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Risk Assessment and Mitigation Strategies for Developing High-Rise Building Projects in Kathmandu Valley

[Subject]

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ABSTRACT:

Kathmandu Valley high population and blistering rate of urbanisation has come forth in collaboration of location explosion of high-rise construction projects, which are a considerable contribution to the expansion of the urban areas in addition to economic progress. It also has a high possibility of operational risk to the implementation of such projects, which has been mostly ignored by most in place of structural, environmental or financial risks. The purpose of this research is to identify and to investigate operational risks of the high-rise construction in Kathmandu Valley. It presents the study within the context of the operational risk management and the PESTEL model that talks about political, economic, social, technological, environmental or legal factors that affect the construction industry within Kathmandu.

Qualitative methodology has been used and that is via case study methodology. Data were collected by using open ended questionnaires with project managers, engineers and other professionals in the construction industry working on the high-rise projects and was complemented with secondary sources. The identification of recurrent patterns and issues under which the construction stakeholders were facing involved the use of thematic analysis. The findings reveal that operational risks related to Kathmandu based high-rise construction projects include, earthquake vulnerability, labour unavailability, unsafe working conditions, site congestion, late procurement, use of foreign materials, regulatory, and communication. The urban, institutional and economic landscape of the region influences such risks. Planning, safety training, coordination of stakeholders and observation of regulations through identification, prioritisation, and mitigation of risks are process undertaken by project managers proactively.

The conclusion of the study is that Operation risk management must be included in the planning of high rise projects in Kathmandu valley. This can be obtained through learning how to conduct efficient risk assessment, improvement of safety culture, labour training, improve supply chain strategies, greater digital monitoring and advanced, timely regulatory engagement to achieve better project outcomes. This research provides valuable insights to the professionals in the construction industry and policymakers on how to manage the risks of operating in a relatively fast-growing, urbanising and seismically active urban environment.

KEYWORDS: Operational risk, high-rise construction, Kathmandu Valley, PESTEL analysis, risk management, occupational health and safety, supply chain, regulatory compliance.

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1 Introduction

This introduction section gives a summary of this study on operational risk related to high-rise building constructions projects in Kathmandu Valley. The chapter starts with a discussion of the high rate of urbanization that has taken place in the area and the growing trend of building vertically because of the lack of land. It proceeds to define the gap in research, that is, the marginal coverage given to operational risks during the implementation stage of the research, in practically all research studies, the structural or financial uncertainties are addressed. The research question is to present the information about operational risks of construction projects in Kathmandu Valley and operationalize it in terms of project planning, labor management, supply chain, safety measures, and compliance with the regulations. The study scopes are identified to be concerned with the operational risks at the implementation stage, using qualitative data given by the industry experts and the secondary resources, and excluding the structural, environmental and long term performances risks in building.

Over the past few decades, the Kathmandu Valley has undergone a high rate of urbanization which has consequently led to massive high-rise building projects that pose immense economic growth prospects and equally threaten the development of the Kathmandu Valley. The rapid rate of population increase as well as urban sprawls over the years, alongside the increased demand on the residential and commercial land has forced the developers to find the alternative solution of offering land as vertical formations to the problem of sufficiency. Moreover, the construction works on the high rise buildings are inherent in nature and are linked with a number of uncertainties which can affect the project and the safety among others and the community. Previous research, including that of Mishra and Mallik (2017), prioritizes the systematic risk management in construction industry, in particular, in big cities. Their results show the topicality of the multifaceted risk evaluation systems elevated on the basis of the local environmental, economical and social factors. These dangers are further compounded in Kathmandu valley where, there is high seismic prone and topography with high urbanization and uncontrolled urbanization. Other researchers, Puri et al. (2025)

address the effects of geographical and socio-economic in the region on construction. Despite the fact that these contributions were ready, one can argue that due to the ever-changing nature of the city environment, much of the risk involved in a project is not studied locally.

However, limited literature has been done on the dynamics of the operational risks that take place when the high-rise construction projects at the Kathmandu Valley are at implementation stage. The prevailing literature is largely devoted to structural safety, environmental impact or financial unpredictability, but operational problems in the real life are given little attention. Recent works by Mishra (2022) require more comprehensive researchers on the demonstrations of risks when undertaking project implementation. These studies suggest that operational risks operational risks, such as poor project management, labor shortages, failure to coordinate, failure of the supply chain, congested site, poor safety management, and regulatory compliance issues, have a direct impact on project result and tend to be decisive. In addition, the major part of these risks is conditioned by the socio-economic and institutional peculiarities of the Valley, i.e. by variability of labor markets, poor infrastructural conditions, red tape and high rates of urbanization. As a result, an overall and localized framework that can reflect the working reality of high-rise construction projects in this area is still lacking. This gap needs to be dealt with to make it efficient, reduce delays and cost overruns as well as improve the level of safety.

In line with this gap, this research paper aims to fill this gap by answering the following research question: What are the operational risks of high rise building construction projects in Kathmandu Valley? With its emphasis on the operational dimensions directly, the study is likely to produce a practical set of information which can both directly inform the project management practice and the policy decisions. This exploration is grounded on the issues caused by regular construction operations as compared to bigger explorations which address structural risks or financial risks. These involve the project coordination and planning, managing of employees, procurement and logistics, on the field safety, contact with the stakeholders as well as adhering to the rules of regulation during the construction. These are extremely important factors

to be observed because of the probable trickle down effect in operational inefficiencies that can endanger the timelines, quality and even safety deliverables of the project.

In order to study this research question, the research problem to be studied is that of high-rise construction projects in Kathmandu Valley in Nepal where vertical development has been worsened by high urbanization levels, land scarcity, and population growth. The unique risk environment of the Valley lies in the factors of high seismic vulnerability, dense urbanization, complicated terrain, and regulatory constraints, which make it an ideal site to study operational risk in large-scale building construction, although the results might not be all-encompassing applicable to other sites because of the differences in context (Mishra & Sreeramana Aithal, 2021). The analysis of the operational risks is during the implementation period; they are project planning and coordination, human resource management, procurement and supply chain disruptions, site congestion, safety management, stakeholder communications, regulatory compliance, which are not structural design, environmental impacts, financial viability, and long-term building performance. The work is based on profound insights (with the assistance of primarily the qualitative data of the industry experts and supported with the secondary source) that might be compromised by the lack of access to the proprietary data of the firms and the fact that the research focuses on the current practice as opposed to new technologies. In the context of up-to-date project implementation schemes and institutional legacy, the research could not reveal forthcoming policy and technology modifications, yet it has practical site-centered recommendations as to how to transform better high-rise structures in Kathmandu Valley into efficient, secure and risk-averse structures (Nel, 2024).

2 Literature Review

In this section, an in-depth discussion on the different operational risks in building of high-rise buildings in the Kathmandu Valley can be discussed. Some of the main risks discussed in the chapter are associated. The chapter also discusses the nature of project managers in uncovering, evaluating and alleviating such risks. By outlining both direct and indirect effects of these risks on the success of the project, the chapter seeks to create a wide perspective of the complexities encountered in construction high-rise projects in the Valley as well as the mitigation measures required to improve the performance, safety and efficiency of the projects.

2.1 Types of High-Rise Building Projects

2.1.1 Residential High-Rise Projects

The high-rise residential designs have been one panhandling solution to the rocketing housing requirement within the urbanized regions especially in Kathmandu Valley. The level of housing demand is high due to the large scale migration to the urban areas and unavailability of land that will support the high rises of the houses such as luxury apartments and the affordable houses complexes. This is precipitated by the fact that strain becomes the need to serve an increasing population which, is further worsened by the fact that there is no proper land that can facilitate horizontal development (Sengupta & Bhattarai Upadhyaya, 2016).

Other peculiarities of Kathmandu Valley, such as extensive urbanization, historic areas and giant-sized cultural objects, only make the construction of the high-rise even more problematic. The area policies on historical preservation tend to take down the size and structure of buildings to be built within an area (some changes) in certain areas and, hence, it is not so easy to manoeuvre through zoning regulations and licensing applications. The residential high rise developments in Kathmandu valley, according to Sengupta & Bhattarai Upadhyaya (2016), the residential high rise projects are usually affected by the non-useful land acquisition process where land disagreements and illegitimate settlements will likely increase the project timelines.

The high-rise residential projects are opposed by the local people besides land acquisition and zoning aspects. Generally speaking, community opposition is usually witnessed in those places where individuals are concerned that high-rise developments are going to alter their lifestyle, their ability to see the sun, or to overcrowd. Such opposition could result to colorful negotiation processes, sluffs on acquiring the necessary permits and additional costs to the project developers (Sengupta & Bhattarai Upadhyaya, 2016).

Additionally, informal labour market at Kathmandu Valley is an additional crucial facet which has been one of the factors which have enhanced operational risk of these projects. In the context of construction, undertrained/ most of untrained construction workforce, factors in low safety rates and high risks of accidents in construction site. Koirala (2018) observed that one of the most dangerous occupations in the region is paying the manual labour, mainly operating with bricks, plastering, and painting, particularly high-rise buildings. Occupational safety and health risks are also usually pitiable and exacerbated by the skill of the poor quality of safety precautions which make up on personal protective equipment (PPE). Additionally, the informal job policy assumes that they can strip the employees of benefiting them with proper insurance or benefits, and, therefore, is more likely to bring about the conflict and slowdown.

Another risk factor, in the residential high-rise projects is that Kathmandu Valley is prone to seismics as well. Nepal is near an earthquake prone area and earthquakes are always a feared specter. The quake in 2015 which left the buildings with gigantic damages made it obvious that high rise buildings were predisposed in Valley. Due to the engineering methods involved in high rise constructions constructed in such an environment, the building becomes resistant to the seismic force making the methods used in engineering the high rise buildings to be high. This is not so easy because of unavailability of good quality materials and professional engineers in the area. Mohamud et al. (2024) tend to agree that due to the cost-prohibitive nature of technologies and materials that help prevent earthquakes, small developers cannot afford to provide high safety rates.

The managers of high rise construction in residential high rises, therefore, must be able to sail through a complex maze of regulatory compliance, community relations and technical issues. They should ensure that they encourage that the project complies with the local building standards, manage the risks arising due to the site conditions and implement effective safety regulations. Also, it is important to involve the local stakeholders such as the community members and sensitize them about the issues so as to create it without interference. Containing the risks entailed in legal and regulatory compliance as well as providing assurance of project realization as per the expectations of the community as well as the developers, is one of the aspects of project manager.

2.1.2 Commercial and Mixed-Use High-Rise Projects

Their complex nature in their design and multi-purpose nature of the fulfillment of a variety of objectives are due to the characteristics of commercial high-rise developments which include office towers, shopping malls and mixed-use developments. They also seem enormous contrasting to the residential high-rises because of their sophisticated functions and blending of different kinds of business operations into a huge structure (Kheir Al-Kodmany, 2023).

Kathmandu has witnessed the augmentation of the high-rise development with mixed-use because of the escalation in urbanization. Generally mixed-use towers are used to accommodate an office block, shopping center, as well as residential apartments and sometimes hospitality (in a single high-rise building). All these factors make them complicated on a logical basis, when compared to commercial or residential buildings. The complexity of the nature of operation in these projects is further complicated by the cost that they must serve the different needs of different users who can be composed of corporate tenants, retailers and consumers. The fact that, as Generalova & Generalov (2020) present that , in Kathmandu, one of the top issues that developers need to work through is the coordination of various stakeholders whose interests are not similar, makes coordination a key element that will have to be employed in Kathmandu, as well. These include the design team, contractors, tenants, the

regulatory bodies and financiers who should all work together in ensuring that the development is able to strike the commercial objectives in addition to meeting the safety and quality assurance.

Multi-functional projects are mixed-use as well, therefore, not easy to finance. It is this because the various applications have been integrated within the same framework and therefore financing facilities have had to be lower profile and in a combination of commercial loans, investment capital and in some instances government stimulus. Commercial office space might demand varied financing property as opposed to residential/retail space that will bear their cash flow and occupancy properties. The challenges of the sourcing of capital that best suits the numerous demands of these spaces pose as well an extra risk, especially in a market like Kathmandu whereby the financial institutions might be reluctant in relation to such a varied and capital intensive endeavors (Generalova & Generalov, 2020).

Two areas that are important as far as project management is concerned are risk control and scope management. On the mixed-use projects, in particular, managing the project scope is even more difficult because one change in design of one aspect of the building e.g., the office spaces may have a subsidiary impact on the other areas of the building e.g., the retail outlets or apartments. One such area is the fitting of retail systems i.e. special HVAC or fire safety in which case it can be vastly different to that fitted in an office or residential environment. These differences in technical requirements might cause delays, cost escalation and rework particularly where coordination is not effectively taken early on. Even more so, when the beauty of the architecture and the structural effectiveness and mechanical processes are to be adjusted, the high level of coordination among the architects, engineers and contractors is demanded to make sure that the building will fulfill both the functional and aesthetic goals (Keshk et al., 2018).

In summary, the commercial and mixed-use projects demand risk management structures which are unique to the enormous artistry of potential risks. This is not

limited to some of the technical risks of design and construction but also the commercial risks of the tenants occupancy, lease agreement and the market developments. Overcoming such threats, project managers have to make sure that they use the most up-to-date planning programs and risk analysis techniques because it is only in this manner that they can ensure that the project proceeds as scheduled and within the limits of the budget.

2.1.3 Infrastructure-Integrated High-Rise Projects

Infrastructure Integrated high-rise projects are unique in that they incorporate key infrastructure amenities such as parking garage, transit interfaces and utility hubs into the high-rise development. The projects tend to be more challenging and risky compared to the normal high-rise projects mainly because they are dependent on the completion and coordination of the external infrastructure amenities within the deadline. The combination of infrastructure and high rises has been an increasing trend in Kathmandu Valley particularly in regions where the urban landscape needs to take away optimal utilization of space and resources (Kheir Al-Kodmany, 2023).

One of the key problems in such projects is timing the activities of the external infrastructure in relation to the construction activities. As an example, when a high-rise development has a parking garage or a transit interface a high-rise development could rely on the local government to permit the design and construction of the nearby roadways or public transportation (transit). Delays in the approval of such approvals or even development of buildings can bring about a sizeable inconvenience to the development of the high rise. Chitrangkumar Sureshbhai Chauhan et al. (2022) carried out a research on a mixed infrastructure-building project in Kathmandu and pointed out that the delays in getting the necessary regulatory approvals and liaising with utility vendors usually resulted in significant delays in the project schedule.

Infrastructure-integrated high-rise projects have high-risks in site logistics and infrastructure connectivity, as well. Combination of living systems such as water, electricity, heating, cooling and sewage should be strategically put in place so that all

other systems are coordinated and they work in the optimal manner. This could be the installation of a utility point in a high-rise; this would link on to the local power and water suppliers and this would ensure that the equipment of the building is connected to the already existing supply grid. Failure to do follow-ups or decelerate such integrations can in turn result in inefficiency, unnecessary expenditures and redundancy. These dependencies can be so complex that project management experience and tools may not be effective and the external out infrastructure systems would also require a thorough degree of familiarity (Sánchez et al., 2024).

The project managers of high rise buildings which are integrated with infrastructure should concentrate on all stake holders such as government, utility suppliers, contractors and even architects and make sure all levels are well coordinated. The system integration competence is relevant since the effectiveness on the operations of the infrastructure will be anchored on the level of integration by which the building system will be integrated by the external infrastructure. Also, thorough risk forecasting method is required in order to define and predict the dependencies which are outside the distance of the construction scope. This requires a lot of sight and planning and requires one to be flexible in meeting any unexpected delays or alternations of regulations (Torres et al., 2025).

Overall, high-rise in Kathmandu Valley infrastructural-based projects are a special predicament, as they are dependent on the external infrastructure-based machinery and their rights. Project management of such projects should have good degree of coordination, alignment of the stakeholders and proactive risk management strategy so that the project will not suffer much disruption.

2.2 Project Manager’s Role in Risk Assessment and Mitigation

The project managers will play a critical role in the construction of the high rise buildings to dissect the complexities of risk identification, risk assessment and risk mitigation practices to ensure that the project targets are met on time within the budget and of the required quality. Since the high-rise undertakings are complex as

they can be residential and mixed-use development, as well as infrastructure-integrated, the project managers have to look ahead and establish viable solutions to the possible risks at the initial stage of the project life-cycle.

2.2.1 Strategic Risk Assessment and Planning

Risk assessment should be the initial step in the conceptual stage and planning of high rises. It is here the project managers are supposed to define the scope of the project, set up the design requirements and develop strategies on how to purchase. It is a preliminary phase and at this phase, analyses of the potential risks should be carried out by the project managers which will serve as a backbone to the entire project. The initial process in this process is the development of risk register, which is a step by step document, which describes the risks identified, causes, possible effects and mitigation strategies. This register is up to date constantly during the lifecycle of the project as it is a dynamic tool to deal with changing risks (Kumar & Deep, 2023).

Qualitative and quantitative risk analysis should also be done by project managers. Qualitative assessment is that of the risk identification process based on expert judgment and the history compared to quantitative analysis to measure the likelihood and the effect that risks have on the project aims using statistical modelling. Using the two methodologies together will assist the project managers in developing a more in-depth picture of the risks involved and they can prioritize them according to the extent in which they may affect the project (Alexander, 2025).

The responses of risk should be in line with organizational strategy and project objective. Adebayo (2024) stated that the possibilities to respond to a risk and they are risk avoidance, risk mitigation, risk transfer, and risk acceptance. Indicatively, the seismic vulnerability is a high-priority risk in high rise development project in high-rise areas such as Kathmandu Valley. The project manager might resort to some of the risk control measures in such areas, which may involve the integration of the new earthquake resistant orientation, monitoring of the local seismic codes as well as the services of an earthquake design specialist engineer.

Shrestha et al. (2025) investigated the construction sector in Nepal and illustrated the significance of considering risk at the initial stage. They determined that cost overruns could be minimized (12-28 percent) by determining the risks during the planning stage of a project and including them in the risk identification process. This is especially relevant in high-rise building projects in Kathmandu where a characteristic of the place, the impact of earthquakes, and the break up of the supply chain is the order of the day. When all these risks are identified early, the project managers are able to institute the contingency plan within the cost and schedule base of the project and consequently increase the likelihood of effectively implementing the project.

Indicatively, unexpected variation of supply chains due to global scarcity of materials has been quoted as having resulted in much of delays and cost overruns in a residential high-rise project in Kathmandu. The risks in early stages would have been evaluated more closely by the project manager and meeting the suppliers during the planning process at an earlier stage would have accustomed the suppliers to evolve alternative ways of handling the supply chains, like local supply, or source diversification to prevent the delays (Shrestha et al., 2025).

In conclusion, strategic risk should be evaluated on the high rise projects, and be strategically planned. Project managers could play a key role in ensuring that the risk identification, evaluation and mitigation plans are integrated into the early lifecycle of the project that will lead to a more effective project implementation process, and reduced general exposure to risk.

2.2.2 Risk Prioritization and Resource Allocation

One of the most important things about dealing in risk management in construction works is risk prioritization when dealing with high-rise buildings. It helps project managers to identify high-impact, high-probability risks, and low-impact, low-probability risks and, therefore, to tackle the potential threats more specifically. The classification of risks and prioritization will allow the project managers to allocate the

paucity of resources that the project managers can command over time, money and human capital to the areas of need that should be tackled first (Titarenko et al., 2018).

Some of the tools that are typically used to classify risks by order of significance and that may be applied in the industry are the risk probability and impact matrices (RPIM), failure modes and effects analysis (FMEA) and Monte Carlo simulations. Acebes et al. (2024) asserts that these tools aid the project managers in assessing the likelihood of the risks detected as well as their implications that enable the project managers to take the most suitable decisions. RPIM is a simple yet effective tool which categorizes risks into many levels basing on the likelihood and impacts of risks and aids project managers in understanding what areas they should focus on during the mitigation process. FMEA is a methodology, which helps to define potential failure modes of the process and an evaluation of result whilst Monte Carlo simulations rely on statistical model and simulates various risk conditions and their potential outcomes.

Priorities of risk in the establishment of the high-rise construction projects in Kathmandu have to encompass a multitude of factors that are both unique. To begin with the seismic and environmental risks should be considered a priority. Kathmandu valley is also a seismic area and the possibility of generating an earthquake is also a significant risk to the constructions made in high rises. Therefore, project managers should be more concerned with the seismic risks in their plans, and incorporate the earthquake resistance designs consideration in their plans to ensure that the local seismic codes are achieved. Another major issue to take into account is labour and productivity risks as on most occasions building in Kathmandu depends on informal and untrained labor (Dixit et al., 2000).

Kumar Mishra & Aithal (2021) note that the project timeline and budget can be greatly impacted by spoilt safety and low productivity. Proper labour management, safety measures, and training should be regarded as priorities, therefore. The other serious threat is regulations and delays in permits which is typically unpredictable in Kathmandu scenario. The ineffectiveness of construction permits or following building

regulations could halt the project and increase expenditures. By foreseeing and prioritising regulatory risks, project managers would have the opportunity to invest in the relationship management with the local authorities and make the process of approval easier.

Supply chain uncertainties also rank highest among the risks, as the world is going through material supply disruptions, so are local logistical related problems. Delays and overruns in cost might be caused by unpredictability of material deliveries and fluctuations in prices. To prioritize this risk, project managers can make sure that they maintain a good relationship with suppliers and have a contingency plan of procuring material supplies of significance. With prioritization, resource allocation becomes of great significance in minimizing the threats which are identified. The key resources such as the safety experts, the quality assurance personnel and contingency budget must be utilized strategically. As an example, the risk connected with labour may be mitigated by creating more materials on safety training and quality control to ensure a building is of the required quality. The availability of contingency funds will also help in having financial reserve, which is going to be implemented in case of unforeseen issues during the construction such as change in regulations/supply chain disruption (Okika et al., 2024).

In conclusion, risk prioritization and resource allocation are extremely vital, to the success of the high rise constructions projects in Kathmandu. Project managers can be more effective when allocating resources to mitigate the most critical threats to the success of the project by risk assessment tools and priorities to the key risks, which include seismic hazards, labour issues, regulatory compliance and supply chain uncertainties.

2.2.3 Safety Risk Mitigation and Culture Development

High-rise construction projects pose significant OHS risks due to the involvement of manual labour, working at height and heavy items in the high-stakes safety concerns. According to Kumar Mishra & Aithal (2021), the most likely operations that were likely

to have an accident were the scaffolding operations that entailed the work to plaster, brickwork, and finishing. The tasks they are doing are high risk and they usually lead to falls, falling objects injuries and musculoskeletal injuries that would have on the project would put it to a stop hence cost will also go up. Speaking of which, project managers in this regard contribute a large portion to the safety risks mitigation as the safety of the workers themselves is a key factor in deciding how long the work will go on and how fairly the entire project will perform.

To prevent such risks in safety, project managers should contribute to the strategic safety training programs as an indicator of risk mitigation measures. Kumar Mishra & Aithal (2021) argue that the training programs must be comprehensive, and they should include such aspects as fall prevention, material handling safety, and proper using of scaffold. These programs are to be periodically implemented and adapted to the risks of the construction projects in high-rise buildings. To use give an example, the employees should be trained to secure the scaffolding, on the fall arrests, as well as the personal protective gear (PPE) like helmets, harnesses, gloves, and so on in order to prevent injuries.

The other important feature of the safety risk reduction is the introduction to utilize PPE. Neither is the use of PPE in Kathmandu construction where the informal labour practices aren't uncommon. It should be a strict necessity that the project managers must embrace in order that the required protective equipment are accorded to the workers. Such enforcement can be done through periodic safety audits, random checks and punitive actions towards non-compliance. Kumar Mishra & Aithal (2021) explain that an aggressive compliance with PPE protocol would assist in injury prevention and the conclusion that the organisation cares about the welfare of its employees can result in the outcome of building a more interested and productive workforce.

Together with short-term efforts to minimize the risks, there is a long-term strategy of reducing the risk, i.e., the creation of a safety culture that could considerably increase

the overall safety and productivity. A good safety culture is not just in adhering to safety regulations, but is in developing a culture, where safety is a part of the work process, and is treasured by all levels of employees. Project managers can instill such a culture by encouraging open safety communication, rewarding safe behavior support and the worker involvement in the making of the safety decision. When workers suddenly feel that their safety issues are being addressed, and they have a share of the safe working environment, then workers are likely to comply with safety, and giving an input to the safe working environment (Asghar et al., 2025).

An example includes a construction project in Kathmandu that embraced a safety culture program, which entailed the use of regular toolbox talks whereby the employees were free to share any problems they had as far as safety was concerned. As a result, the level of accidents in the project decreased considerably and the employees of the working group were uplifted leading to higher productivity. The program further involved a little training on the supervisor about leadership in order to help them become leaders by example and promote safety practice on the field (Asghar et al., 2025).

Finally, the keys to a successful implementation of the high-rise construction projects are in the safety risk management, and in the realization of the most effective safety culture. Implementing systematic safety training, introducing the use of PPEs and promoting the safety culture in the workplace, project managers could have managed to reduce the number of accidents by several folds, make the employees become much more involved in it and increase the rates of the productivity. A safety culture can not only decrease the immediate hazards, but also can be used towards the future success of the project and the interests of each of the parties involved (Tripathi & Yash Kumar Mittal, 2024).

2.2.4 Supply Chain and Procurement Risk Mitigation

Supply chain and procurement risks are very high in high rising buildings construction, especially where the imported construction materials are most likely to suffer a

significant amount of logistical delays as it happens in some locations such as Nepal. The procurement problems related to helping shortages of materials, shipping and cost delays, etc., are likely to implement significant interrupt on the construction process which may contribute to the delay of the project, raise cost and reduce project efficiency. Mitigation efforts of risks are needed to provide the materials timely and project schedules (NF Dyili et al., 2018).

Position risks of the border and customs clearances are commonplace in the case of Nepal where the majority of the construction materials are imported by neighboring countries. NF Dyili et al. (2018) point out that the procurement problems in the construction sector in Nepal will probably intensify with the presence of externalities and this may translate to the unplanned delays in receiving materials. The project managers should devise procurement strategies which involve a variety of sourcing options in order to contain such risks. By getting the materials supplied by other suppliers either locally or internationally project managers will be able to reduce reliance on one supplier and counter possible delays by the supplier. A good example is that of cement which is critical in the erection of high rise buildings, the project managers can source to other suppliers in Nepal and other neighboring countries so that should one supplier drag, the entire project is not crippled.

Other risk dealing strategies that could be used to overcome risks of supply chain are buffer stocks. The critical materials such as steel, cement and finishing materials should be kept in a way that this project will not be the victim of the temporary breakdown in the supply chain. It can be practiced more particularly with high demand materials that make long lead times as with foreign made electrical systems or specialized construction machinery. But, when it comes to keeping stocks of buffers, the big question is how the storage maintenance can be done in a way that keeps its costs minimal on top of keeping the material in unobsolete and good condition (Nel, 2024).

In addition to the traditional procurement strategies, the existence of digital procurement platforms, as well as inventory management, systems, can contribute significantly to enhancing the supply chain are transparent and responsive. The tools can additionally aid project managers in seeing and tracking the material availability, shipment statuses and managing the procurement activities in real time. Through the digital tools, there is also alignment of suppliers, contractors and project teams in coordination of ensuring that the necessary materials are ordered and they arrive on time. This can be illustrated by the fact that an online inventory management was implemented in one construction project within Kathmandu and this assisted the team to track the shipment of the materials, provide future forecasts of the materials that were to be procured and also to make amendments to shipment orders in regards to actual needs of the project. This ensured that the delays and cost overrun were reduced in the project because of shortage of material (Ali et al., 2024).

Lastly, logistics risk analysis is also among the activities that are highly critical in the supply chain to ensure that all the disruptions that might be experienced throughout the supply chain are identified and corrected. The project managers should analyze transport routes, customs process, availability of other means of transport so as to ensure that materials reach the construction site on time. Also, cooperation with logistics specialists may help to understand the disruption it might face due to the geopolitical situation, weather, or infra-structure jamming (Okika et al., 2024).

Decisively, the elements of supply chain and procurement risks are pivotal success factors in the deliveries of high-rise construction project. To make their supply chain resilient, project managers can resort to multiple sourcing, buffer stocks, digital procurement, and logistics risk analysis that would prevent such delays, shortages of materials, and price changes to impact the construction of a building (Okika et al., 2024).

2.2.5 Regulatory and Compliance Risk Control

The high-rise construction projects are also associated with high regulatory risks and in this case; the urban environment like Kathmandu where the building codes, seismic safety codes, environmental clearance and urban zoning are involved; all these are incorporated towards the structuring of this project. These are compliance guidelines which are meant to see to it that the buildings are safe, environmentally friendly and in accordance to the local zoning requirement. However, they also have the capability of creating huge time-consuming, and cost-related deterring costs unless they are managed properly (Mishra et al., 2021).

One such example with regards to Kathmandu where there is a regulatory intervention on the viability of the projects is Kathmandu View Tower. It was initially a multi-story commercial development but due to seismic safety studies only a few stories of the building were cut short as the study revealed that the project was likely not to be robust. It was a regulatory change, based on Nepal. earthquake-resistant building codes that were costly in design and created delays that ultimately impacted the overall viability and profitability of the project (Wikipedia, 2024). The case can also be relevant in highlighting the significance of active and holistic compliance with the regulations in the projecting cycle (Mishra et al., 2021).

Contact with the relevant regulation bodies by project managers should be continuous to eliminate the chances of regulations. This would be the interaction point with the local municipal offices, zoning boards and with the environmental agencies to make sure that all the permits and approvals are received in time. Early and frequent correspondence will help the project managers to anticipate the potential problems and overcome them before causing grave delays. An example is that it can assist in the prevention of last minute changes that may be in the project schedule when one discovers that the seismic safety tests or an environmental impact study requires some requirements that may have to be fulfilled in the earlier part of the design process (Mishra et al., 2021).

The other significant move towards regulatory risks management is to hire experienced compliance consultants. Such professionals are also imbued with local laws, codes and other best practices making them the one that would see the project to the desired level. In Kathmandu where the regulatory environment could be bureaucratic and subject to numerous changes, compliance consultants may guide project managers through the permitting process and make sure that the paperwork is sorted out and submitted prior to the due date. Professional advisory services may aid in such tricky areas as environmental clearances, centralization of cities, which will probably save time wasted in the approval process (Apooyin, 2025).

Besides this, project managers also offer anticipatory updating of the project documentation as well as consultancy of the regulatory bodies in the initial stage of design. This would be more flexible in case of any compliance problems which may occur, without creating serious disturbances to the project schedule. Another example is that, when new seismic safety regulations are involved; the project managers will be able to incorporate the new design and show the documentation on time, without delays. Maintenance of all records also comes in handy in maintaining the project on the right track in a changing regulation (Gil & Tether, 2011).

In summary, compliance and regulatory risks of the high-rise construction projects at Kathmandu need to be well planned and managed. Active communication channels with the authorities, involvement of professional consultants along with timely reading of documentation will allow the project managers to reduce the delays and cost of regulatory intervention and consequently implement the projects and comply with the provisions of the law.

2.2.6 Communication and Stakeholder Management

These other stakeholders include the government agencies, investors, contractors, suppliers, the community groups, tenants and environmental advocates who predominantly contribute towards the project outputs in the high rise construction projects. Stakeholder management and effective communication are highly required in

ensuring that all the parties are on the same page with the project goals, the project time frames and expectations. Mishandling in the form of delays, poor quality and heightened conflict can also occur due to miscommunication and incomplete involvement of the stakeholders and thereby affect the success of a project (Abdo Jaldesa, 2025).

Abdo Jaldesa (2025) argue that the failure to involve stakeholders regularly and in a thorough fashion is one of the causes according to which a schedule slippage and quality considerations emerge in high-rise buildings. Most cases lack proper awareness of the project progress by the relevant parties thus resulting in misunderstanding, unaddressed issues and actual resistance and opposition of the local groups or regulating bodies. One such example is a high rise project in Kathmandu which was extremely stalled when the local community foiled construction works in the pretext of traffic jam and environmental implications. It would have been alleviated through engaging the representatives of the community in planning and discuss their issues in the beginning.

To provide solutions to overcome these risks, it is proposed to cope with stakeholder engagement and through communication with the assistance of a number of strategies. The interactive workshops held at regular intervals to contact the stakeholders will help the project managers inform the stakeholders clearly on the project progress, provide and receive feedback and solve the problems in real time. Another result of such workshops could include collaborative ambience since all the stakeholders will feel that they were listened to and valued. Using a case in point, monthly meetings with the local authority and the community can be held to provide the transparency as well as to reveal the potential issues in advance i.e. zoning or environmental issues (Suvvari & Saxena, 2023).

The other helpful suggestions may include the stakeholder influence mapping wherein the interests, power along with the possible influence of the individual stakeholders are calculated as well as assessed. This is a tool that assists project managers in

prioritizing on the interactions within the stakeholders, and the type of stakeholders that can impact the most on the outcome of a project. The opportunity to negotiate the influence of stakeholders will give the project managers a chance to allocate more resources towards high-impact stakeholder management and mitigate risks associated with the concerns or resistance of those stakeholders (Suvvari & Saxena, 2023).

A detailed communication plan is another valuable tool. It explains the rate, avenues and medium of communication between the different stakeholder groups. The effective communication plan can ensure that the information of key value is delivered in a new, efficient and fast way reducing the risk of miscommunication. Using an example, real time updates, which can be ensured through digital means can inform investors and the contractors of the events in progress at any time, also of the challenges that may arise (Suvvari & Saxena, 2023).

Lastly, the conflict resolution system development will assist in ensuring that the conflicts between the stakeholders will be resolved in the quickest and most effective possible and that they will not escalate into the serious issues. The risk management framework of the project can also include conflict resolution measures, including mediation, or arbitration, which would guarantee the project members that the disagreements will be addressed in a reasoned and prompt way. Such strategies will enable the project managers to control the expectation of the stakeholders, conflicts and delays and the project will be easily executed and the overall project will be even more successful (Hassan et al., 2025).

2.2.7 Technological Risk Mitigation

Risks can be mitigated to a significant degree by the introduction of the higher digital technologies into the construction of high-rise buildings as it will allow better coordinating the project, increasing its visibility, and forecasting capabilities. The technologies are changing the manner in which the construction projects are managed like Building Information Modeling (BIM), project dashboards (in real time) and computerized schedule tools are transforming the way the construction projects are

managed and it has become easy to know what risks may transpire and mitigate the risks before they occur (Manzoor et al., 2021).

BIM is also very useful with respect to the risk management of designing and building structures. BIM is used in the preparation of digital representation of the building and this is a combination of architectural, structural and mechanical elements that can be clashed before the commencement of the construction is carried out. The technology assists in determining the possible incompatibility of building systems like plumbing, and electrical wires and rectify them during design stage, thus saving the costs involved during construction on retrenchment. One such example is a high-rise project in Kathmandu when the electrical and plumbing systems caused conflict, BIM was used to reveal the conflict and it changed the design in its early stages, hence saving the time and cost. With the implementation of BIM in the construction of a high-rise chances of costly delays and inconveniences that found their way into construction due to design flaws and construction issues are reduced (Manzoor et al., 2021).

The other technology option to assist in alleviating the risks would be the project dashboards in real time that will provide the project managers with real time updates on the status of the project elements such as the budget, timeline and allocation of resources. These dashboards are an amalgamation of various project functions hence enabling the managers to have the capacity of tracking and pinpointing probable stalling or difficulties at a young age before they snowball. Here, presence of a project manager with a real time dashboard can know in real time in case there is a delay in the delivery of materials or in case a specific activity delayed by the construction team and hence he/she can take the right actions immediately. In a study done by Acharya (2024) it emerged that project dashboards in the developing world assisted in the enhancement of the effectiveness of the construction projects of high-rise buildings in the improved coordination of the various teams and stakeholders involved (Umana et al., 2022).

No scheduling of automated tools are also necessary in lessening the risk involved in scheduling. They are real time and dynamic scheduling tools that you input past data, parameters of the project and real time inputs in building and updating project schedules. Automated scheduling involves the optimization of the project schedules, minimization of the delays and maximization of resources that is utilized. They will also be able to run on the other project management programs and each group will run on the latest schedule data. An example is automated scheduling in a high rise project in Kathmandu which needed to re-align the schedules to enable the supply chain to delay delivery to other activities to avoid unnecessary delays (Umana et al., 2022).

Finally, the use of the latest technologies in the form of BIM, real-time project boards and automated project schedulers also play a crucial role in addressing technological risks when building high-rise buildings. Such tools make the risk more visible, improve coordination, and proactive decision making, and consequently improve the project outcomes.

2.3 Theoretical Framework for PESTEL Analysis in High-Rise Construction Projects

PESTEL analysis is a strategic tool that helps in the materialization of the macro-environmental forces that can influence a project or business. PESTEL analysis would also be invaluable in the high rise construction of Kathmandu Valley as it would determine the operations risks that were involved during construction of the high rise. The model takes into account the Political, Economic, Social, Technological, Environmental and Legal aspects that might affect the construction process, project timelines and outcomes (Pan et al., 2019).

2.3.1 Political Risks

The high-rise buildings construction works are highly relying on the political processes, particularly in the areas like Kathmandu valley where political climate can adopt the urbanization process. Uncertainties and delay in the process of receiving permit or government policies to construct could be introduced by political instability, change in

regulations and government policies. The high-rise developers in Nepal have commonly been influenced by bureaucracy because of the colorful Nepalese political scenario. In indicative terms, any kind of delays in the process of obtaining construction permits and building approvals due to change in priority of the government can have a direct influence on the project schedule and cost (Kola Olayiwola et al., 2025).

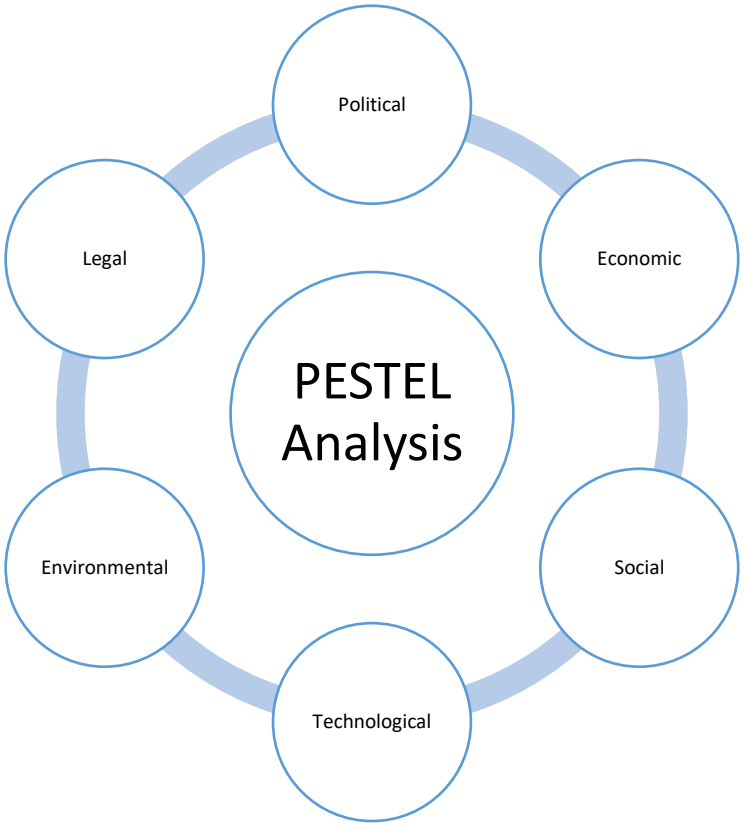
In addition, the political dimension is also one way of hindering effective execution of a project, through corruption or even absence of transparency during the regulation process. In the case of Kathmandu View Tower, the abrupt change in the regulations and seismic safety is a good indication of how unpredictable the political risk of the Nepalese construction industry could be (Chang et al., 2018).

2.3.2 Economic Risks

Economic state of affairs is one of the factors that make high-rise construction projects a success. Such fluctuation in interest rates, inflation and general economic climate, in a developing country such Nepal, can impact material and labor costs and funding. One of the examples includes the border blockade in Nepal of 2015-2016 that demolished construction supplies transportation, provoked shortage of supplies, skyrocketed prices, and hours spent in traffic jams were observed in numerous high-rise buildings construction (Kola Olayiwola et al., 2025).

Other factors such as the fluctuations in the foreign exchange may also influence the economic viability of the projects in cases where the project is utilising imported materials and equipments. Economic crises/recessions would also possibly diminish the demand of high rise premises especially the commercial or mixed use developments to accelerate the chances of the returns on the investment of the developers may require a long time (Anireddy, 2024).

Figure 1. PESTEL Analysis (Kola Olayiwola et al., 2025)



2.3.3 Social Risks

The community social factors, existing supply and social spirit of workforce might have dire negative effects on high rise projects. Unexpected opposition among the local populations, particularly in the densely populated areas is another challenge that is widespread in Kathmandu. In most cases, the locals resist high rises since they are concerned that there would be more traffic, noise or sunshine and privacy would be compromised. This opposition could drag down projects and developers would need to bargain on lengthy and compromised designs or construction techniques (Kola Olayiwola et al., 2025).

In the labour front, the high rise building in Kathmandu relies a lot on informal labour with numerous workers who have not received the safety precautions. This lays bare the threat of occupational harm that can result in time wastage, lawsuit, and fines. Another issue that has made work in a problematic area of scheduling is seasonality of

labor supply as the workers may relocate to other regions during a growing season (Mishra, 2022).

2.3.4 Technological Risks

The technological risks involved in the high-rise construction are related to the availability and utilization of the high-level construction techniques, equipment and management software. Whereas new technologies, such as Building Information Modeling (BIM) and automated scheduling systems could be devised into improving the efficiency of a project, they have not been offered to the Nepalese market due to its financial and technical constraints. The non-availability of the latter machines and operators of the heavy equipment is one of the reasons why the probability of the equipments failure is such a big one, and this results in the postponements and cost growth of the project (Kola Olayiwola et al., 2025).

In addition, the unavailability of digital tools to track the real-time and control the project implies that it would be difficult to track the progress, identify the risks in advance and take the appropriate action to rectify the situation. Any postponements or unexpected alterations to scope of supply chain deliveries would be hard to deal with absent these technologies and it is interesting to note that developers should take into account the application of the latest technological applications in the management of project risks (Onyia et al., 2024).

2.3.5 Environmental Risks

The external environment, particularly construction related to the seismic vulnerability at Kathmandu and seasonal weather are highly perilous to high-rise constructions. The ease of the Valley to earthquakes necessitates that it should be exposed to earthquake resistant construction designs that make the construction extremely costly and bulky. The case in point is the 2015 Gorkha earthquake, which resulted in a lot of destruction of buildings and construction sites; therefore, it is clear that the seismic risk needs to be constantly monitored and that the new building codes should be adopted (Kola Olayiwola et al., 2025).

Along with this, difficulty of constructing it during the monsoon season can be listed as heavy rainfall, landslides and soil erosion that can slow down the process of constructing it and destroy the material. The vulnerable areas to such environmental hazards include places near rivers or steep areas. Flood resistant foundations and improvement of drainage should also be highlighted to be used in all the high rise development to mitigate the effect of the development (Onyia et al., 2024).

2.3.6 Legal Risks

Legal issues in constructing high rise buildings cover adherence to building codes, zoning ordinance, green laws and labor laws. Given the current condition in Kathmandu where the regulatory frameworks are likely regarded to be inconsistent and unreliable, non compliance to these legal requirements can have drastic consequences; i.e. project suspension, financial fine and worst still project suspension. It can also influence the time frame of the project and project feasibility in case regulatory issues replace them, such as restricting zoning or height of buildings (Kola Olayiwola et al., 2025).

As an illustration, the Kathmandu View Tower had significant setbacks with implementation of height allowing limit after the 2015 earthquake. This regulation not only had an influence on the restriction of maximum height of the building but also led to additional expenses and wastes of time, as the project had to be redesigned to correspond with the new legal acts (Arya, 2016). In addition, the legal risks on labor, i.e. the disagreement concerning the rights of workers or the violation of the safety standards, can lead to the costly legal suits or strikes that, on the contrary, will slow down the progress of the building development.

To mitigate these legal risks a proper knowledge of the legal environment in the early life cycle of the project lifecycle should be formed. This incorporates utilizing legal professionals and specialized people on the initial informed level in order to ensure that legal preliminaries are well defined and implemented to the project planning and execution (Arya, 2016).

In summary, PESTEL analysis of high-rise construction projects in the Kathmandu Valley is a systematic way of determining the different external factors that determine the outcome of the project. All the six components, Political, Economic, Social, Technological, Environmental and Legal have their own challenges and risks and need to be mitigated using specific strategies. The awareness of these macro-environmental variables will aid the developers and project managers to predict the issues in the project at an earlier stage in the project lifecycle, in allocating the resources effectively and in taking the initiative to deliver the high-rise construction project on time and at a reasonable cost.

Such risks should be developed systematically not only will this enable the developers to safeguard their investments but the sustainable urban development in Kathmandu Valley as well. The PESTEL knowledge should be integrated in strategic planning and management of the project risks in order to implement the project successfully.

3 Research Methodology

In this chapter, the research methodology of this research is described. It begins by discussing the philosophy of the research which forms the foundation of this research and then gives an account of the research strategy and approach to be applied. The chapter continues by outlining the specifics of data collection and data analysis processes in detail that gives some insight into the way the research should be conducted. In addition, the validity and reliability are also considered so that the findings of the study could be robust and credible. The chapter ends with an extensive overview of ethical concerns of the research process.

3.1 Research Philosophy

The philosophy of research will specify how the research problem will be addressed which will be influencing the data collection methods and the methods of data analysis (Gamage, 2025). In this paper, the external challenges to building high-rise buildings in Kathmandu Valley are analyzed under a PESTEL (Political, Economic, Social, Technological, Environmental, and Legal) analysis framework. The study uses a critical realist approach with recognition that the society and institutional structures are important in the creation of the external environment of construction projects. The school of thought is based on interaction of the mentioned macro-environmental forces and their influence on operations and risk management strategies of construction companies.

The research follows an interpretivist paradigm, grounded in constructivism, to understand how different stakeholders, such as project managers, engineers, and regulatory bodies, perceive and respond to the PESTEL factors. The focus is on how these external influences impact the operational risks and decision-making processes during the implementation phase of high-rise building projects. The study addresses the gap in existing literature, which often overlooks the operational risks associated with such projects, instead focusing on structural and financial uncertainties (Gamage, 2025).

By utilizing a qualitative case study approach, the research seeks to document the lived experiences of industry experts and provide a deep understanding of how political, economic, social, technological, environmental, and legal factors shape the construction landscape in Kathmandu Valley. The study's aim is to fill the knowledge gap regarding the operational risks faced by construction projects in this rapidly urbanizing region and offer actionable insights for future projects (Gamage, 2025).

3.2 Research Approach and Strategy

The qualitative type of study method used in the study is a case study analysis but incline with a special bias towards the qualitative type of study as one of the methods used to identify the lived experience of the respondents. Techniques in research are very crucial in order to ensure that data collection and analysis is accomplished at a systematic level. There are typically two research approaches: the deductive research approach that with most of the times is compatible with the quantitative research and the inductive research approach which is mostly compatible with the qualitative research. The deductive method is founded on testing hypothesis or theory but the inductive one begins with blanket observations and moves towards some cases, which can end up creating a theory. The best research method that can be utilized in accordance with inductive methodology is qualitative research since it can be used to collect personal points of data to build new theories or knowledge (Mtisi, 2022).

Inductive method was adopted in this work as the qualitative nature of the study endeavour is to comprehend the different external offshoots i.e., political, economic, social, technological, environmental and legal (PESTEL) forces which are engaged in high-rise building projects in Kathmandu Valley. It offers a sufficient room to explore the experiences, thoughts and concerns of the different stakeholders in construction projects in a holistic fashion that would otherwise have been easily measured in a quantitative approach. The study does not attempt to test the hypothetical premonitions alternatively it attempts to find the trends and insights which are cut out of the information. The qualitative study particularly comes in handy where the objective is to gain better insight into a given complex phenomenon, such as the

operational risks in high-rise building, in which a variety of external and internal elements combines dynamically and remains context-specific. Qualitative research, as Mtisi (2022) say, is interested in exploring quality, situation, and nature of events, especially in the social and organizational settings.

The approach of research is qualitative, and its emphasis is on the case study method. This approach was selected since it will be feasible to elicit more detailed and contextual insights regarding the operational risks of high-rise buildings projects At Kathmandu Valley. Case study method is particularly useful when the study deals with the phenomena found in a natural environment, and there are no specific demarcations between the phenomenon and the context (Yin, 2018). Through questionaires from industry professionals, construction stakeholders and project managers, the goal will be to collect soft information of how the various construction industry respond to operational risk to the response to all the PESTEL factors to the Kathmandu Valley construction industry.

Although qualitative research outlines detailed and contextual based data, it is limited. Because of the latitude of qualitative data collection, the qualitative data may be subjective to inconsistency and interpretation particularly with curd or vague responses. Additionally, qualitative studies are time consuming and can hardly be generalized to a huge data to make generalizations. However, the breadth and depth of the information that the qualitative techniques yield offers an insight that is not possible through quantitative research (Gamage, 2025). The information made available through the application of qualitative research gives an enormous context and understanding especially when assessing an issue of more complexity such as operation risk in construction projects where a variety of aspects needs to be considered.

3.3 Research Design and Sampling Strategy

The Research design is significant in defining how the research will address the research questions and objectives. The qualitative case study research design informs

this paper because it aims to examine the operational risk(s) of the high-rise buildings development in Kathmandu Valley. Case studies are useful to study complex phenomena in their natural environment and especially when there are no apparent boundaries between the phenomenon and the surrounding world (Yin, 2018). The case study approach will facilitate the in-depth investigation of the socio-cultural, economic and environmental problems which construction industry in Kathmandu is exposed to and in particular in the context of the severe urbanization and increase in demand towards the vertical construction. This will provide a convenient platform through which the intricacies of the stakeholders in the industry like the project managers, engineers and the regulatory authorities can understand and discuss the operational risks as they adapt to the external PESTEL environments.

The sampling technique of the research will be guided by a concept of purposive sampling in which the sample will be chosen by their relevance and expertise when it comes to the objectives of the research (Tajik et al., 2024). The professionals that take up high rise construction project in Kathmandu valley like project managers, architects, engineers and government officials that undertake urban planning and regulation will be considered in the study. The nature of the operational risk of high-rise building projects will already be familiar to these respondents, who will then be able to contribute some valuable information about how these risks are mitigated considering the local social-economic, political as also environmental factors. Open ended questionnaires: rich, in depth information will be obtained using open ended questionnaires and the experience, perception and strategies of respondents dealing with operational risks are free to be discussed.

It will be based on the small target group and case studies in high rise building projects in Kathmandu. The methodology is not directed towards extrapolation of the results on a greater population but simply as a challenge in seeking a holistic understanding of the operational risk management practices applied in specific projects. The case study design and purposive sampling approach will be used to develop a rich description of the practices of the construction sector stakeholders to balance the dynamics of

operational risk, regulatory forces and resourcefulness in the Kathmandu urban development specific problems (Yin, 2018).

3.4 Data Collection and Analysis Methods

At The use of a process that collects accurate, reliable, and structured data to find answers to the research questions and to obtain the targeted results is called data collection. In context of determining the credibility of the conducted research, research integrity and validity are of utmost importance. Data can be gathered in 2 ways; Secondary and primary. Primary information is obtained by the respondents themselves, but secondary information is retrieved by the already existing sources, a lengthy task, as well as resource-intensive (Taherdoost, 2021).

It covers the operational risks the high rise building projects of Kathmandu Valley which has been examining how external issues such as; political, economic, social, technological, environmental and legal (PESTEL) factors influence risk management strategies. Data will be collected using qualitative based data collection methods because they are apt since the research will seek to understand the complex nature of operational risks in construction. The questionnaire will cover responses with the most important stakeholders in the construction sector, such as project managers, engineers and government officials to come up with an insight into their experience and how they deal with operational risks. Open-ended questions will be utilized to enable participants to provide details on their opinions creating a deep rich comprehensive data set of information on how these risks are addressed in the midst of the rapid urbanization of Kathmandu and its regulations (Taherdoost, 2021).

The qualitative research is particularly effective upon revealing the complex phenomena when we are interested in knowing about the experiences, beliefs and perceptions of the people that act within a given sphere of activity. In this analysis, the thematic analysis method is the method that will be applied in calculating the data. Thematics analysis will provide a framework that would aid in unravelling patterns, themes, and common concepts in the information, and this is critical in understanding

how operational risks are managed in the high-rise construction environment (Taherdoost, 2021). The approach would guarantee that the research would be able to generate significant data regarding the effects the different PESTEL issues have on the operations decisions undertaken by construction management and professionals in Kathmandu Valley.

Thematic analysis is quite variable and could be shaped to infer specific themes that are relevant to the research, such as risk management, regulatory compliance and sustainability in building practices. Yet, it should be addressed with cautions so that the realized themes could be presented with the consistency of elaboration and logical manner. Even though the thematic analysis could be a very useful tool to unveil more profound insights, one must consider that this method may also introduce some bias or discrepancies and that all those will have to be addressed when examining the data (Polat, 2025). Despite these challenges, the thematic analysis will be the best tool to use in analysis of the qualitative data in the study since it will provide in-depth understanding of the situation of the management of the operational risks of high-rise building projects in Kathmandu Valley.

3.5 Validity, Reliability, and Ethical Considerations

The validity and reliability of the research instruments play a vital role on a research that leaves the accurate records of the phenomena that are under study. A concept of permanence and inferential consistency of measurements in places at different times, or of the measurements of the same tool of different types, is known (in measurement theory) as reliability. Test-retest reliability where respondents are administered the same test at a later time to test reliability is used in the current study to establish whether the same respondents give the same answers after a given period of time (Taherdoost, 2016). Validity will make sure that what is being measured with the help of the research instrument is in fact what is intended to be measured and that it is also in a position to distinguish the variables of interest and that they can be based in theoretical frameworks. The issue of validity is a sensitive one to qualify as qualitative research since it is by the experiences and perceptions of the participants that one will

make decisions thus reducing the chances of distorting the reality of the research. Validity and reliability are important to guarantee the integrity and strength of findings of the study.

Though, reliability is still a major aspect with respect to qualitative studies, more emphasis is normally given to credibility and authenticity of the results. This is whereby a continuous and smooth narrative is created out of the real life experience of the subjects in the real world. In the given research, bringing together the mission to scrutinize the operational hazards of high-rise building projects, the delivery of research-based findings and inferences, which effectively indicate the lived lives of the construction professionals, is the aim (Taherdoost, 2016). It should be noted, though, that the bias may sometimes be created not only by the researcher, but also by the participants and it can make the results difficult to validate. To the lowest possible level, bias should be reduced but there is to some degree an inevitability of bias in qualitative research. Therefore, to minimize those risks and maximize the validity of data collection, such measures as insuring the anonymity and encouraging free communication with participants have been implemented (Yin, 2018).

Qualitative research has a limitation with the small sample size which poses a challenge in the generalization of the results. Considering the fact that the study is going to be carried out with the help of a few respondents, the opinion of each of the respondents will be meaningful to the analysis process. This will give additional depth and context to the information and also limit the ability to generalize results within a larger population. Accordingly, their conclusions, although insightful in their understanding of the risks of operational activities that were present in high-rise building projects, should be regarded as circumstantial and inapplicable (Subedi, 2023). The limitation is identified and the outcomes given as they are applicable to such or similar environments, but may not be to all or all construction environments.

Also, qualitative research is subjective in nature and the researcher can be hardly subjective. To minimize biasness of the researcher, a heavy and straightforward data gathering and analysis system was employed in the study. The integrity of the data was

ensured through fostering trust to get unbiased and crude feedbacks on interview making it less likely that the researcher would affect the answers (Boudes et al., 2020). The influence of etiquette was embedded into this process and subjects were informed of the research aims and objectives, their consent was obtained and their privacy was guaranteed throughout the investigation (Subedi, 2023).

In this study, informed consent, privacy and confidentiality issues were observed in comparison with the ethical considerations. The participants were informed of the intention of the research, how the data that they had provided will be used and was given an assurance that he could pull out of the study at any instance without any repercussions. Of special concern was the sensitivity of the data collected in the context of the high-rise construction practitioners particularly the pressure that they may experience in balancing the operational risks and compliance and financial constraints with the regulations. The integrity and credibility of the data would not have become possible without the ethical openness and sensitivity of the participants, which helped to create an environment where the participants were comfortable enough to share their experiences and insights (Al Habsi, 2024).

4 Reseults and Discussion of the Study

This chapter presents the results of the open-ended questionnaires. The case company's participants were asked to share their views on the operational risks on high-rise building construction projects in the Kathmandu Valley. This chapter will therefore present their views and thus the key findings and results.

4.1 The Empirical Results from the Case Company

The empirical data in this section will be attributed to interview with the very important stakeholders in high-rise construction projects in Kathmandu Valley. These were project managers, engineers and other professionals who were involved in construction and management of high-rise buildings. Their answers give a great insight into the issues encountered during the operational side of the construction stage and how these issues are affected by the larger political, economic, social, technological, environmental and legal (PESTEL) influences.

4.1.1 Operational Risks

The respondents have set up certain operational risks that affect the construction process and have vastly brought into the limelight the seismic risks. The Kathmandu Valley is located in a seismically active region and this has significant consequences towards planning and execution of construction projects. When one of the respondents said:

> *The seismic risk issue, i.e., the need to offer all the safety measures should be considered the most significant in construction, as it should be relevant to the high needs of the post-2015 earthquake.*

This response underlines how dire the need is to have advanced seismic surveying and use of sound structural designs to aid in containing such dangers. In high rise buildings, it is essential to consider seismic safety as an important factor in maintaining stability in a place where earthquakes are prevalent. The respondents emphasized the need to

adhere to safety measures and difficulties of integrating the recently emerged engineering innovations just to deal with these seismic hazards.

4.1.2 Workforce Management

The other significant challenge was in the form of workforce management. The lack of skilled labor, especially in terms of such specialized work as electrical work and the operation of cranes, was a common characteristic of the respondents. The project manager commented:

> *There are labor shortages including the skilled labor like the electricians and crane operators among others which we normally have to rely on our neighboring area to supply us with inefficient laborers, thus this poses a problem of skill gaps or gaps in skills.*

The reaction shows how problematic it is to keep a qualified and experienced workforce, and this issue might directly impact both the quality of a construction project and its timeline. Also, depending on external laborers poses issues concerning the lack of uniformity in competence, further hindering the construction process. The lack of the vocational training programs, which could help to close the skill gap in the local job market, exacerbates such issues relating to labor.

4.1.3 Occupational Health and Safety (OHS)

The issue of occupational health and safety (OHS) became extremely pressing to the respondents. The value of healthy working environment was stressed and the problem with implementation of the safety regulations on the ground in particular was highlighted. One of the construction engineers said:

> *We do have a thorough OHS plan, but the practical side of this will be implementation whereby everyone at the site will be adhering to safety.*

This response is eye opening to the degree of safety need, yet the implementation of all the layers of the work force is an enormously huge task. Compliance with OH

standards is one that is vital in accident prevention and fostering the welfare and health of workers. The principles of consistency highlighted by the respondents in regards to monitoring and supervising to ensure that safety measures are being implemented are particularly important given the fact that there is a peren that is continually evolving and untrained labor force.

4.1.4 Site Congestion and Urban Environment

Kathmandu city presents more compound problematic situations to construction projects especially the site overcrowding and logistics. It has small streets, and overcrowded infrastructure that makes transporting building materials and people a crashing point in the meager streets and congestions of the city. One respondent explained:

> *The Kathmandu narrow, street is a nightmare, regarding delivering the materials, we are always in a fuss because of the traffic jam and, thereby, contradicts the whole construction plan.*

This has been crucial in the face of the geographical and infrastructural constraints to the construction projects in Kathmandu. The high urbanization rate and geographical reduction of Nepal places the significant burden of logistics and the supplies resources are delayed while the delivery of the most significant supplies is slowed down contributing to the tardiness in the project. According to the respondents, with proper planning and coordination the challenges could be mitigated by coming up with other forms of transport or other new ways of ensuring that disappointments caused by jamming were avoided.

4.1.5 Supply Chain and Procurement Risks

The issues that were most dealt with were supply chain risks and procurement risks. Challenges in the sourcing of materials were cited as a problem to most of the respondents, particularly because Nepal is a landlocked country that depends in imports. Based on one procurement manager, it was:

Being a landlocked country, we have the delays in receiving materials, especially steel and cement and this affects on our project schedules. To keep costs low, we are at times forced to substitute materials, which may undermine integrity of the structure.

This reaction gives a picture of what pivotal procurement issues the construction sector in Nepal has. The duration it takes to receive materials such as the need to change material that is limited by budget constraints and the resulting impact on the quality and safety of the construction have been an issue of concern. Besides, political and economic factors, including international trade agreements, tariffs, and uncertainty to the stability of the supply, can be applied to regulate such supply chain concerns. The respondents observed that these procurement risks are one of the components of the developing country construction in which access to the global markets is not high.

Overall, there is empirical evidence in the case company that reveals and brings to focus some interrelated problems that have influence on high rises construction works in Kathmandu Valley. The data given by the interviewees demonstrates how complicated the construction in the economically developing, geographically restricted and seismically active area is. These challenges are influenced by a set of the operational, social and environmental factors and are relevant in appreciating the bigger picture of the implication of the construction projects in the region.

4.2 Discussion of Empirical Research Findings

Empirical research findings are strongly supported with the aid of theoretical background based on the PESTEL (Political, Economic, Social, Technological, Environmental, and Legal) analysis. This framework can be applied to give an overall analysis of the informal- factors influencing the high-rise building projects in Kathmandu Valley. The findings based on the respondents will show the multi faceted nature of challenges that the construction process takes and how they interact with the forces that the region is exposed to.

4.2.1 Political and Economic Factors

According to respondents, the political and economic factors were always mentioned as significant on the construction industry. The dependence on imported materials exposes Nepal to changes in the world economies such as fluctuations in international prices, tariffs, as well as the stability of the trade routes. One respondent explained:

> *This implies that, as Nepal will be relying on imports to bring the materials required in its constructions, we must be sensitive to global pricing fluctuations, and the fact that no political stability will only make matters worse.*

This observation underscores the weakness of the construction business to the fluctuations of the economy, not to mention the political instabilities. Political issues such as a change in policy by the government can disrupt the supply chains, delaying the availability of necessary supplies, and making supply chains more costly. In the meantime, economic factors, such as inflation, changes in the value of currencies, come as an extra source of budgeting and project planning uncertainties. These political-economic processes accentuate what is weaker in construction supply chain in Nepal and what requires more solid procurement strategies to become more resilient to absorb the instability of the political and economic environments.

4.2.2 Social and Cultural Factors

In construction workforce in Nepal, social and cultural environment play a big part in the determination of this workforce. The cultural and social factors, especially, the generational movement in career choices as pointed out by the respondents, compound the situation of lack of skilled labor. According to one of the project managers, it was said as:

> *The difficulty in acquiring skilled labour is that culturally there is British reluctance to take construction work but the white-collar works, which the younger generation enjoy doing are preferred.*

Here, a very important social issue- the social image of construction work, is highlighted. The young generations have a tendency towards room jobs or office jobs lest they end up in the manual or expert jobs in construction. Accordingly, management of a talent workforce is also a challenge in the industry and has directly affected the efficiency and quality of construction projects. Moreover, the absence of vocational training campaigns also contributes to the widening of the skill gap as it is challenging to develop a new generation of employees with technical skills needed to perform complicated constructions. In addition to the fact that the change in this culture weakens the formation of the labor force, it may even stall the entire industry because the demand in competent workforce is greater than what is offered.

4.2.3 Technological Factors

Technological development particularly in respect to increasing the safety standards and efficiency of the activities were among the potential answers that the construction industry sought in a way to address some of the issues that it had. However, the utilization of new technologies is often limited due to financial issues and limitations. One project manager specified:

> *To counter seismic risks new technology can prove useful; however, the cost of such systems is high and we cannot afford it due to our budget. We use its old fashioned ways which may not work in long term.*

This response demonstrates that there exists a discord between what can be acquired with the technological events such as a more advanced safety system and what can be acquired with the budget. Construction industries, particularly those where the financial means are limited like Kathmandu, have no option, but to employ the old methods of construction that are not effective to address the modern risks. This shows the need of having cost-effective technological solutions that may enhance safety and efficiency without surpassing the economic abilities of any construction companies. In addition, the respondents also cited that technology can also be a very big enabler in terms of combating seismic risks, but there is a necessity to balance both investment

prioritization as well as availability of cheaper solutions that can fit the local environment.

4.2.4 Environmental and Legal Factors

There are other environmental and legal issues that are also critical in defining the construction landscape in Kathmandu. Among the most prominent issues that can be linked to the seismic activity are environmental issues because of exposed nature of the area to earthquake. According to one of the respondents:

> *A legal change in the codes of seismic resistance resulted in increasingly rigorous codes since the earthquake. Our buildings should be able to endure tremors and this is not easily possible when we consider building in the past in the primitive manner it was done.*

This observation brings out the dynamic legal status that is inclined towards more demanding conditions towards the seismic resistance in the construction industry. Although the regulations are necessary in deciding safety, they also create extra financial and logistical taxations to construction companies. The increased legal demands compel the industry to change and transform, and the inaccessibility to newer and better technologies and the seniority of the construction practices, leave the compliance as a hazard. With Nepal still experiencing the seismic threats, environmental issues like seismic safety will be a focus in the design, materials and construction procedures adopted in high rise buildings.

In addition to seismic issue, the law environment surrounding the construction is also not flawless and requires certain more strict rules concerning various issues, including safety levels, environmental friendliness and labour. This new system of regulation can affect the compliance cost as a cost increment and delays, but the ultimate solution is to come up with safer and resilient buildings. The challenge however lies on how to adapt to these changes in such a way that will bring about safety, cost and efficiency.

5 Summary and Implications

This chapter gives a brief summary of the summary of research and then a discussion of theoretical implications of the findings follows which is on the basis of PESTEL analysis framework. It then gives the managerial implications and examines the policy implications based on the study findings. Finally, the chapter addresses the limitations applied in the study and recommendations to be made in the future research.

5.1 Research Summary

In this research study, the risk assessment and mitigation during the building projects in Kathmandu Valley, Nepal is discussed. Using some of the significant operational challenges, the study clearly highlights how prone the risks of seismic activity, workforce, occupational health and safety (OHS), site congestion and procurement are. The report is founded on the interviews with the project managers, engineers and other construction experts who work in high rise projects in the region.

The seismic risk in the area of Kathmandu that is situated in a mining earthquake zone was listed on the list of most remarkable issues. The participants emphasized that including the application of advanced seismic safety to construction activities, especially following the 2015 earthquake, is extremely important to ensure structural resilience and stability. The use of modern engineering methods and technologies to deal with these risks proved to be a common reply, but financial constraints in many cases, can limit these innovations.

The other major issue is related to the management of workforce, especially the lack of skilled labor. This is exacerbated by a training imbalance, and a culture of whites migrating to white collar jobs at the expense of manual workers that leaves the external workforce uncredentialed and of low performance that may not be up to the standards required. This kind of workforce shortage directly impacts on the project schedules and quality.

Another significant feature in the study is occupational health and safety (OHS) issues. Although the safety plans were there, according to the respondents, the issue of safety practices in real locations of construction site is still a big challenge. This issue is augmented owing to the sporadic surveillance and semi-annual modifications in labour force. The infrastructure in Kathmandu that has a narrow street system, as well as being congested, also complicates the construction projects. Sometimes, traffic also results in hampering of transportation of materials, thus delaying and creating inefficiencies. This is particularly troublesome in a city that is rapidly urbanizing, where construction and delivery space is in more and more restricted.

And lastly are other supply chain and procurements challenges. Nepal is a country that is landlocked and therefore basic material used in construction such as cement and steel is not imported on time. These delays, coupled with the need to seek alternative that should be economical to adopt at other times, compromise structural integrity of buildings.

This study finds that these operational, environmental, social, and legal issues combine to present an intricate construction environment in Kathmandu Valley. To address these issues, it should be brought with a mixed approach that has been better managed with, better training, more focused in technology and improved regulation systems to minimize the risks and assist in the development of the high-rise projects to materialize feasibly.

5.2 Theoretical Implications

The study contributes to the theoretical framework on the management of construction risk, within the high-rise buildings project in developing countries. It takes the most significant models and risk management approaches to the next level by introducing them to the unique legal and regulatory challenges that can be witnessed in Kathmandu Valley. The study is based on the developed theories of risk assessment and management, especially in the construction industry and puts them into perspective in a local context. Among the notable contributions towards the

development of theoretical models is the adaptation of these models in the quest to tackle issues like conformity to emerging building codes and seismic requirements which are major concerns in the safety and maintenance of the high-rise in seismically prone areas.

In addition, the research emphasizes the need to incorporate environmental risk factors in construction risk management theory, especially in the regions where natural calamities are common. Tracing down the defects of the regulatory frameworks and the following implications on the viability of the construction processes, the given research will provide the insights of utmost significance as to the interaction of the regulatory frameworks on the local level and the success of the construction projects.

5.3 Managerial Implications

The research within the context of the managers indicates the need to make the construction companies actively alleviate legal and regulatory risks. The managers will ensure that their projects meet all the local regulations, including zoning, building and environmental requirements. The results indicate that the project managers ought to initiate early consultations with legal specialists and take part in extensive risk analysis prior to construction initiation. Additionally, the consistent conformity to the regulatory norms within the local area and alterations in building codes and regulations, ongoing training and awareness of the personnel or staff members are all necessary to ensure all the steps of a project life cycle. Another significant point brought out in the study is the need to adopt technology that could improve on regulation compliance issue and risk management that would otherwise largely reduce delay and cost overruns in the high rise projects.

5.4 Policy Implications

In the policy level, the results of this study recommend more robust and solid legal frameworks of the high-rise buildings projects in Kathmandu Valley. It is recommended to policymakers to work on issues of enhancing transparency and consistency with building codes and zoning laws in order to minimize ambiguity and risk of developers.

According to the research, local authorities are recommended to strive to create a better regulatory environment, which will promote sustainable urban development and still maintain the safety of the population, especially in seismic areas with high risks. Additionally, the study suggests integrating environment factor in the policy and the need of policies that can support the utilization of eco-friendly building material, energy saving, and disaster resistance.

Another interesting aspect of the research is the involvement of the government in collaboration with the private sector to introduce clarity in the process and availing easily accessible procedures of the construction projects. An improved ability to foresee the regulatory environment would reduce the risk of the project delays and cost increments.

5.5 Future Research.

This study leaves various opportunities to new research in the sphere of construction risk management. In the high rise construction projects in the regions that are likely to experience seismic in future, the influence of the new technological invention, such as Building Information Modeling (BIM) and new seismic resistant material can also be explored in the future. A further future study might be on the need to compare risk management techniques across countries in the construction of a high rise, particularly highlighting in other developing nations that have these same regulatory and environmental issues.

Besides, future development of the high-rise buildings in the Kathmandu Valley could be researched with the contributions of the public-private partnerships (PPP). To practitioners and policy makers, a study on the potentials of government interventions and policy reforms to enhance the resilience of constructions to risks would be beneficial. Lastly, longitudinal research such as the follow up of the effectiveness and sustainability of the risk mitigation strategies in the high rise building projects may offer more insights into the effectiveness of the strategies in the long run.

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Appendices

Appendix 1. Survey Questionnaire

Interview Questionnaire

1. What are the most significant operational risks you encounter during the implementation phase of high-rise construction projects in the Kathmandu Valley?
2. How do the seismic risks in the Kathmandu Valley affect the operational planning and safety measures in high-rise construction projects?
3. Can you describe the challenges you face related to workforce management, particularly regarding labor shortages or skill gaps in high-rise construction? How do you address these challenges?
4. What role does occupational health and safety (OHS) play in mitigating operational risks? How do you ensure compliance with safety protocols on site?
5. How does site congestion and the dense urban environment in Kathmandu affect the coordination of construction activities? What measures do you implement to manage these challenges?
6. What are the primary supply chain and procurement risks in high-rise construction, particularly given Nepal's landlocked geography and reliance on imported materials? How do you mitigate these risks?
7. How do environmental factors such as monsoons or soil instability affect construction schedules? What contingency plans do you have in place to address these environmental risks?
8. How do regulatory changes and compliance issues affect project timelines and costs in Kathmandu's high-rise construction sector? Can you provide an example of how regulatory delays have impacted a project you've worked on?
9. What technological advancements, like Building Information Modeling (BIM), do you use to reduce operational risks in high-rise construction projects? How effective are these technologies in improving project coordination and safety?

10. In your experience, how does community opposition or social factors impact high-rise construction projects? How do you engage with local communities to address their concerns and ensure smooth project progression?
11. What are the key challenges in managing the procurement of specialized components, such as elevators or glass systems, for high-rise projects? How do you ensure timely delivery and quality control of these components?
12. Given the informal labor market in Kathmandu, how do you manage training, safety, and worker morale to ensure productivity and reduce accidents on high-rise construction sites?