

RISK ANALYSIS AND MITIGATION TECHNIQUE IN INDIAN TRANSPORTATION INDUSTRIES: A REVIEW

Jyotin Shaileshbhai Rana, Dr. J. R. Pitroda

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Construction Engineering and Management,
BVM Engineering College, Vallabh Vidyanagar, Gujarat, India
Jyotinrana97@gmail.com

Abstract

During the past decade, risk management has been implying into a parent business practice in government and industry. The objective of risk mitigation in the transport industry has been to strength increases and intensity. Hazardous material shipments are involved, this leads to prevention tearing down and minimizing the consequences when a release develops. Managing the transport network along with the management of the business, the creation of programs, and the implementation of projects is extremely complex and fraught with doubt. Administrators, planners, and engineers collaborate as well as provide technical support to improve the quality of the transit system. The approach to transportation risk management assumed that when man-made disasters occurred, they were accidental in nature and not due to spiteful intent. Risk management in the construction industry is not at all and simple process. Because risk creates different problems in cost, quality and time. If risks are not managed properly, order of works will get influenced in construction sites. There are six types of risks, their causes and serious issues faced by Contractors, Project managers and engineers. Therefore, questionnaire has been prepared to find out the root causes of risks and its origin. Here I shared some reviews and some ideas to reduce the risks. Thus, risks are determined, quantified, and suggestions have been given to reduce or control the risks.

Keywords: Risk Management, Risk Assessment, Risk Mitigation, Transportation Industries

I. Introduction

Being an owner of some small building or contracting company be a dream for everyone. Design of some high-risk systems. The job of management authorities are not so straightforward to finish the project on schedule and quicker. Most building programs fail to implement the time, expense and intent of the project. The founders, companies, contractors, banks and economic agencies, sellers & suppliers, every have their risks in carry out their business. By the point the sum of threats becomes unknown. Building schemes are often special and threats derive from a variety of different sources. Some behaviors or event that can impact project task performance is considered danger. Every initiative that has a danger that cannot be prevented so that we can retain the danger and monitor. For the last two years, the business owner has chosen a contractor depending on their bid because of the extremely dynamic contractor environment and has been preferred by the contractor

to reduce their prices with fewer expertise, efficiency, protection and creativity. Hence, it causes the project to exceed expenditure expense and timeline.

The construction cycle has several uncertainties and risks which increase project size and complexity. PMI defines project risk as an indefinite event or condition and has both positive and negative effects on the objective of the project, such as time, cost, scope or quality. As we know, construction industries are more at risk than any other industry. The explanation for this is because of the difficult complexity of the building, operation, climate and organization activities. The risk in road project will lead to disability to achieve the required project goals. Delays, expense, and time overruns, and decreased capital supply are detrimental consequences of intimate highway project threats. There, the value of risk estimation, risk sharing, and risk control in successfully planning any highway construction project. Risk assessment will be brought up, and issues reported.

II. Literature Review

Following are the literature review based on risk management and their mitigation strategies in construction of transportation infrastructure.

Perera et al. (2009) conducted work on Sri Lankan road projects aimed at defining contracting parties risk liabilities with a view to strengthening their risk management strategies. Their study followed the Multiple Case Studies method and concentrated on close completion of two major foreign-funded road ventures. The research started with 26 risk factors that were identified by literature analysis and interview transcripts and it was observed that the two case studies were appropriate to only 23 sources of risk. The results showed that road building ventures in Sri Lanka are exposed to multiple sources of danger while the bulk of threats are faced by parties who have been allocated risk by contractual clauses. Parties, however, that were not assigned with the defined threats, still had the consequences of the risks. Ultimately, it was decided that there is no right approach to react to a challenge, and that various risk reduction approaches can be followed to comply with threats effectively. [4]

Anmol Okate et al. (2014) was developed Road building works which carry a great deal of risk due to their scope across a wide geographical area and the danger of underground conditions. Risk can be described as a known uncertainty situation and this uncertainty is calculated in terms of its probability of occurrence. Risk has a direct impact on all of the aspects of a project, including project expense, time or scope. Understanding risks at the initial phases of a project will assist the project management to reduce its own effect and produce the job in a continued to improve and more efficient way. [2]

G. Bhagavatulya et al. (2014) gives information on risk management in India 's transport programs. Because Indian infrastructure is a big part of Indian GDP, the significance of transport industries affecting our country is clearly described here. Researcher will take some questioner survey with several well-known transport project experts. Several methodological approaches implemented after survey data collection to assess association between variables and Relative Significant Index. As a consequence of statistical system researcher, several big factors are discovered that often influence the project. Some statistical techniques are used here to measure precision of results, mathematical formulae quantify correlation between variables and relative index. [5]

Serpella et al. (2014) addressed risk management challenges in building projects utilizing a knowledge-based framework and suggested a three-fold structure technique that involves risk management role analysis, feature assessment and the development of best practices model. Researcher was stated that most of the time risk is mitigated by adding contingencies (money) or floats time and that in certain situations it is simply inadequate to cover the implications of the risks

that arise during the realization of a project. Thus, projects finish with expense overrun and late in most cases. Therefore, it is necessary to provide a good and systematic methodology and, most specifically, awareness and practice of different styles to create accurate and efficient risk management. [11]

Nguyen et al. (2014) done an analysis undertaken to classify 140 risk factors involved in Indian transport projects by literature review, which was reduced to 30 aspects for the survey questionnaire. Therefore, these threats were grouped into 4 specific categories, namely Contractor-Associated Threats, Owner-Associated Risks, Designer-Associated Risks and Project Manager-Associated Risks. The threats were rated using mathematical measures such as Cronbach Alpha, association between factors, and RII. Results revealed that the most important danger is project framework adjustment in the context of alteration to a current design or introduction of new elements to the program. Ultimately, the report concluded that building risk reduction would be of greater value to ensure that programs are finished on schedule and under budget. Despite various influences affecting the smooth execution of transport programs, there is ample room for developing a better approach for risk reduction. Study results indicated that all of the identified risks had a major effect whereas the risk of prevalence is low, including the bankruptcy of a contractor. [8]

Mahmoud H. Mansour et al. (2015) conducted in the UAE and 33 risk factors were identified for the highway construction industry. A test was developed to gain the opinions of construction experts. Further experiment was done out using RII (Relative Importance Index) to determine the danger ranking used to assign danger for more predictive assessment or reaction preparation the findings showed that the most significant risk in the UAE highway construction industry is the inefficient planning. This also provides suggested distribution of threats. In comparison, the rank correlation coefficient of the Spear man was used to research the frequency of relationships between the contractors' and consultants' opinions. [7]

R. R. Singh et al. (2016) identified and established variables impacting the organization of the construction facilities at the concept production and review stages. The top five aspects include the project's size and scope, the construction team's level of expertise, the consistency of the building project's preliminary / conceptual design, Clarity of the owner's expectations and goals, committed project expenditure and organizational capabilities of management team leaders. [9]

Agarwal et al. (2016) provided no such detailed methodology is available to prioritize the management of low-volume road network activities. Most portion requirements evaluation approaches are sophisticated, expensive and involve specialist equipment and man power. While it is basically useless to use such technique on remote networks. There is also an important need to implement practical approaches that focus on rural road networks that are cost-effective, reliable and convenient to operate. [1]

Mane et al. (2017) has presented Pavement Maintenance and Management System (PMMS) methodology was introduced using AHP for rural roads in India, where historical traffic congestion pressure data was difficult to obtain. The work finding has been valuable to field engineers and decision-makers for successful distribution of the fund for surface repair. This research can be extended extensively to rural roads in different regions of India, which would be helpful in establishing a universal distress ranking guideline for rural roads, as environment and traffic characteristics in different regions directly influence the cycle of pavement deterioration. [6]

III. Introduction to Indian Transportation

Risk assessment as a central business strategy between policy and industry has grown over the past decade. In the transport sector, the main risk reduction strategy has been to increase the possibility and type of harm. Where imports of toxic products are concerned, this task applies to the mitigation of leaks and mitigates the effects when a leak happens. Before recently, the transportation risk assessment strategy believed that they were accidental in nature when manmade accidents happened, and not attributable to specific intent. Terrorist actions. In fact, we also found that transportation risk evaluation has to be carried out with a more extensive scope to handle terrorism situations that historically may have been thought too impossible that they would not merit exposure to risk management. Similarly, in terms of the number of incidents, the allocation of recovery services and the collaboration of departments, first personnel will be able to handle impacts well beyond what was previously feasible.

Some vulnerability to potential failure may be described as a construction risk. Since each building project is special, there are a number of legal threats to it. A contractor that works on a building project must be able to recognize and evaluate the threats to ensure the success of a project. So, then the provider needs to be worthy of managing such threats. In financial terms, risk is defined as the possibility that the actual outcomes from an occurrence or investment may differ from the planned effect or gain. Benefit needs a potential risk of an initial investment, or more.

A. Introduction to Indian transportation Economy

Risk is a part of every business. India's building companies continue to face difficulties relating to manpower shortages, rising material and labor expenses, and socio-economic shifts. Construction is on the rise due to large-scale expansion plans and infrastructure programs like transport, electricity and natural resources. Fig. 1. shows contribution of infrastructure to GDP of India in last decade.

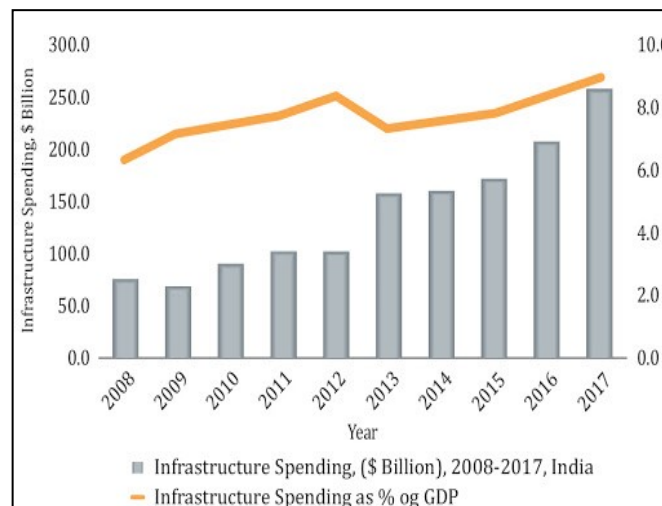


Figure 1: Contribution of infrastructure in GDP

IV. Introduction to Risk Management

Danger is described as an incident that is expected to arise, but if that risk happens, it may have either a positive or negative impact on a project. A risk will have one or more reasons and one or more impacts if it really does arise. For example, a reason can need an environmental permit to do research, or have limited personnel assigned to plan the project. The danger case is that the authorizing agency will take longer than expected to grant a permit, or the necessary and allocated staff might not be sufficient for the operation. When one of these uncertain things occurs, the expense of the project may be impacted.

A danger is a possible future risk that may occur from some current action, such as a project interruption or an increase of costs. The cost is mostly calculated in terms of actual financial harm, but in terms of success, potential profit, and property or life harm, it may often be a disaster. The overall aim of risk management was to improve the frequency and extent of accidents in the transport industry. In the case of imports of dangerous materials, this function applies to the prevention of leakage and mitigates the impact when breaches arise.

A risk is a possible future damage that could arise from an existing action; such as a delay in the timetable or a cost overrun. The failure is sometimes known as a simple financial loss, although it may often be a loss in terms of reputation, possible company and property or life loss. Two other essential things are to be discussed as part of implementing risk reduction, Firstly, the preventive measures that should be implemented to minimize the risk of an incident happening, secondly, the action method or a set of actions that will come into effect during or at the moment of the incidence. Mitigation acts also come at a premium. The expense of mitigating the risk can sometimes exceed the cost of taking on the risk and incurring the effects Until agreeing on executing a contingency plan, it is necessary to determine the likelihood and effect of increasing danger against the expense of the mitigation strategy. Pre-risk mitigation strategies adopted are pre-emptive measures intended to will the effects or minimize the danger as a whole. In addition, contingency plans introduced after a risk occurs can only lessen the impact.

A. Project Risk Management

Project Risk Assessment includes the mechanisms of preparing, defining, assessing, organizing solutions, executing responses and monitoring danger on a project. The project risk management objective is to increase the chance and effects of identified risks, and to decrease the chances and/or impact of negative risks to improve the project's probability of success. Fig.2. shown some major variables of project risk management.



Figure 2: Project Risk Management

Risk reduction is a large factor that affects a variety of business fields, but it is also a factor that any human being on earth will tackle with regard to their way of living because if ignored human life is left in the path of damage and susceptible to illness, disease and hunger.

Building owners, project managers and contractors often identify and execute risk-management activities on a project differently. Owners can use informal methods or methods that they view as risk management operations, such as process gate approval, Contractors may describe risk control as monitoring future change orders and project managers may claim that 'all we do is manage risk.' Although all of these practices help define and handle specific elements of project harm, they don't explain clearly a thorough risk assessment approach to project.

B. Risk management Process



Figure 3: Risk Management Process

Here, Fig.3. shown the process chart of risk management.

- 1) Risk Management Planning: Since undertaking risk management practices are assessed in the proposed model (scope, timetable, and cost) to assess their risk potential. This evaluation (or risk screening) tests all activities against a range of traditional screening categories in the areas of building, system management, health, regulatory and environmental, infrastructure, architecture, capital, spatial migration etc. This can monitor activities that are known as project threats.
- 2) Risk Identification: Identify risks that may impact the successful completion of the project. Risks are identified for the entire life cycle of the project. Risk associated with context, expense, and schedule of project work is defined by systematically examining the project's assumptions, logic, and complexity, and by examining the identified uncertainties associated with each project stage.
- 3) Risk Assessment: Assess the risks to determine their likelihood and impact on the project's cost, schedule, and/or work scope. This provides both a qualitative and quantitative assessment of the consequences (impact) of the risks and the probability.
- 4) Risk Handling: Determine the strategy for risk-handling, whether to reduce, transfer, prevent, minimize or assume.
- 5) Risk Management Impact and Control Actions: Assesses the risk impact on the project and the effect of the risk handling strategies. Risk handling strategies will be reflected in the project's baseline, whereas residual risks will be reflected in the project contingency.
- 6) Risk Reporting and Tracking: Risk reporting and tracking is the documentation of the risk management process.

V. Risk Mitigation

A. Introduction to Risk mitigation

Risk mitigation implies a reduction to a reasonable level of the probability and/or effect of an adverse risk occurrence. Early intervention to minimize the probability and/or effects of a danger arising on the project is always more successful than trying to minimize the harm after the risk arises.

The possibility of price inflation of building materials such as steel, cement, bitumen etc. in the airport ventures. It seems that the proper planning of available resources and management of waste during transportation and development has maintained and mitigated what represents the project expense considerably.

The possibility of the subcontractors' financial loss has been mitigated by checking the subcontractors' previous records and experiences, as well as from the clients' list of licensed subcontractors. Contract was only awarded if it meets all political, technological and other commercial requirements. The groups who have good relations with the contractor in the past have been given mainly subcontracts.

Labor related problems at one of the airport projects sites have been mitigated by supplying accommodation for school or their children near the facility, pharmacy, grocery store, and transportation from the accommodations to the location. Previously having labor has been a very big challenge, as there are many builders in and around various metros where they get a decent pay closer to their home but comparatively the danger has been reduced after offering the above listed facilities.

In one of the airport locations, which is an extension area, theft and fire damage to land, material and equipment has been mitigated and protection is of high concern in any regard. Highly complex safety standards are being implemented such that only licensed and permitted labor and workers may access the field of operation. Building industries are also a main economic sector in India, accounting for 15 per cent of the GDP. So, it is important to control building threats in India.

B. Risk Categorization

- 1) **Site Risk:** The danger associated with the land acquisition can be mitigated with the project beginning only after the government procures and hands over the necessary property. Even, by giving pre-notice for the purchase to the property owner, so that the sale process can be quickly completed. The Regular Project Report (DPR) program should be fully implemented for effective site inspection and the DPR format should provide site photos, regular resource use, daily manpower working, and volume of work completed etc.
- 2) **Material Risk:** The Regular Project Report (DPR) program should be fully implemented for effective site inspection and the DPR format should provide site photos, regular resource use, daily manpower working, and volume of work completed etc. We will also have the standard certificate for through material, such as ballast, sleepers, ties, etc., often used in railway line laying. Also, the agency will have many choices i.e. several number of products dealers. And if one struggles unless the correct content is shipped on schedule, another may produce the specific element on site on time to reduce the risk associated with delay.
- 3) **Design Risk:** As the key period needed to complete the railway project is the Design and Survey process, Ideal Design is necessary in railway projects, as millions of kilograms of load must be moved in that direction. Therefore, the railway department spends more time writing papers on construction and survey. In this scenario, the tender winery, which prepares the design and survey reports of this enterprise, has six months to detailed complete reports including GADs (General sheet arrangements), hydrology of each major and minor bridge, railway curves, Track descriptions with differing chain length. But it can be mitigated by providing proper concept documentation and by owner and contractor before beginning the project. Yet again, such a danger may be mitigated by recruiting seasoned surveyors yet planners or by providing the fresher employee adequate training under the supervision of experts.

- 4) Contractual risk & Exposures: The forms of danger of contractual responsibility have had a rather serious effect on the project, in this case, for the design process, one private consulting company has refused to carry out the whole survey of a specific road, so breach of contract happens, in order to complete such incomplete work, the railway ministry needs to offer another tender again, So after all the boring tendering process every other consulting company would carry over the task of doing the balance of the job, which would trigger a lot of misunderstanding so repetitive work. To mitigate such a possibility, the railway ministry should be strictly informed in the initial tendering phase of contract violation.
- 5) Financial Risk: This is also important to look at the strategies for analyzing project cash flow, which is a major feature of risk management mechanism, since recognizing the danger involved in a Railway project. The essential methodology in cash flow control notes that, In the first two stages and in the last two stages of the development process, the project cost will be between 8% and 10% of the overall budget and, in the remaining period, it differs with the rise at the center, the lowest at the middle and the reduction towards the end arising from the 'bell curve.'
- 6) Site Safety: Such a possibility was found to be very popular not only in rail projects but in the building industry as well. And steps to minimize such a risk, include wearing safety equipment including helmets, hand gloves, gloves, goggles, etc., are often very common. Many government undertakings and commercial companies will not obey such a policy as would be understood. Apart from this, for starters, there are other actions for the benefit of people examples,
 - a. The Workmen's compensation act, 1923
 - b. The Employees Compensation act, 1923
 - c. The Trade Unions Act, 1926
 - d. The Payment of Wages Act, 1936
 - e. The Employers Liability Act, 1938 and many more.
- 7) Management Risk: Management danger in such a project which is working with public agencies is considered to be very critical risk. Here the railway ministry outsources the tender to private entities and private entities work in their comfort according to the capital available. Often supplies are not accessible on time and they would have alternate supplier solutions available to alleviate such a danger, so the project does not stop due to resource unavailability.
- 8) Organizational Risks: This form of danger exists with private consultancies that are going to operate for the Railway Ministry, the subcontracted products and other construction reports such as GADs, hydrological reports etc. do not meet the head office or corresponding site locations on time, which often helps to prolong the procurement of permissions and postpone the implementation of research. Then the private consultancies will handle proper transport networks to resolve such a risk. The products held on site will also be well secured against heat, wind and other unnecessary items such as robbery, waste etc.
- 9) Human resource risk: Such a problem arises again primarily for private consultancies, as some trained employees employed on these massive contracts exit the positions, and the firms have to find any new staff and have to train them first, which takes so much time that indirectly affects the project delay.
- 10) Construction risk: Those threats are more prevalent in the building sector, and typically such a danger arises during the project implementation process. Due to confusion, the requirements provided in the sketches and design reports are becoming different at the location. The site engineer will first review the proposal in depth with senior engineer to address such a possibility. The implementation process should also be carried out correctly, since millions of kilograms of weight would be transported through that path. Instead of

traditional ethical practices, new equipment can be used by the State for cheap and convenient building.

- 11) Legal Risk: Many of the government agencies / civic bodies etc. that are influenced by the development of this Railway line in one or the other, had to give separate permissions for the project, which would be a complicated and time-consuming procedure throughout the construction period. However, with a project of this size the government would have a single window clearance.

C. Mitigation Techniques

- 1) Increase Responsiveness: Increasing responsiveness related to faster deliveries, which accounts for a 20% increase in production rates. The faster one gets the item into consumers hands the better.
- 2) Reducing Cost risks: Many of the specific expense challenges encountered when a project has to be done immediately include the consistency of expense forecasts, incomplete or missing adequate problems with timeline compression financing. Risks in cost forecasts are reduced by way of adequate preliminary planning and preparation via the fast-track project execution. If the team may recognize project problems early in the planning phase, expense projections are more far-reaching, mitigating future risks, unexpected surprises.
- 3) Mitigating schedule risks: When modularizing equipment, it is vigorous for the project team to include merchants early and to introduce an expediting equipment measure to avoid potential scheduling barricades caused by deliverers of equipment or harm during transport.
- 4) Mitigating safety and quality risks: Quick track ventures can mitigate issues created by delays in the construction environment by creating a schedule of an hour to an hour that recognizes places of activity that overlap and enables the project manager to create contingency arrangements to avoid that overlap.
- 5) Rapid prototyping and test feedback: This are an integral component research analysis appropriate might not be accessible on the market or inside the enterprise. This may, therefore, be part of the market's quality control mechanism, even inside the organization / project. The sample suggestions should be carefully examined and discussed, and appropriate recommendations should be accompanied throughout the duration of the project for improvements. Upon crucial review of such projects, the danger such as grid contact, delays in start-up, or maintenance problems could be gone.
- 6) Political, policy and regulatory risks: Similar financial, legislative and economic threats. Continuous inconclusiveness on prospective government assistance or regulatory conditions related to the criteria for solvency resources. Thanks to ongoing activities providing an evaluation of potential prospective policy reforms, such as through defining indices of political danger.
- 7) Staff training: This approach involves the creation and promotion of organizational building and soft skills training in teamwork, collaboration, facilitating, service leadership, analytical thinking strategies and strategic analysis, as well as technological competence. Proper staff preparation becomes necessary because the recruited team may not have experience operating in the individual area and managing the different equipment.
- 8) Efficient Communication: The life-blood of a project is productive and reliable coordination with all main actors over the lifespan of a project. No project is expected to function without successful and secure coordination system through the web. The value rises much further in such as creative ventures, as the absence of proper and timely coordination between the project management and all stakeholders will generate uncertainty that can serve as a baseline for significant project setback.
- 9) Counterparty risk: Financial security of activity and repair facilities for the vendors or contractors is important. The counterparty danger for the significant problem of major

suppliers or contractors for offshore wind parks, where financial strength concerns contractors with existing credit evaluation and performance track record, especially important for offshore wind parks, as well as long-term contracting.

VI. Case Study

This case study is on Risk Management in infrastructure project of pune metro construction.[3]
Location: Pune, India.

Researcher states the risk involve during project life cycle are varies extensively having uncertainties and too much complex and that directly affect the cost to institution to the national wealth. They establish analytical method for recognizing, analyzing and controlling risk as part of a contract is not enforced. Risk assessment, statistical data generation of ongoing programs, review and conclusion of project-specific decisions and project implementation recommendations. They create their own methodology for managing risk and privations methods. Here, in fig. 4. describe the methodology that they were created to manage risk is shown.

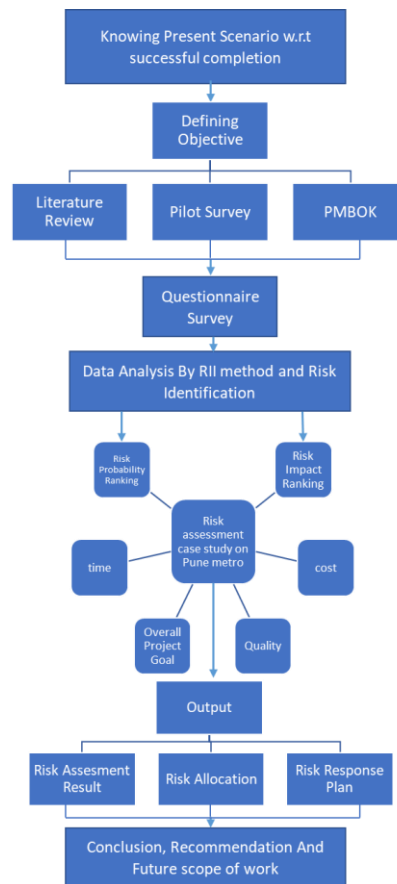


Figure 4: Methodology for Pune metro risk management

VIII. Conclusions

From the extensive literature review and the case study on the importance of Risk analysis and mitigation in construction of Indian transportation industries.

- 1) Due to an overview of the protective process, it is inferred that danger is usually passed to certain parties or that they apply to prior and current related programs.
- 2) Many threats may be easily minimized from the parties involved, such as risks resulting

from the Acts of Christ, from service companies, from local interactions, from matters of public health and protection, from legislation and from the difficulties of receiving permits. Employer interference, which serves the government, is especially critical in solving community, public safety concerns.

- 3) Risk transfer is also an essential risk management tool because it may serve as a buffer against such losses and to attain each party's organizational goals. However, vendors were hesitant to submit requests for damages to prevent damaging the employer's good partnership. The presence of insurers in this instance is important.
- 4) The prevention approaches introduced in terms of both proactive and corrective interventions are primarily tailored to policy-making and strategic decisions to reduce the risk and extent of various forms of ship disturbances.
- 5) The current focus of the analysis was limited to the detection during the construction phase of essential risk factors. This can also extend to all building projects in the legal and functional stages.
- 6) Political risk can play an important role in complex projects such Large International Airport Projects, where agreements, agreement and contract issues are an important part of the project management process. As always, in the case of the current research, there was no presence of international danger and geological / climate risk. Some conclusions can be drawn from the extensive study of literature and case studies on various practical solutions and methods to human resources.

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