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PROJECT RISK ANALYSIS AND PERFORMANCE OF NATIONAL IRRIGATION AUTHORITY PROJECTS IN KENYA

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Abstract

Risk and uncertainty are inherent to projects and the incidence of risk in agricultural projects is important to policymakers at national and international levels. Agricultural projects are subject to a wide range of risks due to the variable economic and biophysical environment in which farming operates. The general objective of this study was to investigate the relationship between project risk management process and the performance of National Irrigation Board projects in Kenya. Specifically, the study analysed the relationships between risk analysis on the perfomance of National Irrigation Board projects. This study was anchored on uncertainty theory. This study adopted a descriptive research design and a positivism research philosophy. The target population of this study was the staff in all the 7 irrigations schemes under National Irrigation Board. The unit of observation was staff members under managers, deputy managers, supervisors, farm project managers, project team leaders, and farmers representatives. The study used a questionnaire for data collection. Primary data was collected using structured questionnaires and data was analyzed using SPSS. The study used stratified random sampling to select 201 staff from the target population. Proportionate sampling was used to select the number of staff per category. The test of the hypothesis was done at a 95% confidence interval. The statistics generated were descriptive statistics and inferential statistics. The study found that risk analysis positively and significantly relates with performance of NIA projects in Kenya. The study thus recommends management of irrigations schemes under National Irrigation Board to improve the practice of risk analaysis within their organization in order to improve their performance.

Keywords: *Project Risk Analysis, Performance, National Irrigation Authority Projects*

INTRODUCTION

Risk and uncertainty are inherent to projects and the incidence of risk in agricultural projects is important to policymakers at national and international levels. Agricultural projects are subject to a wide range of risks due to the variable economic and biophysical environment in which farming operates (Hopkinson, 2017). While some of these sources of risk are faced in common with other industries, many are specific to agriculture. Their presence affects production choices with implications for the overall economic efficiency of agricultural production. Further, where the realization of the risks leads to falls in incomes, they can

adversely affect the economic welfare of those working in such projects, with the potential to constrain future investment and performance of these irrigation projects (Ogunlana, 2014).

In Kenya, Agriculture has been the mainstay business in the national economy as it contributes roughly a GDP of 27 % directly; it boosts Kenya's economy by providing 18% of formal employment and 80% of informal employment in the rural areas. This sector accounts for 65% of the country's exports, and in turn, it reduces imports (Ministry of Agri, Livestock and Fisheries 2017). The agriculture sector currently is a source of employment and income for many Kenyans. WFP (2011) who are Strategy architects, agricultural (growth) experts, and farmers have faith in that irrigation farming is the remedy for improving food production in Kenya.

According to Hardaker, Lien, Anderson, and Huirne (2015), risk analysis is the process of identifying and analyzing potential issues that could negatively impact key business initiatives or critical projects to help organizations avoid or mitigate those risks performing a risk analysis includes considering the probability of adverse events. Risk analysis is used to anticipate and reduce the effect of harmful results from adverse events and to evaluate whether the potential risks of a project are balanced by its benefits to aid in the decision process when evaluating whether to move forward with the project (Dahal, Shrestha, Shrestha, Krakauer, Panthi, Pradhanang & Lakhankar, 2016).

Globally efforts have been made targeting food sufficiency by increasing staple food production through irrigation farming as one of the key approaches. According to Valcour e*t al*., (2015), irrigation plays an important part in poverty reduction in the world, all this have been achieved through the enhancement of production, an increase of job prospects and steadiness of income and consumption using access to reliable water, and in conclusion, irrigation also plays a vital role in the nutritional status, health, communal equity, and environment. Historically, irrigation has had a huge impact on poverty reduction and livelihoods, both in the rural and urban regions, by generating affordable food for everyone and the provision of jobs for the landless poor (Dorosh & Thurlow, 2018).

In Africa, agriculture frames the foundation of the majority of the continent's economies, giving about 60% of all employment. Amid the most recent decade, per capita, agricultural production has not kept pace with population growth. Thus, according to the Food and Agriculture Organization's (FAO's) appraisals, toward the finish of the 1990s, 30 nations in Africa had over 20% of their population undernourished, ascending to 35% in the 18 more affected nations (FAO, 2015). Regarding total numbers, between1997– 99, 200 million individuals were malnourished, with 194 million of these individuals living in sub-Saharan Africa (SSA). The sustenance gap evaluated at 17 million tons in 2000 was filled by imports (14.2 million tons) and food aid (2.8 million tons) at the expense of US$18.7 billion.

In 1966 the National Irrigation Board (NIB) was framed through irrigation Act top 347 to oversee inhabitant based national irrigation schemes (NIB, 2017). In 1978, the Netherlands gave funds to NIB which was then changed over into a division of Irrigation and Drainage under the Ministry of Agriculture for improvement of smallholder irrigation schemes (Muema, Home & Raude, 2018). From the late 1970s, vast scale commercial ranchers delivering for the most part coffee extended irrigation schemes utilizing mechanical water abstraction and overhead sprinkler applications. In the period after the 1980s, agriculturists particularly in the horticulture industry, received new and current water saving water system technologies, for example, drip irrigation under green houses for the creation of high-value harvests and flowers.

For a project manager, the risk analysis very significant that the ruling of individuals with the related data and experience, which includes the professionals required in the project like the project managers, farmers, and Farm supervisors may differ due to their personality, values, perception, and preferences, hence the need to use tools like an expert judgment that uses

their anonymity to avoid conflict. Odedeh (2016) said that the National Irrigation Board (NIB) is the major body of the Government of Kenya which has been authorized to develop, manage, and control public irrigation schemes in Kenya. In 2003, the organization adopted strategic management as a core concept for achieving institutional objectives and to guarantee the long-term survival of the organization (Muema, Home & Raude, 2018).

NIB is currently implementing the third cycle of its strategic plan which was set to end in June 2017. The Board's annual development budget rose from two million shillings in 2002 to or above ten billion shillings in 2016 (NIB, 2017). However, its success in strategic practices on the board was not evaluated against the objectives of long-term survival and superior organizational performance. It is crucial to evaluate the organization's performance with a view of aiding the policymakers, farmers, and other stakeholders in decisions. Changes in the government's economic policies in the 1970s through to the 1980s have had a significant impact on NIB leading to its near-collapse between 2000 and 2003.

As a consequence, the Bura, Tana, Ahero, West Kano, and Bunyala schemes collapsed dragging down with the commercial activities in the nearby towns and centers such as Bura, Hola, Ahero, and Nyadorera (Muema, Home & Raude, 2018). The impact of the near-collapse of the Board affected thousands of people either directly or through lost business opportunities and livelihoods. NIB prepared its first strategic plan in 2003 which culminated in a staff right-sizing process leading to the laying off of 85% of the workforce, re-definition of the business domain, and formulation and promotion of a new culture and value system throughout the organization. Each plan has a five-year time horizon. NIB has consistently engaged in strategic management from 2003 to date (Odede, 2016).

Statement of the Problem

Whereas irrigation in Kenya is practiced on about 3% of land used for agricultural production, it accounts for 25% of the value of agricultural exports. A review of the National Irrigation Board quarterly reports (2011 to 2014) on the progress of irrigation projects indicates that it takes longer than planned. The major projects that have missed the targeted implementation deadline for agricultural production over the last five years have risen by 20 % (NIB, 2018). Besides, the cost overruns of the irrigation schemes have increased by 25% over the period 2012-2017 from risk-related costs. Irrigation in Kenya accounts for simply 3% percent of total land area under agricultural production but National Irrigation Authority has been experiencing a lot of risks in implementation, management, and construction of irrigation projects due to human risks, financial risks, market risk, organizational risk as well as climate change risk (heavy destructive rainfalls, famine, and drought, pests, and worms). These risks pose a great threat to food production and incurring of great losses during project implementation in the irrigation schemes.

Some of the studies conducted in these are present gaps; Ondiek and Muathe (2017) conducted a study to establish the extent to which disaster risk management process affect the performance of small agribusiness firms in Kiambu County. The study did not focus on how risk management planning influences the performance of NIA projects in Kenya. Kamundia (2016) conducted a study on factors influencing the construction of irrigation projects on the National Irrigation Board, Kenya. The study was focused on managerial planning on construction of irrigation projects whereas the current study is focusing on establishing the influence of risk management process on the performance of NIA projects in Kenya. Mutula (2013) conducted a study on the effects of human resource factors on project performance in Nairobi County in Kenya. The study was limited to human resource factors as a project resource factor but did not look at the frequency of funding, the conditionality of funding, adequacy of financial resources, and the adequacy of human resources.

Further, Kiogora (2013) conducted a study on the influence of local community involvement in project planning on the sustainability of projects in Embu County, Kenya. The study

looked at resource mobilization, and hence it did not focus on the frequency of funding, the conditionality of funding, adequacy of financial resources, and adequacy of human resources. Pervea *et al*. (2016) conducted a study on the management of agricultural risk in Bangladesh. The study focused on establishing risk identification in the process of article information in Bangladesh, and the current study will examine how the risk identification process influences on national irrigation board project performance in Kenya. Therefore, this study investigated the relationship between Project risk management process and performance of National Irrigation Authority projects in Kenya.

Research Hypotheses

H_{01}: There is no statistically significant relationship between risk analysis and the performance of NIA projects in Kenya.

Theoretical Review

The Uncertainty theory was presented by Li and Liu 2010 is used in deciding on which risk analysis tools such as the probability impact matrix that is applied to analyze the possibility of a risk occurring and the impact that it has on the project success (Li & Liu 2010). During the risk analysis process, the project manager can also use the Montecarlo simulation technique that is a methodology for calculating the risks that may occur in a project through models that substitute a range of values which have a possibility of occurrence by calculating the results over and over while using a different set of randomly selected values from the possibility of occurrence. A project manager needs to guarantee that risk management is implemented from the project identification stage and not when it happens amid project implementation (Dongli, Yinglong, Cunping & Renle, 2018). Early advancement of activity network techniques during the 1950s, for example, PERT (Program Evaluation and Review Technique), perceived the likelihood of variety in task duration. Qualitative approaches that require the examination and audit of different tools and furthermore the event and effects that may cause problems through the project were produced to guide project managers to get ready for vulnerability with risks decrease and utilization of different possibility measures (Henriksen & Uhlenfeldt, 2016).

Uncertainty theory is relevant as it acts as a guide to the national irrigation project managers as a risk analysis tool to assess the probability impact to analyze the possibility of a risk occurring in the irrigation projects and the impact that it has on the project performance. The theory asserts that it is vital for a project leader, for instance, the irrigation project leaders to ensure that their team has the required risk management skills to foresee risks skills and that help in managing their interactions with responsibility charts such as a daily site report that is filled by the site supervisor and reviewed regularly. Further, the irrigation project managers require disciplined risk management that guarantees that the identification of potential risk that could influence the project is all around reported and methodologies set up for risk response which is trailed by the planning of preventive measures to block adverse events and numerous contingent approaches that are then triggered by such events.

Conceptual Framework

In this investigation, the framework clarifies the connection between the independent variables, which is risk analysis and the dependent variable, which is the project performance.

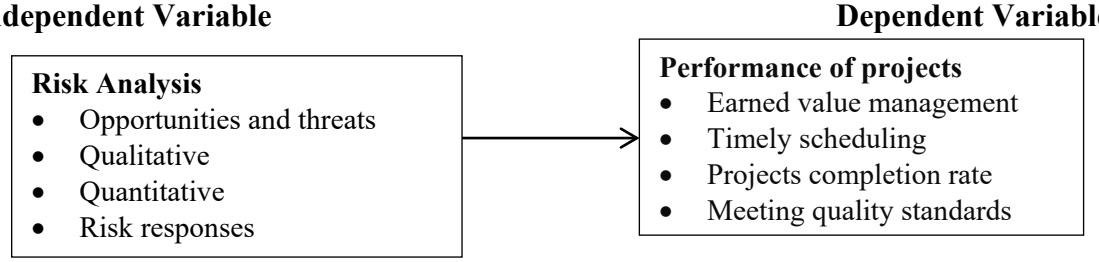

Figure 1: Conceptual Framework

Empirical Review

In the Lithuanian construction projects, there was a difference between the local companies managing projects from foreign countries companies that are in the same industry. This is because they implement and adopt a risk management process. This also affects the outcomes of the local projects as compared to the internationally managed ones since the local professionals do not have the required information. They suggested that construction companies should include risk assessment as an important part of their construction projects. In the risk management framework, construction projects can be improved by using both qualitative and quantitative methodologies for risk analysis since it gives the professionals the required information to improve their projects (Banaitiene & Banaitis, 2012).

According to a study done by Darnall and Preston, (2010) it indicated that while most risks may seem predictable, it is very important for the project team to ensure that they still implement proper risk management practices. This is because the impact that these risks have on projects can lead to cost overruns or project termination. Banaitiene and Banaitis (2012) also discussed risk management in Lithuanian projects and stated that the correct risk management practices enable the construction companies in identifying and quantifying risks, and that risk reduction and control policies should be considered.

A study done by (Enshassi *et al.*, 2015) within the Gaza strip identified four main causes of time delays as strikes and border closures, material related factors, lack of materials in markets, and delays in material delivery to the site. Three main causes of cost overruns were price fluctuations in construction materials, contractor delays in materials and equipment delivery, and inflation. They suggested that the project managers should ensure that the risk management process is implemented in construction projects to minimize delays and cost overruns

Studies have been undertaken which indicates that the construction projects are facing delays in their completion. Sambasivan and Soon, (2017) conducted a study in Malaysia and concluded that cost overruns affected the progress of the projects due to the various changes and delays in the disbursement of funds. This is caused by the fact that when project financiers delay in payment, it may lead to projects stalling or being terminated (Hanna *et al.* 2015). There is also a need to ensure that a contingency reserve is set which enables to overcome the construction mistakes committed during the construction work. Rework cost can be 10-15% more as compared to that of estimated cost (Sun & Meng, 2019). Due to these factors cost overruns can be said to be one of the most common effects of delays (Smith *et al.* 2010).

Contractors also indicated that cost overruns affect the overall expectation of the projects regarding delivery on milestones in the construction industry. This also leads to time overrun that in return is the main reason for cost overruns (Memon *et al.,* 2011). This is also supported by Sun and Meng, (2019) who concluded that the various delays in terms of schedule and cost overruns are mutually exclusive since form the previous studies are done, it was found out that cost overruns affect the project timeline hence requiring more time than anticipated since the project sponsor has to approve those changes.

METHODOLOGY

This study adopted the correrlational design. Correlation research design is typically guided by hypothesis and focuses on the frequency with which something occurs or the relationship between variables (Maxwell, 2012). This study adopted a positivism research philosophy. Positivism research philosophy reflects the belief that reality is stable. This reality can be observed and described from an objective viewpoint without necessarily interfering with the phenomenon itself (Russell, 2013). The target population of this study was the staff in all the 7 irrigations schemes under National Irrigation Authority. The National Irrigation Authority projects in Kenya was chosen as it is mandated to oversee the performance of national

irrigation projects in Kenya and major projects that have missed the targeted implementation deadline for agricultural production over the last five years have risen by 20 %. The sampling frame encompassed 405 staff members under managers, deputy managers, supervisors, farm project managers, project team leaders, and farmers representatives, representatives from government and development agencies working in NIA projects.

The sample size was determined using Yamane (1967) Formula.

$$n = \frac{N}{1 + NE^2}$$

Where by:

n = no. of samples

N = total population

E = error margin / margin of error (0.05)

$$n = \frac{405}{1 + 405(0.05^2)}$$

$$= 201.115 \approx 201 \text{ respondents}$$

This study used primary data collected through semi-structured questionnaires. The statistics generated were descriptive statistics and inferential statistics. The specific descriptive statistics included percentages and frequencies while the inferential statistics included a simple linear regression model.

FINDINGS AND DISCUSSION

Response Rate

The selected sample size for this study was 201 key project risk personnel. However, the researcher was able to collect back only 184 questionnaires having been dully filled. The response rate was 89.8%. According to Mugenda and Mugenda (2013), a response rate of 50% and above is adequate for analysis and reporting, a response rate of 60% and above is good while that of 70% and above is excellent.

Descriptive Statistics

In this section, the study presents the findings of the study. On the likert scale questions, the scale was 5 with 1 Strongly Disagree, 2 Disagree, 3 Moderate, 4 Agree and 5 Strongly agree. Means and standard deviations were used to interpret the results.

Descriptive Statistics for Risk Analysis

Table 1: Descriptive Statistics for Risk Analysis

Statement	Mean	Std. Dev.
Defined the risk measurement criteria to be used, e.g., high/medium/low	3.975	1.169
Defined risk materiality, i.e., when risk is important	3.902	1.235
Defined risk time frame applicable to risk impact and risk probability, i.e., when risk is expected to occur	3.902	1.235
Determined the level of acceptable risk, i.e., the risk tolerance level for the organization	3.902	1.345
Determined the risk cause, risk duration, risk volatility	3.836	1.207
Established the risk profile, e.g., high probability/high impact, high probability/low impact	3.83	1.3
Assessed risks by quantitative analysis methods, e.g., probability, sensitivity, scenario, simulation analysis	3.817	1.142
Assessed risks by qualitative analysis methods, e.g., direct judgement, comparing option, descriptive analysis	3.764	1.168
Aggregate Score	**3.866**	**1.225**

The findings specifically show that the respondents agreed that they defined the risk measurement criteria to be used, e.g., high/medium/low (M= 3.975, SD= 1.169); that they defined risk materiality, i.e., when risk is important (M= 3.902, SD= 1.235); they defined risk time frame applicable to risk impact and risk probability, i.e., when risk is expected to occur (M= 3.902, SD= 1.235); and that they determined the level of acceptable risk, i.e., the risk tolerance level for the organization (M= 3.902, SD= 1.345). Respondents further agreed that they determined the risk cause, risk duration, risk volatility (M= 3.836, SD= 1.207); that they established the risk profile, e.g., high probability/high impact, high probability/low impact (M= 3.83, SD= 1.3); and that they assessed risks by quantitative analysis methods, e.g., probability, sensitivity, scenario, simulation analysis (M= 3.817, SD=1.142).

Respondents also agreed that they assessed risks by qualitative analysis methods, e.g., direct judgement, comparing option, descriptive analysis (M= 3.764, SD= 1.168); that they defined the risk measurement criteria to be used, e.g., high/medium/low (M= 3.975, SD= 1.169); that they defined risk materiality, i.e., when risk is important (M= 3.902, SD= 1.235); and that they defined risk time frame applicable to risk impact and risk probability, i.e., when risk is expected to occur (M= 3.902, SD= 1.235). They also agreed that they determined the level of acceptable risk, i.e., the risk tolerance level for the organization (M= 3.902, SD= 1.345); they determined the risk cause, risk duration, risk volatility (M= 3.836, SD= 1.207); and they established the risk profile, e.g., high probability/high impact, high probability/low impact (M= 3.83, SD= 1.3); and that they assessed risks by quantitative analysis methods, e.g., probability, sensitivity, scenario, simulation analysis (M= 3.817, SD= 1.142). They also assessed risks by qualitative analysis methods, e.g., direct judgement, comparing option, descriptive analysis (M= 3.764, SD= 1.168).

The findings are in line with those of Haitham (2013) that risk analysis enables a project manager to identify risks and calculate their probability of occurrence and the effect that they have on the project's planned budget and schedule. In qualitative risk analysis, the project manager or the experts analyzing the results define the characteristics of each risk. This assessment involves the identification of risks depending on their order of occurrence at the time, which is based on the probability of risk that is calculated using the probability impact matrix facilitating the project team to analyze the scope of the risks.

The study also sought to determine other ways in which risk analysis has influenced performance of irrigation schemes. Respondents explained that risk can be hard to spot, however, let alone to prepare for and manage. And, if you're hit by a consequence that you hadn't planned for, costs, time, and reputations could be on the line. Similarly, overestimating or overreacting to risks can create panic, and do more harm than good. Therefore, risk Analysis an essential tool. It can help you to identify and understand the risks that you could face in your role. In turn, this helps you to manage these risks, and minimize their impact on your plans. By approaching risk in a logical manner, you can identify what you can and cannot control, and tackle potential problems with measured and appropriate action. This can then help to alleviate feelings of stress and anxiety, both in and outside of work.

Descriptive Statistics on Project Performance

Table 2: Descriptive Statistics on Project Performance

Statement	Mean	Std. Dev.
Project met operational performance goals	3.975	1.169
Project earned value management	3.836	1.207
Timely scheduling of projects.	3.83	1.3
There is efficient completion rate of projects	3.817	1.142
Project results met stakeholder expectations	3.764	1.168
Stakeholders were satisfied with projects results.	3.896	1.21

In our scheme projects were completed within budget	3.836	1.234
Aggregate Score	**3.851**	**1.204**

The findings show that all the mean values were above 3.5 an indication that the respondents agreed on average with the statements about performance of NIA projects in Kenya. The findings show that the respondents specifically agreed that project met operational performance goals (M= 3.975, SD= 1.169); that project earned value management (M= 3.836, SD= 1.207); and that there is timely scheduling of projects (M= 3.83, SD= 1.3). They also agreed that there is efficient completion rate of projects (M= 3.817, SD= 1.142); that project results met stakeholder expectations (M= 3.764, SD= 1.168); that stakeholders were satisfied with projects results (M= 3.896, SD= 1.21); and that in their scheme projects were completed within budget (M= 3.836, SD= 1.234).

The findings agree with Floricel, Michela and Piperca (2016) that budget variance aids in evaluating the financial performance of your project. Cost variance compares your budget set before the project started and what was spent. Quality is entailed what the customer or stakeholder needs from the project deliverables. Project managers oversee implementing a project quality management plan. The main idea is to deliver a product or service to the specifications of the customer or stakeholder.

Simple Regression Analysis

A univariate analysis was conducted to examine the relationship between risk analysis and the performance of NIA projects in Kenya. The null hypothesis stated:

H_{01}: There is no statistically significant relationship between risk analysis and the performance of NIA projects in Kenya

The r-squared for the relationship between risk analysis and performance of NIA projects in Kenya was 0.404; this is an indication that at 95% confidence interval, 40.4% variation in performance of NIA projects in Kenya can be attributed to changes in risk analysis. Therefore, risk analysis can be used to explain some changes in performance of NIA projects in Kenya. The findings also show that risk analysis and performance of NIA projects are strongly related as indicated by correlation coefficient value of 0.636.

Table 3: Regression for Risk Analysis on Performance

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.636[a]	.404	.374	.11803

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.725	1	4.725	123.369	.002[b]
	Residual	6.970	182	0.038		
	Total	11.695	183			

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.360	0.123		11.057	.000
	Risk analysis	.595	0.101	0.636	5.891	.002

a. Dependent Variable: Performance

From the analysis of variance (ANOVA), the study found out that the regression model was significant at 0.002 which is less than the selected level of significance (0.05). Therefore, the data was ideal for making a conclusion on the population parameters. The F calculated value was greater than the F critical value (123.369> 3.893), an indication that risk analysis significantly influences performance of NIA projects in Kenya. The significance value was less than 0.05 indicating that the model was significant in predicting performance of NIA projects in Kenya.

From the results the regression model was;

$Y = 1.360 + 0.595 X_3 + \varepsilon$

The above regression equation revealed that holding risk analysis to a constant zero, performance of NIA projects in Kenya will be at a constant value of 1.360. The findings also show that risk analysis is statistically significant in explaining performance of NIA projects in Kenya ($\beta = 0.595$, $P = 0.002$). This indicates that risk analysis positively and significantly relates with performance of NIA projects in Kenya. The findings also suggest that a unit increase in risk analysis would lead to an increase in performance of NIA projects in Kenya by 0.565 units. The findings agree with Banaitiene and Banaitis (2012) that the correct risk management practices enable companies in identifying and quantifying risks, and that risk reduction and control policies should be considered.

Conclusions

The study established that risk analysis is statistically significant in explaining performance of NIA projects in Kenya. This indicates that risk analysis positively and significantly relates with performance of NIA projects in Kenya. Based on the findings, the study concludes that improvement in risk analysis would lead to an increase in performance of NIA projects in Kenya.

Recommendations

Improvement in risk analysis was found to improve project performance. The study thus recommends irrigations schemes to conduct risk analysis of each project they are involved in to ensure projects are successful. They should also focus on opportunities and threats when conducting analysis. Also, it is important that they consider various forms of risk such as qualitative and quantitative and how the risks can be handles. Also, analysis should involve critical review of ways each risk can be responded to.

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