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Risk Factors Affecting Construction Contract Management of the Government that are friendly towards the Environments

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The purpose of this research is to study risk factors affecting the construction contract management of government that are friendly towards the environments. Construction is an industry that causes negative impacts on the environment. This research presents an analysis of the severity of each risk factor using the severity index (SI). The results of the analysis showed that the first-order factor is construction risk management (SI = 39.398%), the second-order management aspect was government procurement and supplies (SI = 43.909%) and third is building construction that is friendly towards the environments (SI = 38.597%). As for the order of risks in construction risk management, each factor is as follows: Labor shortage, design problems and high construction costs. As for the management of government procurement and supplies, each factor includes changing and editing the list format, incomplete design has errors, delayed decision-making process. And in terms of building construction that is friendly towards the environments, the factors include: Preventing air pollution from dust, from soil and construction materials, wastewater drainage control and prevention of air pollution due to dust from soil and construction materials that cause health impacts to workers. And when considering the order of severity combined with factors, the first factor is labor shortage (SI = 63.229%), the second factor is design problems (58.668%), and the third factor is high construction costs (56.573%). The risk criteria are medium level which was corrected together with the quality team.

Keywords: Risk Factors, Construction Contract Management, Construction Risks, Friendly towards the Environments.

1. Introduction

Office of the Public Sector Development Commission (2023) defines risk as any event or action that may occur under uncertain circumstances and have consequences, cause harm lead

to failure, or reduce the likelihood of achieving the goals of important plans or projects as specified in the annual operational plan of the government agency. Risks have been categorized as strategic risks, operational risks, financial risks, and legal or regulatory compliance risks. (Channuwong, 2018; Kongswasdi, 2011). The process of risk management within an organization can be broken down into steps, including goal setting, risk identification, risk assessment, impact analysis, risk management planning, reporting and monitoring, and evaluation (Larpbula, 2021). Risk management in construction is of paramount importance, and a well-structured control and management system must be in place. Construction project managers need to possess experience and expertise, as complex construction projects require technical understanding, construction design, and a thorough understanding of the objectives, goals, human resources, and other factors such as expectations, construction contracts, work schedules, budgets, and plans (Channuwong et al, 2023). Please note that this translation is based on the provided text and may vary depending on the context and specific terminology used in the field of risk management and construction.

Projects in which the public sector collaborates with private contractors for construction must adhere to the Public Procurement and Government Procurement Act of 2017, with the objective of preventing corruption and promoting transparency. Work on such projects must be carried out within the framework of regulations to ensure effective management. However, issues often arise in the construction process due to pre-project activities by government agencies. Typically, construction projects involve predetermined specifications, itemized budgets, and various pre-determined documents. The procurement process is initiated before the project itself, which can significantly impact subsequent contract management processes within government agencies. This, in turn, affects the scheduling, construction costs, and budget allocation for the project. Shortened competitive bidding timelines, lack of detailed inspections, and insufficient attention to detail in the procurement process are risk factors that can impede effective contract management for public sector construction projects (Suwannang, 2015).

Therefore, controlling and preventing project management problems from becoming severe and challenging to rectifying involves proactive risk management. The risk management approach includes gathering data on risk events and their probabilities of occurrence during the construction. This information serves as experiential data for managing future risks. Disputes over claims, penalties, labor costs, and construction timelines that lead to legal proceedings pose risks to stakeholders. Assessing engineering facts without reference to contract language can result in disputes and workability issues, necessitating problem-solving to manage potential risks. Successfully planning work to address these risks is considered successful risk management (Pooworakulchai & Kongsong, 2019).

2. Research Methodology

This research is conducted as quantitative research, involving the collection of problem factors from various sources of information such as documents, articles, academic publications, and related research through variable analysis within a questionnaire as a research tool. Data will be gathered from specific stakeholders, including the client group, design group, contractor group, project management group, and project consulting group, within the Bangkok

metropolitan and suburban area. The research aims to assess the influential factors affecting contract management and determine the sample size using Taro Yamane's criteria (1973:725; Srisaard, B.1995; Thai Green Building Institute, 2023).

When opportunities arise from the mode as the criterion for measuring the severity level, for factors that impact construction projects with values ranging from 1 = "None", 2 = "Low", 3 = "Medium", 4 = "High" and 5= "Very high", based on the most repetitive criteria for each factor obtained from the questionnaire data collection. These criteria serve as indicators for measuring the success of contract management concerning factors that are significant obstacles to construction projects that are environmentally friendly and essential for sustainable development in Thailand.

3. Result and Analysis

All this research is a study of key factors that influence the management of construction contracts for public sector construction projects that are environmentally friendly. The study was conducted from February 2023 to April 2023, using a sample group of 330 respondents. From Table 1, the analysis revealed the Severity Index (SI) rankings, which indicate the level of impact on construction projects. These rankings were divided into three categories: Risk Management in Construction (SI = 49.398%) Procurement and Public Procurement Management (SI = 43.909%) Environmentally Friendly Building Construction (SI = 38.597%). From Table 2, the top three factors among all 45 factors influencing the risk management of environmentally friendly public sector construction projects are; 1. Labor Shortage Factor (SI = 63.229%, Mode = 5, Very High), 2. Design-related Issues (SI = 58.668%, Mode = 5, Very High), and 3. High Construction Cost Factor (SI = 56.573%, Mode = 4, High) It's important to note that the Mode values indicate the most common severity level for each factor, with Mode 5 (Very High) being the most frequent in the top three factors.

Table 1 - The Severity Index (SI) Rankings and the Rank for Factors Influencing the Management of Construction Contracts for Public Sector Construction Projects

Rank	The issue of risk management factors.	RII (%)		SI (%)
		Likelihood	Impact	
1	Risk management in construction	68.353	72.268	49.398
2	Procurement and public procurement management	64.238	68.353	43.909
3	Environmentally friendly building construction	61.266	62.999	38.597

Table 2 - Ranking of Risk Factors Affecting Public Construction Contract Management that Are Friendly towards the Environments

Rank	Risk factors	SI (%)	Mode
1	Labor Shortage (3)	63.229	Very high
2	Design Problems (3)	58.668	Very high
3	High Construction Costs (3)	56.573	high

(3) Risk management in construction

From Table 3, the results of data collection and analysis of the Severity Index (SI) for factors affecting the management of construction contracts for public sector construction projects

were as follows, with the top three factors having the most significant impact: Change in Modification of Specifications (SI = 56.551%, Mode = 4, High) Incomplete and Error-Prone Designs (SI = 54.824%, Mode = 4, High) Delayed Decision-Making Processes (SI = 53.352%, Mode = 5, Very High). These factors are identified as significant obstacles occurring both in the pre-construction phase and during the construction process, impacting contract management practices.

Regarding building construction that is friendly towards the environments, the factors with their Severity Index (SI) and Mode values are as follows: Prevention of Air Pollution from Dust and Construction Materials (SI = 50.924%, Mode = 5, Very High) Management of Wastewater Discharge (Effluent from Wastewater Treatment Systems) (SI = 49.295%, Mode = 5, Very High) Prevention of Air Pollution Resulting from Dust from Soil and Construction Materials Impacting Worker Health (SI = 46.072%, Mode = 3, Medium). It is evident that the first and second factors have the highest Mode values, indicating they are the most critical factors. These are negative factors or obstacles arising from construction processes that impact the surrounding environment and contract management practices.

In terms of construction risk management, the factors with their Severity Index (SI) and Mode values are as follows: Labor Shortage (SI = 63.229%, Mode = 5, Very High) Design-related Issues (SI = 58.668%, Mode = 5, Very High) High Construction Costs (SI = 56.573%, Mode = 4, High). It is evident that the first and second factors have the highest Mode values, indicating they are the most critical factors. These are negative factors with a significant impact on budget and project timeline, primarily arising from changes in construction and additional work not specified in the contract and design-related issues, which occur before the project is contracted.

Table 3 - Ranking of Contract Management Risk Factors Affecting Public Sector Construction that Are Friendly towards the Environments

Procurement and Public Procurement Management

Rank	Factors Affecting Construction Contract Management	SI (%)	Mode
1	Changes in Modification of Specifications	56.551	High
2	Incomplete and Error-Prone Designs	54.824	High
3	Delayed Decision-Making Processes	53.352	Very high

Environmentally Friendly Building Construction

Rank	Factors Affecting Construction Contract Management	SI (%)	Mode
1	Prevention of Air Pollution from Soil and Construction Material Dust	50.924	Very high
2	Control of Wastewater Discharge (Treated Wastewater Effluent)	49.295	Very high
3	Prevention of Air Pollution Resulting from Dust from Soil and Construction Materials Impacting Worker Health	46.072	Medium

Risk Management in Construction

Rank	Factors Affecting Construction Contract Management	SI (%)	Mode
1	Labor Shortage	63.229	Very high
2	Design Problems	58.668	Very high
3	High Construction Costs	56.573	High

Table 4 - Risk Assessment Criteria and Risk Level

Risk	Likelihood	Impact	Degree of risk		Description
			Degree of risk	Rating	
1	Highly unlikely	Very Low Impact	Very Low	1-2	Determine Corrective Actions, Guidelines, and Establish Risk Prevention Policies
2	Low likelihood	Low Impact	Low	3-4	Take Corrective Actions

Table 4 (continue) - Risk Assessment Criteria and Risk Level

Risk	Likelihood	Impact	Degree of risk		Description
			Degree of risk	Rating	
3	Medium likelihood	Medium Impact	Medium	5-10	Collaborate on Corrections with Quality Team
4	likely	High Impact	high	11-19	Collaborate on Corrections with Quality Team and Management
5	Very frequently	Very High Impact	Very high	20-25	Urgent Corrections and Establishing a Prevention Policy for Recurrence

From Table 5, the analysis results indicate that there are two critical risk factors that have a significant impact on the management of environmentally friendly public construction projects, requiring immediate risk management. And the establishment of policies to prevent recurrence: Error factors from contractor's work. This factor represents the risk associated with errors or mistakes made by the contractor during a project execution, Non-compliance with project specification requirements. This factor represents the risk associated with the project not meeting the specified requirements and standards. Regarding the procurement and public procurement management aspects, no immediate risk factors related to environmentally friendly building construction have been identified. However, it's important to note that the risk criteria for these factors are at a very high occurrence level (very frequently) and have a very high impact level (very high). These factors have a direct and significant impact on construction project management and are closely related to the management of environmentally friendly building construction contracts that need to be addressed and improved immediately to ensure the highest level of efficiency.

Therefore, the identified risk factors from the perspective of construction risk management include errors in contractor work and non-compliance with project specifications. These factors require immediate attention and the development of effective policies to prevent their recurrence in environmentally friendly building construction projects.

When considering the challenges and obstacles arising from groups within the project, originating from the Employer Group, we have: From the Employer Group: Construction Cost Estimation: Challenges associated with the preparation of construction cost estimates. From the Contractor Group: Errors in Contractor's Work: Challenges stemming from mistakes or errors made by the contractors during the execution of the project. Non-Compliance with Project Specification Requirements: Issues related to the failure to adhere to the project-specified requirements and standards within the contractor's group. From the Project Management and Design Consultants: Work Stoppage due to Changes or Modifications in Project Specifications: Challenges that may result in work stoppages due to alterations or modifications in the project specifications, typically within the project management and design consultant's sphere. Challenges arising from contract implementation procedures: Problems

occurring during the practical execution of the project per the contract terms, such as discrepancies in work progress concerning the requirements or delays.

These challenges and obstacles within the project can significantly impact the effective management and execution of environmentally friendly building construction projects. Addressing these issues in a timely and efficient manner is crucial to ensure project success and environmental sustainability.

The analysis results indicate that most of the obstacles and challenges in the management of environmentally friendly construction contracts for public sector projects are primarily derived from risk management issues within the project-related groups. These factors also stem from practical work activities occurring during the construction process or arise from contract implementation procedures. They have a direct impact on the cost and quality, ultimately affecting the success of the public sector construction contract management.

Table 5 - Risk Level of Factors Affecting the Management of Construction Contracts that Are Friendly towards the Environments

Table 5.1 - Procurement and Public Procurement Management

item	Consideration of Risk Factors	SI (%)	Risk Level	
1	Changes or modifications in project specifications	56.551	15	High
2	Incomplete or flawed design	54.824	6	Medium
3	Delayed decision-making process	53.352	12	High
4	Value of construction according to green building design	48.721	6	Medium
5	Inefficiency in contractor's work	50.262	12	High
6	Construction duration according to green building design	46.374	4	Low
7	Errors or mistakes in the contractor's work.	47.611	20	Very High
8	Unclearly defined scope and objectives of construction work	49.828	4	Medium

Table 5.1 (continue) - Procurement and Public Procurement Management

item	Consideration of Risk Factors	SI (%)	Risk Level	
9	Unclear reasons for contract extensions	45.038	2	Very low
10	Work not in compliance with the specifications	43.612	25	Very High
11	Incorrect cost estimation	44.484	16	High
12	Adherence to government laws or regulations during project execution	40.190	2	Very low
13	Contract management interactions with the employer	40.056	4	Low
14	Requesting approval for the quality of materials or equipment used in the project	39.143	4	Low
15	Lack of understanding of the principles of the government contract	42.310	9	Medium
16	Force majeure	40.924	12	High
17	Communication errors affecting the level of project success	38.481	6	Medium
18	Defining the warranty period	33.367	9	Medium

Table 5.2 - Environmentally Friendly Building Construction.

item	Consideration of Risk Factors	SI (%)	Risk level	
19	Preventing air pollution from dust and construction materials	50.924	2	Very low
20	Controlling wastewater discharge (treated wastewater)	49.295	12	High
21	Preventing air pollution caused by dust from soil and construction materials that affect the health of workers.	46.072	12	High
22	Developing a cleaning plan	35.786	12	High
23	Preparing areas for clear waste separation.	36.657	2	Very low
24	Preventing soil erosion and sedimentation due to rain and wind water runoff into drainage pipes or waterways.	36.108	1	Very Low
25	Preventing construction activities that disturb wildlife and nearby plant species	36.364	1	Very Low
26	Organizing employees to perform waste sorting duties and coordinate with	33.671	2	Very low

	waste buyers periodically.			
27	Developing a waste separation plan for recycling, on-site decomposition in the factory, and incineration (Raiseable)	35.121	1	Very Low
28	Controlling sources of toxic emissions, dispersion, paint, adhesive, and pharmaceutical substances	31.149	2	Very low

Table 5.3 - Risk Management in Construction

item	Consideration of Risk Factors	SI (%)	Risk level	
29	Labor shortage	63.229	9	Medium
30	Design problems	58.668	9	Medium
31	High construction cost	56.573	9	Medium
32	Construction planning	51.968	9	Medium
33	Changes in construction or additional work not specified in the contract	54.178	12	High
34	Decision-making process with delays	53.195	12	High
35	Project document inaccuracies	52.848	12	High
36	Construction cost estimation	49.602	25	Very High
37	Non-compliant site condition conditions with the format requirements	47.784	12	High
38	Defects or errors arising from construction	47.040	12	High
39	Work stoppage due to changes in format specifications or work suspension.	45.442	25	Very High
40	Preparation of material and resource utilization plans in construction.	45.149	16	High
41	Adding construction procedure steps.	46.208	12	High
42	Having too many stakeholders involved in the project	45.886	9	Medium
43	Redundant division of roles and responsibilities among stakeholders	43.736	6	Medium
44	Considering inspections of work stages that do not conform to the specifications or are delayed	41.842	25	Very High
45	Lacking sufficient expertise to prevent adverse effects on the construction project	39.895	9	Medium

4. Discussion

The study results indicate that the most significant obstacles affecting contract management in public construction projects, as measured by the Severity Index (SI), are as follows: For Procurement and Public Procurement Management (Table 5.1): 1. Labor shortages, 2. Design problems, and 3. High construction costs. The risk level criteria are rated as "Very High" for the following factors: Errors in the contractor's work. Work not conforming to the specified format or specifications. For Construction of Environmentally Friendly Buildings (Table 5.2): 1. Prevention of air pollution from soil and construction materials dust, 2. Control of wastewater discharge (treated wastewater), and 3. Prevention of air pollution from dust, soil and construction materials affecting worker health. The criteria for the level of risk is rated as "High" for the following factor: Prevention of air pollution from dust, soil and construction materials affecting worker health. Preparation of cleaning plans for Construction Risk Management (Table 5.3): 1. Labor shortages, 2. Design problems, and 3. High construction costs. The criteria for the level of risk are rated as "Very High" for the following factors: Preparation of construction cost estimates or Issuing work stoppage orders due to changes or modifications in project specifications or work suspension. And inspection and acceptance of work stages not conforming to specifications or delayed. Please note that these are rough translations, and the exact wording may vary depending on the context and specific terminology used in construction and contract management.

In summary, when considering severity based on the Severity Index (SI) criteria, most obstacles primarily arise from individuals directly involved, including the contracting party

and designers. These obstacles encompass changes in construction or additional work not specified in the contract, delayed decision-making processes, and design-related issues. Meanwhile, for project controllers and contractors, the main obstacles involve labor shortages and high construction costs. The SI rankings highlight factors with a clear and direct impact, both internally and externally, on the project, stemming from the stakeholders involved (Kuranan, S. 2019). A study of problems arising from the use of the Prime Minister's Office regulations on procurement Act B.E.1992. For public construction projects revealed that the index of the most significant issues was project delays beyond the set deadlines due to changes in project scope and inadequacies in the contract's content, particularly in certain unclear contractual terms. Furthermore, (Kongsong & Pooworakulchai 2019). A study analyzing the relative importance index (RII) of factors contributing to construction project delays found that the top-ranked cause of delays was labor shortages, followed by delayed decision-making processes. From the perspective of employers, the primary causes were unclear project scope and objectives, while for contractors, it was errors in their work and labor shortages. Finally, from the perspective of designers and architects, the main contributing factor was delayed decision-making. In addition, (Triwong, T., Yaemsot, N. & Pongsuwan, A. 2022) a study on factors affecting construction project delays for buildings found that the strongest correlation leading to project delays was between factors related to work performance and changes in the project specifications requested by the project owner. These factors were primarily caused by personnel-related issues. Preventive measures focused on construction personnel understanding and adhering to work plans, the payment disbursement process, comprehension of contextual differences and problem causes, appropriate site planning and environmental conditions, and efficiently managing the surrounding community's perception of and responsibility towards the construction project can be the most effective in preventing project delays. Moreover, Pooworakulchai (2020) in his study on risk analysis of severity factors in construction projects in terms of quality found the following factors: Quality-Related Factors: Role in Inspecting the Work by Involved Parties and Clear Definition of Project Scope and Objectives, Time-Related Factors: Labor Shortages, Delayed Decision-Making Processes, Errors in Contractor Work, and Changes in Construction Work, Cost-Related Factors: Design Problems, Changes in Construction Work, Labor Shortages, Additional work not included in the contract. These factors highlight the importance of clarity in project scope, effective communication and decision-making processes, and addressing labor shortages as key areas to manage risks and prevent delays in construction projects.

This highlights deficiency arising from the clarity of work scope and design, client-side activities, or pre-construction processes that contribute to issues during the construction phase. It also encompasses factors related to project stakeholders from within the project. The two factors at a very high-risk level (Very high) from the contractor group are errors in the contractor's work and work not conforming to the specifications of the itemized contract. As for the factors from the client group that arise from the contract execution phase, they include construction cost estimation, work stoppage due to changes in the itemized format, or suspension of work, as well as the evaluation of work progress that does not conform to the specifications or is delayed. These are factors with a very high risk index (very high) and require urgent corrective measures to be taken, along with the establishment of prevention policies to prevent recurrence.

This corresponds to Pooworakulchai (2020) who studied on risk analysis for construction projects in terms of time and cost. In his study, the factors affecting the project include: From the client's perspective: 1. Clear definition of project scope and objectives, 2. Changes in construction work, and 3. Differing levels of understanding regarding project success. From the designer and project manager's perspective: 1. Design-related issues, 2. Delays in decision-making processes, 3. Contract execution phase, including labor shortages, contractor work errors, and cost-related factors such as additional work not covered in the contract, construction cost estimation, and economic uncertainties, and 4. Overly optimistic warranty periods. These factors often occur during the construction phase.

Furthermore, Tritong and Prasitsom (2018) evaluates the construction project risks under the supervision of local government organizations. The risks are categorized into budget, quality, opportunities, and impacts, with contractors being at a low level of risk. The time frame for opportunities and impacts on contractors is also at a very low level, followed by a low level of risk. In terms of risk control measures, the following strategies are employed: 1. Pre-planning meetings before actual work, 2. reviewing and verifying designs and payment specifications, 3. Qualifications of contractors, 4. Material transportation and coordination, and 5. implementing water prevention systems in the construction area. corresponds to (Aida Bidin, 2023) The sustainable development approach to addressing environmental issues and promoting sustainable development in Malaysia involves recognizing the importance of implementing sustainable concepts, policies, guidelines, and strategies. It involves giving importance to the development of strategies related to environmentally friendly procurement (Green Procurement: GP) in Malaysia's action plans. This is aimed at fostering systematic and sustainable development in the construction industry and (Fitri, 2023). The identification of delays and disputes in closing accounts results in financial burdens, poor project performance, and damage to reputation. Closing accounts within the agreed-upon timeframe to the satisfaction of all parties is a crucial factor in measuring the success of a construction project. Because it ensures that all financial matters are accurately and transparently settled, understanding the early-stage factors and specifications is essential for finding appropriate solutions to minimize conflicts and achieve successful closure of accounts.

This aligns with the research findings of Tien-ngern et al. (2021) which identified the most significant factors affecting the management of public construction projects using the RII. The factors with the highest level of importance and the most significant impact on the projects are as follows: Delay in subcontractor work, Inefficiency of subcontractor work, Inefficiency of subcontractor work on a smaller scale, Overall project disruption, Negative attitudes or perceptions of project participants, Changes in project scope, Design errors, Impact on project schedule, Inefficiency of contractor work, Delay in contractor work, Labor shortages, Design errors, Impact on project quality. Cost impact on the project, Delay in contractor work, Inefficiency of contractor work, Changes in project scope, and Errors in estimating project costs. These factors are significant and have a major impact on various aspects of the construction projects, including project timelines, quality, and costs.

Pooworakulchai and Kongsong (2019) identified the root causes of delays in construction projects as follows: 1. Labor shortages (ranked first), and 2. Delayed decision-making (ranked second). The causes attributed to the group of project owners are lack of clear project scope and objectives. While causes attributed to the group of designers and project controllers

include: Delayed decision-making. Lastly, causes attributed to the group of contractors are: Errors in the execution of work. And Labor shortages. These root causes play a significant role in causing delays in construction projects, and addressing them is crucial for project management and successful completion. corresponds to (Kim, 2023). factors that cause construction project delays were found from experts such as short initial construction periods, errors in design documents and rework, Increased risk of work accidents and quality Construction delays can be reduced with basic measures such as estimating spare construction period reviewing design documents before work and thorough quality control.

5. Conclusion

The factors that hinder the Severity Index (SI) and risk management goals of public-sector construction projects that are environmentally friendly are primarily related to issues such as labor shortages, problems arising from design aspects of risk management, and the preparation of construction costs. Work stoppages due to changes in project specifications or suspensions fall within the very high severity level (Very High), indicating that these factors mainly occur during the construction phase. This suggests that the major impediments largely stem from the actions of the groups involved, manifesting as obstacles in terms of severity, risk, and importance that impact project quality, time, and cost.

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