. However, it is important to note that a more detailed and comprehensive analysis will be required to make specific decisions and policies in response to such a risk. To improve the accuracy of the analysis, more advanced methods and tools can be incorporated, such as quantitative risk modelling, historical data analysis and scenario planning. This multi-layered approach allows decision makers to gain a preliminary understanding of geopolitical risks before delving into more detailed assessments.

2.3.4.2 Examination of Failure Modes and Consequences

FMEA, or failure mode and effects analysis, is a technique for analyzing potential failures and determining how they would affect the system as a whole. Using an inductive approach, we look into what would happen if each system component failed. The technique entails a methodical examination of the system's constituent parts in order to pinpoint all significant failure modes and assess their bearing on the performance of the whole. It is assumed that all other components are in perfect working order and that only one component is timed. FMEA is therefore not appropriate for identifying combinations of critical component failures.

One of the earliest systematic techniques for examining technical system failures was FMEA, which was created in the 1950s. The method first appeared with slightly different content and various names. The analysis is frequently referred to as an FMECA if we rank or describe the criticality of various failures in the FMEA (Failure Modes, Effects and Criticality Analysis). Failure incidence, frequency, and probability all influence criticality. FMEAs and FMECAs don't really differ from one another. An FMEA must now be included in the design process in many businesses, and the analysis' findings must be included in the system documentation. A particular FMEA form is utilized to ensure a systematic analysis of the system. The FMEA form may, for example, include the following columns:

- Identification (column 1). Here the specific item is identified by a description and/or number. It is also common to refer to a system design or functional diagram.
- Operating status (column 2). The function of the element is briefly described, i.e. its tasks in the system. The state of the element when the system is in normal operation is described, for example, whether it is in continuous operation or standby.
- Failure mode (column 3). All possible ways in which components can fail to perform their function are listed in this column. Only failure modes that can be observed from the "outside" are included. Internal failure modes should be considered as causes of failure. These causes may possibly be listed in a separate column. In some cases, it is also interesting to look at the underlying physical and chemical processes that can lead to failure (failure mechanisms), such as corrosion. We also often state how the different failure modes of the component are identified and by whom.
- Effect on other units of the system (column 4). In those cases where the particular failure mode affects other components of the system, this is indicated in this column. Emphasis should be placed on recognizing failure propagation, which does not follow functional chains of functional diagrams.
- The impact on the system (column 5). This column explains how a specific failure mode affects the system. It is necessary to describe the operating state of the system following a failure, such as whether it is in an operating state, has switched to another operating mode, or is not operating at all.
- Remedial actions (column 6). Here, we outline the steps that have been taken or that can be taken to address the issue and potentially lessen its effects. We can also make a list of the steps taken to lower the risk of failure.
- Reject rate (column 7). In this column, we list the assigned frequency (probability) for each failure mode and effect. We can provide an overall frequency as well as relative frequencies (in percentages) for the various failure modes instead of listing frequencies for each type of failure.

- Failure rating (column 8). A failure is categorized based on factors like how it affects safety and reliability, how well it can be mitigated, how long it takes to repair, how much production it costs, etc. For instance, we could use the following classification of failure effects:

As minor: we, damage that is acceptable and does not significantly impair system performance, while as major: A failure whose effects can be corrected and under control, but which reduces the system's operational capability below an acceptable level.Furthermore, as critical can be deemed a failure that adversely affects the system's ability to function and produces an unsafe situation, either from an operational or safety standpoint.

Remarks (column 9). Assumptions, for example, are declared here. It is possible to assess the criticality of a particular failure mode by adding failure frequency (probability) and failure outcome (consequence).

FMEA has the advantages of forcing the designer to evaluate the reliability of his system and providing a systematic overview of significant failures in the system. It also serves as a solid foundation for deeper quantitative analyses like fault tree analyses. Uncovering every failure of a crucial component is obviously not guaranteed by FMEA. The majority of system weaknesses brought on by particular component failures will, however, be exposed through a methodical analysis like FMEA.

In FMEA, technical failures are frequently the main focus, and human failures are frequently underappreciated for their contributions. This can be mitigated to some extent by incorporating human functions as system components.

In order to analyze systems with a lot of redundancies, an FMEA might not be appropriate. Analyzing individual component failures in such systems won't be as interesting because they can't directly affect how the system works. The focus then shifts to combinations of two or more events that when combined, have the potential to bring about the system's failure. A system with some redundancies can still benefit from an FMEA's valuable information about potential failures and their effects. An event tree analysis or a fault tree analysis can be effectively launched from the analysis.

The fact that every component is examined and documented, and failures have little to no impact, may be the FMEA method's biggest drawback. Consequently, an FMEA can be extremely demanding. The amount of documentation may be considerable. This issue can be mitigated by using appropriate element definitions. However, doing so would have greatly expanded the analysis's scope without revealing more potential system-wide unfavorable events. It may be advantageous to define subsystems for larger systems (system functions). These subsystem failures might be covered in an initial FMEA. Then, thorough FMEA analyses can be carried out for particular subsystems.33

We can adapt the concept to analyze a geopolitical situation. We can for example do an FMEA for a real geopolitical event such as the annexation of Crimea in 2014 by Russia.

[33] McDermott, Robin E., Raymond J. Mikulak, and Michael R. Beauregard. *FMEA*. New York: Taylor & Francis Group, 2009.

Table 5: Scenario Annexation of Crimea by Russia (2014*)*

Identification	**Operating status**	**Failure Mode**	**Effects on Other Units of the System**	**Effects on the System**	**Corrective Actions**	**Rejection rate**	**Failure Score**	**Remarks**
Russia's annexation of Crimea in 2014	The territorial integrity and sovereignty of Ukraine on the Crimean Peninsula. The result when the system (territorial integrity of Ukraine) is in normal operation is that it is recognized by the international community and controlled by Ukraine.	The annexation of Crimea by Russia, where Russia owns and claims sovereignty over the region.	This failure mode affects other elements of the system, including the territorial integrity of Ukraine, international norms and treaties (e.g. the Budapest Memorandum) and relations between Russia and Western countries.	After the annexation, the system (territorial integrity of Ukraine) goes into a different mode of operation where Crimea is effectively controlled by Russia and the international community largely condemns this act.	Various remedies can be taken, such as diplomatic efforts, sanctions against Russia and international condemnation. Steps can be taken to reverse the annexation and restore Ukraine's sovereignty.	The frequency of this failure mode is a one-time event (added in 2014). The relative frequency of such geopolitical events is low but not zero.	The failure is categorized as "Critical", as it negatively affects the system's ability to function and creates a dangerous situation from the point of view of international law and sovereignty.	Cases may include the role of international organizations and actors in addressing annexation. The criticality of this mode of geopolitical failure is influenced by its long-term implications for regional and global stability.

It should also be noted that the application of FMEA to geopolitical scenarios is a conceptual exercise and may not fully capture the complexity of real events. The FMEA approach is traditionally used in engineering and technical contexts, but it can provide a structured framework for analyzing geopolitical failures and their consequences, especially in assessing the severity and criticality of geopolitical events such as territorial disputes or international conflicts.

2.3.4.3 Risk and functionality assessments

A qualitative hazard analysis technique known as a "hazard and operability" (HAZOP) study is used to find flaws and hazards in a system. This method is usually applied during the design phase. Although the HAZOP method was initially created for chemical processing facilities, it can also be applied to other facilities and systems. For instance, it is widely utilized in Norway's oil and gas sector.

In a HAZOP study, the potential hazards of design deviations from specifications are systematically analyzed, along with the ways in which those deviations may occur in a system. Scenarios that could result in a risk or operational issue are found based on a set of rules. The following are common guide words: Yes/No, More/Less, Additionally, Part, Reverse, as well as But Except Guide words refer to the process' circumstances, activities, materials, timing, and location. The deviation's causes and effects are then investigated. This is accomplished by asking questions. Special forms have been created to aid in the process of creating questions that are meaningful and are based on the guide words.

The following example, (Figure 5), demonstrates the basic HAZOP study principle.

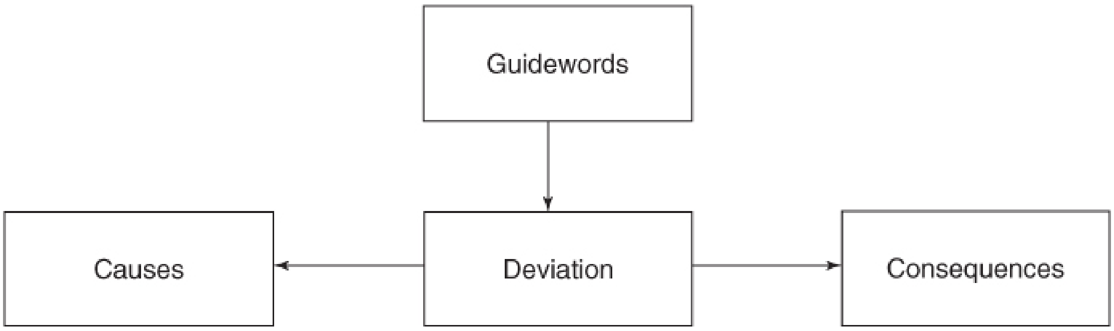

Figure 5: Basic HAZOP study principle (Source: Aven, 2015).

Worksheets are used in a HAZOP study to document deviations, causes, consequences, and recommendations/decisions. These worksheets ought to be viewed as a particular kind of FMEA form.

A staff group under the direction of a HAZOP leader conducts a HAZOP study. The facilitator should be skilled in applying the technique, but it's not necessary that they fully understand how the process works. The team is made up of people who are well-versed in the system under consideration. Along with the HAZOP leader, the team typically consists of five to six individuals.

Critical design elements that need additional analysis can be found through a HAZOP study. Reliability and risk analyses are frequently produced in this way in a detailed, quantitative manner. Similar to FMEA, a HAZOP study of a system will typically be most helpful if it is carried out after the Process and Instrument Diagrams (PI&D) have been created. The HAZOP analysis is a time-consuming and resource-intensive method. The technique has, however, been widely applied to redesigning treatment facility designs in order to create a facility that is safer, more effective, and more dependable.34

Hazard and operability (HAZOP) analysis is commonly applied to identify defects and hazards in technical systems and adapting it to geopolitical scenarios such as a conceptual HAZOP analysis of the 1962 Cuban Missile Crisis is a challenge. HAZOP documentation in the Cuban crisis aims to identify potential risks and deviations, as well as identify measures to address them.

The process of implementing the method includes the following phases:

Definition Phase

i. Definition of the field of analysis
ii. Understanding the causes, possible effects and measures to deal with the crisis.
iii. Study design
iv. Collection of historical data and relevant information about the crisis.
v. Determining how to record the results.
vi. Estimating the time required to complete the analysis.
vii. Set Schedule: Set up a schedule for the analysis.

Examination Phase

[34] Crawley, Brian (2015). *HAZOP: Guide to best practice*. Elsevier.

i. Break the problem into parts: Define the main aspects of the crisis.
ii. Defining expectations for the state of the system.
iii. Using guide words ("What If") to identify potential discrepancies.
iv. Identifying consequences and causes for each deviation.
v. Recognition of the seriousness of the problem and whether it requires immediate intervention.
vi. Identification of protection measures, detection and indications of possible deviations.
vii. Agreement on the measures to be taken to address the identified problems.
viii. Analysis of potential measures that can be taken to address discrepancies.
ix. Repeat the process for each part of the system.

Documentation and Follow-up Phase

i. Recording the results of the analysis.
ii. Confirmation of the correctness of the recorded information.
iii. Report production.
iv. Confirmation that agreed measures have been implemented.
v. Monitoring the implementation of actions.
vi. Review parts of the system if required for additional analysis.

Finalization Phase

vii. Completion of the study.
viii. Creating a final report containing all the results and the measures proposed to address the identified problems.

During this process, each possible scenario that emerges through the application of the HAZOP method should be examined based on its potential consequences and the measures proposed to address them. Documentation and reporting are important steps in enabling the detection, response and monitoring of potential hazards and deviations emerging from the HAZOP analysis.

Following the above process for the Cuban Missile Crisis firstly, we have the Definition phase. For this, we are forming a working group of political analysts and historical experts to analyze the crisis. The system is the political crisis between the United States and the Soviet Union over the placement of missiles in Cuba as the Soviet Union is developing nuclear missiles in Cuba. Then we define the objectives and the process for impact analysis.

We are gathering information on the US response to similar situations and determining the timeline for conducting the study.

For the Examination phase, we analyze the potential implications for US-Soviet relations. We determine the expected reactions and effects. We determine the circumstances of the crisis, including the diplomatic relations between the countries involved and the geopolitical parameters. will the US be aware of? The Soviet Union's deployment of nuclear missiles in Cuba without the US being aware of it is a serious threat to the security of the US, and when its existence is discovered, it is a cause for the severance of diplomatic relations and even the start of a conflict." What would happen if was the US discovering the presence of the missiles in Cuba?" Increasing American concern for their security, escalation of tension, possibly leading to a military response from the US.

For the Documentation and follow up phase, the documentation of the effects such as increasing tension and anxiety in relations between the US and the Soviet Union, potential worsening of the geopolitical situation and international relations worldwide, possible response by the US, including military action, may increase significantly the possibility of a nuclear war. The proposed measures are negotiation and diplomatic efforts to de-escalate the tension. Provision of international guarantees not to use the missiles for offensive purposes. Strengthening negotiation and diplomatic efforts through international organizations such as the UN and the European Union. In addition, we check the accuracy and completeness of the recorded information by reading sources, verifying consistency and comparing the data with other reliable sources and finally creating a report that includes the implications of the situation and proposed measures to address it, presenting the findings of the analysis and the conclusions drawn.

In the Documentation and Follow-up Phase, we record the variances, outcomes and potential consequences of each "What If" scenario in HAZOP worksheets.

Table 6: Screenplay: Cuban Missile Crisis (1962)

REPORT					
Project ID: Cuban Misile Crisis 1962					
Function Identification: Nuclear Collision Prevention					
ID of Design Deviations : Nuclear Missile Development in Cuba					
Guide Word	**Deviation**	**Cause**	**Consequences**	**Recommendations**	**Team Composition**
What if?	deployment of Soviet nuclear missiles in Cuba	Soviet concerns about US missiles in Turkey and Italy	US blockade of Cuba and an increased risk of nuclear war	diplomatic negotiations, the imposition of a naval blockade, or communication with the United Nations	A team of experts in geopolitics, military strategy, international relations and history, led by a HAZOP leader

The identification of design deviations in the context of the Cuban Missile Crisis of 1962 provides valuable insights into preventing nuclear conflict between the United States and the Soviet Union during the Cold War. At the heart of this analysis lies the deployment of Soviet nuclear missiles in Cuba, a deviation from the anticipated geopolitical landscape in the Western Hemisphere. By employing "What If" guide words, analysts can explore potential deviations and their consequences, such as the deployment of nuclear missiles by the Soviet Union and the subsequent discovery of these missiles by the United States.

Cause and effect analysis serves as a pivotal tool in unraveling the intricacies of these discrepancies. Investigators delve into the causes behind such deviations, including Soviet concerns regarding US missiles in Turkey and Italy, and elucidate the ensuing effects, such as a US blockade of Cuba and an escalated risk of nuclear war. Through systematic documentation in worksheets, deviations, their causes, consequences, and potential recommendations or decisions are meticulously cataloged. These recommendations may encompass diplomatic negotiations, the imposition of a naval blockade, or engagement with the United Nations.

The composition of the analysis team is paramount, comprising experts in geopolitics, military strategy, international relations, and history, under the leadership of a HAZOP leader. This multidisciplinary approach ensures a comprehensive examination of the complexities inherent in the Cuban Missile Crisis and facilitates informed decision-making.

Ultimately, the analysis may yield recommendations for de-escalation, negotiation, or military action, while also signaling the need for further analysis, such as game theory or scenario planning, to evaluate possible outcomes and responses. Although HAZOP is traditionally utilized in engineering contexts, this exercise offers a structured framework for contemplating deviations, causes, and consequences in complex geopolitical scenarios, thereby enhancing decision-making and crisis management capabilities in high-stakes situations

2.3.4.4 Structured What If Technique

The Structured What-If Technique (SWIFT) is a method for analyzing risks by methodically using the fundamental question "What if" to find deviations from normal conditions. The procedure employs a pre-established checklist of items to be examined, similar to the HAZOP method. Nevertheless, SWIFT exhibits greater flexibility compared to HAZOP, allowing for effortless customization of the checklist to suit the specific application. The checklist undergoes scrutiny in a SWIFT analysis, where we contemplate hypothetical situations for each of the checklist's separate components. Based on this premise, hazardous situations, accidents, and similar events can be identified.

A multidisciplinary analysis team, comprising individuals with diverse expertise in design, operation, maintenance, safety, and other relevant areas, conducts the study using a methodology comparable to HAZOP. The study outlines potential difficulties and combinations of circumstances that may provide problems, along with methods to reduce the associated risks.

The Structured What-If Technique (SWIFT) can be used to conduct a qualitative risk analysis for a geopolitical scenario, specifically examining the potential ramifications of a country's choice to withdraw from a significant international treaty like the Paris Agreement on climate change.

The act of withdrawing from the Paris Agreement offers an intricate geopolitical landscape, necessitating a thorough assessment from multiple perspectives. Customized checklist items that are specifically designed for the geopolitical setting act as central points for analysis, delving into crucial areas that are pertinent to the decision-making process. The first point to consider is that Climate Impacts highlight the environmental effects of withdrawal, including situations where emissions grow, temperatures rise, and extreme weather events become more frequent. This requires a thorough comprehension of the ecological consequences of deviating from global climate agreements.

Economic Impact examines the possible trade restrictions or sanctions that other countries may apply in response to withdrawal. Analysis in this domain examines the consequences on the nation's economy and its foreign trade connections, emphasizing the interdependence between climate policy and economic stability.

Diplomatic Relations analyses the geopolitical ramifications of withdrawal, exploring situations in which strained diplomatic relations with crucial allies intensify international tension. This facet of study highlights the wider ramifications of withdrawal on global collaboration and diplomatic dynamics.

National Security considerations contemplate the potential for climate-induced wars or resource disputes to intensify in susceptible places impacted by climate change. Evaluating the effects on national security concerns and possible engagement in war highlights the complex relationship between climate policy and geopolitical stability. Internal Consequences, including public opinion and protests, examine the internal repercussions of withdrawal. Analysis in this field evaluates situations in which the decision triggers demonstrations and political turmoil, affecting the political stability and leadership of the country.

The SWIFT study is conducted by an interdisciplinary analytic team consisting of professionals from many sectors such as international relations, environmental policy, economics, security, and public opinion analysis. By methodically examining risk scenarios and implementing ways to minimize their impact, the team proactively anticipates probable repercussions and develops plans to effectively manage the related risks.

The identified risk scenarios encompass a wide variety of possibilities, including the potential for higher carbon emissions resulting in climate-related calamities, as well as the possibility of strained diplomatic relations hindering global cooperative efforts. Mitigation measures including promoting a reassessment of the decision to withdraw, engaging in diplomatic discussions to preserve connections, developing internal policies to minimize economic costs, evaluating the effects on national security, and effectively addressing public concerns through communication.

This tailored SWIFT analysis provides decision-makers with a systematic framework to understand and navigate the complex problems associated with geopolitical decisions, enabling them to make well-informed choices in the midst of intricate global dynamics.

Table 7: SWIFT Analysis: Withdrawal from Paris Agreement (Geopolitical Scenario)

Area of Impact	What-If Scenario	Potential Consequences	Risk Mitigation Strategies
Climate Impacts (Environmental)	Country leaves Paris Agreement, no commitment to reduce emissions.	Increased greenhouse gas emissions, rising global temperatures, extreme weather events.	Encourage rejoining Paris Agreement, develop national policies for emission reduction.
Economic Impact (Trade & Sanctions)	Other countries impose trade restrictions or sanctions.	Negative impact on national economy and international trade relations.	Engage in diplomacy to maintain relationships, develop policies to mitigate economic consequences.
Diplomatic Relations (Geopolitical)	Withdrawal strains relations with allies committed to Paris Agreement.	Reduced cooperation on global issues, potential diplomatic isolation.	Diplomatic efforts to maintain partnerships, address concerns of allies.
National Security (Possibility of Conflict)	Climate-induced conflicts and resource disputes escalate.	National security threats, potential involvement in conflicts.	Assess security risks, develop response plans for climate-affected regions.
Common Opinion & Protests (Internal)	Decision to withdraw sparks domestic protests and public backlash.	Political instability, potential leadership challenges.	Address public concerns through communication and policy adjustments.

2.3.4.5 Analysis of Fault Trees

When Bell Telephone Laboratories conducted a safety assessment of the Minuteman launch control system in 1962, they invented the fault tree analysis technique. The Boeing Company improved the method and employed software for fault tree analysis, both quantitatively and qualitatively. Fault tree analysis has gained popularity since the 1970s and is currently one of the most popular reliability and risk analysis techniques. Its applications can be found in almost every industry. The space industry and nuclear power were likely the two industries that made the most use of fault tree analysis.

A fault tree is a logical diagram that depicts the relationship between the failures of the system's individual components and the system failure, which is defined as a particular unwanted event, such as the start event or the failure of a system barrier. The top event on the tree is the unintended event, and the root events are failures of various components. For a manufacturing process, for instance, a process stoppage could be the top event, and a specific motor failing could be the base event. A significant event might be attributed to human mistake, or failures caused by external factors, such as extreme environmental circumstances, and is not necessarily the result of a single component's failure. A fault tree incorporates symbols that depict significant system events and their interrelationships with the system's state. Logic gates are the visual representations of the relationship. A logic gate's input states determine its output. The graphic symbols differ slightly depending on the template. In a fault tree, the most significant symbols are depicted in Figure 6 along with their definitions.

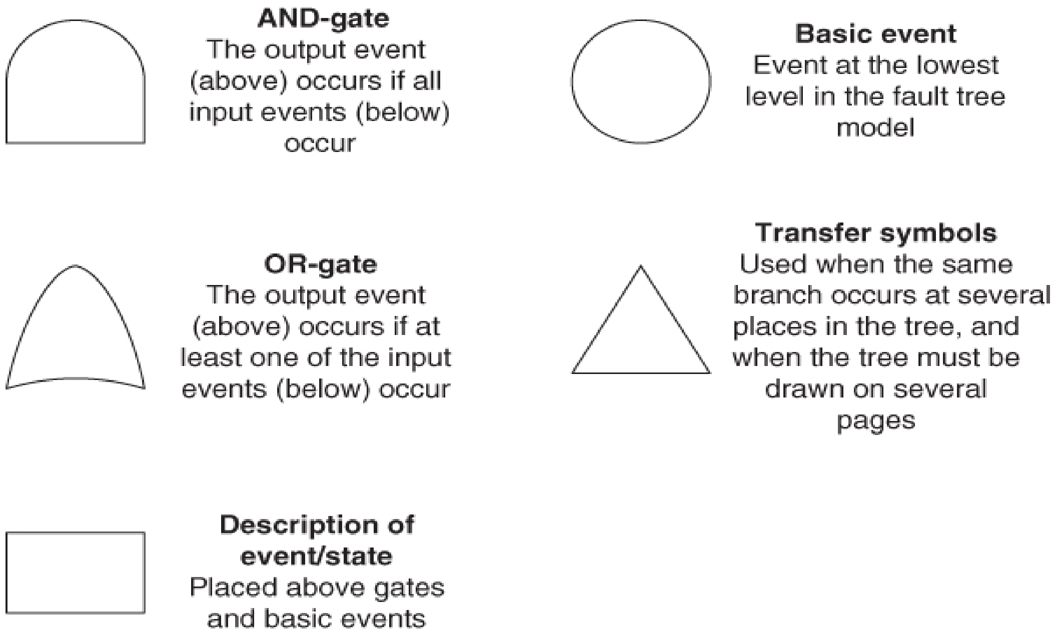

Figure 6: Symbols for fault trees (Source: Aven, 2015).

Another option is to use a reliability block diagram to depict a fault tree that only uses AND and OR gates. This logic diagram illustrates a system's functional potential.A connection between an element's input and output indicates that the element is operating in accordance with the requirements set forth for that analysis. "Functioning" typically refers to success.

When constructing the fault tree, the top event serves as the starting point. The next step is to determine which potential failures (events) might have been the top event's direct cause. A logic gate connects these events to the top event. Then, at the component level, we work sequentially. Deductive analysis is performed by repeatedly pondering questions like "How can this happen?" or "What are the causes of this event?" Once we've gotten the desired amount of specificity, the causal sequence stops from developing. "Think local" is crucial, and a step-by-step process should be used to build the fault tree. Avoid connecting gates directly to one another without offering an intermediate event, or "gate-to-gate connections.” Growing a branch of a tree too quickly without using a methodical downward process is a common mistake in fault tree construction (tendency to want to get to key events too quickly and not use broad descriptions of subevents).

The failure patterns that might result in an unintended event can be learned from a fault tree. A cut set is a failure combination like this. In a fault tree, a cut set is a group of crucial events that, when they happen, guarantee the occurrence of the top event. If a cut set cannot be shrunk while still guaranteeing the top event appears, it is minimal.

A trim set is a group of parts that when one of them fails, the entire system will also fail. If a cut set cannot be reduced further without losing its cut set status, it is said to be minimal. If the fault tree is straightforward, the associated reliability block diagram or the fault tree itself can be used to determine the minimum cut sets. Generally speaking, using the reliability block diagram would be more practical. An algorithm is required for fault trees that are more intricate. MOCUS is the most popular computer-based algorithm.[35]

A cut set's order is determined by how many events are included in it. The minimal cut sets are arranged in the order that they appear. One could argue that single event cut sets (also known as single jeopardy) are extremely undesirable because only one failure can result in the top event, that double event cut sets (also known as double jeopardy) are preferable, and so on. It is also common to classify information further based on human error and active/passive equipment failure. The qualitative approach, however, may be deceptive. The likelihood of failure may be higher for larger cutting sets than for smaller ones. Analyzing this quantitatively is necessary. A single event can have an impact on numerous events throughout the fault tree, leading to a common cause failure. A power outage might be to blame for the miscalibration of all the sensors. Less obvious factors like common manufacturers, locations, and so forth can also result in failures due to common causes.

It will be possible to conduct a quantitative analysis once we have established the probabilities for the major fault tree events. Typically, we'd like to determine the likelihood that the top event will occur as well as the significance (criticality) of the base events(the tree's components).The following approximate method is frequently used to determine the peak event probability: for each minimum cut set, determine the likelihood that it will fail, then add all the minimum cut sets.

If the likelihood of the top event is low and the base events are independent, the methodology yields reliable results. If the likelihood of a key event happening does not depend on whether one or more of the other key events have occurred, then the key events are

[35] Rausand, Hoyland (2004). "Component importance." System Reliability Theory: Models, Statistical Methods, and Applications.

independent. With this strategy, we discount the possibility that two or more minimal cut sets could be experiencing failure mode at the same time. Alternatively, since the system combines parallel and series structures, we can perform an exact calculation.

Even those with no prior experience with the method can easily understand the fault tree. It is easy to use and has a lot of documentation. Utilizing the technique has the benefit of forcing those conducting the analysis to comprehend the system. The phase of building the trees already exposes and fixes many systemic weak points. A static "picture" of the possible failure combinations that could lead to the top event can be obtained from fault tree analysis. For the analysis of systems with dynamic properties, the fault tree analysis method is not appropriate. Managing common mode failures is an additional issue.[36]

Root cause analysis can be done in a variety of ways. We would like to bring up cause-and-effect analysis (also known as an Ishikawa diagram),[37] which resembles fault tree analysis in some ways but is less organized and does not share a two-state constraint with a fault tree. For quantitative analyses, cause-and-effect analysis is inapplicable.

Fault tree analysis (FTA) is traditionally used in engineering and reliability analysis. An event tree analysis can be a valuable tool for analyzing the escalation of tensions for example between Greece and Turkey. This complex geopolitical situation involves various trigger events and possible sequences of events. Primary Event: The trigger in this case is the escalation of tension between Greece and Turkey. This may be due to various factors such as territorial disputes, competition for resources, historical grievances or geopolitical changes.

Event Sequences: We create a series of yes/no questions to create event sequences. These questions will help identify the different paths that tensions can take.

[36] Xing, Amari. (2008) "Fault tree analysis." *Handbook of performability engineering*: 595-620.

[37] Wong, Cheong, Zhi Woo, and Hui Woo (2016). "Ishikawa diagram." *Quality Improvement in Behavioral Health*. Springer, Cham, 119-132.

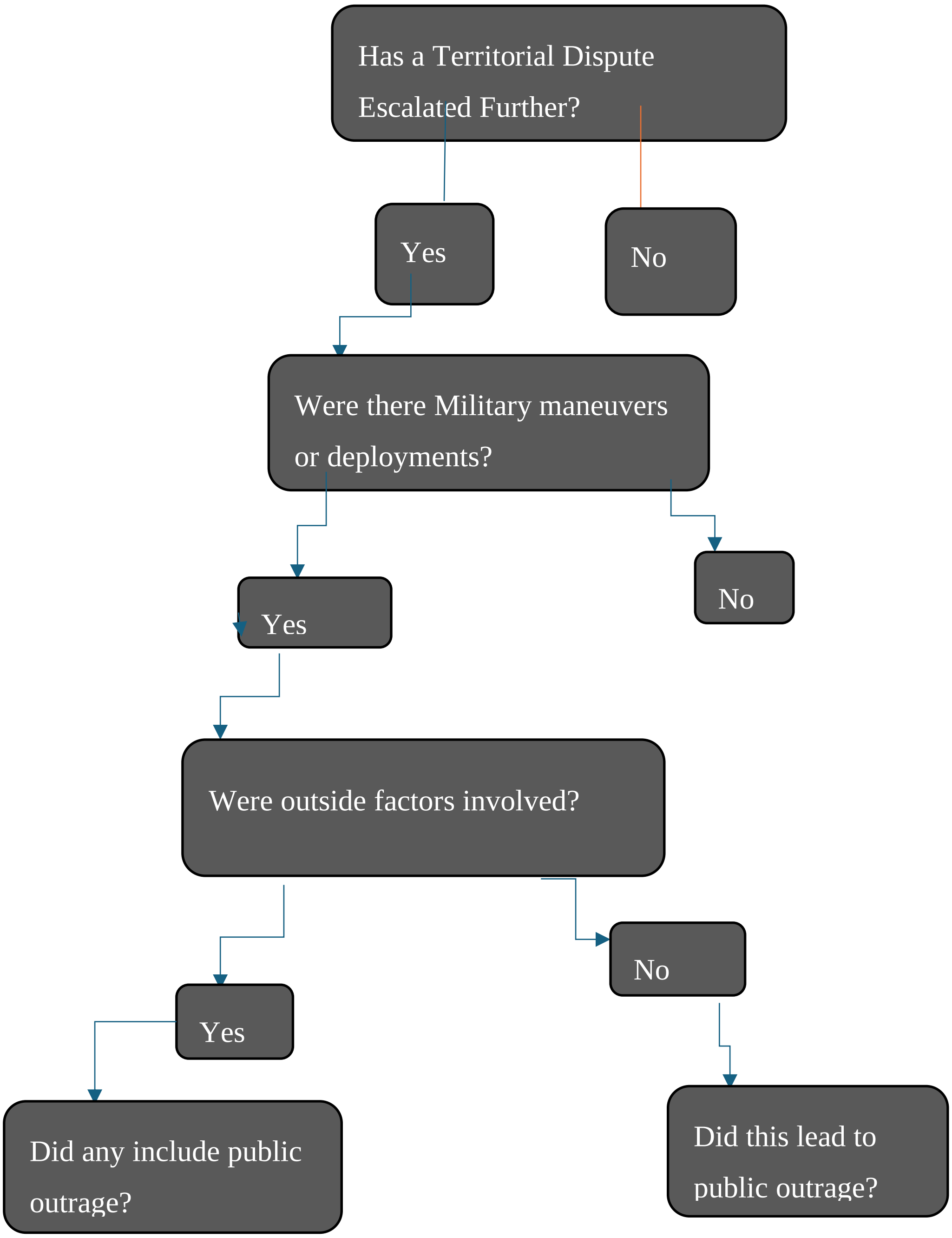

Figure 7: Example of an analysis of fault trees

Based on the answers to these questions, we create different branching scenarios. Each scenario represents a specific sequence of events. These scenarios could range from peaceful diplomatic solutions to full-scale military conflict, with various steps in between.

Next, we develop a consequence table. We list the possible consequences or outcomes for each scenario. These consequences may include either peaceful resolution and limited military involvement to even full-scale war with human casualties, severe economic consequences and possibly the participation of international organizations.

Afterwards, depending on the availability of data and analysis, we can assign probabilities to different industries and outcomes. For example, we can estimate the probability of success of diplomatic negotiations or the probability of military conflicts occurring.

For the Dependency Analysis, the probability of each event depends on the events preceding it in the sequence. We may need to do sensitivity analysis to understand how changing the probability of an event affects the overall outcome.

Finally, it is important to assess the accuracy of the model with the use of Model Validation. Are the probabilities and scenarios reasonable? Do they agree with historical data and expert opinions? Validation is crucial to the credibility of our analysis.

In this context, the analysis of the event tree allows us to visualize and quantify the possible results of the escalation of tensions between Greece and Turkey. It provides decision makers with a structured approach to assessing the risks and consequences associated with various paths of action or inaction. This analysis can inform policy decisions, conflict resolution strategies, and risk mitigation efforts related to this geopolitical issue.

Table 8: Event Tree Analysis: Escalation of Tensions (Greece-Turkey)

Scenario	**Possible Outcomes**
Peaceful Resolution	Diplomatic solution, reduced tensions, regional stability
Limited Military Engagement	Localized conflict, casualties, economic disruption
Full-Scale War	Widespread destruction, high casualties, regional instability

2.3.4.6 Analysis of Event Trees

To analyze how the triggering event has an impact, use an event tree analysis. How many different event sequences (scripts) is the launch event capable of producing? The approach is applicable to both qualitative and quantitative research. The method paints a picture of the potential outcomes in the first scenario. In the latter scenario, probabilities are connected to different event sequences and their outcomes.

As demonstrated in the straightforward example in Figure 7, an event tree analysis is carried out by posing a series of questions with a "yes" or "no" response. A collection of scenarios is produced from the tree branches. It is common practice to construct branch questions so that the "desired" response is always either up (yes) or down (no). The "worst" case scenario will emerge at one end and the "best" case scenario at the other. If we have a lot of branch questions, we'll have a lot of event sequences. The different event sequences are frequently grouped together before further processing in the risk analysis because many of them are frequently nearly identical.

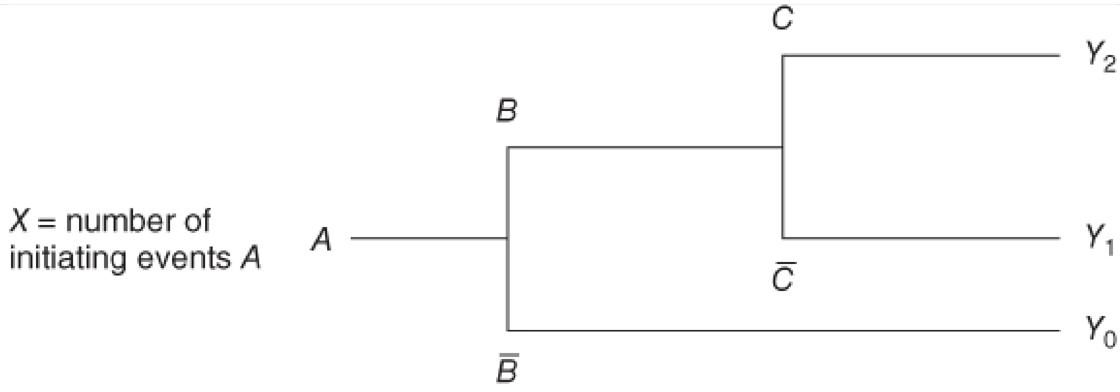

Figure 8: Example event tree (Source: Aven, 2015).

A "consequence table," which lists the effects of each termination event or set of termination events, will be created as the next step in the analysis. We must determine the consequences for each scenario. This can be accomplished in one of three ways: by providing a fixed number, such as 2, by using anticipated values, or alternatively by specifying a probability distribution for the different result classes. The probabilities for occurrences in the chain may be multiplied to come up with a probability for each ultimate event (scenario) if branch questions are given probabilities. It is crucial to understand that every probability depends on the events that came before them in the sequence of events. It is typical to first estimate the outcome and then assume that the outcome is constant for a specific scenario in order to simplify the analysis. Obviously, it is necessary to assess whether this new model is accurate enough.

There are numerous tools available for creating event trees. Block diagrams and event sequence diagrams are a couple of examples. For instance, the former is applied in the aerospace and aviation sectors. Block diagrams are frequently used, for instance, in the oil and gas sector in Norway. By using this method, start events, barrier functions, and stop events all show up in a horizontal line. Below this line are boxes that represent barrier systems (view the illustration in Figure 8). Barrier functions prevent a triggering event from occurring or reduce damage by interrupting a series of unwanted events. Solutions that guarantee the barrier function is actually carried out are called barrier systems. Barrier diagrams' ability to distinguish between barrier systems and functions is one of their many advantages.[38]

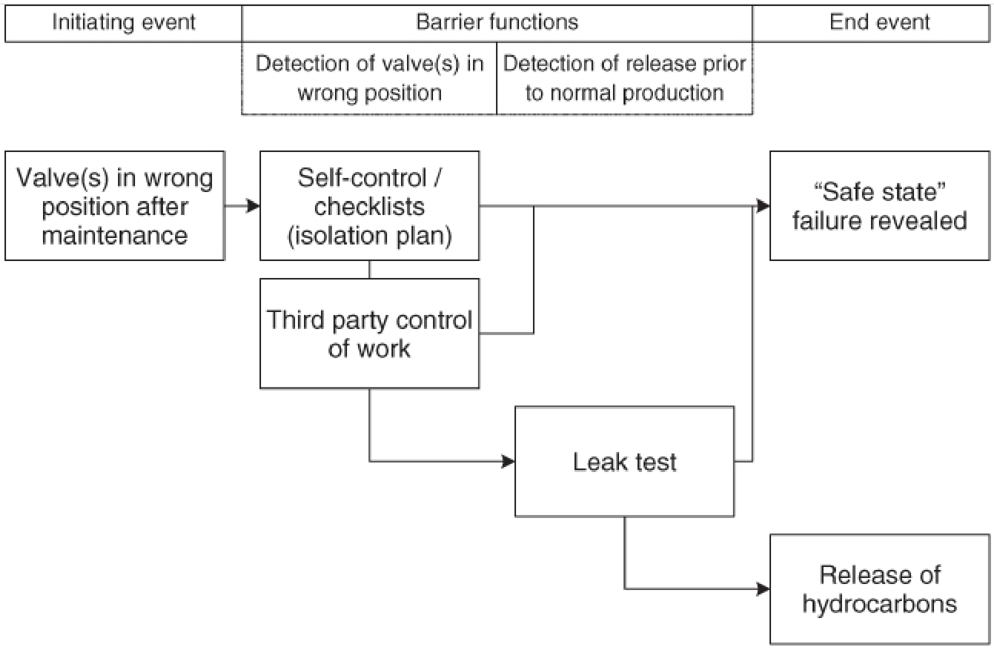

Figure 9: Diagram of a Barrier Block (Source: Aven, 2015).

Event tree analysis can be performed for example as a conceptual Event Tree Analysis of the escalation of tension in the South China Sea.

[38] Andrews, Dunnett (2000). "Event-tree analysis using binary decision diagrams." *IEEE Transactions on Reliability* 49.2: 230-238.

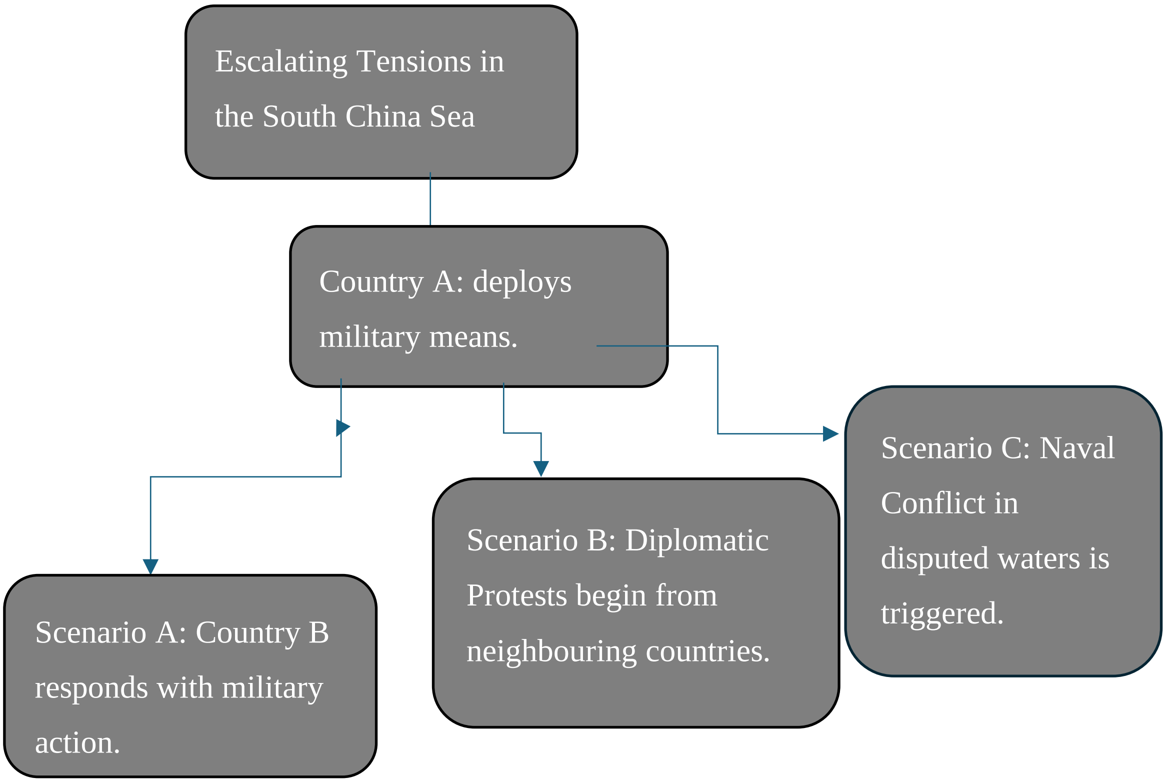

Figure 9: Escalating Tensions in the South China Sea (Geopolitical event tree Example)

Building the event tree begins with the Event Start: Tensions escalating in the South China Sea. This serves as the inception point for analysis, catalyzed by a myriad of geopolitical stimuli. Each branch in the event tree is generated from a query that can be answered with a simple "yes" or "no". These queries probe various potential scenarios that may unfold. For instance, questions may revolve around the deployment of military assets by Country A in disputed territory, or the response of Country B with a military presence in the same region. Additionally, consideration is given to whether neighboring countries in the area express concerns or take a definitive stance, and if military confrontations or skirmishes between forces occur.

Script Development proceeds based on responses to these branching questions. Multiple scenarios are crafted, each depicting a distinct sequence of events that could transpire. Impact Assessment follows suit, wherein repercussions are evaluated across diplomatic, economic, and military spectrums. Diplomatic implications may manifest as protests, breakdowns in negotiations, or international mediation efforts. Economic ramifications could encompass trade disruptions, market volatility, or constraints on resource access. Meanwhile, military consequences might entail naval confrontations or a potential escalation into armed conflict.

Quantitative analysis is subsequently employed. Assigning probabilities and values to each branching question and consequence allows for a numerical appraisal of probabilities and potential outcomes across various scenarios. Nevertheless, the complexity and interrelatedness of geopolitical dynamics often render probabilities challenging to ascertain. Despite this, the exercise furnishes a structured framework for contemplating plausible scenarios and their implications within a geopolitical milieu.

Table 9: Event Tree Analysis: Escalation of Tensions in the South China Sea

Scenario	Potential Consequences
Increased Tensions	Increased military activity, heightened regional anxieties, diplomatic strain
Regional Standoff	Stalemate situation, potential for miscalculation, international pressure for de-escalation
Limited Military Conflict	Localized clashes, casualties, economic disruption, potential for wider conflict

2.3.4.7 Bayesian networks

A Bayesian network is made up of nodes and arrows. Arrows represent dependencies, or causal links. The risk analyst determines the number of states that each node can be in. As opposed to fault trees and event trees, a Bayesian network can exist in more than just two states. Given the causal relationships, we must calculate the conditional probabilities for these states in a quantitative analysis. Direct definition or the application of predefined procedures work well for this. Probabilities may be established by expert opinion or based on experience data that is currently available. Bayesian networks have a wide range of applications, including modeling the factors that lead a ship's commanding officer to make a mistake that causes a collision in relation to maritime accidents. In causal modeling, variables like the time of day, stress, experience, knowledge, shift arrangements, and weather can be taken into account.

Through financial evaluations, that may include evaluations of customer credit. Specifically, age and income, two factors that are believed to affect one's capacity to pay, are modeled. Individual nodes are locked during customer conversations, the model is updated, and the likelihood that the customer won't be able to pay within a certain time frame is determined.

As far as it concerns medicine, with Assist in diagnosis a model is created to represent the relationship between the various symptoms and the analysis results (once by experts in the profession). The model will then calculate the likelihood that a patient has a disease or is healthy based on analysis results and symptoms for specific patients (locking some of the nodes).

However, Bayesian networks have not been widely used in sectors like offshore industry. Instead, they have been frequently used in sectors like the aviation and aerospace industries. However, we observe the technique being applied more frequently in numerous industries, including offshore, healthcare, transportation, banking, and finance.

Bayesian networks have proven to be useful for analyzing complex causal relationships. However, simple techniques like fault and event trees will always be needed in risk analyses. Obviously, different situations necessitate different approaches.[39]

Bayesian networks, with their ability to model complex causal relationships and calculate conditional probabilities, can be adapted to analyze geopolitical scenarios. Let's analyze a geopolitical example: "Tension in the South China Sea" using the method.

Nodes and dependencies are crucial components for analyzing the structural framework in the context of tension in the South China Sea. The Event Trigger Hub serves as the initial stage for evaluating the situation in the South China Sea, where tensions are increasing due to many geopolitical causes, including territorial conflicts, military operations, and diplomatic engagements. The magnitude of these components is clearly defined across multiple nodes, with each node reflecting a different aspect of the circumstance.

Node 1, referred to as "Territorial Disputes," can be categorized into three levels: Low Intensity, Moderate Intensity, or High Intensity. On the other hand, Node 2, known as "Military Activities," can vary between three states: No Activities, Routine Exercises, or Offensive Actions. Node 3, "Diplomatic Interactions," encompasses the various states of Peace Negotiations, Diplomatic Tensions, or Diplomatic Collapse. These nodes function as indicators for the several factors that lead to the intensification of tensions in the region.

The ensuing nodes provide a detailed analysis of the implications that would arise from such an escalation, including diplomatic, economic, and military ramifications. Node 4, titled "Diplomatic Consequences," explores many outcomes related to diplomacy, including diplomatic protests, diplomatic negotiations, and conflict resolution. Node 5, titled "Economic Consequences," explores the effects of Trade Disruptions, Economic Sanctions, or Economic Stability. On the other hand, Node 6, named "Military Consequences," examines scenarios such as Naval Confrontation, Limited Conflict, or Full-Scale War.

The arrows in the diagram reflect causal connections between these nodes, revealing the pathways by which factors influencing intensities result in subsequent outcomes. Arrows originating from nodes like "Territorial Disputes," "Military Activities," and "Diplomatic

[39] Pearl (2011). "Bayesian networks."

Interactions" have a direct impact on related consequence nodes. These consequence nodes represent historical precedents and observations from experts.

Quantitative analysis enhances the assessment process by assigning probability to each node state, utilizing historical data, expert views, and available experience data. This analytical approach enables the computation of conditional probabilities, which helps in gaining a detailed comprehension of the possible paths and results related to the increasing tensions in the South China Sea.

Scenario analysis provides an effective method for comprehending and predicting the results of intricate geopolitical dynamics. Analysts can build several scenarios by systematically considering various combinations of states for the agent nodes, thereby capturing the whole spectrum of potential outcomes. For example, a situation could arise if there is "Intense Conflict" in territorial disputes, along with "Forceful Measures" in military operations, finally resulting in a "Breakdown of Diplomatic Relations." This approach enables a thorough investigation of the possible trajectories that events may take.

Probability evaluation is essential in scenario analysis as it allows analysts to measure the possibility of different events happening as intensities increase. By utilizing estimated probability and analyzing scenarios using a Bayesian network architecture, it is feasible to offer probabilistic estimates for the likelihood of specific outcomes. This quantitative study offers useful insights into the comparative probability of various situations and aids decision-makers in evaluating risks and planning accordingly.

The use of Bayesian network analysis allows for a detailed examination of the possible outcomes of increasing tensions in the South China Sea. Through the examination of different geopolitical aspects and their probabilistic connections, analysts can develop a more profound comprehension of the ongoing dynamics and predict possible outcomes. Nevertheless, it is crucial to acknowledge that real-world geopolitical situations are marked by inherent intricacy, encompassing a multitude of interconnected elements and uncertainties that may not be comprehensively represented inside a model. Although there are limitations, employing scenario analysis in a Bayesian network framework presents a systematic method for dealing with the intricacies of geopolitics and delivers useful insights for decision-making.

Table 10: Bayesian Network Analysis: Escalation of Tensions in the South China Sea

Node	States	Description	Dependencies
Event Trigger Hub	Tensions in the South China Sea	Starting point	
Factors Affecting Intensity			
Node 1: Territorial Disputes	Low Intensity, Moderate Intensity, High Intensity	Intensity of territorial disputes.	Event Trigger Hub
Node 2: Military Activities	No Activities, Routine Exercises, Offensive Actions	Level of military activity.	Event Trigger Hub
Node 3: Diplomatic Interactions	Peace Negotiations, Diplomatic Tensions, Diplomatic Collapse	State of diplomatic relations.	Event Trigger Hub
Escalation Consequences			

Node 4: Diplomatic Consequences	Diplomatic Protests, Diplomatic Negotiations, Conflict Resolution	Diplomatic outcomes based on escalation.	Territorial Disputes, Military Activities, DiplomaticInteractions
Node 5: Economic Consequences	Trade Disruptions, Economic Sanctions, Economic Stability	Economic impacts of escalating tensions.	Territorial Disputes, Military Activities, Diplomatic Interactions
Node 6: Military Consequences	Naval Confrontation, Limited Conflict, Full Scale War	Military outcomes based on escalation.	Territorial Disputes, Military Activities, Diplomatic Interactions

2.3.4.8 Monte Carlo Simulation

Monte Carlo simulation is an alternative to analytical calculation methods. The procedure involves constructing a computational representation of the system being studied, potentially depicted as a dependability block diagram, and thereafter simulating the functioning of the system within a pre-established timeframe. We generate computer-based visualizations to represent system performance. By sampling from the appropriate probability distributions, one can ascertain the durations of residence in various states. In the case of a two-state component, the durations of operation are obtained from a lifespan distribution, while the durations of downtime are obtained from a repair time distribution. Over a period of time, the status of the system is computed and documented. We are able to calculate several system performance measures, such as the duration of time that the system has been operational. By iteratively modelling the system's performance, we can estimate the probability distribution for the system's uptime and the probability of it being online at a particular time. For example, the likelihood is estimated based on the average value of realizations in the system's working environment. The margin of error in the estimation may diminish as the number of trials increases.

Managing the temporal aspect is more straightforward with a Monte Carlo simulation model compared to an analytical method. A Monte Carlo simulation can provide a reasonably accurate representation of the real world. Monte Carlo simulation typically necessitates comprehensive input data. It is necessary to ascertain the distributions for both the lifetime and repair times. Adequate mean values, commonly employed in analytic models, are inadequate. Conversely, the output of a Monte Carlo simulation model is highly complete and informative.

The primary disadvantages of the Monte Carlo simulation technique, when compared to an analytical approach, are the expenses and time required for model development and execution. Simulation requires a significant number of tests, particularly when the system is operational most of the time, in order to obtain precise findings. When doing sensitivity analyses or utilizing the model to examine the impacts of altering system configurations, the time and cost considerations are of utmost importance. Assessing the accuracy of a complex Monte Carlo simulation model and the reliability of its results can be a difficult task.
Monte Carlo simulation is a potent method that can be used to analyze intricate geopolitical situations, particularly when confronted with numerous uncertain factors. For instance,

employing the Monte Carlo simulation analysis technique to assess the economic consequences of the implementation of US sanctions on Iran is a complex and delicate matter, marked by several factors and uncertainties. The choice to sanction Iran is essentially a binary variable, indicating whether the US imposes sanctions (1) or not (0). Nevertheless, the economic consequences of these punishments are affected by numerous factors, each characterized by its own probability distribution.

The economic impact variables consist of a range of factors, including "World oil prices" which are distributed normally, "Trade Restrictions" which follow a triangle distribution, "Exchange Rates" which have a uniform distribution, and "Inflation rate" which adheres to a log distribution. Simultaneously, Iranian economic indicators, including GDP, trade balance, inflation rate, and unemployment rate, offer valuable insights into the home consequences of the sanctions.

A computer model is constructed to simulate the complex dynamics of the Iranian economy in response to the impact of US sanctions. This model includes equations and connections that describe how fluctuations in global oil prices, trade limitations, currency exchange rates, and inflation rates impact Iran's economic environment. The model is implemented using Monte Carlo simulation techniques, running for a specific time period that aligns with the lifetime of the punishments.

Throughout each simulation iteration, values are randomly selected from the designated probability distributions for economic impact variables, enabling the assessment of Iran's economic performance across different scenarios. Iterative simulations, frequently reaching a count of hundreds or thousands, produce a range of plausible economic scenarios for Iran in reaction to US sanctions.

Afterwards, information regarding economic results from each simulation run is gathered, including variations in GDP, trade balance, inflation rate, and unemployment rate. By doing thorough analysis, the probability distribution for each economic parameter is established, enabling an evaluation of the possibility of various economic scenarios occurring as a result of the penalties.

Sensitivity analysis improves the modelling process by assessing how alternative policy decisions or external factors affect the outcomes. Nevertheless, it is crucial to acknowledge that real-life situations are influenced by several factors, including geopolitical factors and intricate elements that may not be fully captured in comprehensive modelling.

Furthermore, the effectiveness of such models depends on the quality of the data and the accuracy of the underlying assumptions, emphasizing the inherent constraints of predictive modelling in the field of geopolitics.

We proceed with data analysis to ascertain the probability distribution for each economic parameter and evaluate the possibility of various economic scenarios arising as a result of the penalties.

Sensitivity analysis involves the adjustment of parameters and distributions to evaluate the influence of various policy actions or external influences.

Real-world situations encompass supplementary factors, geopolitical factors, and intricacies that are challenging to comprehensively describe. Moreover, the precision of such a model is greatly influenced by the quality of the data and the soundness of the assumptions established.

Table 11: Monte Carlo Simulation: Economic Impact of US Sanctions on Iran

Component	Description	Variable	Probability Distribution
US Sanctions	Binary variable representing imposition of sanctions	US Sanctions	Binary (0: No sanctions, 1: Sanctions imposed)
Economic Impact Variables	Factors influencing economic impact with probability distributions: ▪ Uncertainty in world oil prices ▪ Uncertainty in trade restrictions imposed on Iran ▪ Uncertainty in exchange rate fluctuations ▪ Uncertainty in Iran's inflation rate	World Oil Prices ▪ Trade Restrictions ▪ Exchange Rates ▪ Inflation Rate	

Iranian Economic Parameters (Initial Values)	Initial economic indicators before sanctions: ▪ Gross Domestic Product ▪ Trade Balance ▪ Inflation Rate ▪ Unemployment Rate	▪ GDP ▪ Trade Balance ▪ Inflation Rate ▪ Unemployment Rate	Deterministic Value (Fixed Starting Point)
System Model	Computer simulation of Iranian economy	Equations & Relationships	Defined based on economic principles
Monte Carlo Simulation	Repeated simulations over time frame: ▪ Sampling Values ▪ Estimating Performance ▪ Number of Simulations	From economic impact variable distributions Iran's economy under sampled conditions	

Production	Changes in Economic Parameters: ▪ GDP ▪ Trade Balance ▪ Inflation Rate ▪ -Unemployment Rate		
Analysis	▪ Probability distribution for each economic parameter ▪ Likelihood of Scenarios	Economic outcomes due to sanctions	
Sensitivity Analysis	Impact of external factors on model outputs: ▪ Policy Decisions ▪ External Factors	▪ How policy changes affect results ▪ How external events influence outcomes	

3.4 Discussion

Geopolitical risk refers to the potential for political, socioeconomic and cultural events, trends and developments to affect the stability, health and well-being of businesses and nations. It includes both political risk within countries as well as broader international relations and macroeconomic factors.

To effectively manage geopolitical risks, it is important to recognize the wide range of factors that can affect the global landscape. This includes political events, socio-economic changes, cultural developments and transnational issues. Businesses and governments need to be aware of how these factors can interact and create risks.

The use of financial market prices is a means of quantifying geopolitical risk. By analyzing how geopolitical events and trends affect financial markets, organizations can gain insights into the potential risks they face. The risk formula, which considers threat, impact and probability, provides a structured approach to assessing and measuring geopolitical risks. It is crucial to make the distinction between political risk, which pertains to circumstances within a certain country, and geopolitical risk, which takes a more comprehensive view. Geopolitical risk analysis involves examining the impact of cross-border microeconomics, interstate relations, and the dynamics of major global powers. Comprehending these differences is crucial for thorough risk management.

The term "geopolitical flux" emphasizes the importance of taking into account the potential dangers and possibilities that arise from geopolitical changes. Organizations should prioritize not only reducing risk but also recognizing potential advantages that may result from global political engagement. Geopolitical study should encompass socioeconomic and political endeavors, in addition to overarching global patterns. The current geopolitical environment is not constrained by physical proximity. Events and trends in a particular region might have significant global ramifications. The presence of this connectivity emphasizes the necessity for a more comprehensive strategy to manage geopolitical risks. In order to proficiently handle geopolitical risks, it is imperative for corporations and governments to formulate policies that consider potential scenarios and their consequences. This may include scenario planning, investment diversification, contingency planning and working with experts in geopolitical analysis.

Geopolitical challenges often require transnational cooperation. International diplomatic efforts, arms control and non-proliferation initiatives are ways to address global security challenges. In today's world, cooperation between nations and international organizations is vital to managing geopolitical risks.

Geopolitical risk management is a continually evolving topic. Organizations and governments need to be adaptive and continue to acquire knowledge from geopolitical events. By remaining knowledgeable and proactive, individuals can enhance their level of preparedness and reduce the impact of potential threats. To effectively manage geopolitical risks, one must possess a comprehensive grasp of the complex nature of these risks, employ both quantitative and qualitative techniques to evaluate them, and adopt a proactive strategy to minimize risks and capitalize on potential opportunities. It also involves acknowledging the interdependence of the global landscape and the significance of international collaboration in tackling geopolitical concerns.

Examining geopolitical risk is an intricate undertaking that necessitates the use of several approaches. Each of the described methodologies offers a systematic approach to risk analysis. They help break down complex geopolitical risks into more manageable components and assess their potential consequences. In addition, they include the assessment of the probability of occurrence of different risk scenarios and the possible consequences or impacts of these scenarios, allow the modeling of dependencies between different events or factors that contribute to geopolitical risk. Geopolitical risks often involve a series of interrelated events. Many of these methods rely on data and historical information to estimate probabilities and consequences, making them evidence-based approaches, and often use visual aids such as fault trees, event trees, and Bayesian networks to represent relationships between events, consequences, and outcomes. possibilities.

Geopolitical risk analysis methods can be applied in various situations depending on the specific nature and context of the analysis.

In particular coarse risk analysis is often used in scenario planning exercises to assess general geopolitical trends and possible future scenarios, as it can provide a quick initial assessment of geopolitical risks when detailed data or time for in-depth analysis is limited. Modes of Failure and Their Consequences Examination is employed to examine the failure mechanisms and repercussions related to critical infrastructure vulnerabilities caused by geopolitical threats. This strategy can be employed by companies to identify probable failure modes and their repercussions in global supply chains caused by geopolitical upheavals.

Governments can employ the Risk and Functionality Assessments methodology to evaluate the potential hazards linked to geopolitical events that may impede their capacity to operate efficiently. Within the realm of business, this aids in evaluating the impact of geopolitical risks on the fundamental operations and procedures of an organization.

SWIFT is also designed specifically for financial risk analysis, particularly for banks and financial institutions. It is used to assess risks associated with international financial transactions and geopolitical events that could affect financial markets.

Fault Tree Analysis is used to assess the root causes of infrastructure failures due to geopolitical events such as cyber-attacks or natural attacks. It helps identify the flaws in disaster preparedness plans when considering geopolitical factors.

Event tree analysis is valuable in crisis management, especially when assessing the sequence of events following geopolitical crises. Governments and international organizations can use event trees to assess the potential outcomes of diplomatic efforts to resolve political conflicts.

Bayesian networks are used for information analysis to model complex dependencies and uncertainties in geopolitical events. They are applied to security assessments to assess risks from various geopolitical actors, including terrorism and conflict.

Monte Carlo Simulation is frequently employed in financial institutions and investment organizations for analyzing various geopolitical situations along with assessing portfolio risk. This tool is employed to simulate the possible impacts of climate change on geopolitics, incorporating factors such as resource scarcity and migratory trends.

Moreover, there are significant differences between the methods, while for each geopolitical problem and depending on the results sought, a different method should be used. Thus, Coarse Risk Analysis provides a high-level overview of risks and is less detailed, while Examination of Failure Modes and Consequences focuses on identifying potential failure modes and their consequences. Risk and Functionality Assessments emphasize the impact of risk and the functionality of the system. SWIFT is a dedicated risk assessment framework for financial institutions. Fault Tree Analysis focuses on identifying the root causes of failure events. Event Tree Analysis focuses on modelling sequences of events and their consequences. Bayesian Networks employ probability theory and conditional interdependence to represent intricate systems. Monte Carlo Simulation is a computational method that generates many scenarios by employing random sampling and statistical approaches.

Monte Carlo simulation and Bayesian networks are appropriate tools for modelling intricate and interrelated geopolitical concerns. Alternatively, the Coarse Risk Analysis method is more qualitative in nature and is commonly employed for a rapid preliminary evaluation.

Techniques like fault trees and event trees utilize tree topologies to visually depict risk scenarios. Bayesian Networks and Monte Carlo simulations primarily emphasize probabilistic modelling and may not offer an apparent visual representation. SWIFT is a specialized platform created explicitly for the purpose of managing financial risks within the banking industry. Alternative approaches are more versatile and can be utilized across several domains, including geopolitics. Monte Carlo simulation and Bayesian networks are quantitative methodologies that offer numerical risk projections.

Some methods, such as Monte Carlo simulation and Bayesian networks, are more quantitative and provide numerical risk estimates. Others, such as Gross Risk Analysis and Risk and Functionality Assessments, may include qualitative risk assessment.

In the context of geopolitical risk analysis, the choice of method depends on the specific objectives, the data available and the level of detail required. More data-rich methods such as Bayesian networks and Monte Carlo simulations are appropriate when extensive data are available, while simpler methods such as Coarse Risk Analysis or SWIFT can be used when a rapid assessment is required. Undertaking an analysis of failure mechanisms and effects is beneficial for comprehending certain risks within a geopolitical framework. The selection of a methodology should be in accordance with the intricacy and characteristics of the geopolitical concerns under examination.

Chapter 3: Conclusions

3.1 Conclusions of Thesis

In conclusion, this thesis has demonstrated an understanding of the intricate and ever-evolving landscape of geopolitical risk, as well as the analytical and mitigation strategies that are utilized in this area of study. In light of the fact that international relations are in a constant state of flux, it is of the utmost importance to have a comprehensive understanding of the several aspects of geopolitical risk. These aspects extend beyond basic financial and economic issues and encompass political, social, and cultural aspects as well.

Throughout the course of this research project, we have studied a wide range of risk analysis methods, ranging from intricate quantitative models to qualitative assessments. While each approach brings a unique perspective to the overall understanding of geopolitical risk, it also makes it possible to conduct an evaluation that is more comprehensive and in-depth. Due to the fact that a single strategy is incapable of fully conveying the complexity and unpredictability of geopolitical events, it has become abundantly clear that the integration of many ways is of the greatest significance.

The geopolitical case studies included in this thesis also demonstrate how these risk analysis techniques are used in real time. By analyzing cases in which geopolitical dangers have come to pass, emphasis is placed on the necessity of proactive risk mitigation. The implementation of a comprehensive and flexible risk analysis plan that takes into account both long-term patterns and sudden disruptions can be a substantial advantage to organizations, governments, and other parties concerned.

To be more specific, a rudimentary risk analysis provides an initial appraisal of risk and is typically utilized as a first step in the process of recognizing potential dangers. Despite the fact that it is a helpful first step, it might not provide a complete understanding of the precise factors that influence risk. An analysis of the potential failures and the repercussions that might emerge from them. The methodical evaluation of the impact that defects can have on a system is facilitated by analysis, which is valuable for the reduction and avoidance of risks. Assessments of risk and functionality analyze not solely the potential dangers that a system may face but also its capacities to carry out its functions. Through applying this methodology, one can gain a better understanding of how threats can have an effect on the overall operation of a system and receive direction for making decisions that will ensure the system continues to work properly. Through the utilization of "what-if" inquiries on potential scenarios, SWIFT is a strategy that is known for its systematic approach to detecting dangers. It is a very useful method for coming up with ideas on potential dangers and the potential consequences of such dangers. An examination of the links between suspected causes of system malfunctions can be accomplished through the use of a visual technique known as fault tree analysis. It provides a clear illustration of the ways in which several factors contribute to a particular failure event. Event tree analysis, on the other hand, is a method that precisely investigates the sequence of occurrences that might lead to a particular conclusion.

It helps in understanding the probabilities of occurrence of different events and their consequences. Bayesian networks provide a possible framework for modelling and analyzing complex systems. This method is useful for assessing the probability and impact of various events and their inter-dependencies. Finally, Monte Carlo simulation is a powerful tool for risk analysis that involves running multiple simulations to assess the likelihood and impact of different scenarios. It is especially valuable when dealing with complex, uncertain systems.

Moreover, this thesis demonstrates that in order to remain ahead of geopolitical threats, one must engage in ongoing monitoring, scenario planning, and a readiness to reevaluate presumptions in light of new information. Thus, traditional quantitative risk analyses, which use calculated probabilities and expected values, give a relatively limited picture of risk. Alternative strategies that focus on qualitative elements are more suitable, especially for issues with significant uncertainties. It is necessary to describe the risk in "broad" terms. This is also true when opposing viewpoints exist regarding the values that should be upheld and the priorities that should be established. The main issue is value judgments, but they ought to be supported by reliable scientific analyses that also provide a comprehensive picture of risk. For risk management to be implemented "successfully," it is crucial to acknowledge uncertainty as a significant factor in risk.

Prior to using the terms "risk-critical system" or "vulnerability-critical system," we must make it clear whether we are worried about risk or vulnerability. We can compile a list of critical vulnerability modules if we decide to implement a criticality ranking system for the failed modules as a basis for selecting which modules should be given priority in the repair queue (e.g. by highlighting the expected data values and uncertainties of appearances start of events). However, in the majority of situations, risk is the key idea, and criticality should be ranked using risk expressions. Finally, system managers should prioritize education and awareness as a top priority given the growing complexity of the geopolitical risks associated with system operation.

In conclusion, this combination of theoretical frameworks, analytical instruments, and pragmatic insights furnishes a basis for maneuvering across the intricate terrain of geopolitical risk. In an ever-changing global world, people and organizations can anticipate potential obstacles and strategically position themselves to capitalize on opportunities by adopting a multidimensional view and utilizing a variety of risk analysis tools. The knowledge gained from this research serves as a guide for the future in an ever-evolving geopolitical landscape.

3.2 Recommendations of Further Studies

Based on the information and analysis provided in this thesis regarding the assessment and control of geopolitical risk, it is recommended that further investigation be undertaken across various industries to enhance our comprehension of this vital subject and enhance its real-world implementation.

Given that many industries face geopolitical risks in unique ways, it is crucial to conduct sector-specific risk assessments. To enhance the accuracy and effectiveness of risk mitigation measures, specialized studies can be carried out to examine the impact on various industries, including energy, finance, technology, even agriculture. By gaining insight into the particular vulnerabilities and risk factors linked to each industry, it becomes feasible to develop tailored solutions that enhance the durability and adaptability of these sectors.

Another important area for future research is the examination of how emerging technologies, such as blockchain technology and the Internet of Things (IoT), contribute to both the increase and decrease of geopolitical risks. Conducting study on the impact of these technologies on the political atmosphere is crucial for developing effective risk management strategies. By conducting this kind of study, businesses can develop the capacity to anticipate and navigate the complex relationship between technological advancements and geopolitical dynamics.

In depth case studies of historical geopolitical events can refine theoretical frameworks and provide practical lessons. This may benefit organizations and governments in identifying patterns and strategies that they might employ to effectively handle forthcoming geopolitical dangers. Events that can be subject to analysis include the Arab Spring, Brexit, and the trade war between the United States and China. The utilisation of these case studies has the potential to enhance the solidity of risk assessment models and management strategies by providing empirical data and a nuanced understanding.

In order to expand the scope, it is necessary to conduct comparison studies to analyse the effectiveness of quantitative models vs qualitative assessments in measuring geopolitical risk. Research can explore the integration of these diverse views to generate a more precise and comprehensive understanding of geopolitical dangers. The outcomes of these research would aid in identifying the pros and cons of each approach, so fostering a more thorough and nuanced understanding of the measurement of geopolitical risk.

Ultimately, it is crucial to thoroughly examine the policy and regulatory implications of geopolitical risks within both domestic and global contexts. Research could explore strategies for countries and international organizations to develop policies that mitigate the effects of these hazards and promote global stability. Furthermore, integrating environmental and social governance (ESG) concepts into geopolitical risk management methods can help organizations effectively handle risks and simultaneously contribute to the attainment of sustainable development goals. Enhancing comprehension of global geopolitical processes can be achieved by advocating for collaborative international research efforts that engage scholars, practitioners, and policymakers. This can offer a multitude of perspectives and contribute to the development of a more comprehensive comprehension.

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