International Journal of Research in Engineering, Science and Management
Volume 8, Issue 1, January 2025
https://www.ijresm.com | ISSN (Online): 2581-5792

Risk Management Practices in Engineering Projects Towards Effective Project Implementation in Construction

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***Abstract*: This study aimed to assess the risk management practices in engineering projects towards effective project implementation in construction at Department of Public Works and Highways – Quirino District Engineering Office. The descriptive method was utilized, with a questionnaire serving as the primary data collection tool. Statistical tools, including the weighted mean and Likert scale, were employed to analyze and interpret the data. Results of the study revealed that 1) The project engineers often practice risk management in engineering projects. 2) There is no significant difference in the risk management practices in engineering projects. 3) The project engineers encountered serious problems in engineering projects. 4) There is no significant difference in the degree of seriousness of the problems encountered in engineering projects as assessed by the project engineers themselves and engineer's assistants. To enhance risk management practices in engineering projects: for effective project implementation in construction, several key recommendations are proposed based from the findings. First, ensure continuous training and certification in updated safety protocols and regulations to effectively implement and monitor on-site safety measures. Second, rigorously supervise construction activities to ensure compliance with safety standards, especially regarding electrical safety, machine guarding, and structural stability. Lastly, maintain detailed documentation of safety incidents, near misses, and compliance checks to facilitate continuous improvement and accountability.**

***Keywords*: Risk Management, Engineering Projects, Project Implementation, Construction.**

1. Introduction

In construction projects, risks are defined as the probability of an event that may negatively affect the life cycle or the schedule of the project and will expose the project to a viable loss (Shibani et al., 2022). Risk are events that have some probability and impact on the project and organization (Alleman & Quigley, 2024). Project Management Institute (2019) defined risk as an uncertain event or condition that, if it occurs, has a positive or negative effect on one or more objectives. Similarly, Stojičić et al. (2023) opined that risk represents the degree of probability that a certain event will occur, based on knowledge of substances and conditions that can lead to danger, as well as knowledge and ability to perform certain actions when unwanted events and dangers occur. Risk management is the process of identifying, analyzing and minimizing the negative effects of information security in an enterprise and making decisions about maximizing its positive results. (Iminova et al., 2019). Risk management provides a comprehensive and integrated framework for addressing and managing risk at all levels of the organization, from porfolios through programs, projects, and operations (Project Management Institute, 2019). The successful completion of construction projects is enhanced by a well-applied risk management (Shibani et al., 2022).

Every construction project, regardless of its size, complexity, nature, or location has inherent risks that persist throughout its life cycle (Yakubu, 2023). Many construction projects in the past have suffered from project delays, over-budgeting, and substandard quality due to failure to properly handle risks (Yue, 2023). Okudan (2021) pinpointed that construction projects are often deemed as complex and high-risk endeavors, mostly because of their vulnerability to external conditions as well as project-related uncertainties.

The project success is correlated with three major aspects of cost, time, and quality where risks cannot be eliminated but can be effectively managed (Shibani et al., 2022). Therefore, a project is considered a success if the aspects of cost, time and quality as defined by Shibani et al., (2022) have been satisfied, meaning its implementation is effective.

Although a project's success is highly related to a systematic risk management, the construction industry has not yet fully standardized it as a primary process. Gajewska & Ropel (2011) observed that more construction companies are starting to become aware of the RMP (Risk Management Process), but are still not using models and techniques aimed for managing risks. The Department of Public Works and Highways (DPWH) issued a Risk Register under Department Order No. 44, Series of 2019 that enumerated risk events and its corresponding risk factor and action plan but field engineers are often unaware of such issuance and its significance in managing risk. The Risk Register is also lacking in risk events that may actually occur in project implementation. The risk events are generalized and does not include specific risks in every type of structure. The action plan is also vague and does not offer a specific solution.

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A. Background of the Study

DPWH implemented projects often extends beyond its original completion date, exceeds its original contract amount and contains minor defects. DPWH is aware of such events and deemed it inevitable that is why various issuances were crafted that serves as a guideline were it to occur. Deviation to the planned schedule and costs of a project is only rectifiable to an acceptable degree and exceeding the prescribed parameters are met with penalty. These issuances provide rules that serve as a deterrent to field engineers and contractors from falling behind schedule, cost overruns and defect. These memoranda and department orders are punitive in nature which only provides sanctions so that a risk event should be avoided and proper measures are not specified on how to avoid a risk event.

In the aspect of time, field engineers and contractors who are the main actors in project implementation are discouraged to have a negative slippage or the project may be terminated if the negative slippage exceeds 15% according to Department Order No. 193, Series of 2016. A slippage is the percent actual accomplishment minus the percent planned accomplishment. These accomplishments are computed as of date and represents the percent of the project's progress which describes if the project is on schedule or delayed. Thus, if a project is scheduled to have a 20% accomplishment today, and the actual accomplishment only accounts to 4%, then it has a 16% negative slippage and thus, behind schedule. If there is a negative slippage, the project will not be completed on its original expiry date unless activities are hastened. However, it is allowed to suspend the project for the time being through a work suspension order due to reasons enumerated in Department Order No. 42, Series of 2020 but a voluminous paperwork is required for it to be approved. This will cause the original expiry date of the project to be postponed by how many days it is suspended. Hence, a project that is suspended for 30 days will be completed 30 days behind the original expiry date. Other forms of mitigation employed by DPWH to dissuade negative slippages is through liquidated damages charged against the contractor. In liquidated damages, the contractor is ordered to pay the 1/10 (one-tenth) of 1% or 0.1% of the project cost every day the project is not complete beginning from the expiry date. So, a project with an amount of ₱10,000,000 that is not yet complete 10 days after its expiry date will cost the contractor ₱100,000 worth of liquidated damages.

A variation order may be issued by DPWH if the original cost of the project was found to be insufficient due to the increase in quantities or an introduction of new items to suit actual field conditions. This department sanctioned cost overrun is allowed due to complexity of construction of projects that may cause the cost to increase. According to the DPWH Procurement Manual Volume II and IRR of RA 9184, variation order shall not exceed 10% of the original project cost. Department Order No. 28, Series of 2015 which aims to control variation order suggested designs with a degree of accuracy that will permit estimates of quantities to be within plus or minus five to ten percent (5-10%) of the final quantities. Exceeding 10% up to 20% may be also allowed but sanctions will be imposed on the designer, consultant or official responsible for the original detailed engineering design which failed to consider the Variation Order beyond 10% (DPWH Procurement Manual Volume II, 2016). Variation Orders prior to approval will require multiple documents as set forth on Department Order No. 11, Series of 2021 that must be accomplished. The time and effort required for such paperwork thwarts the actors of the project to go through variation order if possible.

The DPWH is strict when it comes to the quality of projects they implement. This is the only aspect where there is no issuance that allows the quality to be compromised. Contractors with projects that have defects are not allowed to full payment. Defective projects are not given a Certificate of Completion which is required for payment of the project. According to Department Order No. 99, Series of 2015, before the issuance of the Certificate of Completion an Inspectorate Team must first inspect the project for defects/deficiencies. If defects/deficiencies are present the Inspectorate team shall instruct the contractor to correct the same. One year after the issuance of the Certificate of Completion also known as one-year defects liability period, the project will be inspected once more to ascertain if defects/deficiencies are still present which shall have been repaired. If present, the contractor is once again instructed to rectify said defects/deficiencies. The deployment of Quality Assurance Unit (QAU) from central office to implementing offices also ensures that completed projects are with the right quality. To inspire quality projects erring engineers with defective projects are sanctioned depending on its gravity.

Despite of DPWH's policy to prevent risks of time, cost and quality, some projects still fail on this matter. In the year 2023, DPWH Quirino District Engineering Office tallied 13 Variation Orders, 10 Time Extensions and 20 Notice of Defects/Deficiencies. These numbers are indicative that risk management is not systematically applied to construction, if applied at all within the district office's area of jurisdiction.

Previous studies (Wang et al., 2004; Gajewska & Ropel, 2011; Banatiene & Banaitis, 2012; Serpell et al. 2014; El-Karim et al., 2015) have been conducted in the past but most were at an international setting. The concepts, processes, methods and instruments of these studies align with the aims of this research but differs on the location. Wang et al.'s study is located in Singapore; Gajewska & Ropel: Sweden; Banatiene & Banaitis: Lithuania; Serpell et al.: Chile; El-Karim et al.: Egypt. This study aims to evaluate risk management in construction and to help constructors identify risks on a local environment in the province of Quirino. The findings would be beneficial to the construction sector in the province of Quirino and its neighboring provinces with similar setting in formulating a risk management framework.

B. Research Questions

1. What are the risk management practices in engineering projects as assessed by the project engineers themselves and the engineer's assistants?
2. Is there a significant difference in the risk management practices in engineering projects as assessed by the project engineers themselves and the engineer's

assistants?

3. What is the degree of seriousness of the problems encountered in engineering projects as assessed by the project engineers themselves and the engineer's assistants?
4. Is there a significant difference in the degree of seriousness of the problems encountered in engineering projects as assessed by the project engineers themselves and the engineer's assistants?
5. What measures may be proposed to improve the risk management practices in engineering projects?

C. Research Hypothesis

1. There is no significant difference in the risk management practices in engineering projects as assessed by the project engineers themselves and the engineer's assistants.
2. There is no significant difference in the degree of seriousness of the problems encountered in engineering projects as assessed by the project engineers themselves and the engineer's assistants.

D. Significance of the Study

This study would be beneficial to the following groups and individuals:

DPWH Field Engineers. The study's findings would provide guidance to Project Engineers and Project Inspectors who are assigned to projects in risk management through identifying risks, quantifying risks and responding to risks during the project's construction. Systematically managing risk will improve the probability of project's success against time risks, cost risks and quality risks.

Contractors. Results from this research will provide assistance to contractors who are implementing projects in delivering it right on time, with the right cost and with the right quality. Likelihood for sanctions and penalties imposed on the contractor would also be minimized due to effective project implementation.

Department of Public Works and Highways (DPWH). The findings of this study will help DPWH in crafting issuances and guidelines that pertains to risk management during construction in district offices. Results from this study will lower the chance for the applications of Variation Orders, Contract Time Extension and Notice of Defects/Deficiencies.

Future Researcher. The result from this research will offer future researchers information relevant to risk management applied on a local construction environment.

E. Conceptual Framework

Shown above is the paradigm of the study utilizing the Input Process Output (IPO) model. The input contains risk management practices in engineering projects and the problems encountered in engineering projects. The process involves assessing risk management practices in engineering projects and assessing the problems encountered in engineering projects through survey questionnaire. The Output involves the proposed measures to for effective project implementation in construction.

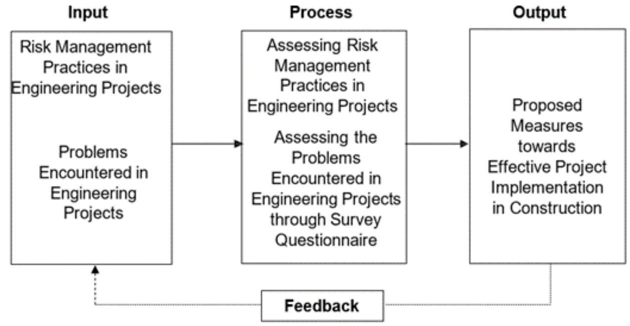

Fig. 1. Paradigm of the study

F. Literature Review

1) Risk Management

Risk management system in a construction industry deals with planning and evaluating the project risk, then, it must be followed by the implementation of the processes, procedures, and systems to mitigate the risk (Joble & Briones, 2022). Multiple risks might arise in the realization of construction projects that is why it is imperative to plan and execute risk management systematically that relies on standardized processes. Current practice if practiced at all, in the local construction industry is to deal with risks or threats upon discovery basically disregarding a systematic approach to risk management.

According to Heldman (2005), risk management, unfortunately, is probably one of the most often skipped project management knowledge areas on small-to-medium sized projects. District offices of the DPWH that implement small-to-medium sized projects often do not consider risk management as a core process in construction, as a result projects incur delay, overrun costs and deficiency. One of the main concerns of district offices is focused on speedy construction of the projects which ironically causes the delays due to lack of foresight and planning.

Wang et al., (2004) claimed that risk is inherent and difficult to deal with, and this requires a proper management framework both of theoretical and practical meanings. Constant practice of risk management will gradually enhance management of risks of actors involve in the construction industry, specially to those who are involved in small-to-medium sized projects that lacks the funding to outsource through transference. Heldman (2005), also added that on a small project, even just an hour or two of time spent on risk management can mean the difference between project success and project failure.

Serpell et al., (2014) observed that for many years, risk management in construction projects has been approached using a reductionist approach that produces poor results and limits the quality of project management. This is evident in the local setting where some projects are delayed indefinitely due to the lack of vision of contractors to formulate a systematic risk management plan that entails identifying all the possible risks that might occur through various methods, quantifying the probability and impact of such through qualitative or quantitative methods, and to derive a risk response, it should materialize. Contractors often focus too much on the profits of the projects that they fail to see the importance of risk management.

According to Banatiene & Banaitis (2012), practitioners have tended to associate construction project success with the aspects of time, cost and quality outcomes. El-Karim et al. (2015) also stated that the key success indicators of construction management system(s) include completing the project with cost and time, within the planned budget and duration, and within the required quality, safety and environmental limits. Thus, a project is successful if delivered right on time, with no cost overruns, and with the right quality intended for its purpose.

There are many possible risks which could lead to the failure of the construction project, and through the project, it is very important what risk factors are acting simultaneously (Banatiene & Banaitis, 2012). Therefore, it is necessary to deeply study and apply advanced risk management methods and decision analysis tools to cope with the multi-level and multi-dimensional challenges faced by construction projects (Yue, 2023).

2) Risk Management Processes

The Standard for Risk Management in Portfolios, Programs, and Projects, 2019 by the Project Management Institute enumerated the risk management processes which are: a) Plan Risk Management; b) Identify Risks; c) Perform Qualitative Risk Analysis; d) Perform Quantitative Risk Analysis; e) Plan Risk Responses; f) Implement Risk Responses; and g) Monitor risk.

According to Wang et al., (2004) however, a systematic approach to risk management in construction industry consists of three main stages: a) risk identification; b) risk analysis and evaluation; and c) risk response. Gajewska & Ropel's (2011) risk management model consists of a) risk identification; b) assessment/analysis; c) risk response; d) monitoring. Gajweska & Ropel pointed out that there are many variations of Risk Management Processes available in literature, but most commonly described frameworks consists of those mentioned steps, and in some models, there is one more step added, and the majority of sources identify it as risk monitoring or review.

3) Risk Identification

Identify Risks was defined by Project Management Institute (2019) as the process of identifying individual project risks as well as sources of overall project risk, and documenting their characteristics. According to Wang et al. (2004), risk identification is of considerable importance since the process of risk analysis and response management may only be performed on identified potential risks. Gajewska & Ropel (2011) suggested that in order to find all potential risks which might impact a specific project, different techniques can be applied. Gajewska & Ropel compiled various risk identification techniques from literature.

4) Risk Analysis & Evaluation

Risk analysis sets out to quantify the effects of the major risks that have been identified (Mills, 2001). It incorporates uncertainty in a quantitative and qualitative manner to evaluate the potential impact of risk (Wang et al., 2004). Gajewska & Ropel (2011) suggested that qualitative methods are most applicable when risks can be placed somewhere on a descriptive scale from high to low level. Quantitative analysis involves more sophisticated techniques and methods to investigate and analyze construction project risk (Banatiene & Banaitis, 2012). Heldman (2005) suggested that qualitative risk analysis is the method of choice for small-to-medium-sized projects. Heldman also added that qualitative risk analysis is a simple method for determining risk values, and it provides a consistent way to assess probability and impacts. This research has utilized qualitative analysis for its risk analysis and evaluation because projects implemented by the DPWH Quirino District Engineering Office range only from small to medium size projects. Big ticket projects are usually implemented by the DPWH Regional Offices and Central Office.

5) Risk Response

Risk Response indicates what action should be taken towards the identified risks ang threats (Gajewska & Ropel, 2011). Heldman (2005) suggested that the most common risk response strategies are a) Avoidance; b) Transference; c) Mitigation; d) Acceptance; e) Contingency planning; and f) Independent verification and validation (IV&V).

Avoidance – if the risk has significant impact on the project, the best solution is to avoid it by changing the scope of the project or, worst scenario, cancel it (Gajewska & Ropel, 2011). Avoidance may involve changing some aspect of the project management plan or changing the objective that is in jeopardy in order to eliminate the threat entirely, reducing its probability of occurrence to zero (Project Management Institute, 2019). This response strategy is one of the most effective since the likelihood of the risk is almost eliminated.

Transference – involves shifting ownership of a threat to a third party to manage the risk and to bear the impact if the threat occurs (Project Management Institute, 2019). Risks that cannot be managed by the actors of a project, may be transferred to a third party that is capable of its management. Transference techniques includes a) Insurance; b) Contracting; c) Warranties; d) Guarantees; e) Performance bonds (Heldman, 2005). Transference is rarely used by the DPWH in construction projects and risks are usually dealt with by the implementing office.

Mitigation – attempts to reduce the probability of a risk event and its impacts to an acceptable level and is the most common strategy in risk response planning (Heldman, 2005). If a risk is not possible to be avoided or transferred, it may be reduced or mitigated to lessen its probability and impact.

Acceptance – acknowledges the existence of a threat, but no proactive action is taken (Project Management Institute, 2019). Acceptance may also happen by default because the risk team was unable to come up with an acceptable response strategy for a risk.

2. Methods

A. Research Design

This study made use of quantitative descriptive design to evaluate the application of Risk Management. This method was used to identify risks and problems experienced in the projects, to quantify the likelihood and impact of the identified risks, to determine what responses were taken (if any) to manage the risks, and determine if the projects were a success. The projects implemented by the Department of Public Works and Highways – Quirino District Engineering Office in the year 2023 with a 100% accomplishment were chosen for this research and will only be evaluated in its construction stage. Construction is the stage under project implementation where construction work is carried out through the Project Management Office (PMO) and the Regional/District offices (DPWH). This research has adapted the definitions of risk given by (Shibani et al., 2022).

B. Study Site and Participants

All in all, there are fifty-five (55) respondents. There were twenty-five (25) project engineers and thirty (30) Engineer's Assistant. Since the respondents are limited for the study, it used complete enumeration.

C. Population, Sample Size and Sampling Method

The participants of this research were Project Engineers and Engineer's Assistant in the Department of Public Works and Highways – Quirino District Engineering Office who were assigned to projects with a 100% accomplishment implemented in the year 2023.

D. Instruments

Questionnaires were utilized to gather data on risk management practices in engineering projects. The researcher adopted the questionnaire of Sarmiento (2022). The Questionnaire on risk management Part I was designed based on the construction safety guidelines outlined in Rule 1410 of the Department of Labor and Employment (DOLE, 2016). Additionally, Part II of the questionnaire drew inspiration from the research conducted by Renuka (2014) in the Journal of Civil Engineering Research, Vol. 4(2A), pages 31- 36.

The questionnaire has two parts. Part I. Risk management practices in engineering projects. It has twenty five (25) items, regarding: Health and Safety Committee, Alternative Methods and Materials, Electrical, Machine Guarding, Fire Protection, Lighting of Work Areas, Lifting of Weights, Pipelines, Protection of the Public, Protection from Falling Materials, Protruding Nails and Loose Materials, Protection against Collapse of Structure, Safe Means of Access, Storage of Materials, Storage of Cylinders, Traffic Control, Vehicular Loading, Vehicle Driving, Internal Combustion Engine, Personal Protective Equipment, Excavation, Scaffoldings, Demolition, Mechanical Demolition and Explosives. Part II. Elicited information about seriousness of the problems encountered in the engineering projects.

E. Data Gathering Procedures

In order to attain an ideal set of data and to delineate the actual conditions of risk management applied in construction projects, the researcher requested to float questionnaires to personnel involved in the implementation of projects of DPWH Quirino District Engineering Office. The researcher also solicited data of completed projects in the year 2023. The survey (questionnaires) was administered during the regular working hours of the DPWH Quirino District Engineering Office subject to the availability of the participants within the office. The researcher sent a formal communication to the District Engineer of the abovementioned office requesting to distribute questionnaires to Project Engineers and Engineer's Assistants/ Personnel assigned to Project Engineers, to retrieve on the same day of the floating.

Every questionnaire was ensured by the researcher of its veracity and completeness, and each participant was asked if the questionnaire was properly answered upon retrieval.

F. Data Analysis

The data that were gathered and submitted for statistical treatment were as follows:

1. Weighted Mean was used to assess the level of implementation and the seriousness of the problems encountered in engineering project management.
2. T-test was used to determine the statistically significant difference in the risk management practices of most engineers in engineering project as assessed by the project engineers themselves and engineer's assistants.
3. Likert scale was used in rating the evaluation on the survey performed. The Likert scale technique presents a set of attitude statements. Subjects were asked to express agreement or disagreement in a four-point scale. The Likert scale used in the study, measures the extents to which a person agrees or disagrees with the questions. The researcher utilized a 4 – point Likert scale. The scale has the following descriptions:

Table 1

Scale	Range	Qualitative Description
4	3.25 - 4.00	Always/ Very Serious
3	2.50 – 3.24	Often/ Serious
2	1.75 – 2.49	Seldom/ Slightly Serious
1	1.00 – 1.74	Never/ Not Serious

G. Ethical Considerations

Data confidentiality was strictly implemented. Participants were afforded anonymity regarding their identities to preserve their privacy. Before floating the questionnaire, participants were first briefed about the nature of the research and by participating they must sign a form stating their willingness to answer the questionnaires voluntary. The researcher assured the participants that the data collected will only be for academic purpose and personal information shall not be disclosed to the public.

3. Results

Part 1. Risk Management Practices in Engineering Projects as Assessed by the Project Engineers Themselves and the Engineer's Assistant.

Table 2
Risk management practices of project engineers in building construction as assessed by the project engineers themselves and the engineer's assistants

	Items	Project Engineers WM	Engineer's Assistant WM	Composite Mean	
1.	Health and Safety Committee At every construction site there is an organized and maintained a Health and Safety Committee conforming with Rule 1040 and a medical and dental service conforming with Rule 1960.	3.56	3.26	3.41	Always
2.	Alternative Methods and Materials The construction, composition, size, and arrangement of materials used may vary provided that the strength of the structure is at least equal to that herein prescribed.	3.26	3.19	3.23	Often
3.	Electrical Before any construction is commenced, and during the construction, steps are taken to prevent danger to the workers or operating equipment from any live electric cable or equipment either by rendering the cable or apparatus electrically dead or by providing barriers to prevent contact.	3.18	3.72	3.45	Always
4.	Machine Guarding All moving parts of machinery used are guarded in accordance with the requirements of Rule 1200.	3.40	3.56	3.48	Always
5.	Fire Protection Fire Protection equipment are, provided in accordance with the requirements of Rule 1940.	3.64	3.29	3.47	Always
6.	Lighting of Work Areas Every work-area and approach thereto, every place where raising or lowering operations with the use of a lifting appliance are in progress, and all openings dangerous to workers, are lighted with the minimum requirements provided in Rule 1210.	3.49	3.48	3.49	Always
7.	Lifting of Weights For continued lifting, a male worker is not be made to lift, carry or move any load over fifty kilograms (50 kgs.) and female workers over twenty-five kilograms (25 kgs.). Weights over these shall either be handled by more than one worker or by mechanical means	3.64	3.29	3.47	Always
8.	Pipelines Repair work on any section of a pipeline under pressure is not undertaken until the pipeline is released of the pressure or the section under repair is blocked off the line pressure to ensure that no worker will be endangered.	3.48	3.59	3.54	Always
9.	Protection of the Public A safe covered walkway is constructed over the sidewalk for use by pedestrians in a building construction work less than 2.3 m. (7 ft.) from a sidewalk or public road.	3.59	3.48	3.54	Always
10.	Protruding Nails and Loose Materials Material or lumber with protruding nails is not used in any work or be allowed to remain in any place where they are a source of danger to the workers.	3.74	3.38	3.56	Always
11.	Protection against Collapse of Structure All temporary structure are properly supported by the use of guys, stays, and other fixings necessary for stability during construction.	3.67	3.18	3.43	Always
12.	Safe Means of Access Safe means of access and egress are provided and maintained to and from every place where work is undertaken.	3.28	3.29	3.29	Always
13.	Storage of Materials Building materials and equipment are not placed or stored on a permanent or temporary structure exceeding its safe load carrying capacity.	3.59	3.15	3.37	Always
14.	Storage of Cylinders Compressed gas cylinders are stored in upright position protected against heat and overturning and when not in use, the control valves shall be covered by protective caps screwed to proper positions.	3.48	3.65	3.57	Always
15.	Traffic Control In construction sites where a worker's safety is likely to be endangered by a vehicular traffic, flagmen, warning signs, barriers or lane control devices are installed.	3.37	3.29	3.33	Always
16.	Vehicular Loading No person shall remain on or in a vehicle during loading or unloading except those required to be there and only when all necessary protection against hazards are provided.	3.48	3.45	3.47	Always
17.	Vehicle Driving No person operates any vehicle or equipment in a construction site unless he has adequate training and experience to operate such vehicle or equipment and is authorized by his immediate supervisor	3.18	3.84	3.51	Always
18.	Internal Combustion Engine No internal combustion engine is operated in an enclosed area unless: the exhaust gases or fumes are discharged directly outside to a point where the discharge gases or fumes cannot return to the enclosure.	3.28	3.67	3.48	Always
19.	Personal Protective Equipment Personal Protective equipment as required in Rule 1080 are provided to the workers.	3.28	3.43	3.36	Always
20.	Excavation The walls of every excavation over 1 m. (3 ft.) deep is supported by adequate shoring and timbering to prevent collapse, provided that this shall not apply to an excavation:	3.54	3.62	3.58	Always
21.	Scaffoldings Every scaffold is of good construction of sound materials and strength for the purpose for which it is intended.	3.53	3.71	3.62	Always
22.	Demolition All demolition operations of building or other structure over six (6) meters high are under supervision of a competent person. No person except the workers who are directly engaged in the demolition shall enter a demolition area to within a distance equal to 1 1/2 times the height of the structure being demolished, where this distance is not possible the structure shall be fenced around and no unauthorized person shall be allowed within the fenced area.	3.25	3.56	3.41	Always
23.	Mechanical Demolition The demolition area where work is done by mechanical devices such as weight balls or power shovels shall: (a) be barricaded for a minimum distance of 1 1/2 times the height of the structure.	3.29	3.38	3.34	Always
24.	Explosives A competent person is appointed in charge of and personally present at a blasting operation who shall supervise the fixing of all charges and other blasting, activities.	3.50	3.56	3.53	Always
	Overall Mean	3.44	3.46	3.45	Always

As revealed in Table 2 project engineers/project inspectors and engineer's assistant always practice risk management as indicated by the following statement: Scaffoldings (3.62), Excavation (3.58), Storage of Cylinders (3.57), Protruding Nails and Loose Materials (3.56), Pipelines (3.54), Protection of the Public (3.54), Explosives (3.53), Vehicle Driving (3.51), Lighting of Work Areas (3.49), Machine Guarding (3.48), Internal Combustion Engine (3.48), Vehicular Loading (3.47), Fire Protection (3.47), Lifting of Weights (3.47), Electrical (3.45), Protection against Collapse of Structure (3.43), Health and Safety Committee (3.41), Demolition (3.41), Personal Protective Equipment (3.36), Mechanical Demolition (3.34), Traffic Control (3.33), Storage of Materials (3.37), and Safe Means of Access (3.29).

Meanwhile, the project engineers and engineer's assistants often practice risk management as presented in the following statement: Alternative Methods and Materials (3.23). With an overall mean of 3.45 this implies that the engineers always practice risk management in engineering projects as assessed by the project engineers themselves and the engineer's assistant.

The data indicate that there is a lower degree of response among the project engineers than the engineer's assistant. There is a 0.02 difference in the overall mean however, such difference did not cause a big difference in the level of the scale used.

Part 2. Significant Difference in the Risk Management Practices in Engineering Project as Assessed by the Project Engineers Themselves and the Engineer's Assistants

Table 3
Significant difference in the risk management practices in engineering project as assessed by the project engineers themselves and the engineer's assistants

Respondents	Mean	S.D.	Computed t	p-value	Decision
Project Engineers	3.44	0.51	-0.259	0.398	Not Significant
Engineer's Assistants	3.46	0.58			

Table 3 shows that the t-test yielded a computed value of -0.259 with a p-value of .398 which is greater than .05, revealing no significant differences in the assessment of the project engineers themselves and engineer's assistant on the perceived risk management practices. Hence, the null hypothesis of no significant difference is accepted. Therefore, there is no significant difference in the risk management practices of project engineers in building construction as assessed by the project engineers/project inspectors themselves and engineer's assistant.

Part 3. Degree of Seriousness of the Problems Encountered in Engineering Projects as Assessed by the Project Engineers Themselves and the Engineer's Assistant.

Table 4 presents the problems encountered in building construction management as assessed by the project engineers themselves and engineer's assistant.

Table 4
Degree of seriousness of the problems encountered in engineering projects as assessed by the project engineers themselves and the engineer's assistants.

Items	Project Engineers		Engineer's Assistants		Composite Mean	
Scope and design changes	3.36	VS	3.18	S	3.27	VS
Site conditions and Unknown Geological Condition	3.62	VS	3.17	S	3.40	VS
Inflation	3.19	S	3.38	VS	3.29	VS
Unavailability of Funds	3.28	VS	3.28	VS	3.28	VS
Inadequate Managerial Skills (Coordination)	2.29	SS	3.11	S	2.70	S
Lack of Availability of Resources	3.18	S	3.24	S	3.21	S
Weather and Climatic Conditions	3.48	VS	3.45	VS	3.47	VS
Statutory Clearance and Approvals	2.28	SS	3.13	S	2.71	S
Poor Safety Procedures	2.49	SS	2.89	S	2.69	S
Construction Delays	3.48	VS	3.41	VS	3.45	VS
Overall Mean	**3.07**	**S**	**3.22**	**S**	3.14	**S**

As presented in table 4, both groups of participants affirmed that they have encountered very serious problems along the following: weather and climatic conditions (3.47), construction delays (3.45), site conditions and unknown geological condition (3.40), inflation (3.29), unavailability of funds (3.28), scope and design changes (3.27),

Meanwhile they have encountered serious problems along the following: lack of availability of resources (3.21), inadequate managerial skills (coordination) (2.70), statutory clearance and approvals (2.71), and poor safety procedures (2.69). With an overall mean of 3.14, this implies that the engineers encountered serious problems in engineering projects as assured by the project engineers themselves and the engineer's assistants.

Part 4. Significant Difference in the Degree of Seriousness of the Problems Encountered in Engineering Projects as Assessed by the Project Engineers Themselves and the Engineer's Assistant

Table 5
Significant difference in the degree of seriousness of the problems encountered in engineering projects as assessed by the project engineers themselves and the engineer's assistants

Respondents	Mean	S.D.	Computed t	p-value	Decision
Project Engineers	3.07	0.26	-0.93	0.182	Not Significant
Engineer's Assistants	3.22	0.03			

Part 5. Proposed Measures to Improve the Risk Management Practices in Engineering Projects

Based on the findings, it is evident that both project engineers and construction workers face serious challenges in engineering projects.

To improve risk management practices in engineering projects, the following proposed measures can be considered:

1. Alternative Methods and Materials (CM=3.23). The construction, composition, size, and arrangement of materials used must vary, provided that the strength of the structure is at least equal to that prescribed.
2. Safe Means of Access (CM=3.29). Safe means of access and egress must be provided and maintained to and from every place where work is undertaken
3. Traffic Control (CM=3.33). In construction sites where a worker's safety is likely to be endangered by vehicular traffic, flagmen, warning signs, barriers, or lane control devices must be installed.
4. Mechanical Demolition (CM=3.34). The demolition area where work is done by mechanical devices such as weight balls or power shovels must be barricaded for a minimum distance of 1 1/2 times the height of the structure.
5. Personal Protective Equipment (CM=3.36). Personal Protective equipment as required in Rule 1080 must be provided to the workers.

4. Discussion

Part 1. Risk Management Practices in Engineering Projects.

The following are the risk management practices of project engineers in engineering project as assessed by the project engineers themselves and engineer's assistant (in order of rank): Scaffoldings, Excavation, Storage of Cylinders, Protruding Nails and Loose Materials, Pipelines, Protection of the Public, Explosives, Vehicle Driving, Lighting of Work Areas, Machine Guarding, Internal Combustion Engine, Vehicular Loading, Fire Protection, Lifting of Weights, Electrical, Protection against Collapse of Structure, Health and Safety Committee, Demolition, Personal Protective Equipment, Mechanical Demolition, Traffic Control, Storage of Materials, Safe Means of Access, and Alternative Methods and Materials. Alternative Methods and Materials" suggests a concern with the variability and control of safety practices related to this item compared to the more standardized and consistently applied measures in other categories.

Gajewska, E., & Ropel (2011) conclude that risk is often perceived negatively, despite theoretically having two dimensions. In the construction industry, professionals employ risk management techniques described in literature without necessarily recognizing them as such. Risks are managed daily in the industry, though typically not in as structured a manner as described in the literature. This gap in understanding is confirmed by other researchers, indicating a low level of knowledge regarding risk management (RM) and risk management processes (RMP), despite the increasing popularity of the concept in construction.

Respondents express a willingness to adopt RMP, contingent on its ability to benefit the organization financially. Implementing a straightforward method enables easy identification of potential risks and facilitates pinpointing which of these risks have the most significant impact on time, cost, and quality. Addressing these critical risks through appropriate actions, such as mitigation or elimination, is crucial.

Tohidi, H. (2011) states that a comprehensive management plan and program for mitigating risks are crucial. Understanding the processes of risk management and the key individuals involved in executing these processes is vital for ensuring organizations achieve their goals securely. This understanding is essential and necessary. Achieving these goals also hinges on widespread support and active participation from managers, members, and officials within the organization.

Part 2. Significant Difference in the Risk Management Practices in Engineering Project.

There is no significant differences in the assessment of the project engineers themselves and engineer's assistant on the perceived risk management practices. Hence, the null hypothesis of no significant difference is accepted. Therefore, there is no significant difference in the risk management practices of project engineers in building construction as assessed by the project engineers themselves and engineer's assistant.

Risk Management is explained by Gajewska (2011) as a structured way of managing risks and other threats in daily work. This is of great importance in the construction industry where projects are often exposed to uncertainties and risks. According to the theory, following all steps of the RMP facilitates achieving success with a project. For everyone who has been studying construction management, RM is recognized as a widely used concept and is emphasized in many courses.

But when investigating the concept in practice, there are not many who understand the meaning and content of RM. Surprisingly, actors operating in the construction industry are not even familiar with the expression "risk". Findings from the interviews showed that the term risk was more understood as an undesired event, problem or threat that makes it difficult to achieve project objectives. The same result was obtained by Klemetti (2006) who reports that respondents considered risk as a negative concept.

Part 3. Degree of Seriousness of the Problems Encountered in Engineering Projects

Respondents affirmed that they have encountered very serious problems along the following (in order of rank): weather and climatic conditions, construction delays, site conditions and unknown geological condition, inflation, unavailability of funds, and scope and design changes.

Meanwhile they have encountered serious problems along the following: lack of availability of resources, inadequate managerial skills (coordination), statutory clearance and approvals, and poor safety procedures.

The project engineers encountered serious problems in engineering projects as assured by the project engineers themselves and the engineer's assistants.

According to Serpella et. al (2014) one of the major roles undertaken by a project manager is the management of the risk of a project. However, this duty is particularly complex and inefficient if good risk management has not been done from the beginning of the project. An effective and efficient risk management approach requires a proper and systematic methodology and, more importantly, knowledge and experience. Previous research results in Chile have shown that both, owners and contractors do not systematically apply risk management practices, resulting in negative consequences for projects' performance. Serpella et. al (2014) addresses the problems of risk management in construction projects using a knowledge-based approach, and proposes a methodology based on a three-fold arrangement that includes the modeling of the risk management function, its evaluation, and the availability of a best practices model. This approach is part of a research effort that is underway. Risk management in construction projects is still very ineffective and that the main cause of this situation is the lack of knowledge. It is expected that the application of the proposed approach will allow clients and contractors to develop a project's risk management function based on best practices, and also to improve the performance of this function.

Part IV. Significant Difference in the Degree of Seriousness of the Problems Encountered in Engineering Projects.

There is no significant difference in the assessment of the two groups of respondents. Hence, the null hypothesis is accepted. Therefore, there is no significant difference in the degree of seriousness of the problems encountered in engineering projects as assessed by project engineers themselves and the engineer's assistants.

5. Conclusion

Based on the findings of the study, the following conclusions are drawn:

1. The project engineers often practice risk management in engineering projects as assessed by the project engineers themselves and engineer's assistants. This highlights strong adherence to risk management, suggesting ongoing training could further enhance these practices.
2. There is no significant difference in the risk management practices in engineering projects as assessed by the project engineers themselves and engineer's assistants. The alignment suggests effective communication and consistency, which should be maintained to avoid discrepancies.
3. The project engineers encountered serious problems in engineering projects as assessed by the project engineers themselves and engineer's assistants. This underscores the need for strong problem-solving mechanisms and better support systems to address complex project challenges.
4. There is no significant difference in the degree of seriousness of the problems encountered in engineering projects as assessed by the project engineers/ project inspectors themselves and engineer's assistants. The shared perception facilitates cohesive problem-solving but requires effective communication to ensure quick responses.

6. Recommendations

Based on the aforementioned conclusions, the following recommendations were made:

A. For the Project Engineers/Project Inspectors

1. Rigorously supervise construction activities to ensure compliance with safety standards, especially regarding electrical safety, machine guarding, and structural stability.
2. Maintain detailed documentation of safety incidents, near misses, and compliance checks to facilitate continuous improvement and accountability.

B. For the Engineer's Assistants

1. Conduct thorough daily inspections of work areas and equipment to identify potential hazards promptly and take corrective actions.
2. Actively promote a safety-first culture among peers and contractors through regular safety meetings, and training sessions.
3. Be prepared to respond swiftly and effectively to emergencies, ensuring all personnel are aware of emergency procedures and evacuation routes.

C. For the Future Researchers

1. Investigate and propose innovative approaches to construction materials and methods that maintain structural integrity while offering flexibility.
2. Explore the integration of advanced technologies for enhancing safety measures, such as automated monitoring systems and real-time risk assessment tools.
3. A similar study may be conducted focusing on the

variables not covered in the study.

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