Improving Preparedness to Accelerate Post-Disaster Housing Delivery in Indonesia

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Preface

All praise is due to Allah SWT, by whose grace this research has been completed. The issue addressed in this study holds personal significance, originating from my own observations of post-disaster housing challenges in Indonesia. This research aims to contribute to the development of better strategies for preparing and delivering urgent housing projects, particularly in post-disaster contexts.

I extend my heartfelt gratitude to my supervisors, Dr. Straub and Dr. Houwing, for their invaluable guidance and continuous support. I also thank all stakeholders, experts, and practitioners who generously shared their insights and provided essential data for this study. Most importantly, I am deeply grateful to my family and friends whose constant support, patience, and encouragement have been the cornerstone of this accomplishment.

It is my sincere hope that this research offers valuable insights to improve preparedness in public procurement strategies and contributes to more effective and timely post-disaster project delivery, not only in Indonesia's housing sector but also in broader applications.

Akbar Azizul Hakim
Delft, August 2025

To support the clarity and correctness of the written text, grammar and language use were reviewed with the assistance of ChatGPT 4o (OpenAI) and Gemini 2.5 Pro (Google). The use of these tools were limited to language refinement and did not influence the content, data analysis, or conclusions of this thesis.

Cover image of Lumajang Post-Disaster housing (c) Hutama Karya.

Construction, Management and Engineering
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Abstract

The increasing frequency of urgent projects, driven by both natural disasters and aging infrastructure, demands a global shift towards enhanced preparedness to build resilience to align with principles of the Sendai Framework for Disaster Risk Reduction (SFDRR) and the Sustainable Development Goals (SDGs). In the context of post-disaster housing in Indonesia, this requires a paradigm shift from a reactive, crisis-driven approach to a proactive one. This transition is supported by converging trends in disaster management, construction, and public procurement, which all show a move towards greater flexibility, collaboration, and proactive planning.

This research addresses the challenge of project delivery delays by developing and evaluating a procurement strategy to accelerate reconstruction. The study employs a three-phase Design-Based Research (DBR) methodology, combining literature synthesis, a comparative analysis of three case studies, and stakeholder interviews. In the first phase, Analysis & Exploration, a novel preparedness framework was developed from literature, identifying seven aspects: Community Involvement, Knowledge, Industrial Resources, Land Planning, Regulations, Funding, and Projects & Programmes. Analysis of current practices revealed a missed opportunity in project governance, where operational capacity is not fully translated into efficient and timely project outcomes, slowing down the overall recovery process. This issue is then addressed in the second phase, Design & Construction, by designing a new procurement strategy. This strategy is centered on a pre-disaster Framework Agreement that integrates design-build delivery with the pre-stocking of modular components (RISHA). In the third phase, Evaluation & Reflection, this strategy was validated and refined through stakeholder interviews.

Utilizing the framework as the assessment tool, the study concludes that a collaborative, customized framework-based procurement strategy provides a tangible mechanism to improve preparedness by shifting institutions from a reactive to a proactive stance. This research contributes to the scientific discourse by providing a practical bridge between high-level international frameworks and the realities of project delivery. For future work, it is recommended to pursue integrated governance reform, particularly establishing national land banks and ex-ante disaster financing, and to pilot the proposed strategy in diverse contexts to further refine its application.

Keywords: post-disaster housing, proactive, preparedness, procurement strategy, framework agreement

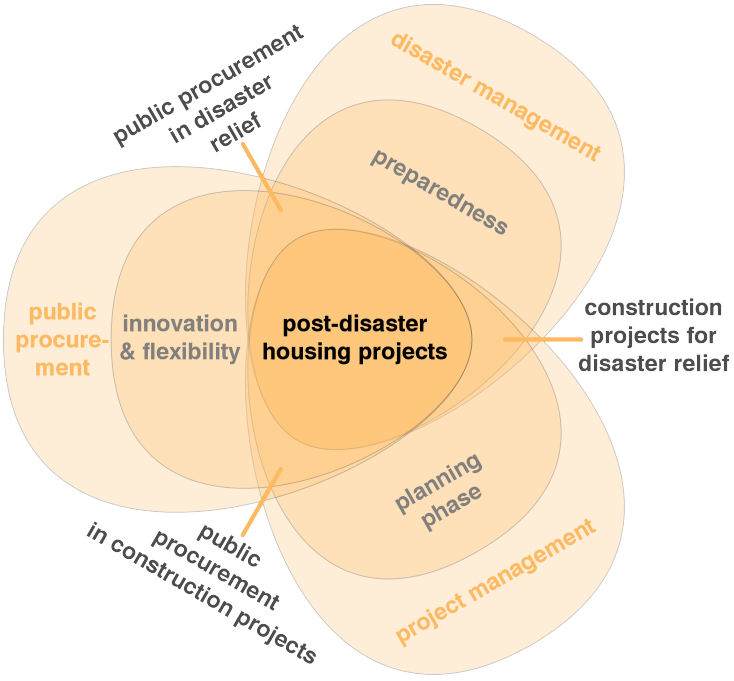
Executive Summary

Introduction: The Urgency of Preparedness

The increasing frequency of urgent projects, driven by both natural disasters and aging infrastructure, demands a global shift towards proactive preparedness to build resilience, a core principle of frameworks like the Sendai Framework for Disaster Risk Reduction (SFDRR) and the Sustainable Development Goals (SDGs). In Indonesia, post-disaster housing reconstruction exemplifies the opposite: a reactive, crisis-driven approach where the preparation phase, not construction, is the primary bottleneck, consuming up to 56% of the total project timeline (as detailed in Table 1.1). While procurement is a powerful lever for shifting from a reactive to a proactive stance, a clear strategy for how to achieve this in practice is lacking. This gap leads to the central research question of this study: ***"How can procurement strategy improve the current state of preparedness to accelerate Post-Disaster Housing Delivery in Indonesia?"*** The purpose of this research is to answer this question by developing and evaluating a procurement strategy designed to accelerate project delivery by fundamentally enhancing pre-disaster preparedness in the Indonesian context.

Converging Trends in the Literature

The literature review confirms that the necessary shift from a reactive to a proactive paradigm is supported by converging trends across three key fields.



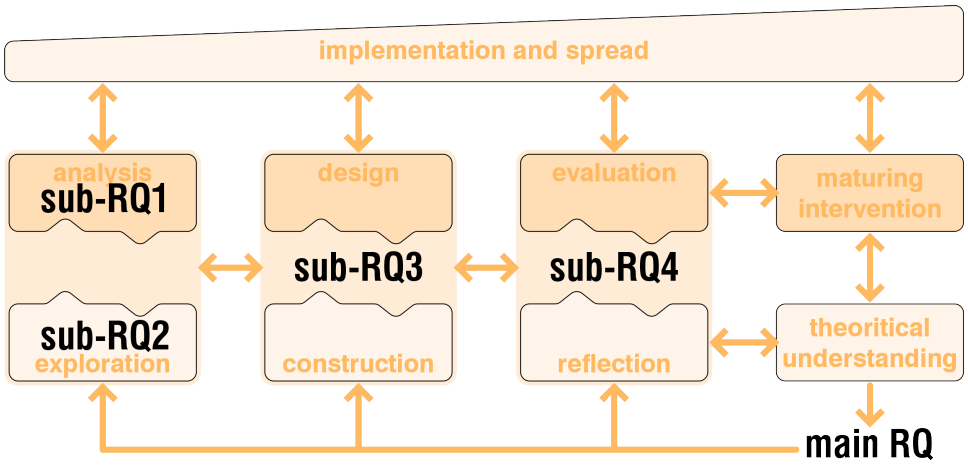
- **Disaster Management**, the focus has evolved from a simple reactive cycle to proactive frameworks like Disaster Risk Reduction (DRR), emphasizing preparedness and community-led resilience.
- **Construction Project Management**, the industry is moving from fragmented, linear processes towards integrated and flexible models like Integrated Project Delivery (IPD), industrialized methods (DfMA), and digitalization (BIM).

- **Public Procurement**, there is a clear transition from rigid, output-based contracts to flexible, outcome-focused, and collaborative arrangements that can better manage uncertainty and drive innovation.

Together, these shifts provide the ideal theoretical foundation for designing a modern, preparedness-oriented procurement strategy.

Methodology: A Design-Based Approach

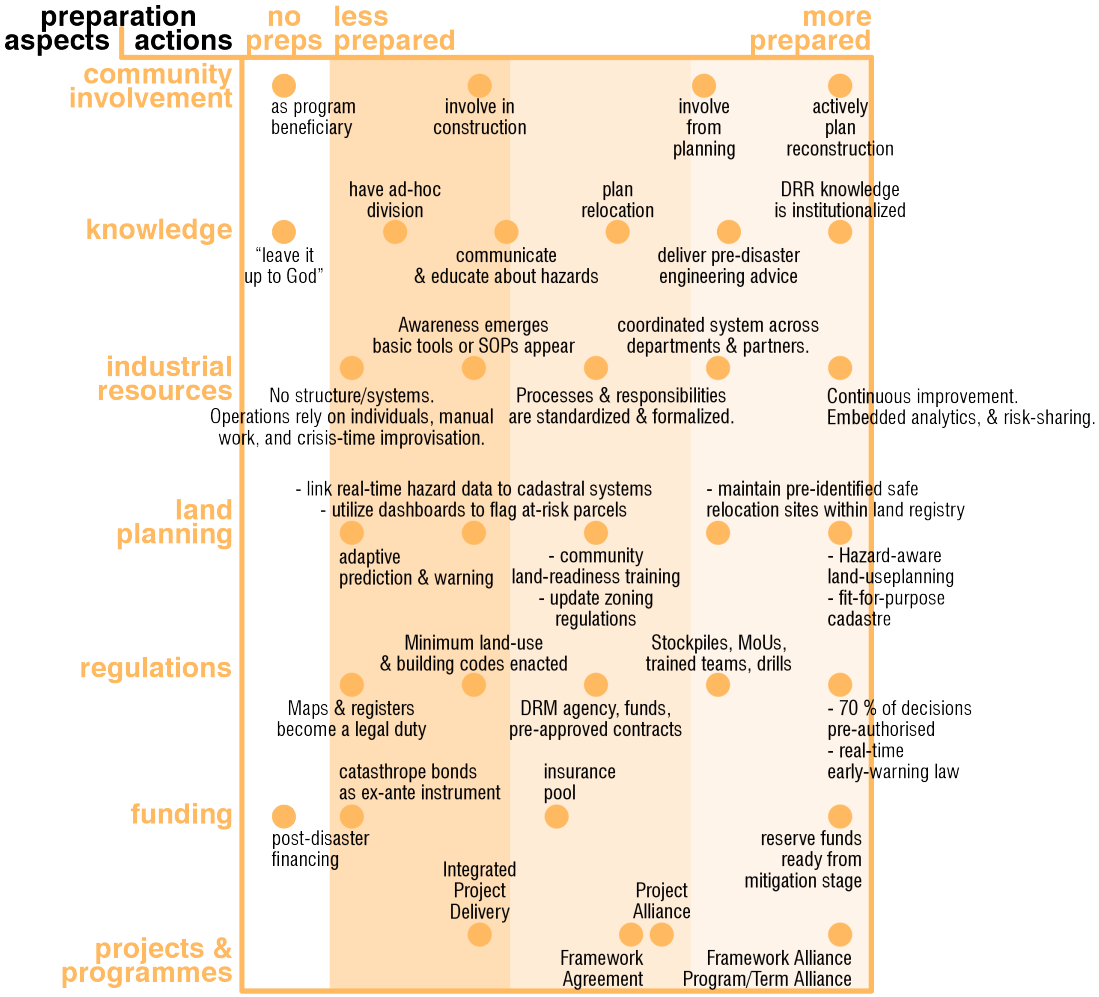
This research employed a Design-Based Research (DBR) methodology, structured in three iterative phases to develop a practical and theoretically grounded solution. The study combined an extensive literature review, a comparative analysis of three key case studies, and in-depth interviews with national-level stakeholders.



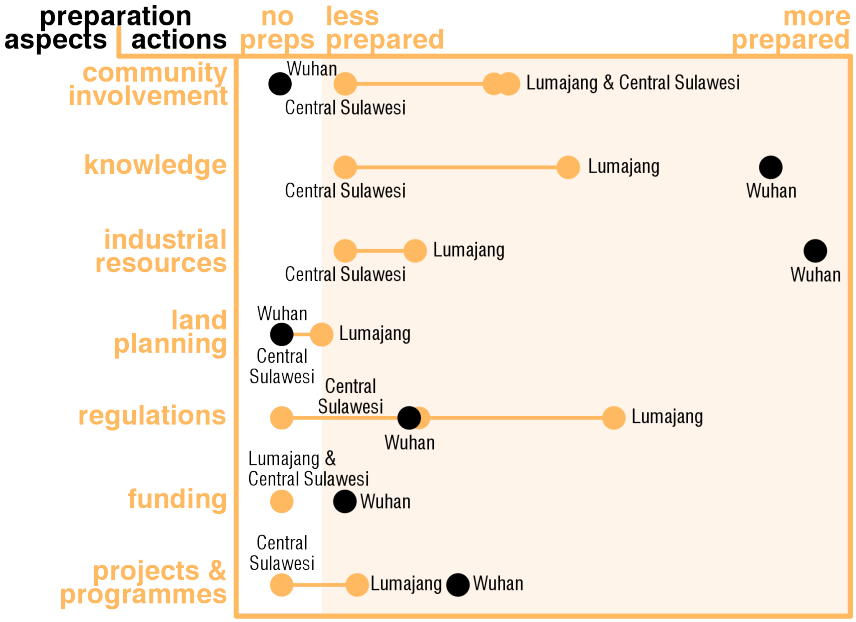
- **Phase 1: Analysis & Exploration:** This initial phase established the theoretical foundation by answering: *"What aspects define disaster preparedness for post-disaster projects, and how can the level of preparedness within them be assessed?"* (Sub-RQ1) and *"To what extent do recent urgent projects being prepared, and what are the gaps between theory and practice?""* (Sub-RQ2).
- **Phase 2: Design & Construction:** Building on the initial analysis, this phase focused on answering: *"What procurement strategy design is suitable to improve the current state of preparedness in post-disaster projects?"* (Sub-RQ3).
- **Phase 3: Evaluation & Reflection:** The proposed strategy was then validated and refined through stakeholder feedback to answer: *"How can the proposed procurement arrangement for urgent projects be evaluated and refined for practical implementation?"* (Sub-RQ4).

Key Findings: A Systemic Preparedness Gap

The research first established a novel preparedness framework from the literature to answer sub-research question 1, *"What aspects define disaster preparedness for post-disaster projects, and how can the level of preparedness within them be assessed?"*, by identifying seven critical aspects that define readiness for urgent projects: **Community Involvement, Knowledge, Industrial Resources, Land Planning, Regulations, Funding, and Projects & Programmes**.

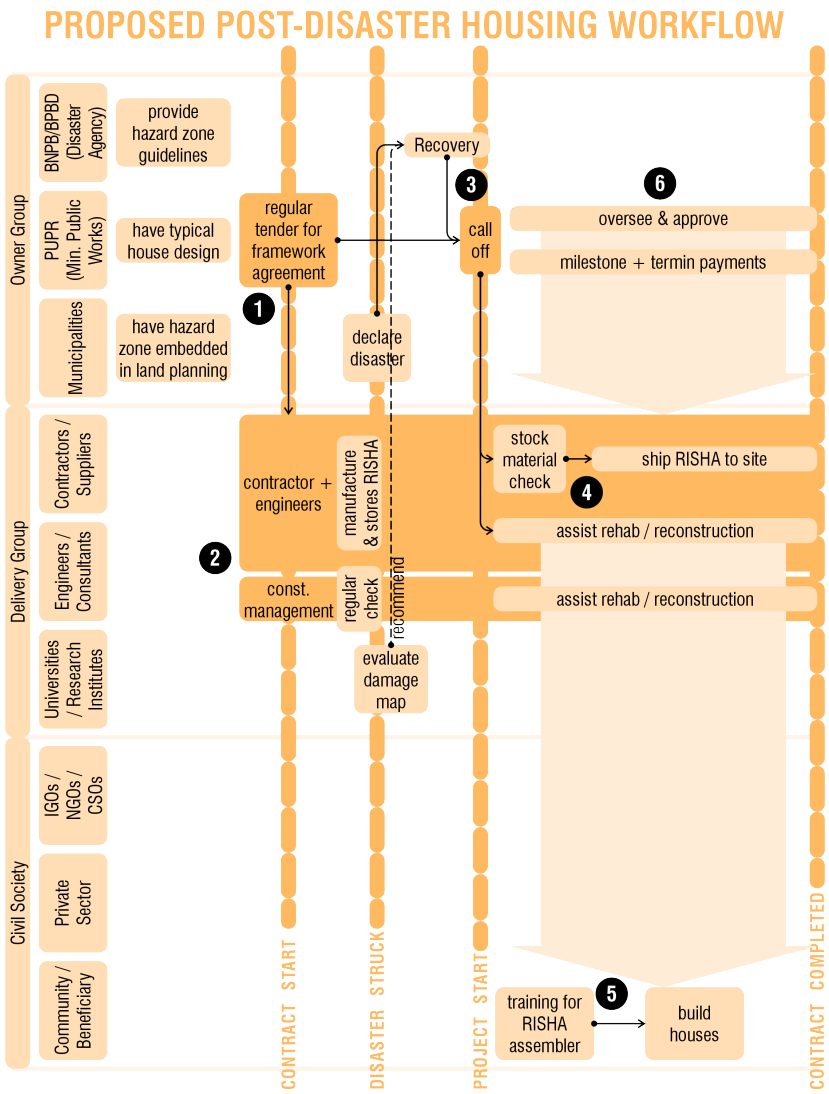


When current practices in Indonesia were assessed against this framework (as summarized in Figure 4.4.1), a consistent and critical gap emerged. While Indonesia demonstrates strong reactive and operational capacity such as in technical knowledge and mobilizing industrial resources, it suffers from systemic weaknesses in areas requiring long-term strategic governance. It is revealed that there is a missed opportunity in project governance, where operational capacity is not fully translated into efficient and timely project outcomes, ultimately slowing down the overall recovery process. This fundamental lack of proactive planning is the root cause of most project delays. This is the answer of sub-research question 2, *"To what extent do recent urgent projects being prepared, and what are the gaps between theory and practice?""*



The Proposed Solution: A Proactive Procurement Strategy

To bridge this gap, this research designed a new procurement strategy centered on a **pre-disaster Framework Agreement**. This strategy shifts the paradigm from reactive tendering to proactive readiness. This acts as the answer of sub-research question 3, *"What procurement strategy design is suitable to improve the current state of preparedness in post-disaster projects?"*



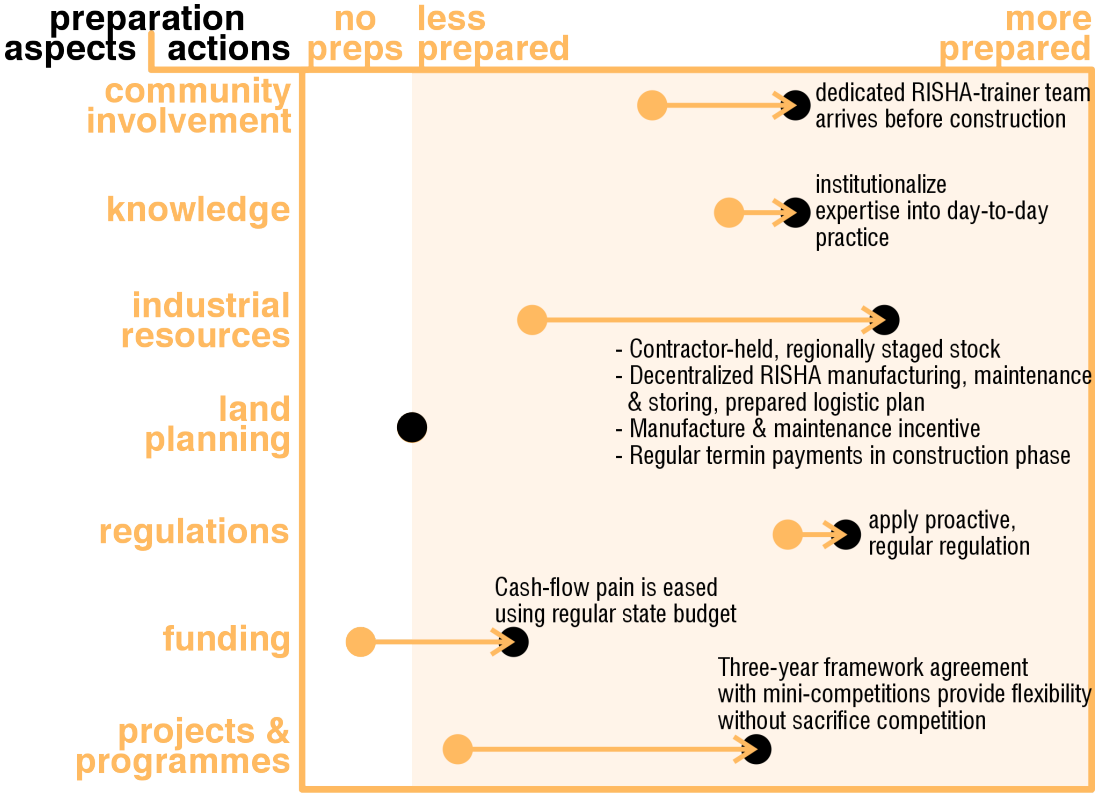
Key features of the proposed strategy (illustrated in Figure 5.2.2) include:

- **Pre-Disaster Tendering:** A multi-year Framework Agreement is competitively tendered during normal conditions to establish a panel of qualified contractors and construction management consultants.
- **Integrated Scope:** The agreement integrates design-build delivery with the manufacturing and pre-stocking of modular housing components (RISHA) in regional depots.
- **Rapid Mobilization:** When a disaster occurs, a rapid call-off procedure is triggered, allowing a project to be initiated within days, not months. This eliminates the need for emergency tenders and leverages a ready supply of materials and pre-vetted partners.

Evaluation: A Measurable Improvement in Preparedness

The proposed strategy was validated through stakeholder interviews and evaluated against the preparedness framework. The feedback was generally positive, but several refinements like the neccessity of formal community upgrading and the importance of post-disaster land safety check for in-situ reconstruction. Barrier to implement the strategy also persist, where implementing agency needs to develop its own technical guideline, as the regulation has not been established. Looking forward, the planned national pooling fund for disasters presents a major opportunity to create a more

integrated recovery efforts, improving preparedness from both funding and regulatory perspectives. This acts as the answer of sub-research question 4, *"How can the proposed procurement arrangement for urgent projects be evaluated and refined for practical implementation?"*



	Lumajang	Central Sulawesi	Proposed	Benefit
panels manufacturing volume	small batch	small batch	large batches	- economic of scale - lower cost
risk of wasted panels	in single project	in single project	in multiple projects / portfolio	less risk of waste
panels' role in construction phase	De-coupled, panels manufacturing are outside project timeline	Coupled, any delay in the factory directly delays the on-site work	De-coupled, panels manufacturing are outside project timeline	guaranteed availability
panels owner	client	contractor	contractor	Efficient mutual risk management
project administration vs execution	coupled, procurement then execute	coupled, procurement then execute	de-coupled, administration is separated than execution	efficient administration

The evaluation (summarized in Figure 6.2.1) shows that the strategy significantly improves preparedness in five of the seven aspects. The most significant gains are in **Industrial Resources** (moving from reactive supply to pre-positioned stock) and **Projects & Programmes** (moving from rigid, single-project contracts to a flexible, continuous framework). From broader preparedness perspective, the application of Framework Agreement creates a strategic, long-term partnership that offers significant mutual benefits by shifting the perspective from a single project to a whole portfolio view, as presented in table 6.1.

Conclusion and Recommendations

Finally, answering the main research question *"How can a procurement strategy improve the current state of preparedness to better support the implementation of Build Back Better principles?"*, this study concludes that a collaborative, framework-based procurement strategy provides a tangible and legally feasible mechanism to enhance preparedness and better support the implementation of "Build Back Better" principles. It shifts the focus from mastering reactive execution to embedding proactive, systemic readiness.

Based on these findings, the following recommendations are made:

1. **For the Ministry of Public Works and Housing (PUPR):** Adopt and pilot the proposed Framework Agreement strategy, starting with the development of a standard contract template in collaboration with the Public Procurement Authority (LKPP).
2. **For National Governance:** Pursue parallel, integrated reforms to address the most critical systemic gaps. This includes establishing a **national relocation-land bank** and operationalizing the forthcoming **disaster pooling fund** to provide the ex-ante financing that is currently missing.
3. **For Future Research:** Continuously evolve the seven-aspect preparedness framework and test the application of this procurement model across a broader range of urgent infrastructure projects beyond post-disaster housing.

By implementing these recommendations, Indonesia can move from a position of strong reaction to one of true resilience, ensuring that when future crises strike, the nation is not just able to respond, but is already prepared to act.

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Chapter 1 Introduction

1.1 Background

The increasing probability of natural or man-made disasters poses a growing threat to human settlements. Many regions like pacific ring of fire, southern europe, and southern asia, have experienced increased number of disaster. The Intergovernmental Panel On Climate Change (IPCC) (2023) reports that the frequency and intensity of extreme weather events are expected to rise in coming decades. Indonesia is one country that include in that list. In the last five years alone, Indonesia's National Disaster Management Authority (Badan Nasional Penanggulangan Bencana, 2024) recorded an average of approximately 5,400 natural disasters annually, most occurring in densely populated areas. The country, which located in the tropical climate and several tectonic plates, place it at continuous risk of hazards such as floods, earthquakes, and tsunamis. Beside Indonesia, there are handful of countries that experience the same phenomenon. The reality reinforces the need of a robust disaster management system, including quicker and more effective post-disaster recovery.

As one of the stakeholders in disaster management, the role of the government is significant at every phase of the disaster, including at recovery stage. Khorram-Manesh et al. (2021) and McEntire (2015) explains that recovery stage happens after a disaster event, and is designed to restore social and economic life to pre-disaster conditions. While this phase is not as critical as the response phase, being able to recover quickly plays a vital role in strengthening community resilience, rebuilding livelihoods, and reducing long-term socioeconomic disruption (Hallegatte et al., 2018). Among the sectors requiring immediate attention, housing reconstruction is a critical sector due to its direct effect on daily life, social stability, and community well-being (UN Habitat, 2019). For example, following the 2018 tsunami and liquefaction in Palu, Central Sulawesi, the Ministry of Public Works and Housing had 67 projects of post-disaster housing with more than 10,000 houses built. However, all these projects followed the same reactive pattern: only initiated the project after disaster strikes. This reactive approach consumed precious recovery time, prolong the construction phase that leading to project inefficiency, and ultimately, undermines the community resilience essential for long-term social stability (United Nations, 2015).

Although the decision to launch such recovery projects is purely political, the Ministry has consistently executed similar projects every year. This predictability raised a question why do each reconstruction projects should always start with redundant and reactive mechanisms, and not try to shift from a reactive to a preparatory approach. This logic is in line with international frameworks such as the Sendai Framework for Disaster Risk Reduction and the Sustainable Development Goals (SDGs). The Sendai Framework by United Nations (2015) emphasizes the need for pre-disaster preparedness and the principle of "Build Back Better" during recovery. Similarly, the SDGs, particularly SDG 9, SDG 11, SDG 13, and SDG 17, highlight the importance of resilient infrastructure, sustainable cities, climate adaptation, and multi-stakeholder collaboration. Hence, advancing infrastructure preparedness as a solution is not only practical but also internationally validated.

This idea of anticipatory planning is not solely applicable to disaster recovery. It also reflects strategies used in other infrastructure sectors where time pressure is a central factor. A key difference is that post-disaster urgency is driven by a past catastrophe, while strategic urgency is often driven by the need to prevent a future crisis (Schexnayder & Anderson, 2010). For example, much of the infrastructure in the Global North is nearing or exceeding its design life, which creates significant safety risks that require proactive modernization (Doyle et al., 2008). This parallel between responding to a past event and preventing an expected one highlights a common need for

institutional readiness and adaptive planning. This shared challenge has led countries to develop more effective approaches for managing such time-sensitive projects.

Together, these international cases emphasize that urgency in infrastructure, whether reactive or proactive, can be managed more effectively through planning ahead, preparing systems for acceleration, and aligning governance tools with context-specific needs. For countries like Indonesia, which face both disaster-induced and strategically constructed infrastructure urgencies, integrating these global insights could help shift from a reactive posture toward a more resilient, preemptive infrastructure development strategy.

1.2 Problem Identification

Given that time is a critical factor in post-disaster recovery projects (Hallegatte et al., 2018), shifting key preparatory tasks from the post-disaster periods to the pre-disaster phase presents opportunity to accelerate reconstruction. This proactive approach and aligns well with global frameworks aimed at efficient recovery through preparedness measures (United Nations, 2015) as well as sustainable development goals (SDGs). However, in order to understand how to improve the project delivery in such specific context, the first task need to tackle is to understand the bottlenecks. this section will dive deeper into the understanding of the scope of post-disaster housing projects, illustrate the importance of time in disaster recovery, and briefly analyse the way project preparation contributes to the prolonged recovery project delivery.

1.2.1 the Context of Urgency in Post-Disaster Housing

Urgent project, summarizing from Smit (2024) and Van Wijk and Fischhendler (2017) is characterized by a short timeline that demands immediate action to prevent escalating negative impacts. In short, it demands immediate attention or action. Post-disaster housing reconstruction is a clear example of such a project. In post-disaster context, the goal is not to prevent the past disaster but to mitigate its ongoing social and economic consequences through effective reconstruction (Khorram-Manesh et al., 2021). This focus on post-disaster action, however, represents only one side of a larger strategic challenge rooted in the concept of resilience.

Resilience is a system's ability to both withstand hazards and recover from their effects in a timely and efficient manner (Bosher & Chmutina, 2017). This definition presents two distinct capacities. The first is the capacity to withstand, which is developed through pre-disaster vulnerability reduction (Perry & Quarantelli, 2005; J. Walker & Cooper, 2011). The second is the capacity to recover, which is measured by the speed and quality of post-disaster response (Bosher & Chmutina, 2017). This reveals the tension in disaster management: the balance between proactive vulnerability reduction and reactive disaster recovery.

Covey (2020)'s important-urgent matrix offers a useful model to visualize this tension between proactive and reactive work (Covey, 2020), as shown in Figure 1.2.1. Strategic and preventive actions, which build the capacity to withstand shocks, ideally occur in the second quadrant: "important but not urgent." However, when actions like deferring bridge maintenance or delaying energy transition planning are neglected, they escalate into the first quadrant: "important and urgent." This inaction transforms manageable long-term tasks into emergencies similar to post-disaster scenarios

The reverse is also possible: with proactive planning, preparedness frameworks, and resilient infrastructure design, even inherently urgent projects such as post-disaster reconstruction can be partially repositioned into the second quadrant of Covey's quadrant as shown in figure 1.2.1. In this sense, Both SDGs and Sendai framework for Disaster Risk Reduction already highlights

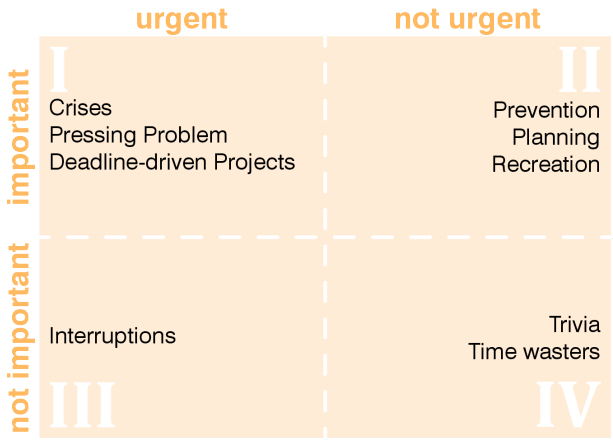

Figure 1.2.1: urgent-important matrix (Covey, S. R., 2020)

this approach. By anticipating needs, pre-positioning resources, and designing for modular or rapid deployment, institutions can reduce the intensity and chaos of post-disaster response (Bosher et al., 2021). In this sense, this study contributes to this proactive shift, working to embed resilience and preparedness into infrastructure systems so that when a disaster strikes, the urgent becomes manageable and avoid chaotic handling.

1.2.2 the Reactive Approach Illustration

Table 1.1: Summary of post-disaster housing construction performance (2020–2024).
Source: Ministry of Public Works & Housing, Indonesia

Completed by	2020	2021	2022	2023	2024	Total
Amount of projects (projects)	2	23	6	6	23	60
Avg project start since disaster (days)	468.00	65.30	294.50	818.17	1591.96	647.59
Avg project finished since start (days)	357.00	187.13	306.67	253.50	590.22	338.90
Avg project delivered since disaster (days)	825.00	252.43	601.17	1071.67	2182.17	986.49
Time spent preparing (%)	56.73%	25.87%	48.99%	76.35%	72.95%	56.18%
Time spent constructing (%)	43.27%	74.13%	51.01%	23.65%	27.05%	43.82%
Total unit (units)	630	2,460	3,292	1,292	2,729	10,403
Productivity (m^2/day)	67.06	499.54	407.92	193.67	175.70	268.78

The need to shift from reactive approach to proactive approach in disaster management can be illustrated by reconstruction projects by the Indonesia's Ministry of Public Works and Housing. An analysis of 60 completed post-disaster housing projects between 2020 and 2024, as shown in table 1.1, reveals that delays are rooted more in the preparation stage than in the construction phase. On average, projects took 986,49 days from disaster to completion, with 647,59 days (56.18%) allocated to preparation and 338.90 days (43.82%) to construction. The 2024 data is striking with projects taking over 1,500 days, or over 4 years, just to start, despite lessons from earlier years. These findings align with Smit (2024), who emphasize that urgent projects demand more attention in the preparation stage, as this is where key constraints emerge. Moreover, the rapid construction of two hospitals in Wuhan that completed in just 10 and 12 days during the COVID-19 outbreak demonstrates how intensive and integrated preparation can dramatically accelerate execution (H. Lu et al., 2023; Tan et al., 2021). To conclude, the significant challenge in delivering the project sooner is not in how quickly houses are built, but in how soon the construction can begin.

1.2.3 Identified Problem & Research Scope

In post-disaster contexts, timely housing delivery remains a persistent challenge in Indonesia. Although average response times have improved, recent data in Table 1.1 show that up to 56% of the overall delivery period is still absorbed by the preparation phase. Delays arise not from the construction itself but from the time required to launch projects once a disaster has struck. Shifting critical preparatory tasks, especially those that can be embedded in procurement terms, into the pre-disaster period therefore offers a direct route to faster and more resilient recovery.

This study concentrates on this preparation phase of post-disaster housing and examines how a procurement strategy can accelerate overall delivery. Literature like Grandia and Meehan (2017) and Fazekas and Blum (2021) highlights that procurement can directly impact policy outcomes while several project life cycle frameworks like Succar (2009) and Fewings (2005) (see appendix .1) put procurement at the interface of planning phase and construction phase. It transforms scope, schedule, risk, finance, and stakeholder roles into binding, actionable commitments (Uyarra & Flanagan, 2010). In doing so, it provides a practical bridge between high-level disaster management principles, such as the Sendai Framework for Disaster Risk Reduction and "Build Back Better," and the contractual arrangements that govern reconstruction.

Post-disaster housing, as used in this study, refers to the construction of permanent housing infrastructure provided during the recovery phase, and not temporary shelters or transitional accommodations. Amaratunga and Haigh (2011) explained that emergency or temporary shelter is an early form of accommodation with usually minimal expectations, focusing on providing shelter from hostile climatic conditions, a place to store belongings, and a sense of emotional security and privacy. Traditionally, this takes the form of plastic sheeting, tents, or emergency centres in communal buildings or relief camps. This type of housing falls within response phase in disaster management. Then, Post-disaster housing in recovery phase is permanent housing, which involves returning to the original residence or establishing a long-term dwelling. The overall process of "Housing reconstruction and rehabilitation" is focused on achieving these permanent solutions. Post-disaster housing, then, represent a long-term investment in community rebuilding and infrastructure resilience. This distinction is essential, as the procurement and planning mechanisms for permanent infrastructure are fundamentally different from those used for emergency shelter provision.

However, not every preparatory task can be codified within a contract. Broader institutional challenges like community engagement, land readiness, and inter-agency coordination require instruments beyond the procurement domain. Therefore, these elements will be documented as complementary findings to contextualize the proposed solution but are not the primary design target. Instead, the study focuses on preparatory actions that can be formalized within a procurement strategy, such as pre-approved supplier panels, clear project governance, and leveraging existing emergency procurement clauses. By maintaining a clear boundary between contract-configurable tasks and complementary institutional enablers, the research aims to deliver a strategy that is both impactful and implementable within Indonesia's existing regulatory and market environment.

1.3 Knowledge Gap

Several studies have explored disaster-management principles (Bosher & Chmutina, 2017; Sawalha, 2023) and recommended preparedness actions such as community training, land banking, and contingency funding. Other research has proposed partner-selection frameworks for reconstruction projects (Demirci & Isik, 2024). However, only a small number of studies attempt to translate these high-level principles into concrete, pre-disaster procurement strategies that allow governments to mobilise contractors, materials, and resources quickly after a disaster occurs. Among those, none

specifically focus on Indonesia's housing sector. As a result, public agencies are often left with general guidance but lack practical tools that can be directly implemented.

This study aims to address that gap by developing and validating a procurement strategy that is grounded in disaster preparedness principles. In doing so, it provides a practical link between international frameworks and the specific needs of Indonesia's post-disaster housing programs, helping the country move from a reactive to a more proactive reconstruction approach.

A structured search using Web of Science supports the existence of this gap. A broad search covering publications from 2015 to 2025, to align with the Sendai Framework era, identified 411 articles across relevant fields such as civil engineering, disaster studies, and construction management. However, when filtered for studies that specifically address disasters, urgency, preparedness, and procurement in the context of infrastructure or housing, only 10 articles remained. This shows that while each topic is individually well covered, integrated studies that connect disaster risk principles to practical procurement design during the preparation phase are rare. This research responds directly to that gap and contributes new insights to both academic and practical discussions on post-disaster project delivery.

1.4 Problem Statement and Research Questions

Building upon both empirical observations and insights from current literature, this study proposed that the key to improving the timeliness of post-disaster housing projects, or similar urgent infrastructure efforts, lies in the early identification and integration of critical preparation tasks into a well-designed procurement strategy. Such a strategy must reflect the latest theoretical development in disaster management and public procurement including incorporating socially and environmentally sustainable practices while accommodating as many preparatory activities as possible. By doing so, it enhances pre-disaster preparedness, accelerates project delivery, and ultimately contributes to quicker recovery and improved living conditions for affected communities.

Therefore, this research intends to identify essential preparatory actions specific to high-urgency construction contexts and translate these into a procurement strategy that is both proactive and feasible. Moreover, this study also intends to develop a model that facilitates not only faster and more efficient project delivery in post-disaster scenarios, but also inline with build back better principles. This central goal is synthesized to the following research question:

> ***"How can procurement strategy improve the current state of preparedness to accelerate Post-Disaster Housing Delivery in Indonesia? "***

To address the main research question, this study is structured around four sub-research questions that align with the stages of the Design-Based Research (DBR) methodology. The study begins with Sub-Research Question 1: ***"What aspects define disaster preparedness for post-disaster projects, and how can the level of preparedness within them be assessed?",*** which explores ideal practices drawn from literature and theory. This is followed by Sub-Research Question 2: ***"To what extent do recent urgent projects being prepared, and what are the gaps between theory and practice?"***, which analyzes empirical cases to assess real-world implementation and gaps. Together, these two questions form the analysis and exploration phase of the research. Building on these insights, Sub-Research Question 3: ***"What procurement strategy design is suitable to improve the current state of preparedness in post-disaster projects?"***, constitutes the design and construction phase, in which a strategic procurement arrangement is formulated. Finally, Sub-Research Question 4: ***"How can the proposed procurement arrangement for urgent projects be evaluated and refined for practical implementation?"*** forms the evaluation and reflection phase, where the proposed solution is tested with stakeholders. The detailed methodology, including case selection and data sources, is presented in the following chapter.

1.5 Purpose Statement

The study aims to serve several purpose such as accelerating project delivery and moving the focus of stakeholders during reconstruction. The primary goal of preparing the recovery project is to speed up project delivery within the current state of preparedness. However, that is not the sole objective. Even if the recovery projects do not end up being delivered significantly faster, preparing them in advance ensures that when a disaster strikes, all stakeholders can focus on solving problems that are urgent on the field rather than on the paperwork behind their desks. If the project itself has been always ready to launch, the chaotic initial phase of a recovery project can be replaced with a more structured and focused implementation. This approach is expected to produce better project outcomes and, ultimately, align more closely with the principles of "Build Back Better" (United Nations, 2015). Additionally, as the focus of this study is to permanent infrastructure in post-disaster situation, it is then intended that the findings and proposed solutions of this study, while mainly are for post-disaster housing in Indonesia, are for broader application within the same urgent conditions such as healthcare facilities, schools, or transportation systems.

Currently, post-disaster housing mechanisms in Indonesia, which rely on reactive behavior, left some room for improvement. To address these challenges, this research will compare the Indonesian approach to international best practices in urgent project procurement and disaster recovery frameworks. Through a comparative case study approach, the study will analyze how other countries accelerate project initiation and resource mobilization in post-disaster or urgent contexts. The research findings will lead to practical recommendations on how Indonesia's post-disaster housing delivery can be improved through better planning, regulatory adjustments, and more effective procurement strategies.

By investigating alternative models and identifying adaptable solutions, this study seeks to contribute to the broader discourse on disaster preparedness, resilient infrastructure planning, and procurement efficiency in post-disaster recovery efforts. It is expected that policy makers and other stakeholders, especially those who deals with disaster management, be enriched by this study.

1.6 Outline

The study will be presented in 7 chapters, ranging from introduction until recommendation. In the Chapter 2, wide variety of literature that discuss about theoritical frameworks from three foundational topics: public procurement, disaster management, and construction project management, and their combinations will be discussed. The aim of this chapter is to build a comprehensive understanding of the studied topic started from the foundation. Then, preparation of urgent projects are discussed deeper in Chapter 3 to build a framework of tasks that needed to accomplish optimized project preparation, so it will be ready when the project needed, based on available theoritical literature. This chapter intends to build the ideal preparation needed to accomplish the most optimized, shortest preparation once a project become urgent, like those post-disaster housing. Moving on to the Chapter 4, international practices about the most recent post-disaster reconstruction projects are discussed using both literature and prime data to gain insight of aspects that define disaster preparedness for post-disaster projects, the way these aspects are being assessed, the way recent urgent projects being prepared, and revealed gaps between theory and practice. This chapter aimed to provide preparedness framework to assess current practices and establish the baseline of the current state of preparedness. In Chapter 5, both baseline from previous chapter and the reconstructed workflow of current practices are utilized as the starting point to design possible solution. The output of this chapter is a procurement strategy that addresses what areas need to be improved from the current practices. By chapter 6, the feedback from indonesian post-disaster housing stakeholders to the proposed solution will be discussed, including the potential of improving the plan, what missed from the proposal, and what challenges to implement that in

the real world. Moreover, this chapter also evaluates the improvement gained by the proposed procurement strategy design against current state of preparedness. Finally, wider discussion, findings, and recommendation for the future studies are presented in the chapter 7. This chapter intends to bring this study to the wider discourse of project preparation optimization that will benefit urgent projects like post-disaster housing. By using this arrangement, it is expected that the study will contribute to the body of knowledge in project management and specially handling urgent projects and post-disaster situation.

Chapter 2 Literature Review

To build an understanding of the research topic, this literature review adopts an inward layering approach, as shown in Figure 2.0.1. The discussion begins with three foundational topics: disaster management with emphasize on preparedness, construction project management with emphasize on the planning phase, and public procurement with emphasize on flexibility and innovation, as both needed in dealing with new approaches and uncertain nature of disaster. Initially, the literature from each of these areas is examined separately. Then, the synthesize are drawn to discuss the core intersection: public procurement in post-disaster housing. This structured approach aims to clearly define the specific role of government in providing post-disaster housing based on foundational theories.

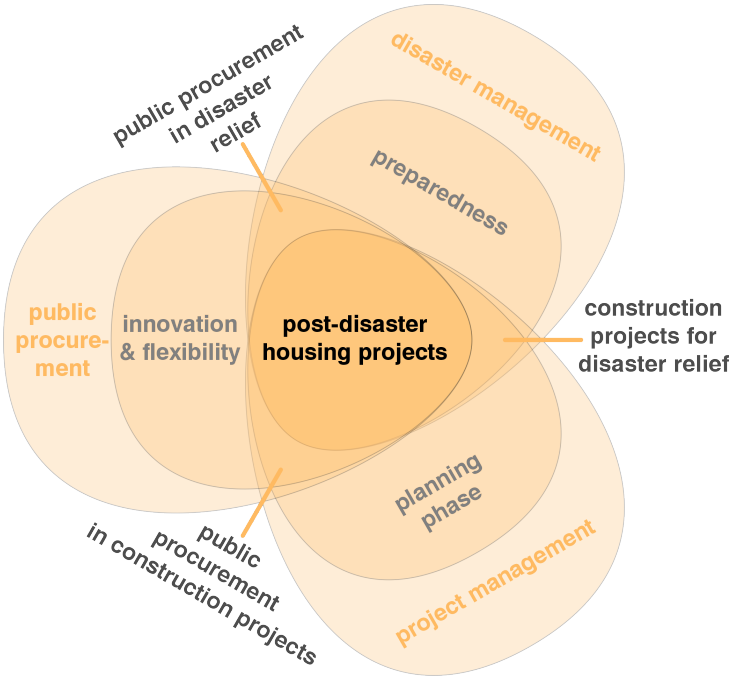

Figure 2.0.1: the Venn diagram of the intersection of three topics

As an overview, across all domains, shifts are occurring in response to societal, economic, and environmental demands. In disaster management, society and the economy demand greater resilience, leading to the development of frameworks such as the Disaster Management Cycle and Disaster Risk Reduction. In construction project management, economic and environmental pressures call for greater efficiency, effectiveness, and sustainable infrastructure, prompting the emergence of approaches like Integrated Project Delivery (IPD), Industrialized Construction, digitalisation, and, in the environmental context related to disaster management, resiliency. In public procurement, both economic and societal demands drive a move toward greater efficiency, effectiveness, and reduced uncertainty, resulting in a shift from strict to flexible procedures, from output-based to outcome-focused models, and from fragmented to integrated systems. Collectively, these shifts influence how post-disaster reconstruction projects are managed, especially during the preparation phase.

2.1 Disaster Management

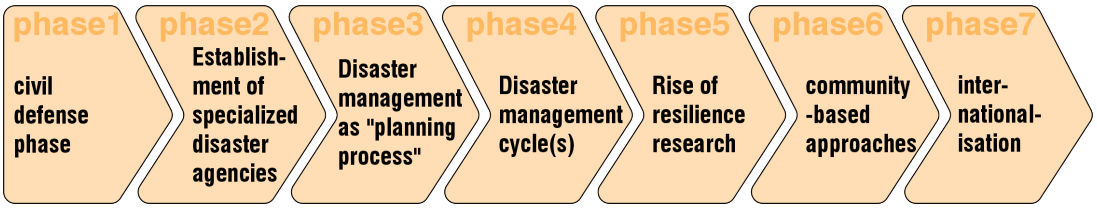

Figure 2.1.1: phases of disaster management evolution (Sawalha, 2023)

In disaster management, there are several frameworks that can be utilized. Two approaches that are popular are the Sendai Framework for Disaster Risk Reduction that introduced by the United Nations (2015) and Disaster Management Cycle that originated since 1920s. Sawalha (2023), on the other hand, found that there are seven conceptual approaches in disaster management that evolve over time, as seen in the figure 2.1.1. Disaster Risk Cycle and Sendai Framework are only two out of seven and sit at 4th and 5th in the evolution position, preceded by disaster management as a ”planning process” and succeeded by the community approach. It can be inferred that disaster management cycle rose first, and resiliency was developed later. From the paradigm standpoint, disaster management cycle is more reactive, with the actions start and finish from disaster events, and resiliency is more proactive by aiming risk reduction for the upcoming disaster. Understanding these frameworks and their evolution is critical to shape future disaster management action plan that able to exploit opportunities to improve relief efforts.

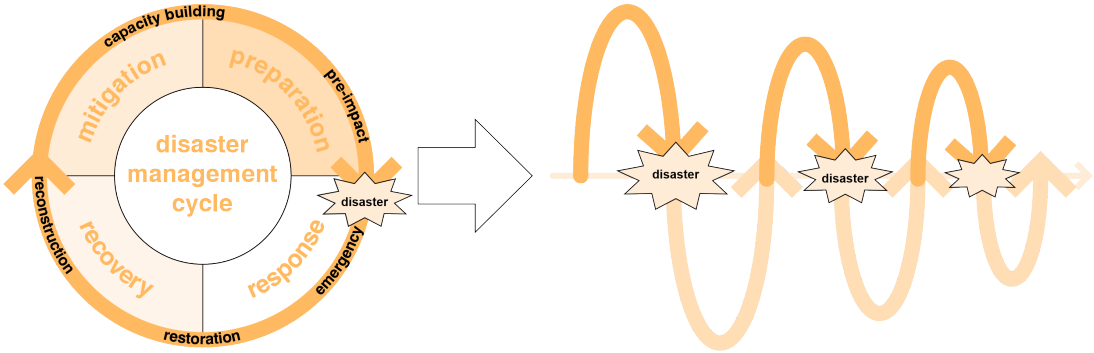

Figure 2.1.2: Original concept of Disaster Management Cycle (DDMA, 2021) with new paradigm proposed by Bosher et al. (2021)

The Disaster Management Cycle is a theoritical concept that rose since the 1920s and has been redefined since then (Sawalha, 2023). As the name suggests, the circle indicates that there are some steps from start to finish. It starts with a disaster event, then the response stage, recovery stage, planning stage, mitigation stage, and ends back at disaster event. The latest reshape proposed by Bosher et al. (2021) is based on the reactive nature of the conceptual approach; it starts and ends with the disaster event. In this proposed paradigm, as shown in figure 2.1.2, the cycle is changed into a helix to visualize that disaster impact should be lower due to understanding and experience from previous disaster.

Response phase is defined as the efforts to save lives and minimize properties' damage before, during, or directly after an emergency occurs by providing emergency medical care, relaying information to the public, and managing the arrival of donations and volunteers (McEntire, 2015). Then, the recovery phase is defined as actions taken to return vital life support until back normal life or better (McEntire, 2015). In the response phase, there is a consensus that time is the more prioritized by the government than money and quality. In the recovery phase, however, there are differences of opinion,

especially between theory and application. both Hallegatte et al. (2018), Murao (2020), and Safapour et al. (2021) conclude that time should be prioritized to restore the lives of disaster-affected residents , but in practice the government often prioritizes savings over immediate recovery. Rouhanizadeh and Kermanshachi (2019), Bilau et al. (2018), and Safapour et al. (2021) proved that while ideally time should be prioritized, government chose to prioritized money during recovery stage. Literature suggest that there is a paradox on prioritising success drivers, a tension that also highlighted by Safapour et al. (2021).

On the other hand, there is Sendai Framework. The BBB paradigm is also adopted by Indonesian government when it come to recover from disaster. For example, The Sendai Framework for Disaster Risk Reduction (2015–2030) provides a transformative shift from reactive disaster management to a proactive, risk-informed development approach. One of its most critical insights is the emphasis on preventing the creation of new risks and reducing existing ones, rather than solely responding to disasters after they occur. This forward-looking perspective is grounded in four priorities: understanding risk, strengthening governance, investing in resilience, and preparing to ”Build Back Better” during recovery. The framework also highlights that disaster risk is not just a natural phenomenon, but largely shaped by social, economic, and environmental vulnerabilities—calling for cross-sector collaboration and all-of-society engagement, including the private sector, academia, and local communities. Furthermore, the Sendai Framework underscores the need for data-driven decision-making, multi-hazard planning, and inclusive governance, especially for marginalized groups. By aligning disaster risk reduction with sustainable development and climate adaptation, it sets a comprehensive foundation for resilient, equitable growth worldwide.

the Sendai Framework by UNDRR (2015) derives to many literature that discuss about action plan of managing disaster, both before the disaster or after it. Katoh and Misumi (2024), for example, propose a preparatory actions against disaster Advance Recovery Community Development Plan (ARCP) based on the four prioritized actions in the Sendai Framework, by putting native community as the main actor of resiliency by making a reconstruction plan in the safe zone in their living area. Mannakkara (2014), on the other hand, set off from the response part of the Sendai Framework, propose a series of action plan from before the disaster happens to after it. There is also Opdyke and Wang (2021) that derives from Sendai Framework, that highlights the importance of technical assistant for the affected communities in post-disaster reconstruction. Then Çetin and Kirchherr (2025) integrates Circularity into the Sendai Framework to propose 10 action strategies in post-disaster reconstruction projects.

The more recent framework, sitting in the sixth phase in Sawalha’s framework, is empowering the community themselves to be resilient against disaster. Zhang et al. (2015) proposed this approach by incorporating community into PPP by adding another P, people, to be PPPP that centered around community empowerment against disaster. by doing this approach, he argues that both efficiency and effectivity in disaster relief efforts can be achieve since the affected community already knew what the plan were, and how to execute that, while other Ps like government and private sector supports what the affected community needs like raw material, funding, and technical assistance. this is inline to what UN Habitat (2019) and Katoh and Misumi (2024) proposed by saying that technical assistance either to plan recovery once disaster hits or the reconstruction after disaster is the key to empower potential affected communities to be resilient. Moreover, Vahanvati and Mulligan (2017), Lyons (2009) and Maly et al. (2022) proved how community involvement in post-disaster reconstruction improve longer term benefit by strengthening affected communities’ understanding about dealing with disaster, both before and after the event.

All of these insight might be valuable to manage future post-disaster projects. It is worth noting, however, that the existing literature might not sufficient for the future disaster relief, as Sawalha (2023) found that disaster management is still evolving.

2.2 Construction Project Management

In construction project management, economic and environmental pressures call for greater efficiency, effectiveness, and environmentally friendly infrastructure (Uusitalo et al., 2024) which then impact how construction projects are being manage, especially in front-end phases. The demands then trigger shifts within the industry toward integration, industrialization, digitalization, and environmental responsibility (Evans et al., 2023; Uusitalo et al., 2024).

Economically, the need for better project outcomes has encouraged the use of industrialized methods, and digital tools. Industrialized construction like lean construction and DfMA improve resource use and quality. Digital tools like BIM, GIS, and digital twins enhance decision-making, transparency, and real-time coordination (Uusitalo et al., 2024). At the same time, environmental concerns such as climate change and resource limits are pushing the industry toward sustainable and resilient practices. Sustainable infrastructure improves environmental performance and long-term value by reducing lifecycle impacts (Trejo & Gardoni, 2023) while resilient strategies help infrastructure withstand disruptions while maintaining essential functions (Sánchez-Silva et al., 2025; Trejo & Gardoni, 2023). Based on the existed pressures, several strategies are raising to tackle that, such as lean construction, DfMA, BIM, GIS, digital twin, disaster risk reduction, and build back better. Brief information and how each strategy impact front-end phases are as follows:

a) Lean Construction and DfMA

Lean construction and DfMA are strategies aimed at improving construction efficiency by minimizing resource use and reducing waste. Lean construction applies principles from lean manufacturing such as waste reduction and continuous improvement to the construction context. It focuses on maximizing client value through reliable workflows, early stakeholder collaboration, and iterative planning (W. Lu et al., 2021; Roxas et al., 2023). In CPM, lean methods support the integration of design and construction, helping reduce rework and inefficiencies typical of fragmented delivery (W. Lu et al., 2021). Applied during early project phases, lean construction improves goal alignment, risk management, and schedule reliability by involving key participants from the start (Roxas et al., 2023).

DfMA, in contrast, focuses on simplifying design for efficient manufacturing and assembly, either offsite or on-site. It promotes the use of standardized components and considers the assembly process from the earliest design stages (W. Lu et al., 2021; Roxas et al., 2023). DfMA enables prefabrication, modular construction, and aligns design with production efficiency (Roxas et al., 2023). When applied early in CPM, it facilitates collaboration with manufacturers and contractors to identify prefabrication opportunities, resolve constructability issues, and streamline the transition from design to fabrication, and ultimately shortening timelines, reducing errors, and improving quality.

b) BIM, GIS, and Digital Twin

BIM, GIS, and digital twins represent key digitalisation tools in construction, driven by advances in information technology. Building Information Modeling (BIM) is a digital model that integrates design and operational data across a project's lifecycle (Abuhussain et al., 2024; The American Institute of Architects, 2007). It enables multidisciplinary collaboration, supports cost estimation, detects design clashes, and allows scenario planning during early project stages. BIM reduces errors and provides a reliable basis for downstream construction activities.

Geographic Information Systems (GIS) manage and analyze spatial data for site selection, infrastructure planning, and environmental assessment (Abuhussain et al., 2024; Widanage & Kim, 2024). In early CPM phases, GIS helps integrate topographic, regulatory, and environmental data to inform site feasibility and planning decisions, making design more context-sensitive and optimized for real-world conditions (Widanage & Kim, 2024).

Digital twins are real-time virtual representations of physical assets that integrate BIM, IoT data, and analytics (Abuhussain et al., 2024; Javaid et al., 2023). They simulate construction processes,

predict performance, and assess risks before execution. In early phases, digital twins improve stakeholder engagement, enhance constructability analysis, and support better-informed, resource-optimized design decisions (Abuhussain et al., 2024; Javaid et al., 2023).

c) Disaster Risk Reduction and Build Back Better
Disaster Risk Reduction (DRR) involves identifying and managing risks to minimize the impact of natural and human-made hazards (Amaratunga & Haigh, 2011). In front-end project phases, DRR guides site selection, hazard assessment, and resilient design. This helps avoid high-risk areas, improve structural resistance, and ensure preparedness, and ultimately enhancing project sustainability and reducing vulnerability (Amaratunga & Haigh, 2011).

Build Back Better (BBB) is a post-disaster recovery strategy focused on rebuilding infrastructure and communities to be more resilient than before (Amaratunga & Haigh, 2011). In the early phases of CPM, BBB emphasizes higher building standards, hazard-resistant design, stakeholder involvement, and improved land-use planning. It aims to prevent future losses and promote safer, more durable, and sustainable infrastructure (Amaratunga & Haigh, 2011).

In conclusion, Lean construction, DfMA, Green/Sustainable BIM (GS BIM), digital twins, Disaster Risk Reduction (DRR), and Build Back Better (BBB) represent a new generation of construction strategies developed in response to evolving socio-economic and environmental demands within construction project management (CPM). These strategies are not isolated solutions but are closely linked to broader CPM approaches such as Integrated Project Delivery (IPD), industrialisation, digitalisation, and sustainable construction.

Each strategy significantly influences the front-end phases of CPM by promoting early stakeholder collaboration, advanced modeling, risk-informed planning, and sustainable design. Together, they lay a strong foundation for project success: enhancing efficiency, resilience, and long-term value from the beginning. Ultimately, these strategies help ensure that built outcomes are better aligned with the complex and dynamic demands of today's environment (Uusitalo et al., 2024), thereby closing the loop between high-level challenges, management approaches, and practical implementation in project delivery.

2.3 Public Procurement

In recent years, public procurement has shifted to improve the efficiency, effectiveness, and adaptability of construction project management, particularly in the crucial front-end phases (Fazekas & Blum, 2021; OECD, 2017). A key change is the shift from fragmented to integrated procurement, aimed at overcoming inefficiencies caused by siloed processes and unclear responsibilities, which Lenferink et al. (2013) describe as "implementation gaps." Integrated strategies connect planning, design, construction, and maintenance, improving project continuity and performance. Integrated contracts like DBFM, as detailed by Lenferink et al. (2013), streamline procurement, enhance collaboration, strengthen lifecycle management, and support more sustainable and inclusive outcomes.

Simultaneously, procurement is evolving from output-based to outcome-based, emphasizing long-term impact over the delivery of predefined products (Fazekas & Blum, 2021; Grandia & Meehan, 2017). This aligns project goals with broader public policies like sustainability and public value to maximize investment returns (Fazekas & Blum, 2021; OECD, 2017). Additionally, there is a shift from strict, rule-based procurement to more flexible models better suited to uncertainty in early project phases (Lenferink et al., 2013; Xu et al., 2022). As Xu et al. (2022) and Tian et al. (2024) explain, both content and execution flexibility help address unforeseen changes, enabling innovation, fairer risk-sharing, and stronger trust and cooperation among project parties (Erik Eriksson & Laan, 2007; Xu et al., 2022).

Together, these shifts from fragmentation to integration, outputs to outcomes, and rigidity to flexibility are transforming front-end project management. They improve integration, emphasize sustainability, and allow adaptive responses to evolving needs, aiming to deliver infrastructure that is efficient, effective, and resilient (Fazekas & Blum, 2021; Lenferink et al., 2013). The following subsections elaborate each transition:

a) Fragmented to integrated for efficiency

The shift from fragmented to integrated procurement seeks greater efficiency by addressing inefficiencies in traditional models where separated phases cause silos, unclear accountability, and coordination problems, resulting in delays, cost overruns, and poor quality (Fazekas & Blum, 2021; Lenferink et al., 2013). The "divorce between design and construction" often limits innovation and timely completion (Erik Eriksson & Laan, 2007). Fragmentation also hampers collaboration needed for innovation, especially in complex PPP or BIM-based projects (Lenferink et al., 2013; OECD, 2012). Mosey (2019), Engebø et al. (2020), and D. H. T. Walker (2015) underscore that collaboration is more encouraged because it provides a more robust, efficient, and proactive way to manage the complexities, risks, and interdependencies inherent in projects. It then leads to better outcomes, stronger relationships, and ultimately improved value for all stakeholders

Integrated procurement models like DB and DBFM consolidate lifecycle stages (design, construction, maintenance) under one contract (Lenferink et al., 2013; Tian et al., 2024). By assigning broad responsibility and linking incentives to lifecycle efficiency and sustainability, this approach aligns interests and encourages a holistic perspective (Lenferink et al., 2013). Integration reduces redesign and rework through concurrent processes (Erik Eriksson & Laan, 2007; OECD, 2017), clarifies accountability, fosters lifecycle optimization, and enables innovation via early collaboration (Lenferink et al., 2013; OECD, 2017). It also achieves economies of scale through centralized or collaborative procurement (OECD, 2017).

At the front end, integration promotes early contractor involvement, allowing construction input during design (Wondimu & Klakegg, 2020). Design becomes constructability-focused, often shifting detail design responsibility to contractors (Lenferink et al., 2013). Procurement shifts to MEAT criteria, emphasizing lifecycle cost, sustainability, and innovation (Lenferink et al., 2013). This fosters trust and reduces adversarial relationships (Erik Eriksson & Laan, 2007), though excessive integration or centralization can hinder innovation or ignore project-specific needs (Lenferink et al., 2013; OECD, 2017). Thus, balance between integration and flexibility is essential.

b) Output-focus to outcome-based for effectiveness

Moving from output- to outcome-based procurement reorients focus from delivering predefined goods to achieving broader value and strategic goals. Traditional output-based models rely on technical specs and performance tied to time and cost (Fazekas & Blum, 2021), whereas outcome-based approaches emphasize problems to be solved and goals to be achieved, allowing greater supplier flexibility and introducing softer evaluation criteria like collaboration (Erik Eriksson & Laan, 2007; OECD, 2017; Uyarra & Flanagan, 2010).

This shift improves effectiveness by expanding "value for money" beyond tender prices (Fazekas & Blum, 2021; Grandia & Meehan, 2017), encouraging innovation (OECD, 2017), and incentivizing lifecycle and sustainability optimization in models like DBFM. Notably, outcome orientation allows procurement to drive wider policy objectives like environmental, social, and economic (OECD, 2017; Uyarra & Flanagan, 2010). Complex outcomes also demand stronger collaboration and flexible project management to manage changes (Erik Eriksson & Laan, 2007; OECD, 2017).

At the front end, clients shift from prescribing specs to defining functional needs such as "best school-locking solution" vs. "mechanical locks" (OECD, 2017). This requires more strategic procurement: selecting capable partners via models like competitive dialogue or DBFM, under supportive policies like EU directives (Grandia & Meehan, 2017; Uyarra & Flanagan, 2010). Evaluation criteria now include quality, lifecycle cost, and innovation (Uyarra & Flanagan, 2010), requiring early contractor involvement and effective coordination (Wondimu & Klakegg, 2020). Though outcome-based models enable smarter risk allocation, they increase front-end

complexity and transaction costs due to detailed planning and innovative bid evaluation (Lenferink et al., 2013; OECD, 2017).

c) Strict to flexible to deal with uncertainties

The shift from strict to flexible procurement responds to uncertainties in modern projects, especially in front-end phases. Traditional methods prioritize low price, detailed client-led specs, and output control, but they limit trust, delay decision-making, and hinder speed (Erik Eriksson & Laan, 2007; Lenferink et al., 2013). Flexible models promote collaboration and innovation through partnering, joint specs, limited bidding, soft criteria, incentive-based contracts, and collaborative tools (Erik Eriksson & Laan, 2007; Wondimu & Klakegg, 2020), which essential for integrating technologies like BIM in PPPs (Xu et al., 2022).

Flexibility is crucial for managing uncertainty. Control-heavy project management underperforms amid change, while flexibility enables adaptive learning and performance improvement (Eriksson et al., 2017). Strict price-based models may cause adversarial relations, whereas trust-based models with compensation as incentive can manage risks better (Erik Eriksson & Laan, 2007). Rigid procurement also impedes innovation, while strategic, innovation-friendly flexibility promotes it (OECD, 2017; Uyarra & Flanagan, 2010). Flexibility spans content (price renegotiation, scope) and execution (mutual trust, adaptability) (Xu et al., 2022).

At the front end, flexibility supports Early Contractor Involvement (ECI), improving delivery speed and value (Wondimu & Klakegg, 2020). CD and negotiated procedures enable effective ECI and joint design planning (Erik Eriksson & Laan, 2007; Lenferink et al., 2013). Contractor selection expands beyond price to include collaboration potential, which is a key for trust (Erik Eriksson & Laan, 2007). Flexible contracts adapt to changes, avoid delays, and manage risks, as seen in BIM-enabled PPPs (Xu et al., 2022). Although open bidding in strict systems wastes resources, flexible procedures lower transaction costs if well-managed to avoid over-specification (Lenferink et al., 2013). Ultimately, flexibility fosters innovation, reduces risk, and enhances outcomes in complex settings (Erik Eriksson & Laan, 2007; Wondimu & Klakegg, 2020; Xu et al., 2022).

Public procurement is evolving from a static, rule-bound process into a strategic lever shaping how construction projects are initiated, procured, and delivered. Literature highlights three reinforcing transitions. *First*, the move from fragmentation to integration realigns incentives across the lifecycle like merging design, construction, finance, and maintenance under unified contracts. It also minimizes gaps, rework, and enabling whole-life value (Erik Eriksson & Laan, 2007; Lenferink et al., 2013). *Second*, the shift from outputs to outcomes reframes success around long-term societal value, enabling innovation and aligning infrastructure with broader policy goals such as sustainability and inclusion (Fazekas & Blum, 2021; Grandia & Meehan, 2017; OECD, 2017). *Third*, moving from rigid, price-centric methods to flexible, trust-based arrangements equips stakeholders to handle uncertainty, adopt emergent technologies (e.g., BIM, DfMA), and improve performance through early collaboration and adaptive risk-sharing (Wondimu & Klakegg, 2020; Xu et al., 2022).

These shifts elevate the front-end phase as a critical arena for integration, outcome definition, and flexible contracting. When balanced, they create a virtuous cycle: integration boosts efficiency, outcomes enhance effectiveness, and flexibility builds resilience, yielding infrastructure better aligned with public value and future demands (Fazekas & Blum, 2021; Lenferink et al., 2013). However, pitfalls remain exist on over-centralization, vague outcomes, or poorly managed flexibility can reduce transparency and accountability. Thus, procurement professionals must tailor integration depth, outcome clarity, and contractual flexibility to each project.

2.4 Combination of the Foundational Topics: Public Procurement in Post-Disaster Housing

This chapter has mapped the evolving landscape of disaster management, construction project management, and public procurement whose intersections shape the success of post-disaster housing delivery, especially during the preparation phase. Following the inward layering approach illustrated in Figure 2.0.1, the review reveals a converging trend across these domains: a shift toward more proactive, integrated, and strategically planned approaches, particularly in uncertain and time-sensitive contexts such as disaster recovery.

In disaster management, the shift from reactive to proactive paradigms is evident in the evolution from the Disaster Management Cycle to frameworks like Disaster Risk Reduction (DRR) and the Sendai Framework. These newer models prioritize preparedness, resilience, and "Build Back Better" (BBB), urging governments to invest in pre-disaster planning, engage communities, and integrate technical knowledge into recovery processes. Resilience has emerged as a forward-looking strategy to reduce vulnerabilities, empower local actors, and ensure long-term recovery that is not only faster but also stronger and more inclusive.

In construction project management, a series of shifts are transforming how projects are managed. The sector is moving from fragmentation to integration via Integrated Project Delivery, from manual to industrialized methods like Lean Construction and DfMA, from paper-based to digitalized systems like BIM, GIS, and digital twins, and sustainable infrastructure. These strategies emphasize early-stage collaboration, iterative design processes, lifecycle thinking, and sustainability. They particularly impact the front-end phase by enhancing decision-making, reducing rework, and embedding risk-informed design from the beginning.

In public procurement, institutional transformation supports and accelerates these trends. The field is shifting from fragmented to integrated models, from output-based to outcome-oriented approaches, and from strict, rule-based procedures to flexible, adaptive frameworks. These shifts promote lifecycle collaboration, encourage innovation aligned with public value, and better accommodate the uncertainties inherent in post-disaster settings. Modern procurement now acts as a strategic tool to align stakeholders, distribute risk, and deliver resilient infrastructure more effectively (Grandia & Meehan, 2017).

In conclusion, these shifts reflect growing societal, economic, and environmental demands. Together, the literature suggests that such paradigm transformations fundamentally influence how urgent projects, particularly in post-disaster contexts, are managed during the front-end phases. By understanding current trends and anticipating future trajectories, the solution proposed in this study aims to bridge empirical challenges with academic insights, ensuring that it is both contextually grounded and theoretically informed.

Chapter 3 Methodology

To explore how post-disaster housing projects in Indonesia, and similar urgent construction contexts, can be delivered sooner, this study adopts a qualitative research approach with Design Based Research method. A qualitative approach is appropriate for this study due to its focus on understanding processes, perceptions, and institutional arrangements within real-world and complex settings (Denzin & Lincoln, 2018). Since the problem involves a range of interrelated social, regulatory, and operational factors which are often context-specific, qualitative inquiry enables the depth and flexibility that needed to capture that complexities (Creswell & Poth, 2018). Furthermore, this research is guided by the principles of Design-Based Research (DBR), a methodology rooted in iterative exploration, stakeholder collaboration, and solution-oriented design in real-world contexts (Plomp & Nieveen, 2013). The study applies DBR in four interlinked phases: analysis & exploration, design & construction, evaluation & reflection, and theoretical contribution; corresponding to the structure of the sub-research questions.

3.1 Research Design

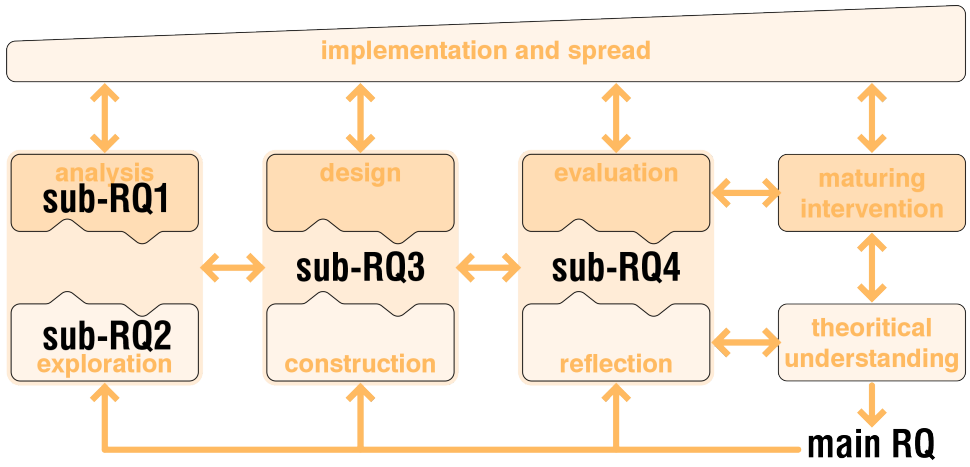

Figure 3.1.1: Design Based Research method adapted from McKenney and Reeves (2019)

The research adopts the Design-Based Research (DBR) framework, as conceptualized by McKenney and Reeves (2019), to iteratively explore, design, and evaluate practical strategies for optimizing the preparation of urgent infrastructure projects, particularly post-disaster housing. The design is structured into four core phases: analysis and exploration, design and construction, evaluation and reflection, and maturing intervention, each aligned with a specific sub-research question. In the initial phase, theoretical and practical perspectives are synthesized to identify ideal preparation tasks (Sub-RQ1), followed by an exploration of current practices across selected case studies (Sub-RQ2). This leads to the design and construction phase, where a procurement strategy is formulated to bridge the gaps identified (Sub-RQ3). Subsequently, the proposed solution is tested and validated with stakeholders in the evaluation and reflection phase (Sub-RQ4). The outcomes are then refined to contribute both to practical improvements in policy and planning, and to theoretical advancements in managing urgent infrastructure delivery. This cyclic and responsive research design ensures both relevance and rigor, as emphasized in DBR methodology (McKenney & Reeves, 2019; Plomp & Nieveen, 2013).

3.1.1 Analysis and Exploration Phase

The first sub-research question, *"What aspects define disaster preparedness for post-disaster projects, and how can the level of preparedness within them be assessed?"*, is part of the analysis phase in the Design-Based Research (DBR) framework. This phase builds the theoretical base to identify key preparation tasks that support early project delivery in urgent settings. The question is addressed through a structured literature review covering disaster preparedness, construction management, procurement, and recovery. Sources include academic journals, handbooks, and global frameworks such as the Sendai Framework and the Disaster Risk Management Cycle. The review focuses on themes like readiness, pre-disaster planning, modular construction, and pre-arranged contracts. From this, a set of ideal preparation tasks will be outlined and assessed for their relevance to fast delivery, adaptability in uncertain conditions, and fit with procurement systems. These may include early design planning, contract setup, supplier pre-qualification, stakeholder coordination, and land readiness. The result will be a framework of ideal tasks that serves as a benchmark for evaluating real-world gaps and guiding the procurement strategy design.

The second sub-research question, *"To what extent do recent urgent projects being prepared, and what are the gaps between theory and practice?"*, belongs to the exploration phase of the DBR framework. This phase looks at how urgent construction projects have been delivered in practice and compares them with the ideal conditions defined earlier. The study uses a multiple case study approach (Yin, 2018), focusing on fast-track projects such as the Wuhan COVID-19 hospitals (China, 2020) and post-disaster housing in Lumajang (2021) and Palu (2019). Indonesian cases will be explored through interviews or focus group discussions with officials from the Ministry of Public Works and Housing, contractors, procurement staff, and regional agencies. For international cases, data will be collected from published reports, project documents, and literature. The analysis will follow a qualitative pattern-matching method, comparing observed practices with the ideal preparation framework to identify common gaps, effective approaches, and limiting factors. The findings will provide a clear view of practical, institutional, and contextual challenges that affect early-stage preparation, forming the diagnosis for the next research phase.

3.1.2 Design & Construction Phase

The sub-research question, *"What procurement strategy design is suitable to enhance the current state of preparedness in urgent infrastructure projects?"*, forms the core of the design and construction phase in the Design-Based Research (DBR) framework. Building on the ideal tasks defined in Sub-RQ1 and the practical gaps revealed in Sub-RQ2, this phase aims to create a procurement-focused intervention to improve the readiness and response of post-disaster housing and other urgent construction projects. The goal is to develop a strategy that addresses key gaps while using lessons from good practices, with a focus on shifting certain tasks to the early planning phase, before a disaster occurs or urgency escalates. The design will be developed through an iterative process that combines the ideal task framework, case findings, international models, and local insights. Although based on literature, the strategy will be shaped through discussions with practitioners in focus groups or individual interviews when group sessions are not possible. These interactions are not for evaluation but help guide the design process through practitioner input. This approach follows DBR principles of researcher-practitioner collaboration to create context-based and practical solutions (McKenney & Reeves, 2019; Plomp & Nieveen, 2013). The result will be a draft procurement strategy that shows how preparation tasks can be built into procurement systems to support earlier project start, which will then be tested and refined in the next phase.

3.1.3 Evaluation & Reflection Phase

The fourth sub-research question, *"How can the proposed procurement arrangement for urgent projects be evaluated and refined for practical implementation?"*, guides the evaluation and reflection phase of the Design-Based Research (DBR) framework. After the draft strategy is developed in Sub-RQ3, this phase assesses its relevance, feasibility, and potential impact within the real context of post-disaster housing in Indonesia. The goal is to ensure that the strategy is not only sound in theory but also fits the legal, procedural, and institutional conditions of public procurement. Evaluation will be done through structured discussions with key stakeholders, preferably through focus group discussions involving representatives from ministries, procurement agencies, contractors, and disaster recovery institutions. If group meetings are not possible, semi-structured interviews will be used instead. This step has two aims. firstly, it aims to collect feedback on which parts of the strategy work, which need revision, and what challenges may arise. Secondly, it aims to reflect on how the strategy fits with current practices and behaviors in Indonesia's procurement system. The outcome will be the evaluation of proposed procurement strategy and foreseen future potential development, challenges, and implementation barriers. The outcomes will be shaped by input from the field and used to reflect on how practical findings contribute to academic understanding of urgent project delivery and preparedness. This phase helps connect theory to practice and strengthens the value and usability of the proposed intervention.

3.1.4 Maturing Intervention & Theoritical Understanding Phase

Following the phases of analysis, exploration, design, and evaluation, this research concludes with the phase of maturing the intervention and theoretical understanding. In this final stage, insights from earlier steps are brought together to finalize the proposed procurement strategy and reflect on its broader theoretical value. As noted by McKenney and Reeves (2019), this phase consolidates the intervention into a clear and well-contextualized solution while shaping refined theoretical contributions. The procurement strategy, aimed at improving preparedness in urgent infrastructure delivery, is refined through repeated input from stakeholders and grounded in real-world data. Once refined, it is considered mature, meaning it clearly defined, tested, and relevant for both practice and research. At this point, the study answers the main research question: ***"How can procurement strategy enhance the current state of preparedness to better support the implementation of Build Back Better principles?"***. This is done by triangulating insights from theory, case studies, and stakeholder feedback, which strengthens both validity and relevance. At the same time, theoretical knowledge is extended by translating practical lessons into broader design principles or propositions on how procurement influences preparedness and responsiveness in post-disaster settings. As McKenney and Reeves (2019) explains, such theoretical outputs are essential for advancing academic and applied knowledge. Together, the final strategy and its underlying theory provide the closing outcome of the study, offering value not only to Indonesian post-disaster policy but also to similar urgent project settings elsewhere.

3.2 Case Studies

To inform the design of a strategic procurement arrangement for urgent projects, this research incorporates a set of comparative case studies selected based on two key performance metrics: massiveness (scale of construction) and quickness (speed of delivery). A framework by Wearne (2002) introduced the that quadrant model as a classification framework for emergency events, as presented in figure 3.2.1. This framework is particularly suitable for assessing urgent projects for several reasons, all grounded in the original paper. First, it simplifies complex variables. Emergency

projects vary significantly in causes, responsible authorities, scale, and location. The quadrant system reduces this complexity into two fundamental dimensions: the scale of the work and the time-scale of urgency. Second, it enables case comparison. The primary function of the quadrants is to serve as a comparative tool. By placing a new emergency event within the appropriate position in the matrix, project managers can identify past cases that are most similar to the current situation.

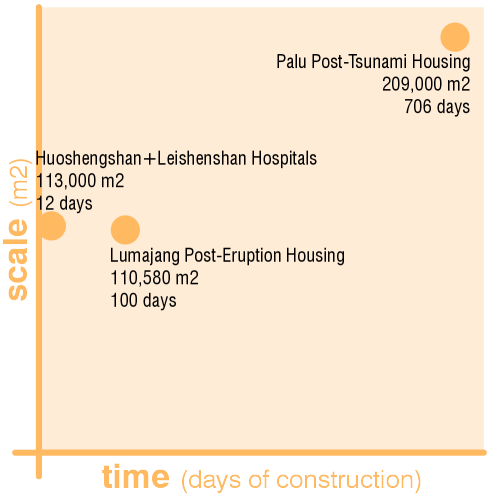

Figure 3.2.1: Selected cases in the scale-time quadrant that adapted from Wearne (2002)

The selected cases are 3: the rapid construction of Huoshenshan and Leishenshan Hospitals in Wuhan, China (2020); the delivery of post-disaster housing in Lumajang, East Java, Indonesia (2021); and the large-scale post-tsunami housing program in Palu, Central Sulawesi, Indonesia (2019). Each case provides a unique profile. The Wuhan hospitals were developed under emergency conditions during the COVID-19 outbreak, commissioned by the Chinese central government and executed through military coordination with construction enterprises. The Lumajang project, constructed by Indonesian state-owned enterprises under the Ministry of Public Works and Housing, delivered nearly 2,000 homes in 188 days following the Mount Semeru eruption. Meanwhile, the Palu housing program, although slower, achieved delivery nearly 5,600 homes, making it one of Indonesia's most extensive post-disaster housing efforts. Detailed profiles of each case by covering their location, client-contractor relationships, delivery mechanisms, scale, and contextual urgency, are presented in the following sections.

3.2.1 Case A: Huoshengshan & Leishenshan COVID-19 Hospitals, China, 2020

The Huoshenshan and Leishenshan hospitals in Wuhan, China, serve as compelling case studies of urgent infrastructure delivery in the context of a public health emergency. Constructed within just 10 and 12 days, respectively, and each covering over 60,000 square meters (Tan et al., 2021), these hospitals illustrate the extreme compression of time possible when supported by advanced modular construction technologies and a highly mobilized industrial base. They were built in response to the escalating COVID-19 pandemic, making them representative of post-disaster emergency projects where infrastructure is required immediately to support public safety. Their significance lies not only in the speed of delivery, but also in the state-led coordination, supply chain capacity, and technological readiness that enabled such rapid execution (H. Lu et al., 2023).

Although such projects may seem difficult to replicate, they offer valuable lessons for other contexts regarding preparedness. These insights are highly relevant for countries aiming to strengthen their emergency infrastructure delivery mechanisms. Given the limited public access to primary project data, the analysis of this case will rely on secondary sources, including academic articles, technical reports, government publications, and credible news coverage.

3.2.2 Case B: Lumajang Post-Mount Semeru Eruption Housing, Indonesia, 2022

The permanent housing development for communities affected by the 2021 Semeru eruption was initiated in early 2022 following a major volcanic eruption in Lumajang, East Java. This project involved the construction of 1,951 housing units for displaced residents from seven villages identified as high-risk areas. The relocation site, located in Sumbermujur Village, was chosen to ensure safety while maintaining proximity to the residents' original social and economic environment (Irawati, 2022).

This project was initiated under high time pressure due to the urgent need to provide safe housing before the following rainy season and religious holidays. The Indonesian Ministry of Public Works and Housing coordinated the preparation and construction process, supported by regional authorities, national disaster agencies, state-owned contractors, academic institutions, and community organisations (Dhafintya Noorca, 2022; Kementerian PUPR, 2022). The use of modular housing technology (RISHA) allowed for rapid deployment and efficient construction within a few months (Bahfein & Alexander, 2022).

This case is relevant to the topic of urgent project delivery because it represents a real-world example of how emergency infrastructure is planned and prepared under compressed timeframes. Data for this case will be collected through interviews with key stakeholders and supported by secondary sources, including news articles, project reports, and academic publications.

3.2.3 Case C: Central Sulawesi Post-Tsunami Housing, Indonesia, 2019-2024

The permanent housing programme in Palu, Central Sulawesi, was conducted following the 2018 earthquake, tsunami, and liquefaction. Due to the disaster, tens of thousands of people were displaced and required relocation from high-risk zones to safer areas. The government, supported by the World Bank and various stakeholders, initiated a large-scale housing development to resettle the affected population and reduce future disaster risk (Kementerian PUPR, 2019; The World Bank, 2019).

This project is particularly useful for examining how urgent housing projects are prepared in complex environments. It involved coordination between national and local governments, international donors, contractors, and research institutions. Modular construction methods, phased site development, and large-scale land acquisition were key features of the preparation phase. These characteristics make the project suitable for analysing how preparatory decisions influence delivery speed and project outcomes.

Data for this case will be collected through interviews with relevant stakeholders and supported by additional sources such as news articles, official reports, and academic publications.

3.3 Data Collection Method

To ensure the proposed procurement strategy is grounded in both policy and practice, this study involves stakeholders across all levels of Indonesia's post-disaster housing system. The interviewees include one representative from the public procurement authority (LKPP), who provided insights into the regulatory and policy framework; one from a planning or disaster policy institution (either Bappenas or BNPB), who explained national disaster planning objectives; and one program director overseeing post-disaster housing, who shared views on program-level decision-making. Two client-side project managers were interviewed to discuss implementation on behalf of the government and internal coordination. Two contractor-side project managers contributed technical

and logistical perspectives from the field. Finally, two local government officials were included to reflect community-level roles such as land provision and communication with affected residents. This range of participants reflects the full chain of influence, from policy to practice, and follows calls by Bosher et al. (2007) and Mannakkara (2014) to align governance, regulation, and delivery systems in order to strengthen disaster recovery. As Yin (2018) notes, complex challenges require input from all organisational levels to understand how strategy works in real-world conditions.

The data collection consists of two rounds of semi-structured interviews. The first round focuses on current practice. Interviewees are asked to describe their role, reflect on their recent recovery project experience, assess each preparation aspects and provide input based on SWOT. These discussions help identify bottlenecks, effective practices, and local limitations. The second round revisits the same respondents after they receive a summary of the proposed strategy. The same framework is used, but questions now assess fit, feasibility, and risk. Each session ends with an open-ended feedback. Interviews are held face-to-face or through secure video calls, either individually or in small peer groups of two to four people. Each session lasts 60 to 90 minutes, is recorded with consent, and transcribed for analysis. Full question details appear in Appendix .3.

Chapter 4 Preparedness Gap

This chapter serves as the analysis and the exploration based on the Design-Based Research scheme that this study adopt, as well as the way to answer both sub-research question 1 and 2. In this chapter, understanding laid down in the literature review are then explored further to find preparedness aspects that can be performed before disaster struck. All of the preparations are found from the literature. Then, reflection from the current practices will be explored to compare how far current practices to the preparations recommended by literature. The findings from this chapter will be foundational for the next chapter as the framework will become the assessment tool of preparedness and practice gap will become identifier of under-prepared aspects as well as the baseline for the improvement.

4.1 Preparedness Literature

Drawing from key sources including Bosher and Chmutina (2017), McEntire (2015), Khorram-Manesh et al. (2021), Phillips and Mincin (2023), Mannakkara (2014), United Nations (2015), and Amaratunga and Haigh (2011), this study groups post-disaster reconstruction preparation tasks into seven aspects: community involvement, knowledge, industrial resources, relocation land, legal framework, funding, and reconstruction programmes. Each group expands on the four priority actions outlined in the Sendai Framework: understanding disaster risk, strengthening risk governance, investing in risk reduction, and enhancing preparedness to Build Back Better. For instance, knowledge aligns with Weichselgartner and Pigeon (2015) on the need for risk awareness, while community involvement reflects the shift described by Sawalha (2023) and the practical guidance from UN Habitat (2019). Industrial resources are emphasized by Amaratunga and Haigh (2011) and Mannakkara (2014), and supported by the SFDRR's recommendation for pre-disaster stockpiling. Funding is essential, as McEntire (2015) notes that plans without financial support cannot be implemented. The programmes and projects group represents the result of all preparatory actions and links directly to the fourth SFDRR priority. Since each group varies in scope and influence, the tasks are arranged along a preparedness continuum, from reactive and ad-hoc to proactive and integrated, based on the principles in the Sendai Framework (United Nations, 2015) and the updated Disaster Management Cycle by Bosher et al. (2021). The next sections present each group in turn, followed by the full list of preparatory tasks, the logic behind their ranking, and the patterns that suggest what works best in practice.

4.1.1 Community Involvement

The inclusion of community involvement as a preparedness aspect is supported by multiple sources. Sawalha (2023) note a growing trend toward greater community participation in disaster management, while Amaratunga and Haigh (2011) show that such involvement leads to more sustainable outcomes. Davidson et al. (2007) introduce the "ladder of participation," which ranges from manipulation to full control, describing the degree of activeness in engagement. Another key factor is timing, as early involvement enables communities to contribute local knowledge on hazards, safe areas, and traditional coping strategies (Amaratunga & Haigh, 2011). Activeness and timing dimensions help define preparedness levels. Less prepared communities are often passive and involved late, with little influence. In contrast, more prepared communities engage early and take part in planning and implementation. For example, UNISDR (2017) describe Myanmar's post-Cyclone Nargis recovery, where lack of early community involvement delayed assessments. By contrast, Katoh and Misumi (2024) propose the Advance Recovery Community

Development Plan (ARCP), which emphasizes proactive engagement before disasters.

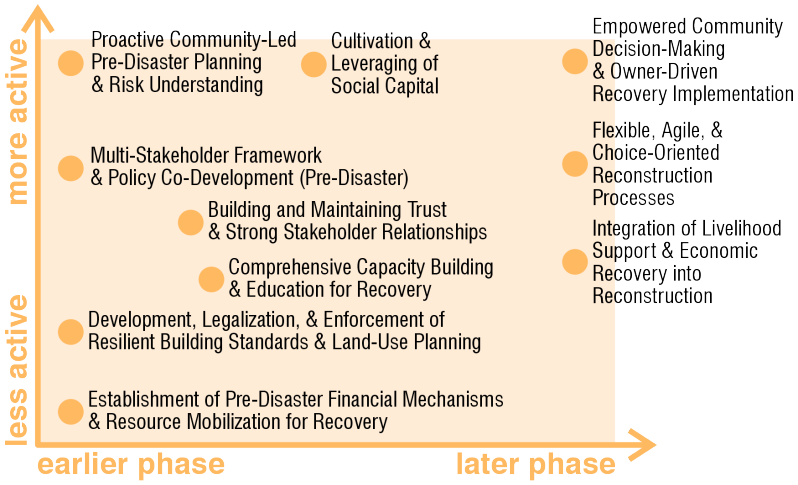

Figure 4.1.1: community involvement preparations, synthesized from UNISDR (2017), Katoh and Misumi (2024), Maly et al. (2022), Vahanvati and Mulligan (2017), and Davidson et al. (2007)

Firstly, less prepared communities are usually passive in recovery and reconstruction. They often act as recipients of aid provided by governments or NGOs. Davidson et al. (2007) explain that their involvement happens late in the recovery process, often limited to providing labor for standardized housing or choosing from a few fixed options. These communities have little influence on early decisions related to project design, planning, or resource use. Even if consultations are held, their input is not always used, and they may only be informed after decisions are final. A strong reliance on outside support is common due to a lack of internal organization, capacity, or previous recovery planning (Maly et al., 2022). Many also lack awareness of disaster risks, safety measures, or recovery strategies, which makes post-disaster training essential (UNISDR, 2017; Vahanvati & Mulligan, 2017). For example, UNISDR (2017) show that after Cyclone Nargis in Myanmar, external actors had to deliver recovery training well after the event because there was no existing review system. In such settings, recovery is often led by external institutions using top-down methods, as community capacity is seen as low and there are no established ways for local engagement (Maly et al., 2022; Vahanvati & Mulligan, 2017).

Secondly, moderately prepared communities show increasing participation, although not always across all recovery phases. Civil society and NGOs often play a central role, helping connect local communities with formal structures, while also supporting local capacity building (Maly et al., 2022). Sometimes participatory models like owner-driven reconstruction (ODR) are introduced, giving people a more active role, though external agencies still provide guidance and support (Maly et al., 2022). These communities and their partners often try new approaches and reflect on past experiences to improve participation. In Bihar, India, pilot projects were used to test an adaptive ODR model that suited local needs. Efforts also focus on creating communication channels and building trust between stakeholders (Vahanvati & Mulligan, 2017). The Kosi River floods recovery in Bihar is one such case, where NGOs moved from implementing projects to shaping policy and building government capacity, allowing communities to become more involved. After the 2014 Chiang Rai earthquake in Thailand, residents also helped with reconstruction using locally supplied materials, and strong relations between local government and residents, supported by NGOs, helped promote safer building practices (Maly et al., 2022).

Finally, more prepared communities take part from the very start of the recovery process. Their role includes pre-disaster planning, needs assessments, project design, implementation, and joint decision-making. Based on Katoh and Misumi (2024) and Davidson et al. (2007), these communities often have recovery plans already in place, such as the Advance Recovery Community Development Plan (ARCP), along with good coordination systems and strong

partnerships with governments and civil society. They show a strong sense of ownership and use local knowledge and skills to guide recovery (Davidson et al., 2007). This reflects the highest level of the participation ladder, where people have real control over decisions. Recovery here is collaborative and people-focused, emphasizing community needs, skills, and goals. High levels of trust and strong social networks help support collective efforts. Engagement often goes beyond rebuilding homes and addresses deeper issues to improve long-term resilience. Several examples show this approach. In the Colombian CGO case, people led their own projects and made real decisions (Davidson et al., 2007). The Disaster Recovery Landscape and ARCP frameworks show how early planning increases ownership and social capital (Katoh & Misumi, 2024). Abhiyan's work in Gujarat, India, used existing trust to create shared decisions early in the process. The Owner-Driven Housing Reconstruction model in India and elsewhere also highlights the active role of homeowners (Vahanvati & Mulligan, 2017). Communities that build strong recovery systems before disasters are better able to apply Build Back Better principles.

In conclusion, the level of preparedness shapes when and how communities engage in recovery. Continuum moves from passive and late involvement to active and early participation. Moving toward higher preparedness involves building local capacity, strengthening CSO and NGO roles, and applying participatory frameworks like ODR and pre-disaster recovery planning.

4.1.2 Knowledge

Disaster knowledge is a key aspect of preparedness with several groups of stakeholders involved. Perry and Quarantelli (2005) argue that understanding disasters sharpens theory, strengthens science, and leads to smarter prevention, preparedness, and resilience. Similarly, Weichselgartner and Pigeon (2015) highlight the role of knowledge in relation to the SFDRR, noting that overall disaster risk reduction can improve when more practical guidance is drawn from disaster knowledge. UN Habitat (2019) further stress the need to improve knowledge across four stakeholder groups: government, aid agencies such as NGOs and experts, the built environment sector, and disaster-affected communities. Brown et al. (2014) then propose four levels of disaster literacy, from basic to critical. Gallego and Tejero (2023) describe a continuum from passive to responsive communities (see Appendix .2). Oyao et al. (2015) introduce five stages of knowledge from novice to expert, aimed at education. These frameworks show different approaches, making it easier to map knowledge levels to suitable groups, as shown in Figure 4.1.2.

The horizontal axis combines the lowest and highest knowledge levels from the literature. It starts with the "high-level passivity" defined by Gallego and Tejero (2023), where people ignore known risks. It ends with expert-level actions described by Oyao et al. (2015) and Seifi et al. (2019), including tasks that involve creating new knowledge and leading change such as scenario modelling, risk-based decision-making, and policy design. At the second level, Brown et al. (2014) describe basic literacy, where people can read messages but do not act, while Oyao et al. (2015) describe novice learners as having disconnected knowledge—both reflect limited action. From the third to fifth levels, a mix of sources (Brown et al., 2014; Gallego & Tejero, 2023; Oyao et al., 2015; Seifi et al., 2019) describe increasing action: acting on known risks, planning for protection, and designing solutions. These levels form a continuum for mapping stakeholder knowledge. The next section explains the position of each stakeholder group along this line.

a) Community
   the community stakeholder's span can be mapped between zero to third point on the combined continuum, which begins with denial and complacency without meaningful knowledge nor action. Gallego and Tejero (2023) elaborates that in the Phillipines, some communities just leave it to God when it comes to prepare for the disaster. A level higher than that, in the first point, Gallego and Tejero (2023) describe that risk is acknowledged, but "people still fail to act," while Brown et al. (2014) ackknowledge that community can

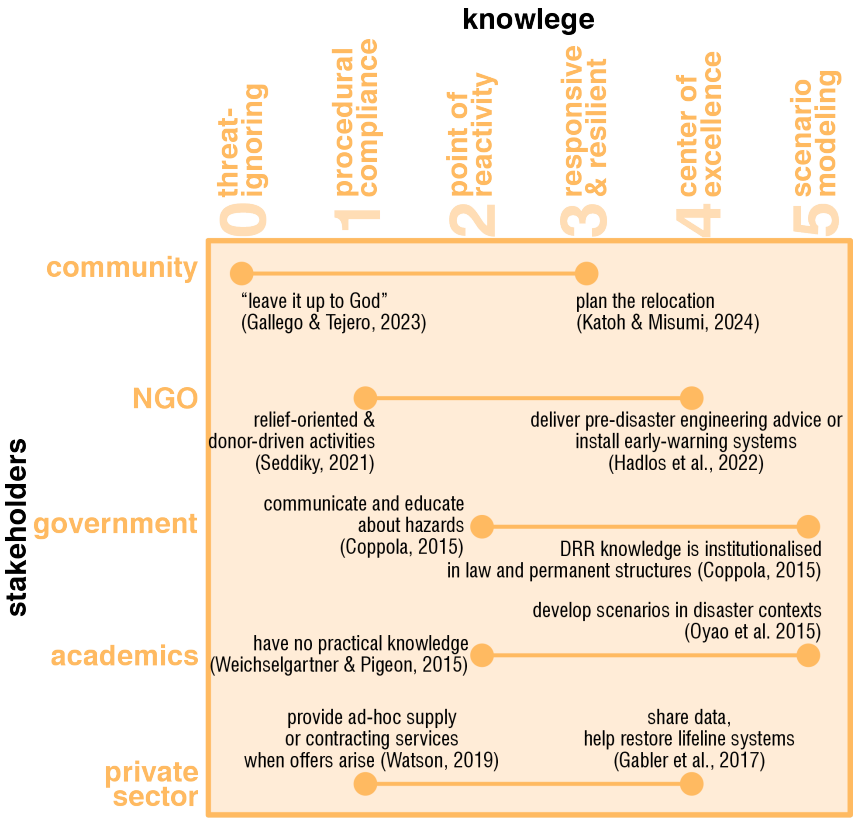

Figure 4.1.2: reconstruction knowledge required as disaster preparation

read simple instructions but with "limited capacity to follow those instructions." In the second point, Gallego and Tejero (2023) mark the moment the public "realises that concrete actions, more than lip service, must be undertaken", while Brown et al. (2014) mark that people can now follow official guidance in this level. Finally, in the third point, both Gallego and Tejero (2023) and Brown et al. (2014) state that communities can become self-reliant and resilient when they can adapt and sustain recommended practices, but not expected to create scientific models or draft policy. Katoh and Misumi (2024) also provides an example when communities plans their relocation, which is a practice that mitigate threats and establish resilient living.

b) NGOs

The disaster-knowledge profile that emerges for non-governmental organisations (NGOs) stretches from reactive, relief-only operations to fully integrated risk-governance partnerships. It starts with the lower edge of the continuum at the first point. Many NGOs possess only additional disaster insight. A survey of Bangladeshi organisations shows that DRR is non-core to the business of most groups. Their activities remain relief-oriented and donor-driven because agencies. They lack the expertise and resources to implement programmes that directly impact DRR (Seddiky, 2021). Moving to second point, the same NGOs become reactively compliant: they can follow official instructions, like staging mock drills, leading awareness rallies, but still confess that often fail to take disaster into consideration due to lack of technology, expertise and empirical research. In the third point, NGOs shift to responsive, resilience-building practice. Case studies in the Philippines and Nepal describe NGOs that mainstream DRR into community services: they retrofit or rebuild 25,000 disaster-proof schools, teach households to map evacuation routes, finance rain-water storage for drought resilience and knit social-support networks that survive long after projects end (Hadlos et al., 2022; Parsons et al., 2016). Finally, at the fourth point, NGOs operate as integrated risk-governance partners. At this tier, NGOs deliver pre-disaster

engineering advice, install early-warning systems, coordinate multi-level stakeholders and help local governments meet Sendai Framework duties for investment, capacity-building and inclusive recovery (Hadlos et al., 2022; Parsons et al., 2016).

c) Government

The disaster-knowledge continuum for government agencies begins in the second point when officials possess just enough knowledge to do their daily business, even in the event of disaster. Coppola (2015) lists risk-communication and education campaigns as the first task of government preparedness. Contrary, the fifth point can be reached when DRR knowledge is institutionalised in law and permanent structures. Mature systems have "national disaster-management laws, statutory authorities, and national committees" that allow the centre of government to move beyond response into setting standards, funding and technical guidance for the entire system (Coppola, 2015). This level demands mastery of legislative design, long-range risk modelling and multi-sector policy stewardship. This is the most advanced governmental knowledge described in the reviewed sources. Between both knowlegde, government's knowledge expands into inter-governmental coordination, which represented by a strong coordination among participating agencies as one a unit of an effective emergency-management organisation (Coppola, 2015). This knowledge can be mapped as third point. Here, government knows not only what needs doing but also how to align its own machinery to do it. Finally, At the fourth, Coppola (2015) expects policy integration: disaster-risk reduction is woven into climate-change adaptation and national development planning. Coppola notes that full integration remains elusive because of "poor communication between CCA and DRR stakeholders" and siloed funding streams, implying a higher tier of governmental competence, although it may still uncommon.

d) Academics & Experts

The knowledge that expected from experts and academics start with the least expected knowledge, as laid out by Weichselgartner and Pigeon (2015) that critics experts because while they have the knowledge, they have little effect to the practical DRR. this is the lowest point found in literature and can be mapped to the second point. contrary, both Oyao et al. (2015) and Seifi et al. (2019) underscores that experts and universities can contribute to the DRR by developing policies, and lobby them to be ratified policies, or model and develop scenarios in disaster contexts. this highlights the most advace knowledge from the literature. between them, experts and academics can, according to Oyao et al. (2015), "create preparedness plans, run community drills, and map building vulnerabilities" while balancing risk and need with STEM tools. this can be mapped to be third point. Next, according to Seifi et al. (2019), experts and academics can act as "centres of excellence for research and knowledge exchange," supplying "basic and advanced training" and "expert surge teams" in disasters. this is suitable in the fourth point.

e) Private Sector

Similar to NGOs, private sector's disaster knowledge stretches from reactive, relief-only operations (point a.) to fully integrated risk-governance partnerships (point d.), especially with the government. in the first point, many firms are still focused in the logistics practice area by providing ad-hoc supply or contracting services without more comprehensive DRR insight (Watson, 2019). Moreover, private sector tend to priorotize commercial motives, and low profits from disaster operations can draw minimal interest and reactive stance from this sector (Zhang et al., 2015). The second point characterized by companies that tend to join short-term collaborations (STCs) only after a shock. They operate from a basic understanding of roles before the disaster event all the way as the crisis deepens (Gabler et al., 2017). In the third point, firms that pre-establish trusted links with government or NGOs can pivot quickly. Gabler et al. (2017) provide example when Walmart's lauded Hurricane-Katrina response and Coca-Cola's water-bottling were able to provide help in a much greater capacity. At most, in the fourth point, private sector's are expected to understand their assets, risks, vulnerabilities, and potential consequences, because

according to Gabler et al. (2017), 85% of critical infrastructure are operated by them. They also expected to maintain short-term collaborations with government before, during and after disruptive events (Gabler et al., 2017). At this level, companies share data, co-design partnerships with the government, and help restore lifeline systems. It is more advanced knowledge set than simple daily operations, but also less advance to what expected from experts and academics.

4.1.3 Industrial Resources

Preparing for urgent situations like disasters can be viewed from an industrial perspective, as this sector supplies the materials needed for reconstruction. Several studies support this view, including Amaratunga and Haigh (2011), Khorram-Manesh et al. (2021), and Bosher and Chmutina (2017). For example, Amaratunga and Haigh (2011) document the 2008 Wenchuan earthquake, where shortages of cement, brick, skilled labour, and fuel delays raised prices and slowed housing starts. They conclude that "pre-event mapping of materials, plant and supply routes is as critical as structural design itself," and report similar issues in post-tsunami Sri Lanka. The Sendai Framework (United Nations, 2015) reinforces this by urging States to "develop, maintain and strengthen people-centred multi-hazard early-warning and logistics systems," highlighting that supply-chain readiness is a core preparedness task. Similarly, Khorram-Manesh et al. (2021) provide practical steps for pre-positioning stock, setting up logistics hubs, and arranging standby contracts with hauliers and suppliers. Sector-specific literature also supports this from a market perspective. Finally, Bosher and Chmutina (2017) frame construction-industry continuity as essential to disaster risk reduction, recommending that governments involve major contractors and suppliers in emergency planning to ensure alternative sourcing and transport routes are prepared in advance. Several sectors within this group are identified: technological mastery, logistics, manufacturing capacity, labor, and contractor premiums.

Table 4.1: Synthesis of industrial resource maturity stages in disaster preparedness

Maturity → Subsector ↓	Initial	Reactive	Lean	Integrated	Optimised
Technology mastery (Grest et al., 2020; Resende et al., 2023; Tubis & Werbi ska-Wojciechowska, 2021)	Processes "mostly manual and paper-based; no dedicated ICT"	"Basic office software, isolated databases" start to appear	"Lean principles supported by simple ERP modules; data captured systematically"	"End-to-end IT integration, real-time tracking, shared dashboards"	"Advanced analytics, mobile & cloud platforms; technology used to substitute for scarce physical assets"
Logistics & supply-chain network (Grest et al., 2020; Tubis & Werbi ska-Wojciechowska, 2021)	Ad-hoc aid drops; no pre-positioned stock or route planning ("relief distribution only")	Reactive supply chain with "limited coordination and sporadic information sharing"	Lean SC: "forecast-based buffers, documented flows, waste reduction"	- Integrated SC: "joint planning with partners, visibility across nodes, contingency routes" - risks analysed and mitigated systematically	- Frugal SC: "resource-smart, multi-hazard design; network re-configures dynamically" - continuous improvement loop on risk metrics
Manufacturing capacity (Adeniyi et al., 2018)	Disruptions handled "case-by-case", no formal process; success "depends on individual effort"	- Some departments use simple templates - importance recognised but no resource allocation	Standardised continuity plans, capacity data tools, and staff training in place	Statistical analysis of capacity risks with supporting quantitative data	Predictive analytics and continuous improvement enable flexible surge capacity
Labour & experts (Resende et al., 2023)	"Little or no trained personnel; activities depend on volunteers"	"Some staff receive SOP training"	"Staff regularly trained; roles and responsibilities formally defined"	"Cross-functional, multi-agency teams; continuous drills and simulations"	"Lessons-learned system, certification programmes, knowledge sharing with external actors"
Contractor premium (Adeniyi et al., 2018; Tammineedi, 2010)	No protocols for calling contractors; no vetted vendor list	Basic vendor list and informal SLAs; prices/premiums ad-hoc	Formal contracts include agreed rates and BCM audits	Risk-based cost models; contractors join internal drills	Integrated, risk-sharing partnerships with continuity alignment and advanced protection strategies

a) Technology Mastery

The technology mastery continuum refers to the progressive capacity of an organization, especially industrial or logistical entities, to utilize digital tools, systems, and integrated technologies in support of disaster preparedness and response operations. It spans from basic manual processes to sophisticated digital ecosystems. In this context, it is not just about having technology, but about how it is used to support decisions, the degree of integration across functions and partners, and the ability to anticipate, absorb, and adapt to disruption using technological capabilities. This subsector matters because it acts as the backbone for coordination, information flow, and resource deployment in disaster-prone environments. Organizations that lack adequate technological tools tend to operate in silos, struggle to track assets or people in real time, and have poor visibility into their supply chains or operations. This leads to slow responses, resource wastage, and reduced resilience. Conversely, organizations with high technology maturity can preemptively model risks, allocate resources dynamically, ensure coordination across stakeholders, and reduce uncertainty and losses during disasters. As Grest et al. (2020) point out, technology is essential for transitioning from reactive, fragmented humanitarian logistics to integrated and frugal supply chains that can operate under constraint.

In the least stage, the initial stage or Ad-hoc, organizations operate with paper-based systems or unstructured digital files like Excel or simple spreadsheet. In this phase, organizations have Lack of investment, knowledge, or urgency; processes are reactive and uncoordinated. Therefore, coordination depends on individual effort. No common IT platform. Data, if available, is fragmented (Grest et al., 2020). The next stage is reactive stage or basic digital tools, where some digital tools begin to emerge like isolated software and basic databases. It happens when there is recognition of the limitations of manual systems after experiencing a disruption. In this phase, systems are localized within departments and information flow remains slow and unstandardized. As Grest et al. (2020) stated, there are "basic office software, isolated databases start to appear." Then, there is Lean stage (Structured but simple systems). It introduces lean principles and basic ERP (Enterprise Resource Planning). In this stage, there is desire for efficiency and waste reduction, often driven by internal audits or donor requirements in humanitarian context. In practice, data starts to be captured systematically; processes are standardized across units. Grest et al. (2020) mentions this stage as "Lean principles supported by simple ERP modules." In the more mature situation, there is Integrated stage. In this stage, technology enables end-to-end visibility. Systems talk to each other across partners. It happens when organizations need to manage complex risks and coordinate across agencies and supply nodes. In practice, they use Real-time tracking like GPS for vehicles or IoT for inventory, shared dashboards, and automated reporting become the norm. As Grest et al. (2020) highlights, there is "End-to-end IT integration, real-time tracking, shared dashboards." In the most mature stage, there is Optimised stage (Predictive, analytics-driven, mobile-capable). In this stage, technology is not just integrated but proactive and adaptive. Systems use data to make predictions and reduce vulnerability because in volatile environments, resilience requires not just reacting, but anticipating disruptions. In practice, it can be the use of mobile platforms, cloud systems, advanced analytics, or even simulation modeling for scenario planning. Grest et al. (2020) called it as "advanced analytics, mobile and cloud platforms, where technology used to substitute for scarce physical assets."

b) Logistics & Supply Chain Network

Logistics & supply chain continuum assesses the maturity of logistics and supply chain systems, from basic ad-hoc relief activities to highly adaptive resource, as well as smart networks that can anticipate, absorb, and adapt to disaster conditions. It includes inventory prepositioning, transportation routing and tracking, inter-organizational coordination, risk analysis and mitigation, and continuous improvement mechanisms. Both Grest et al. (2020)

and Tubis and Werbińska- Wojciechowska (2021) offer structured models. Grest focuses on the humanitarian supply chain, while Tubis frames the discussion around logistics risk management maturity.

This subsector matters because in disaster contexts, logistics performance directly affects speed of response, access to affected populations, and efficiency of resource use by avoiding waste, duplication, or bottlenecks. Failures in supply chain coordination lead to delayed aid, stock-outs, or oversupply of non-priority goods. As disasters become more frequent and complex, logistics systems must move beyond reactive transportation into resilient, risk-informed networks. As Grest et al. (2020) stated, "A proactive and integrated humanitarian supply chain is essential to reduce operational frictions and meet time-critical needs during emergencies."

The continuum starts at initial stage where logistics operations are random and undocumented (Tubis & Werbińska- Wojciechowska, 2021) purely reactive without preparedness plans nor network coordination. This stage is typical when logistics is seen as a transactional (Grest et al., 2020), last-minute function rather than strategic. In practice, aids are distributed ad-hoc, often through direct drops without route planning or prepositioning. Operations are slow, redundant, and wasteful. The second stage is reactive or repeatable. In this stage, basic processes are repeated in multiple events but remain siloed and inefficient. This stage is achieved when organizations start recognizing that ad-hoc responses are not scalable but haven't committed to systemic reform. It characterises by SOPs that starts to be introduced and basic tracking of supplies begins, but coordination is still minimal.Grest et al. (2020) characterizes this stage with "limited coordination and sporadic information sharing" while Tubis and Werbińska-Wojciechowska (2021) note some documentation, but risk is still not managed proactively. The third stage is called lean or defined. It start to introduce lean principles like forecasting and minimizing waste as well as clarifying flow of goods. In this stage, organizations found the need to improve cost-efficiency and reduce redundancy by forecast buffers, make better documentation, and begin data-driven inventory decisions (Grest et al., 2020). Tubis and Werbińska- Wojciechowska (2021) also notes that organizations in this stage are able to identify risk categories and formalize procedures. In the more advance stage, there is integrated or managed stage, where supply chains are strategically coordinated across partners and agencies. It happens when organizations recognize that logistics needs to be integrated to manage multi-agency operations and respond to multi-hazard contexts. Hence, they do joint planning sessions with suppliers and agencies (Grest et al., 2020), have real-time visibility tools, made contingency plans for critical routes, and map risk and assess impact as standard activities (Tubis & Werbińska- Wojciechowska, 2021). The most mature stage is called optimised, which are resilient, frugal, and adaptable. Accorfing Grest et al. (2020), they able to reconfigure itself dynamically in the face of disruption while Tubis and Werbińska- Wojciechowska (2021) notes that logistics decisions are embedded in a culture of continuous improvement and inter-organizational cooperation. This level reflects a mature organization that treats logistics as a strategic enabler instead of a back-office function. In this stage, systems can collect and analyze feedback loops, while multi-hazard resilience built into network design. Moreover, organizations have the ability to operate under constraints such as blocked roads or fluctuating supply.

c) Manufacturing Capacity

The manufacturing capacity continuum is explained by Adeniyi et al. (2018) that assesses how well an organization is prepared to maintain or recover operational production capacity under hazard conditions. This includes having systems and resources in place to avoid or minimize downtime, institutionalizing procedures to continue output despite disruptions, and using analytics and feedback for proactive and continuous improvement. In this context, "manufacturing" is viewed broadly, not just the act of producing, but the institutional capability to keep production running under adverse conditions. This subsector is important due to the ability to produce essential materials or components

becomes critical for both recovery and response in a disaster or crisis. This includes construction materials, critical infrastructure components, and logistical goods. If manufacturers are unprepared, delays could multiply across sectors such as housing reconstruction stalls due to lack of materials. Other impact if munaufacturers are unprepared is emergency needs go unmet and recovery becomes reactive and fragmented. As Adeniyi et al. (2018) argue, maturity in this domain enables an organization to embed continuity into its core operations, rather than relying on improvisation.

Adeniyi et al. (2018) structure the capability maturity model (CMM) into five levels, similar with other subsectors' stages. In the initial stage, no structured approach to protect or restore manufacturing capacity. In this stage, organizations lack awareness, plans, or motivation to prepare. They rely on heroics or ad-hoc decisions. During disaster, disruptions are handled on a case-by-case basis, without coordination. Success depends on the commitment or instinct of individuals, and there are no guidelines or tools to support decision-making. Then, in more mature stage, informal awareness of the need for continuity, but no institutional systems.It happens when organizations have a few departments or individuals that begin to think about continuity but without top-down commitment. In this case, some departments might use templates or tools. Some managers may recognise the importance of keeping lines running, but no dedicated resources or formal strategy is implemented. Moving on the the next stage, continuity is seen as a formally defined process across the organization because they sees continuity as essential and begins building it into operational procedures. It can be achieved by clear roles and responsibilities are defined, capacity databases and documentation are developed, staff are trained for continuity planning, and resources begin to be allocated for ensuring production under disruption. In more mature stage, quantitative systems are used to measure, monitor, and improve capacity and resilience. In this stage, the organization moves beyond compliance and begins managing risk using data and performance metrics by using statistical analysis of capacity vulnerabilities, monitor performance regularly, and support decisions by data. The most mature manufacturers are those that is proactive, self-improving, and highly responsive to change and uncertainty. They remain resilient in a dynamic risk environment, and have ability to anticipate disruptions and adapt in real time. This can be achieved by predict and analyse for demand and risk modeling, having agile resource allocation and flexible production systems, and made feedback loops and continuous learning mechanisms embedded in operations.

d) Labour & Experts

This continuum tracks the development of human capacity, specifically the skills, training, institutional roles, and collaborative effectiveness of personnel responsible for disaster operations using model proposed by Resende et al. (2023). The model focuses on how prepared and capable the workforce is to perform under stress, how formalized their roles and responsibilities are, and how well personnel from different sectors like government, NGOs, logistics, collaborate in real-time operations. In disaster preparedness, people are the foundation. Even the most sophisticated systems collapse without trained individuals to operate, adapt, and coordinate them. Moreoer, human expertise directly impacts the speed and appropriateness of response, coordination among agencies and sectors, trust from affected communities, and the ability to interpret plans into action. A low-maturity workforce may misallocate resources, be overwhelmed by complexity, and cause friction between actors. In contrast, a high-maturity workforce would be able to anticipates needs, executes complex plans confidently, and adapts in real-time through practiced coordination. As Resende et al. (2023) points out, "Human resource capabilities are essential to ensure that defined processes and plans are effectively implemented and adapted during operations."

The first level is initial or ad hoc, in which labour and volunteer efforts are informal, untrained, and reactive. In this stage, organizations are unaware or unprepared to invest in systematic training or role clarity. In practice, individuals step in during crises,

often without preparation. Responses are improvised. Outcomes are inconsistent. For example, volunteers distribute aid without knowledge of logistics and leading to congestion and misallocation. After that, there is a stage of reactive where some personnel begin receiving basic training. In this phase rudimentary processes are known. Typically, after repeated poor outcomes, organizations recognize the need for minimal training and structure. It reflected by SOPs that are developed and disseminated. Moreover, Staff may train periodically, but efforts are fragmented. In the more advance stage, it is defined stage. Here, roles and responsibilities are formalized across functions because there is a need to avoid overlap and gaps in execution. Moreover, organizations begin treating labour and staffing as a professional domain. It relfects in structured training, clear job descriptions, periodic drills, and manuals are used. Also, job roles are linked to planning documents. Progressing to the next stage, it is integrated stage, where reams operate in cross-functional, multi-agency environments. Organizations understand that disasters demand joint operations across departments and sectors like public, NGO, and private sectors. It reflects in the teams that are co-trained and rehearsed in inter-organizational drills. Moreover, information sharing becomes fluid and tactical and strategic functions are distributed by specialization. Finally, the most advance stage is called optimised. In this stage, A learning organization is established where capacity is continuously improved and shared. Organizations realize that real-world events evolve faster than any static training, so human systems must learn and adapt continuously. In practice, lessons-learned systems capture feedback post-operation inside the organization. Moreover, staff certification, mentorship, and knowledge-exchange programs with other actors like government, academia, and other private sector are conducted. Also, there are a form of investment in long-term expertise pipelines.

e) Contractor Premium

The contractor premium continuum refers to an organization's maturity in understanding the financial risk of depending on external contractors during disruption, and proactively managing these risks through pre-arranged contracts, audits, drills, and risk-sharing strategies. This ares is important because in disaster recovery or resilience-building, external general contractors (GCs) are vital for mobilizing workforce, equipment, and logistics. However, contractors often raise premiums due to uncertainty, unclear expectations, or lack of contractual safeguards. If these risks aren't pre-managed, owners may face delays, budget overruns, or complete project failure post-disaster. Tammineedi (2010) notes, vendors are a critical dependency, and their continuity and pricing risk must be embedded into BCM strategies.

In the less prepared stage or initial stage, no systems or plans exist for engaging contractors in emergencies. The organization is unaware of potential premium increases or availability risks. In this stage, contractors are seen as an external problem, not an integrated part of the continuity strategy. It reflected as no pre-vetted vendor list, no clause in contracts for emergency scenarios, and project owners are forced to negotiate in a crisis, often overpaying. Adeniyi et al. (2018) notes that "Organization is unaware of the need and keeps no vetted vendor list." One stage above it, there is reactive stage where organizations maintain a list of critical vendors, but there is little formal structure. In this stage, there is a basic realization that some vendors are more critical than others, but still no formal premium strategy, which reflected by informal agreements like SLAs, setting response times, but rates are still flexible and often surge during crises. In more prepared stage, the defined stage, contracts start to include clearly defined cost rates, risk clauses, and even audit rights for BCM (Business Continuity Management). This intended to control financial exposure and incentivize contractors to prepare as part of the system, by using emergency response costs that are pre-agreed and BCM readiness that is auditable. In this stage, contractors are viewed as continuity partners instead of one-off vendors. One stage just below the most prepared, there is integrated stage. In this stage, financial modeling tools are used to estimate potential losses, premiums, and

risk trade-offs, as organizations seek to quantify exposure and make decisions based on data rather than reaction. In practice, finance & procurement apply risk-based cost models like Monte Carlo or worst-case scenario analyses. Other examples are contractors can be invited to join internal continuity drills or cross-functional planning includes contractor mobilization plans. Finally in the optimised stage, contractors are not only prepared but strategically aligned. Moreover, establised contracts are now involving shared risk, long-term resilience goals, and incentive structures. In this stage, mature organizations see contractors as strategic continuity partners and invest in mutual risk reduction, as reflected in the risk-sharing agreements like early contractor involvement, shared insurance. Also, premiums are smoothed over long-term partnerships, performance-based incentives tied to recovery metrics, and coordination with contractors is institutionalized, not event-based.

Across the five industrial subsectors, the maturity continuum consistently evolves from ad-hoc and reactive practices toward institutionalized, data-driven, and integrated systems. At the initial stage, organizations typically rely on individual improvisation, manual processes, and informal relationships, with minimal preparedness or risk foresight (Adeniyi et al., 2018; Grest et al., 2020). As they progress into reactive and lean stages, there is growing awareness and standardization, marked by the introduction of basic tools, SOPs, and repeatable procedures (Resende et al., 2023; Tammineedi, 2010). Integrated maturity is characterized by structured planning, real-time coordination, and cross-functional collaboration across systems and partners (Tubis & Werbińska- Wojciechowska, 2021). Finally, the optimised stage reflects a fully proactive, adaptive environment that driven by analytics, continuous improvement, and risk-sharing strategies, where organizational resilience is embedded not only in internal processes but across the entire value chain (Grest et al., 2020; Tammineedi, 2010).

4.1.4 Land Planning

From the SFDRR, land use and planning is inline with the third and fourth action: (3) investing in disaster risk reduction for resilience; and (4) enhancing disaster preparedness for effective response, and to “Build Back Better”. In this group, there are several literature that discuss the preparation of land against disaster like Helm (2015), Charoenkalunyuta et al. (2011), and Unger (2019). Helm (2015) speaks in four “layers of security”, from system, risks, resilience, to adaptation. He urge that each layer should be in place all the time, whether in preparation or in recovery. Charoenkalunyuta et al. (2011), on the other hand, follows the UNISDR (2017) that has five-phase cycle, starting from prevention / mitigation, then preparedness, response, recovery, and finally risk-assessment / review. Complementing that, Unger (2019) add a stage, Prediction & Warning, which can suitably placed between preparedness and response. Therefore, from the time / stage perspective, there are six stages: prevention / mitigation, preparedness, prediction & warning, response, recovery, and risk-assessment. however, since the study focuses on disaster preparation, the last 3 stages are removed, as presented in the following table 4.2.

Starting in the top left corner, this cell represents the ideal starting point for disaster-resilient land planning. It captures foundational actions embedded into long-term governance systems such as hazard-informed land-use plans, and legally enforced zoning. Unger (2019) also recommends a fit-for-purpose cadastral systems that clearly register rights, restrictions, and responsibilities. These measures ensure that development avoids hazardous zones from the outset, making this the deepest and most proactive layer of land preparation.

Then, in the preparedness stage of system & Risk Management, there is land systems that are still robust but geared toward readiness (Charoenkalunyuta et al., 2011). It is less ideal since not a long-term avoidance. These include maintaining pre-identified safe relocation sites within the land registry and running scenario-based drills using parcel-level data. These cells reflect a land-governance system that is already capable but now exercises its capacity for anticipation. It’s less permanent than mitigation zoning, but still deeply proactive and strategic.

Table 4.2: Synthesis of pre-event land-governance actions drawn from Helm (2015), Charoenkalunyuta et al. (2011), and Unger (2019)

Stage → **Depth ↓**	**Mitigation & Prevention** keeping land out of harm's way	**Preparedness** tools, people & places ready	**Prediction & Warning** real-time triggers to act
System robust land-governance foundations	- Hazard-aware land-use planning - fit-for-purpose cadastre (Unger, 2019)	Safe-site register and parcel data integrated in the land registry, ready for rapid allocation (Charoenkalunyuta et al., 2011)	Sensor, GIS and parcel layers linked to warn automatically (Unger, 2019)
Risk-management	Multi-hazard land-suitability and zoning models guide where development is allowed/not (Helm, 2015)	Scenario-based relocation and evacuation drills use cadastre + topography to test options (Charoenkalunyuta et al., 2011)	Forecast dashboards with live warnings on tenure maps to trigger pre-agreed land-swap contracts (Unger, 2019)
Resilience-building	- Tenure-security programmes for vulnerable groups (Unger, 2019) - community mapping of safe ground	- Training communities to read early-warning messages (Charoenkalunyuta et al., 2011) - local land-information kiosks in hazard zones	Alerts rights-holders via cadastral contact details(Unger, 2019)
Adaptation	Zoning rules periodically tweaked as climate and exposure data evolve (Helm, 2015)	Safe-site inventory updated as the city expands (Unger, 2019)	Dynamic evacuation routing after warnings issued (Unger, 2019)

In the less prepared, there is layers of resilience building and adaptation. These mid-level cells reflect community-focused efforts and adaptive policy cycles. They include securing land tenure for vulnerable groups (Unger, 2019), community land-readiness training (Charoenkalunyuta et al., 2011), and updating zoning regulations as climate patterns shift (Helm, 2015; Unger, 2019). While not always embedded in law, these actions increase a community's ability to adapt before a disaster hits. They reflect growing awareness, but rely more on soft systems and flexibility than hard regulations.

Heading to the edge of readiness, there are predictive & warning stage of system and risk management layer. In this part, the focus turns to trigger-based preparations. They are linking real-time hazard data to cadastral systems, using dashboards to flag at-risk parcels, and activating pre-agreed land-swap contracts when thresholds are met (Unger, 2019). These actions are still technical and structured but occur very close to the event, often depending on accurate forecasting. They require a well-functioning system, but highly reactive under time pressure.

Finally, at the least prepared, there is prediction & warning stage for adaptation layer. It reflects last-minute, on-the-fly adjustments such as rerouting evacuations or rapidly reassigning land when the hazard evolves unexpectedly (Unger, 2019). These actions are critical, but they depend on improvisation and often suffer from weak institutional backing. In short, they fill gaps left by insufficient upstream planning.

4.1.5 Regulations

Although few studies explicitly define a full continuum of regulatory preparedness, several sources provide progression from basic to advanced stages. A synthesis of Oloruntoba et al. (2018), Bang (2021), Christoplos et al. (2001), and Alexander et al. (2007) outlines a set of tiers

that reflect levels of legal and institutional readiness. At the least prepared stage, governments recognise risk through tools such as hazard mapping or vulnerability assessments (Bang, 2021; Oloruntoba et al., 2018), but lack the legal or institutional capacity to act. At the most advanced stage, laws pre-authorise decisions, procedures are pre-planned, and institutions revise policies based on changing risks (Alexander et al., 2007; Christoplos et al., 2001), as illustrated in Figure 4.1.3. The continuum ranges from basic risk recognition, to embedded mitigation and budget frameworks, to fully operational and adaptive systems. These stages focus not only on written laws but also on how systems are designed to act before a disaster occurs (Alexander et al., 2007; Oloruntoba et al., 2018).

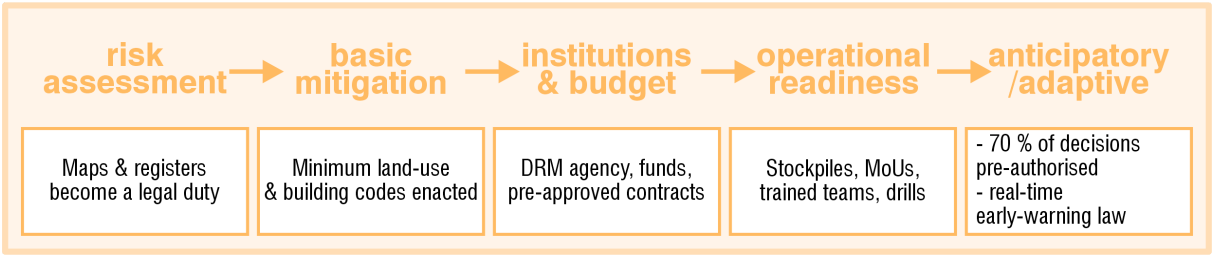

Figure 4.1.3: regulatory preparedness stages synthesized from Oloruntoba et al. (2018), Bang (2021), Christoplos et al. (2001), and Alexander et al. (2007)

In the least prepared , Risk-assessment recognition is a stage where a statute or regulation makes hazard and vulnerability mapping plus periodic updating a formal public duty. In this stage, risk intelligence is "the first element of preparedness" because every later decision depends on knowing what can go wrong (Oloruntoba et al., 2018). Cameroon's gap analysis shows that without systematic risk analysis a country "remains reactive" (Bang, 2021). Typical tools can be utilized like national risk registers, local multi-hazard maps and sector-specific check-lists that planning or finance ministries must consult before approving projects.

In more prepared, there is basic mitigation measures. In this stage, foundational land-use and building controls like set-backs, elevation rules, simple seismic classes, are enacted and referenced by other sector laws. Christoplos et al. (2001) argue that once such measures are main-streamed into ordinary development rules they stop disasters being treated as "aberrations" and instead normalise prevention in daily governance while Oloruntoba et al. (2018) list enforcement of safe-construction standards as a core mitigation policy. Governments can adopt or update model building codes, tie land-use permits to hazard zones, and require developers to pass design checks before construction begins.

Then, Institutions & budgetary preparedness stage is the more prepared form. It happens when dedicated DRM bodies, earmarked contingency funds and standing procurement templates are placed in law. Bang (2021) explains that Cameroon's legislative history (1967 - 2011) shows how successive statutes created a Directorate of Civil Protection, a National Council and later a multi-stakeholder Platform. These bodies "are prerequisites for any proactive system". Without them, responsibilities fragment and money has to be improvised after every event. In practice, Acts of Parliament mandate the agency, specify its budget source like insurance levies, and publish pre-approved contract forms so that ministries can hire contractors instantly when needed.

In the stage of operational readiness, resources, people and procedures are positioned before impact. Stockpiles, mutual-aid memoranda, trained inter-agency teams, field drills, and "logistics & supply-chain agility plans" (Oloruntoba et al., 2018). Municipal guidelines in Italy even require "basic road, water and power infrastructure" to be pre-installed at future shelter sites (Bologna, 2004). These measures convert abstract institutions into deployable capacity, closing the gap between a law on paper and an action on the ground. In practice, annual drills

test command chains can be conducted. other practice like ministries sign MoUs with suppliers or special warehouses keep tents, pumps or telecoms kits under climate control and rotate stock to prevent expiry can be performed.

Anticipatory / adaptive systems is the most prepared stage. In this stage, a large share of technical and spatial decisions, "about 70% of the decisional chain" is standardised and legally pre-authorised (Alexander et al., 2007). Moreover, real-time monitoring and risk-communication protocols are embedded in law so they run continuously, not just after warnings are issued (Oloruntoba et al., 2018). It happens because front-loading decisions slashes lead-times while adaptive clauses oblige agencies to update plans as climate, land use or socio-economic conditions change, avoiding what Christoplos et al. (2001) call "technocratic ruts" that freeze risk thinking in yesterday's context. It relfected when legislation delegates predefined triggers like river gauge values that automatically unlock funds, authorise evacuations or activate crisis cells; it also mandates a rolling five-year review so doctrines evolve with evidence.

Together, these five tiers show that disaster preparation is a continuous process. Jurisdictions move from recognising risks, to embedding them in policy, building institutions and funding systems, developing response capacity, and finally creating systems that anticipate and adapt. Each stage builds on the previous one, and missing a step can weaken overall resilience. The continuum provides a clear framework for governments, development agencies, and researchers to assess current policies and identify needed legal and operational reforms. Grounded in empirical literature, the model connects theory and practice and supports disaster policy development toward more proactive and adaptive governance.

4.1.6 Funding

Access to reliable funding is essential for every phase of disaster management. McEntire (2015) emphasizes that acquiring financial resources such as through budgets and grants is a key part of preparedness, because without funding, even well-designed plans cannot be implemented. Bosher and Chmutina (2017) stress that resilient construction and disaster risk reduction cannot become standard practice unless funding supports long-term efforts throughout planning and development. Similarly, Phillips and Mincin (2023) highlight that recovery activities like rebuilding homes, restoring businesses, and providing social services, are more effective when funding sources are diverse and include both public and private contributions. In other words, financial readiness is a foundation that supports a timely and effective disaster response and recovery process.

In practice, the preparedness from the perspective of funding can be laid into a table by taking two variables into account: the nature of preparation from reactive to proactive, and the layer of risks, as presented in the table 4.3. In the table, cost rises and speed improves as the table move rightward: cheap but slow budget shifts come first. premium-priced but immediate cat-bond payouts sit at the far end (Ghesquiere & Mahul, 2010). Severity rises downward: daily shocks stay in the top row while rare catastrophes drop to the bottom The World Bank (2012).

a) Ad-hoc, ex-post financing: cramble for cash
   When no instruments are arranged in advance, governments fall back on budget reallocations, tax increases, emergency loans or international aid (OECD, 2012; Villacin, 2017). Mexico must sometimes transfer oil-revenue surpluses to FONDEN when disasters exceed the annual allocation (The World Bank, 2012). Ghesquiere and Mahul (2010) label these tools the slowest and riskiest because they arrive only after losses occur and may widen fiscal deficits.
b) Pre-arranged budget contingencies and reserves: cash on hand
   The first proactive step is to earmark annual calamity funds or revolving reserves that disburse immediately for high-frequency, low-severity events (The World Bank, 2012). These

Table 4.3: Continuum of Disaster Funding Instruments Across Risk Layers and Preparedness Stages synthesized from Villacin (2017), OECD (2012), The World Bank (2012), and Ghesquiere and Mahul (2010)

Preparedness → Risk layer ↓	**Reactive / ex-post** (little or no pre-arrangement)	**Ex-ante retention** (budget, reserves, contingent credit)	**Ex-ante risk-transfer** (insurance, cat-bond, market)
High-frequency / low-severity	Budget reallocations, donor aid – cheap but slow; typical first resort in PH and many LMICs (Villacin, 2017)	Annual calamity funds and reserves – e.g., FONDEN's US$800m base layer; low cost, immediate liquidity (The World Bank, 2012)	Rarely used; some countries pilot micro- or parametric cover for rapid relief (speed very high, cost higher) (Villacin, 2017)
Middle layer	Supplemental budgets or emergency loans – moderate cost, slow to draw (Ghesquiere & Mahul, 2010)	Contingent credit lines (e.g., WB/JICA CAT-DDOs for the Philippines) – medium cost, disburses within days (Villacin, 2017)	Indemnity reinsurance – FONDEN's US$400m policy; quicker than loans, priced on actuarial risk (The World Bank, 2012)
Low-frequency / high-severity	Post-disaster borrowing and reconstruction loans – large volume but adds debt (Villacin, 2017)	Exceptional budget allocation (e.g., FONDEN Article 19) – flexible but fiscally volatile (The World Bank, 2012)	Cat-bonds / pooled parametric facilities – e.g., MultiCat, CCRIF; highest unit cost but fastest and diversified (Ghesquiere & Mahul, 2010; The World Bank, 2012)

retained layers are cheap and keep control inside the treasury (Ghesquiere & Mahul, 2010).

c) Contingent credit: money on call
Once internal cash might be exhausted, standby credit lines like the Philippines' US $500 million CAT-DDO, provide medium-cost liquidity within days of a presidential disaster declaration (Villacin, 2017). OECD (2012) lists such pre-arranged borrowing as a bridge between retention and risk transfer, still cheaper than insurance but faster than post-event loans.

d) Indemnity re-insurance: sharing the middle layer
For losses that exceed retained and credit layers, governments purchase indemnity cover; Mexico buys a US $400 million portfolio policy above its first US $1 billion of retained risk (The World Bank, 2012). This shifts medium-severity, less-frequent losses to global insurers while premiums remain linked to actual exposure (Ghesquiere & Mahul, 2010).

e) Parametric insurance & catastrophe bonds: capital-market shield
The top, rarest layer is secured through fast-paying, high-cost market instruments. Mexico's MultiCat bond, around US $290 million, triggers on earthquake or hurricane parameters to give near-instant liquidity (The World Bank, 2012). Cat bonds diversify fiscal risk, offer multi-year cover and bypass slow budget authorisations (Ghesquiere & Mahul, 2010). Villacin (2017) shows the Philippines planning similar sovereign parametric cover for its highest risk layer.

This continuum of financial preparedness moves from the least to the most prepared based on two main factors: whether funding is arranged in advance (ex-ante) or only after a disaster (ex-post), and whether the instruments are designed to match different types of risk (from frequent small events to rare large-scale disasters). At the least prepared end, governments rely on post-disaster fundraising and emergency aid, which is often slow and uncertain. Moderately prepared systems use annual contingency budgets or savings to handle regular small-scale events. More advanced systems adopt pre-arranged tools like contingent credit and insurance to quickly access funds for moderate to severe disasters. At the most prepared end, financial strategies are fully integrated with risk assessment, covering all levels of government and layers

of risk through a mix of budget reserves, credit, insurance, and catastrophe bonds. These systems can respond rapidly and effectively across a wide range of disaster scenarios.

4.1.7 Projects and Programmes

As discussed in the literature review, collaboration models in the construction industry are evolving to become more outcome-oriented, efficient, and flexible. This section compares these types based on their flexibility and collaboration mechanisms. All of these types will be compared from two perspective: flexibility and collaboration characteristics.

Flexibility is compared because urgent projects often arise from unexpected and unprepared situations, which naturally involve many uncertainties (Eriksson et al., 2017). Therefore, the collaboration model must be able to handle such uncertainties. The comparison includes contract and project initiation mechanisms, the ability to manage multiple and uncertain future projects, pre-negotiated terms with deferred details such as time, volume, and location, and the flexibility of funding sources.

Collaboration characteristics are also compared because different models apply different approaches to risk allocation, incentive structures, and decision-making processes (Mosey, 2019; D. H. T. Walker, 2015). These variations fundamentally shape how projects are managed and reflect a broader shift from traditional, adversarial procurement, towards more integrated and outcome-focused methodologies. The aspects compared include the diversity of stakeholders involved, the relationships between stakeholders, decision-making processes, governance structures, risk-sharing mechanisms, task integration across project stages, and the application of a no-blame culture.

Literature like Mosey (2019), Engebø et al. (2020), and D. H. T. Walker (2015) consistently mention three collaboration types: Integrated Project Development (IPD), Framework Agreement (FA), and Alliance Contracting (AC). all of them are considered more collaborative, more flexible, and prioritize overall project success compared to traditional collaboration types. However, they have different degrees both in flexibility and collaboration character. The details of comparison are as follows:

a) Integrated Project Delivery (IPD)

   Integrated Project Delivery (IPD) is typically applied to individual projects where key participants such as the owner, architect, and contractor are involved from the very beginning. It is not commonly used for advance agreements or standby contracts with open-ended scopes prior to disasters, although with contractual modifications, this is possible. Mosey (2019) explains that usually, the project's location, timing, and scope are defined early, which limits its application for uncertain or multiple future projects. Moreover, IPD agreements are highly customized for each project, making them less suitable for managing portfolios. In some cases, IPD contracts may allow certain terms to remain open and be finalized later as project details become clearer, though this may weaken the risk-sharing and financial incentives that are central to the model. Funding is generally arranged in advance for each specific project, but the collaborative structure of IPD can allow some flexibility, such as phased funding or pooled financial resources, if explicitly stated in the contract.

   Collaboration in IPD involves a core team consisting of the owner, lead designer, and main contractor. While additional stakeholders such as government agencies may be included, this can introduce governance complexities, especially with multiple owners. As Mosey (2019) further explains, relationships within the IPD team are horizontal and non-hierarchical, with shared goals, joint risk-sharing, and financial arrangements that distribute both profits and losses. Moreover, The American Institute of Architects (2007) elaborates that major decisions related to project value, scope, and cost are made

collectively, often through consensus or majority among the main parties, although the owner typically retains control over certain key financial decisions. The project is managed by a joint management group with shared leadership and facilitation support. Risk-sharing arrangements are clearly defined and typically involve the core participants rather than the full supply chain, requiring a high level of trust. IPD also integrates tasks from the outset, involving design, engineering, construction, and sometimes operations early in the process to avoid fragmented workflows. To maintain collaboration, IPD fosters a no-blame culture, supported by conflict resolution mechanisms, team health monitoring, and coaching (The American Institute of Architects, 2007).

Overall, gaining insight from the literature, IPD demonstrates very high collaboration, while its flexibility is moderately high due to its limited adaptability for portfolios or advance multi-project agreements.

b) Framework Agreement

Framework Agreements (FAs), including Framework Alliances such as FAC-1, are by nature designed for advance or on-call procurement (Albano & Nicholas, 2016). They allow a master agreement to be established before a disaster occurs, while the specific works are activated later through call-off contracts once needs arise. Under this structure, details such as location, timing, and volume can remain open and be determined when projects are initiated. This makes FAs especially effective for managing uncertainty across portfolios of projects with varying scopes, schedules, and locations, such as widespread rebuilding after disasters. Additionally, large numbers of projects with diverse requirements can be accommodated under one umbrella agreement (Mosey, 2019). The core contract terms are agreed in advance, while the specific project details can remain flexible and be finalized when necessary through transparent call-off processes. Funding can also be arranged flexibly, either by allocating resources per call-off or through program-level standby funds. Multi-source and phased funding options are possible, provided that governance structures and regulations allow (Albano & Nicholas, 2016).

Furthermore, both Mosey (2019) and Albano and Nicholas (2016) elaborate that FAs are highly adaptable for involving multiple stakeholders across different levels of government and private sectors, including ministries, national agencies, municipalities, and private partners. The governance structure allows for multiple sponsors and a wide range of providers to participate. Relationships within framework alliances often follow a partnering approach, where joint core groups coordinate team activities and stakeholder consultations. Decision-making is typically managed by a core group or board that oversees project objectives, performance, and dispute resolution. Some decisions may remain under the authority of specific stakeholders, but efforts are made to reach consensus whenever possible. Governance structures are typically built on alliance core groups, supported by matrix relationships between sponsors, clients, and suppliers. Early warning systems, stakeholder engagement procedures, and dispute avoidance mechanisms are often embedded within the governance framework. Risk-sharing under FAs includes joint risk registers, shared risk management plans, and collaborative incentive structures, such as performance bonuses, profit sharing, and savings sharing. The extent of these mechanisms may vary depending on the specific contract. FAs also support task integration across multiple projects and phases. Capital works, operational services, suppliers, consultants, and contractors can all operate within the same umbrella framework. Similar to other collaborative models, FAs encourage a no-blame culture. Contracts such as FAC-1 promote consensus-based decision-making, clear escalation procedures, and non-adversarial dispute resolution systems.

Overall, Framework Agreements rank very high in flexibility, offering significant adaptability for uncertain and multi-project situations. They also score high on collaboration, though slightly behind IPD and Alliance Contracting in terms of deep integration, but ahead in accommodating diverse stakeholders.

c) Alliance Contracting

Alliance Contracting (AC), including Project Alliances (PA), offers a flexible model that can be adapted for pre-arranged disaster response teams, although it is more commonly applied to specific projects (Mosey, 2019). In some cases, particularly with term or program alliances, the model can cover a series of tasks or future work that has not yet been fully defined. However, this flexibility is still somewhat more limited than what is offered by framework agreements with open call-off mechanisms. In terms of managing uncertainty and multiple projects, program alliances can handle portfolios of projects or uncertain future work, particularly in infrastructure sectors, while classic project alliances generally focus on single projects. Alliance agreements may leave some contract details open, especially in program alliances, though to a lesser extent than frameworks. In some countries, such as Spain and Italy, alliances are used for complex or uncertain public works, allowing for adaptive scopes and flexible durations. Funding is usually arranged on a project or program basis, but may allow for incremental funding tied to milestones or specific outcomes.

Mosey (2019) also elaborates that alliance contracting is well-suited for involving multiple owner teams, combining clients, designers, suppliers, contractors, and even government agencies, local authorities, non-governmental organizations, and private partners. This makes it a strong option for post-disaster recovery projects that require coordination across different agencies. Relationships within alliances are deeply collaborative and horizontal. Partners share authority through a joint leadership structure, often working together in shared offices and forming multi-party agreements built on a culture of consensus. Decision-making is typically unanimous or based on consensus among the main partners, with collective responsibility carried by an alliance board or management group. Governance is managed by this core board, which oversees the project scope, objectives, performance, and any changes, supported by extensive joint management systems and standards such as ISO 44001. Furthermore, D. H. T. Walker (2015) explains that alliance contracting features strong risk-sharing and incentive mechanisms. Pain/gain share models, no-blame agreements, and transparent cost tracking help align interests and support collaborative problem-solving. The ”one team” approach integrates all project stages, from design and construction to handover and operations. This integration supports value engineering and encourages continuous innovation throughout the project lifecycle. A defining feature of alliance contracting is its explicit no-blame culture, which includes formal agreements to avoid litigation and internal processes for resolving disputes before legal action is considered.

Overall, alliance contracting ranks high in collaboration and very high in flexibility for program or term alliances, nearly matching framework agreements. For project-specific alliances, its flexibility is more moderate.

In summary, Integrated Project Delivery (IPD), Framework Agreements (FA), and Project Alliances (PA) each offer distinct strengths and limitations when applied to post-disaster reconstruction. IPD stands out for its deep collaboration, full task integration, joint risk and reward mechanisms, and strong no-blame culture. However, its flexibility is limited, as it is traditionally designed for single, well-defined projects. Adapting IPD for disaster scenarios would require modular frameworks, extended validation phases, and pre-identified partners to allow rapid mobilization. Framework Agreements, particularly in the form of Framework Alliances (such as FAC-1), provide the highest flexibility for managing multiple projects, uncertain scopes, and diverse stakeholders across various agencies and locations. While standard FAs are often transactional, the alliance version strengthens collaboration and governance. To enhance their suitability, alliance overlays, shared incentives, and rapid onboarding processes can be incorporated. Project Alliances offer the most integrated collaboration, with fully shared risks, consensus decision-making, and a strong no-blame environment, making them ideal for complex and highly uncertain situations. However, they are less suited for managing large

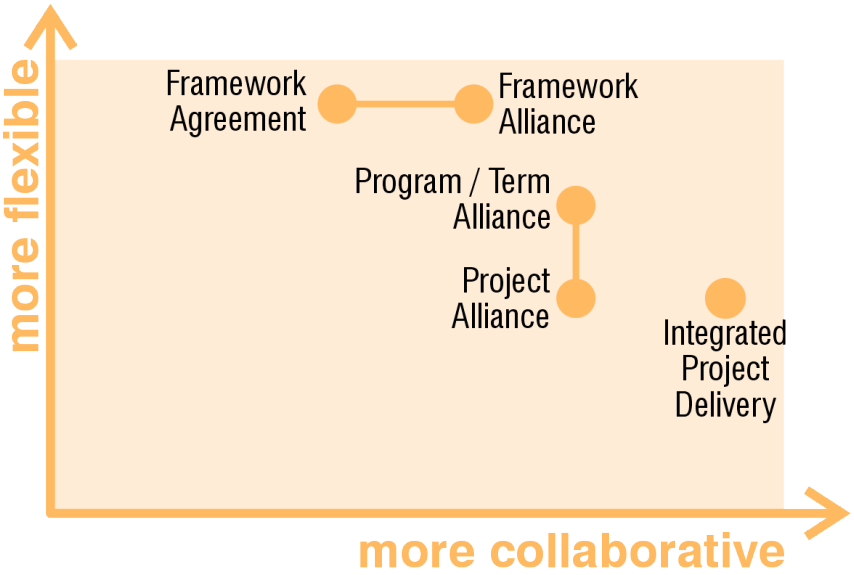

Figure 4.1.4: collaboration types characteristics, analyzed to meet post-disaster project needs

numbers of smaller or rapidly emerging projects unless structured as program or term alliances. Adjustments such as activation clauses, multi-stakeholder governance boards, and predefined mobilization protocols can increase their adaptability. Overall, while each model serves different needs, careful customization allows them to better support the demands of disaster recovery and preparedness.

4.2 Answering Sub-Research Question 1: Preparedness Framework

Insights from literature suggest at least seven aspects of preparation to ensure a project is ready to build when needed in urgent contexts. These are community involvement, knowledge, industrial resources, land planning, regulations, funding, and projects and programmes. These aspects align with the phases discussed by Sawalha (2023), including the disaster management cycle, resilience approach, and community-based practices. Each aspect ranges from no preparation to more prepared. When all aspects are well prepared, as noted by Bosher et al. (2021), the impact of a disaster can be reduced or absorbed, leading to greater resilience. The framework also applies to other urgent conditions beyond post-disaster settings, such as critical infrastructure failure. However, future revisions may be needed as some actions become outdated or new ones emerge. In practice, combining all aspects requires local knowledge and judgement, as achieving full preparedness in every area is complex.

After elaborating each aspect, the first sub-research question, *"What aspects define disaster preparedness for post-disaster projects, and how can the level of preparedness within them be assessed?"*, can be answered. High-urgency projects require all preparation to be in place before a hazard. The seven aspects are as follows:

a) **Community Involvement:** Preparedness ranges from passive aid recipients to empowered groups who plan and lead recovery. Ideal readiness means the community initiates planning from the start.

b) **Knowledge:** Knowledge levels range from denial or passive belief to institutionalised disaster risk knowledge where stakeholders model scenarios and draft policies.

c) **Industrial Resources:** This covers five subsectors: technology, logistics, manufacturing,

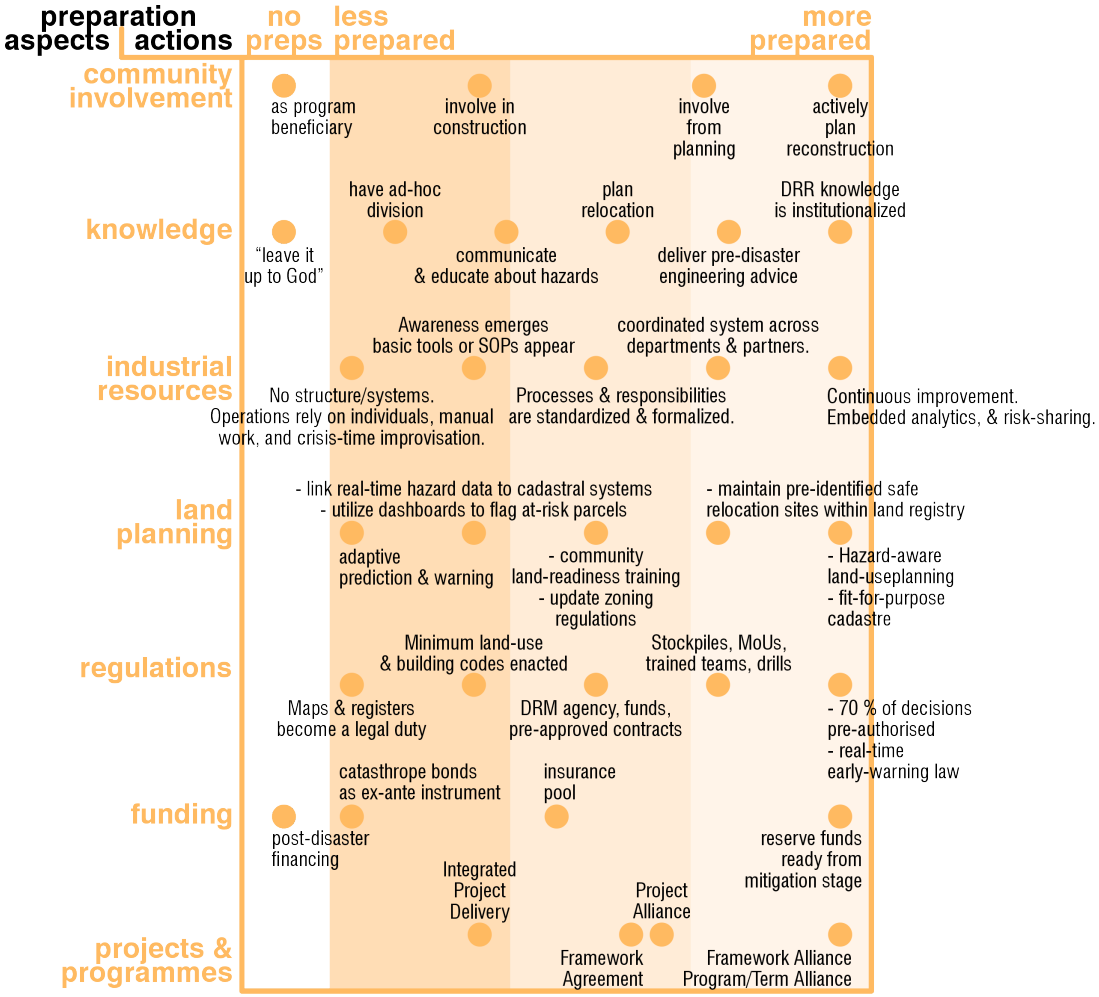

Figure 4.2.1: preparation aspects and actions, synthesized from literature

labour, and contractor capability. Preparedness progresses from reactive systems to integrated, data-based systems able to anticipate and adapt.

d) **Land Planning:** This includes using land governance to manage risk. It evolves from basic mitigation to systems with predictive and adaptive capacity. The highest level integrates hazard-aware planning and cadastral systems into governance.

e) **Regulations:** This focuses on the legal tools for fast action. It ranges from basic risk recognition to adaptive systems where most decisions are pre-authorised and linked to real-time warnings and legal triggers.

f) **Funding:** This covers financial readiness, moving from reactive tools like emergency loans to proactive instruments such as contingency funds, insurance, and catastrophe bonds that provide immediate access to funds.

g) **Projects and Programmes:** This compares collaborative models. It moves from traditional contracts to flexible ones such as framework alliances that allow for rapid mobilisation and adaptation in uncertain conditions.

Across all aspects, the same pattern appears. The least prepared rely on reactive responses. At the middle level, templates, drills, earmarked funds, and vendor lists begin to emerge, making practices repeatable though still fragmented. At the highest level, all areas function as one system. This forms a clear shift from fragmented actions to a single, adaptive system that both resists and transforms future shocks.

4.3 Highly Urgent Project Practices

There are some recent disasters that provide valuable lessons on preparedness played a role in highly urgent projects. Three of the studied case are situated in a disaster or post-disaster scenarion: Huoshengshan & Leishenshan COVID‑19 Hospitals in China that built in 2020, Lumajang Post-Eruption Housing in Indonesia in 2022, and Central Sulawesi Post-Tsunami Housing in Indonesia conducted from 2019 to 2024. All of these cases provide the best practices for either how quick and how vast an urgent project can be conducted. Preparedness from these projects will be evaluated using framework established form the previous section. Expected findings from these cases are gaps that formed between the most prepared scenario from the framework with the practices on the field.

4.3.1 Huoshengshan & Leishenshan COVID-19 Hospitals, China

While the projects look like a massive success due to unprecedented construction time, analysis of individual aspects from the framework reveal that several aspects were still less prepared, as presented in the figure 4.3.1. However, some other aspects are also leaning towards more prepared, which might explain why the projects could be constructed that quick. This analysis explores each aspect in detail to better understand the balance between reactive improvisation and underlying structural readiness in these landmark emergency construction efforts.

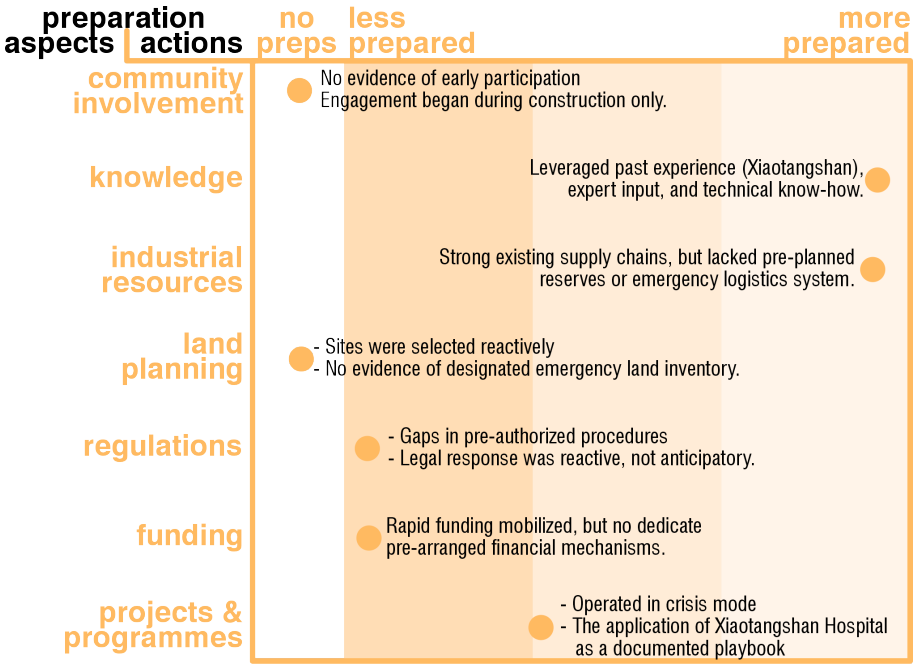

Figure 4.3.1: preparation aspects of the Huoshenshan and Leishenshan hospital projects

a) Community Involvement

The preparedness framework defines ideal community involvement as proactive engagement before a disaster occurs, where communities help shape decisions, lead recovery planning, and participate in risk reduction and mitigation activities. However, the Huoshenshan and Leishenshan hospital projects were initiated under extreme urgency in January 2020 due to the rapid escalation of COVID-19 in Wuhan (H. Lu et al., 2023; Luo et al., 2020). Construction on Huoshenshan began within 48 hours of the decision to build, while Leishenshan followed shortly after (H. Lu et al., 2023; Wang et al., 2022). This urgent timeline left little room for traditional community consultation before site selection or planning.

The literature highlights post-initiation public engagement through information sharing and

online monitoring, described as "cloud supervision" (He et al., 2021). However, no sources indicate that local residents were involved in site selection or project planning prior to the decision to build. Although China's environmental laws encourage public participation (He et al., 2021), the literature does not document their application in this context. Notably, the framework's examples of even minimal community engagement, such as being consulted or informed, were not met in the pre-project phase. Most of the public involvement occurred during or after construction, targeting the broader online community rather than those directly affected on-site.

Based on the absence of proactive or even minimal engagement with local communities before the decision to construct these emergency hospitals, this aspect maps to no preparation on the framework's spectrum. Community involvement was reactive and limited to information flow after initiation, rather than participatory planning before the project began.

b) Knowledge

The Huoshenshan and Leishenshan hospital projects demonstrate a high level of preparedness in terms of knowledge, drawing extensively on pre-existing experience, expertise, and codified standards. Most notably, the design teams immediately applied lessons from the 2003 Xiaotangshan Hospital, with some of the same designers involved from the start (H. Lu et al., 2023; Sultana et al., 2024). This prior knowledge was not developed reactively, but rather already existed as a critical reference. The ability to produce detailed design drawings within hours of project initiation is directly attributed to this existing asset (H. Lu et al., 2023).

Beyond experience, the projects utilized a large pool of skilled professionals and applied advanced methodologies such as BIM and prefabricated construction, which were already in practice across the industry (Chen et al., 2021; Tan et al., 2021). These technologies were not newly introduced but reflect an existing technical capacity that enabled rapid deployment. Furthermore, national standards for infectious disease hospitals such as the "three zones and two passages" design principle were followed, indicating a body of institutionalized disaster-relevant design knowledge (Sultana et al., 2024; Wang et al., 2022).

Compared to the framework, the use of Xiaotangshan experience, application of codified design standards, and integration of advanced technologies reflect the framework's definition of being "more prepared", where disaster risk reduction (DRR) knowledge is institutionalized and applied through expert-led design and engineering processes. The level of knowledge applied clearly exceeds ad-hoc or basic hazard communication measures.

In conclusion from a knowledge preparedness perspective, the projects were suitable at the more prepared. Pre-existing designs, industry expertise, advanced tools, and national standards were effectively leveraged from the outset, enabling rapid and coordinated planning of complex medical facilities. This knowledge base was critical to the unprecedented pace and success of project execution.

c) Industrial Resources

The Huoshenshan and Leishenshan hospital projects demonstrated a high level of industrial resource preparedness, largely due to systemic capabilities, prior experience, and advanced adaptive planning methods. A key foundation was the direct application of knowledge and design principles from the 2003 Xiaotangshan Hospital project, which provided a proven model for rapid infectious disease facility construction (Chen et al., 2021; H. Lu et al., 2023; Tan et al., 2021).

From the outset, both projects employed a "reverse design" or "inventory-based design" strategy, where resource availability such as prefabricated components, equipment, and labor directly informed the design process (H. Lu et al., 2023; Tan et al., 2021). Main contractors conducted immediate assessments of industrial capacity, mobilized supply chains, and coordinated with multiple suppliers to overcome bottlenecks. For example, over 80% of container-type prefabricated units were sourced rapidly by regional contractor branches (H. Lu et al., 2023). These actions demonstrate that while specific materials were not pre-stocked, the system was capable of extremely rapid mobilization.

Technological readiness was another key strength. The use of BIM and prefabrication techniques was widespread and well-integrated. BIM facilitated design coordination, material tracking, and logistics, while prefabrication enabled over 95% of components at Leishenshan to be factory-produced, significantly accelerating construction (Luo et al., 2020; Sultana et al., 2024; Wang et al., 2022).

Governmental coordination also played a critical role, enabling the rapid deployment of medical teams and financial resources. Existing national standards and regulations supported swift implementation, while the selection of well-prepared sites like hardened ground and existing utilities further optimized construction (Cai et al., 2021; Chen et al., 2021; He et al., 2021).

Finally, based on the preparedness framework, the industrial resource aspect of these projects can be categorized as "more prepared". This is due to:

- The strategic application of prior project experience (H. Lu et al., 2023);
- The presence of systemic industrial capacity and coordination mechanisms (Cai et al., 2021; H. Lu et al., 2023);
- The use of adaptive planning methods like reverse design (Tan et al., 2021);
- And the proven ability to rapidly mobilize materials and labor at scale (Luo et al., 2020; Sultana et al., 2024).

Rather than relying on stockpiled materials, the projects capitalized on an advanced, responsive industrial system capable of high-speed adaptation, firmly placing them on the more prepared end of the spectrum.

d) Land Planning

The preparedness framework identifies land planning as more prepared when it includes proactive measures such as hazard-aware land-use planning, pre-identified relocation sites within a land registry, and fit-for-purpose cadastral systems. In contrast, unprepared responses involve reactive land allocation under crisis conditions.

In the cases of Huoshenshan and Leishenshan, land selection was clearly reactive. Huoshenshan was located in a sanatorium area near Zhiyin Lake, chosen on January 23, 2020, with design drawings completed within five hours the same night (He et al., 2021; H. Lu et al., 2023; Sultana et al., 2024). There is no evidence this land was previously designated for emergency medical use.

Leishenshan, initiated two days later, was built on an abandoned parking lot in the Wuhan Military Games Village (Chen et al., 2021). Its selection benefited from hardened ground and nearby infrastructure, which facilitated construction (Sultana et al., 2024), but the decision was still made in response to the crisis and not through activation of a pre-zoned emergency site.

There is no documentation of a pre-disaster land bank, fast-track land-use provisions, or legally pre-cleared emergency zoning for either site. Site decisions were made within days, driven by accessibility and suitability, not by a pre-arranged planning mechanism.

Compared to the framework, the projects do not align with the framework's "more prepared" criteria, such as maintaining legally pre-designated relocation lands. While Leishenshan's use of an advantageous site shows adaptive thinking, it does not fit the less prepared category involving regulatory or community readiness measures. Instead, the site selection process reflects a reactive model, slightly more deliberative than the most basic real-time hazard flagging, but still characteristic of no preparation.

e) Regulations

The preparedness framework defines high-level regulatory readiness as having comprehensive, anticipatory laws that pre-authorize decisions and streamline emergency construction through mechanisms like emergency procurement rules, one-stop approval cells, and delegated authority. Lower levels involve foundational disaster risk management (DRM) regulations or general legal structures, while the lowest level includes only basic building codes.

In the case of Huoshenshan and Leishenshan, China did have pre-existing general laws and technical standards relevant to public health, infectious disease control, and environmental management like HJ 2029–2013 and GB 18466–2005 (He et al., 2021; Sultana et al., 2024). These laws formed a legal baseline for the projects. However, the response to COVID-19 required rapid adaptation: specific regulatory notices and technical guidelines were released after the projects began, and approval procedures were simplified on an ad-hoc basis (Cai et al., 2021; He et al., 2021).

There is no evidence of a pre-established regulatory package tailored for pandemic hospital construction. For example, no laws are cited that pre-authorized 70% of decisions or legally established ”one-stop approval cells” before the outbreak. Instead, the rapid approvals and procurement processes appear to have been enabled through exceptional governmental intervention during the emergency itself (Luo et al., 2020).

Compared to the framework, the presence of established public health laws and design standards places China above no preparation level. However, the lack of specific, pre-scripted emergency construction regulations and reliance on reactive legal adaptations means it does not reach the “more prepared” category. It fits best within the less prepared level where general DRM laws exist, but systems for emergency construction are not fully institutionalized.

f) Funding

The preparedness framework defines high-level funding readiness as having pre-positioned, ring-fenced finance mechanisms such as layered reserves, contingent credit lines, or parametric insurance that enable rapid disbursement. In contrast, the “less prepared” level involves budget reallocations or general contingency funds, while “no preps” reflects a scramble to source funds post-impact, often causing delays.

For the Huoshenshan and Leishenshan projects, the literature indicates that funding decisions were made during the crisis. The government committed to funding Huoshenshan ”regardless of the cost,” a decision that clearly emerged as a reaction to the unfolding COVID-19 emergency (Sultana et al., 2024). Similarly, funding for Leishenshan came from the government’s general fiscal budget (Cai et al., 2021), without mention of a pre-designated disaster fund.

There is no evidence of proactive financial mechanisms such as ring-fenced reserves or pre-arranged financing instruments tailored specifically for rapid hospital construction. The available funding appears to have been mobilized from general budgetary capacity through sovereign decision-making, not from a pre-positioned emergency account.

Compared to the Framework, the projects exceed the no preps level, as funding was committed swiftly and decisively without delays. However, they fall short of the “more prepared” category, which involves structured financial instruments designed and allocated prior to a disaster. The best fit is less prepared, where the state reallocates or commits general funds in response to an emergency, as was the case here.

g) Projects & Programmes

Comparing the Wuhan projects’ governance and preparation to the framework, literature strongly indicates that the decision to build, the selection of main contractors (SOEs), and the formation of project teams were direct, rapid responses to the unfolding emergency. There is no evidence in the provided documents to suggest that China Construction Third Engineering Bureau or the design institutes were operating under a pre-existing Framework Agreement or Project Alliance specifically for ”emergency pandemic hospital construction” that was simply activated. The government’s ability to directly mobilize and task its large SOEs was a key factor, which is different from activating a pre-negotiated FA or PA that might exist in other procurement contexts. The organizational structures, like the three-level matrix for Leishenshan and innovative project management methods like reverse design (H. Lu et al., 2023) were developed and implemented during the highly-compressed project timeline. They were adaptations and innovations born out of necessity and existing high-level capabilities, not the execution of a pre-defined collaborative program structure.

The project hinted they applied high degree of integration in execution that resembles IPD principles, but not a pre-prepared IPD program. The intense collaboration, concurrent engineering, early involvement of construction knowledge in design (reverse design), and shared goals driven by the emergency (H. Lu et al., 2023; Tan et al., 2021) bear resemblance to the highly integrated environment sought by IPD, showing high level of collaboration. However, the framework categorizes IPD under no preparation for programmatic preparedness perspective, implying it's project-specific rather than a pre-established standing agreement for a type of emergency. The Wuhan projects were set up as individual, although massive and concurrent emergency practice. Therefore, the Wuhan hospital projects, regarding the pre-initiation preparedness of a specific collaborative delivery model, would sit on the left side but leans slightly toward the middle.

- The application of Xiaotangshan Hospital as a documented playbook (H. Lu et al., 2023);
- Systematized, coordinated supply chains (Luo et al., 2020; Sultana et al., 2024);
- Use of standardised digital tools (BIM) and industrialised construction methods.

While effective, the projects lacked pre-positioned framework contracts (Level 5) and performance-managed BBB strategies (Level 4). The capability was defined and ready to activate, but not fully pre-configured for this specific contingency.

Based on the detailed analysis of all seven aspects assessed against the preparedness framework, the overall pre-initiation preparedness of the Huoshenshan and Leishenshan hospital projects is best characterized as falling just below the midpoint, firmly on the "less prepared" side of the spectrum.

Among the seven assessed aspects, three stood out as well-prepared prior to project initiation while four aspects were less prepared. The Knowledge aspect was the strongest, marked as "more prepared" due to the immediate and effective use of the Xiaotangshan Hospital experience from the 2003 SARS outbreak. Similarly, Industrial Resources were also "more prepared", demonstrated by the robust capacity of China's industrial base, featuring established supply chains, high-tech adoption, coordinated government support, and adaptive planning methods like reverse design. The Projects & Programmes aspect was rated as defined, reflecting a documented, systematized capability to execute emergency construction using precedent, standardized tools, and coordinated supply systems, even though the activation was reactive. On the less-prepared end, Community Involvement and Land Planning were both assessed as "no preparation", with no evidence of pre-crisis engagement with affected communities or the existence of pre-zoned, designated land for emergency hospitals. Regulations and Funding were each mapped to "less prepared".

This distribution reflects a preparedness landscape where China's industrial and technical strengths enabled extraordinary execution, but critical enabling systems like community integration, land policy, funding structures, and legal frameworks were largely activated reactively, not proactively designed for this specific contingency.

4.3.2 Lumajang Post-Mount Semeru Eruption Housing

On the year end of 2021, Mount Semeru in Lumajang Regency, East Java, Indonesia, experienced a significant eruption, unleashing pyroclastic flows and volcanic ash. The disaster displaced more than 10,000 people, and destroyed thousands of homes and public facilities. The most heavily impacted areas were declared hazardous "red zones," turn the village uninhabitable. In response, the Indonesian government, through the Ministry of Public Works and Housing (PUPR), initiated a large-scale relocation and reconstruction project in early 2022. The ambitious project aimed to build 1,951 permanent houses (huntap) in a safer location in Sumbermujur Village to provide new homes for all affected households. This rapid reconstruction effort, completed in a matter of months, serves as a key case study for managing urgent post-disaster projects in Indonesia. This project however, stands as an example of successful reactive project execution.

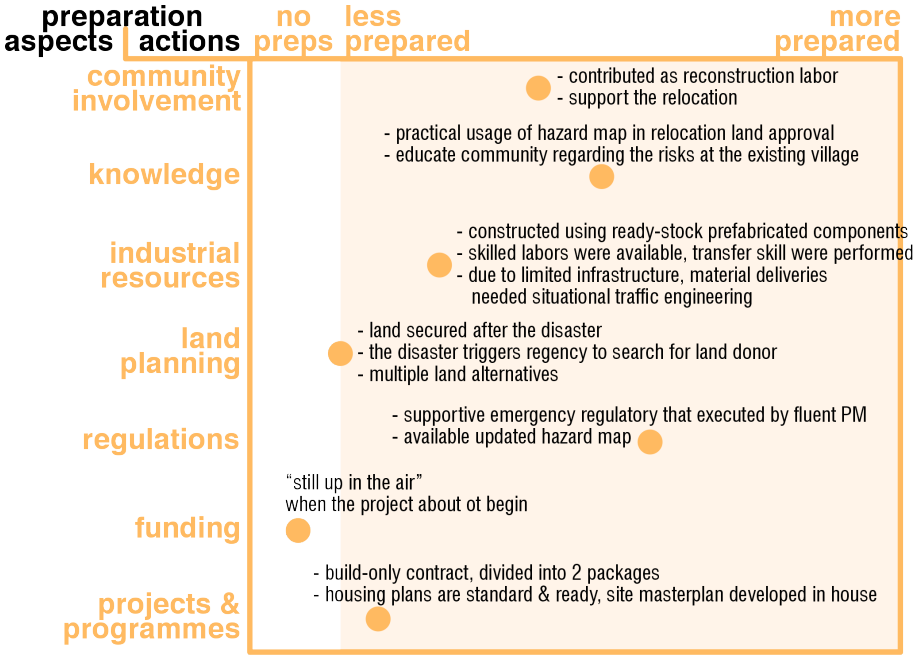

Figure 4.3.2: preparation aspects of the Lumajang Post-Eruption Housing projects

a) Community Involvement

The approach to community involvement in the Lumajang project was defined by a contrast between the community's passive role during the strategic planning stages and their active participation in the physical construction. While the community's support was secured and their labor was utilized, they were not involved in the initial decision-making processes. This places the project's practice on the lower end of the preparedness framework, which idealizes community-led initiatives from the outset (Katoh & Misumi, 2024).

The project's key decisions were driven by government authorities, positioning the community as supporters of a top-down plan rather than as co-creators. The decision to relocate came from president's directive, and the municipality led the search for land. Community support was secured through an education campaign that highlighted the dangers of their original location. The project official explained this approach, stating, *"The community at that time was very supportive of being relocated. And the role of the regional and central government was also through education, that the land they were living on could one day take their lives"*. This top-down governance was further confirmed by an official from the National Disaster Management Agency (BNPB), who attributed the project's rapid pace to the local leader's political skill, noting, *"he knew which people to lobby and who to talk to, which is why the response was fast"*. These actions show the top-down nature of the relocation.

In contrast, the community was actively engaged during the physical construction phase, which provided both economic benefits and skills development. Local residents were hired for non-specialized work and were integrated with skilled laborers from outside the region, as well as turned a labor shortage for the specialized RISHA housing system into an opportunity for empowerment through on-the-job training. The project official detailed this effort, stating, *"...we also empowered the community on how to assemble RISHA. So while they worked, they were also taught directly. The system was like that"*. This participation provided tangible benefits, though it occurred after all strategic project decisions had been finalized.

In conclusion, the preparedness of community involvement for the Lumajang project is placed on the left side (less prepared), leaning towards the middle of the framework. It is positioned on the left side because the community was not involved in the critical upfront planning or decision-making, instead functioning as informed beneficiaries of a government-led plan. However, it leans towards the middle because the active inclusion of residents in the

construction workforce, including on-the-job training, represents a form of participation that is more advanced than complete passivity. This approach, while successful in gaining support and providing labor, fell short of the framework's ideal of fostering community ownership and resilience through collaborative planning from the project's inception.

b) Knowledge

The preparedness for the Lumajang project in the aspect of knowledge was characterized by the effective application of centralized technical expertise, which compensated the lower levels of preparedness at the community and local institutional levels. The project's speed was enabled by leveraging existing hazard information and standardized designs, while its success was also dependent on the ad-hoc competence of a newly appointed local leader rather than a prepared and system-wide readiness.

The project's execution was guided by a solid foundation of technical and hazard-related knowledge. The critical decision to relocate was based on official hazard maps that identified the affected community's location as a high-risk area. The project official confirmed this, stating, *"If you look at the BNPB map, it's a red zone, or a disaster-prone area"*. This knowledge directly informed the selection of a safer site located a considerable distance away from the source of the hazard. As the official described, *"On that land, the distance is about 6 kilometers, lower than the existing village, further from the mountain peak"*. This existing knowledge was then supplemented by new, on-the-ground assessments to ensure the viability of the new site, with the team confirming, *"we check it from a technical perspective. The topography and all sorts of things"*. Furthermore, the construction process itself was significantly accelerated by the use of a pre-existing, standardized housing design. This removed the need for a lengthy design phase, as the project official explained, *"So the design already exists. For our designs, they are already typologies. They all exist, we just need to build"*.

While technical knowledge was well-applied from the central government, the interviews suggest that preparedness at the local government and community level was initially less developed. The rapid response in Lumajang was directly attributed to a last-minute change in the local leadership rather than a pre-existing state of institutional readiness. A BNPB official explained that the original local leaders were ineffective, and progress only began after a more competent replacement was installed, noting, *"the head of the local disaster management agency (BPBD) was replaced twice... the new one... knew which people to lobby and who to talk to, which is why the response was fast"*. This highlights a reliance on individual know-how over institutionalized knowledge. Similarly, community knowledge regarding asset protection is generally low, with a BNPB official stating that public awareness for protecting houses from disasters is *"still very, very minimal"*. This necessitated a post-disaster education campaign by the government to build knowledge and gain community support for the relocation.

In conclusion, the knowledge preparedness for the Lumajang project sits firmly in the middle of the framework's spectrum. It is not on the less-prepared left side because the project team did not act without information; they effectively used existing hazard maps, conducted necessary technical assessments, and deployed standardized designs. However, it does not reach the more-prepared right side, which represents a state where knowledge is fully institutionalized, and communities are proactively planning their own resilience. The project's success depended on the top-down application of technical knowledge and the timely appointment of a capable local leader, rather than on a system where proactive disaster knowledge is deeply and reliably embedded at all levels of governance.

c) Industrial Resources

The preparedness of industrial resources for the Lumajang project was a combination of proactive material stockpiling and reactive problem-solving for logistical and labor challenges. While the strategic stockpiling of RISHA housing components was a significant advantage that enabled the project's rapid start, this was counterbalanced by severe mid-project logistical bottlenecks and initial labor shortages that required ad-hoc management during the project's execution.

A crucial element of preparedness was the pre-existing stock of standardized housing components (RISHA and RUSPIN), which were ready for immediate deployment. This stockpiling policy was not initially designed for disaster response but was later adopted as a formal preparedness strategy after its effectiveness was proven in a prior disaster. The Director of Special Housing explained, *"learning from that [previous post-disaster project], that RISHA and RUSPIN can indeed accelerate the post-disaster housing construction process... every year since then, stockpiling has been carried out... with the objective of preparedness in case of a disaster"*. The project official in Lumajang confirmed the use of these stocks, stating, *"For our RISHA components, the Directorate usually prepares them... We took them from several provinces at that time"*. This pre-positioned inventory was a decisive factor in the project's speed.

While materials were ready, the project faced significant logistical hurdles and labor shortages that were managed reactively. The construction site had only a single access road, creating a major bottleneck for the massive volume of materials needed. The project official described the challenge, *"...the access for mobilizing everything, both tools and materials, was only one entry lane. That's what made us conduct traffic engineering"*. This logistical problem required on-the-fly coordination between the two contractors to prevent gridlock. Similarly, there was an initial shortage of skilled labor for assembling the RISHA components. The project official noted, *"Yes, in the beginning, there was a shortage"*. This was addressed by training local community members on the job, an effective but reactive solution to an unforeseen labor gap.

Another challenge was the financial model, which required contractors to be fully self-financed. This approach offloaded the immediate financial risk from the government to the industrial partners. The Director of Special Housing explained this high-risk requirement, *"...it has to be self-financed. Meaning they have to carry out the construction first, using their own capital first, and then after the construction is completed... and there is an audit... only then are they paid"*. This model creates a high barrier to entry and was acknowledged by the project team as a major difficulty. The project official highlighted the challenge this poses, especially for smaller firms, *"...looking for service providers who are financially capable is also difficult... especially local contractors who have no money. Because you can't build if you don't have money. Not everything can be bought on credit"*.

In conclusion, when placed on the framework's spectrum, the preparedness for Industrial Resources sits between the left and the middle. It leans towards the middle because of the proactive and strategic stockpiling of essential RISHA components. This demonstrates a formalized system for material readiness, moving beyond the purely reactive state on the far left. However, it is pulled strongly to the left (less prepared) due to the significant logistical, labor, and financial challenges that required improvisation mid-project. The framework defines a less-prepared state as one where operations rely on reactive problem-solving. The need to create ad-hoc traffic management, train labor on the fly, and, crucially, place the entire upfront financial burden on contractors are all hallmarks of a reactive system that lacks integrated preparedness for logistics, labor, and financial risk-sharing.

d) Land Planning

The approach to land planning for the Lumajang project was entirely reactive, with all activities for site identification, acquisition, and preparation only conducted after the disaster struck. The success of this phase was not due to pre-disaster planning but was driven by the high-level support and decisive action of the local government, which managed to secure and clear a suitable site quickly. This post-event approach, while effective in this specific case, represents the lowest level of preparedness according to the framework, which idealizes proactive measures such as maintaining a register of pre-identified safe sites long before a disaster occurs (Charoenkalunyuta et al., 2011; Unger, 2019).

The interviews confirmed that there was no pre-identified relocation site before the eruption. The process began only after the presidential visit, with the regency head (Bupati) taking the lead in an urgent search for land. The project official explained, *"the Bupati also came down directly, and finally, the Bupati got the land"*. The land itself was a donation from a plantation company, a process that was greatly accelerated due to the disaster, but it was not

a pre-designated government land bank. Moreover, BNPB highlight the root of the habit, *"...to provide land clearing and land for the local government is a problem in itself, both from the money and the provision itself. And even if it's already bought, this is the land we want to prepare, but a disaster hasn't happened, which is fortunate, but according to the local government, that would be wasteful"*. This represent that the preparation culture is institutionalised.

Once a potential site was identified, a rapid, post-disaster assessment was conducted to ensure its suitability. This involved both administrative and technical checks. The project official described how the local government handled the administrative side to ensure the land was, as project officer said, *"clear and clean"*. His team then performed a technical evaluation, confirming, *"we check it from a technical perspective. The topography and all sorts of things"*. While this assessment was thorough, it happened after the fact. A BNPB official confirmed this is standard procedure, as pre-disaster plans must always be re-validated after an event. However, he also recommended a more prepared approach, stating local governments should at least have a list of potential sites ready for assessment, *"at a minimum, the local government has several alternative land options that could possibly be used for relocation... so that when a disaster occurs, the scope of checking is narrower"*. This recommended best practice was not in place in Lumajang, where the search began from scratch.

When placed on the framework's spectrum, the preparedness for Land Planning is on the far-left side (least prepared). The framework's ideal and most prepared state involves having pre-identified, administratively cleared, and technically vetted safe relocation sites registered and ready for activation before a disaster occurs (Charoenkalunyuta et al., 2011; Unger, 2019). However, the practice in Lumajang was the opposite, as even the searching for land was initiated post-disaster. While the reactive response of the local government's fruits into quick resolution, the approach itself represents a complete lack of proactive land planning preparedness. It is not a coincidence that the project official's primary recommendation for future improvement is about land planning, *"it really goes back to the regional policy to have already prepared land for relocation far in advance, so there are already several plots of land that can be used for relocation, there's already a stock of land"*.

e) Regulations

The regulatory preparedness for the Lumajang project was a key strength that enabled its rapid execution. The project's success was heavily reliant on the effective use of an existing emergency procurement regulation that allowed for the direct appointment of contractors, bypassing standard, time-consuming tender processes. This demonstrates a functional level of legal preparedness for a crisis response. However, the interviews also reveal that while the regulation exists, its application is not yet fully seamless or anticipatory, indicating room for further development.

The project's rapid start was made possible by a specific legal instrument designed for emergency situations. The project official directly responsible for the Lumajang project confirmed its use: *"At that time, we used the Head of LKPP Regulation (Perka LKPP) No. 13 of 2018... Because this is an emergency response, the procurement can be a Direct Appointment"*. An official from the Directorate of Special Housing corroborated this, highlighting its importance in accelerating the project compared to other, slower post-disaster responses. He stated, *"in Lumajang, the mechanism was direct appointment... this was very influential in accelerating the implementation of the work"*. This readiness to switch from a standard to an emergency procurement track is a clear indicator of a prepared regulatory system.

Despite the existence of this effective regulation, its implementation is not without challenges. An official from the Directorate of Special Housing pointed out that a lack of explicit clarity can cause hesitation among project managers, stating *"perhaps from the regulatory side, it could be more detailed... explicitly stating that the mechanism can use direct appointment procurement. Because in its implementation, many project managers (PPK) are hesitant or afraid because they worry about making a misstep"*. This suggests that while the tool exists, its usability could be optimized to create a more robust and confident response system. This reflects a broader challenge noted

by a BNPB official, *"Everything is there: the regulations are there, the steps are there, the substance is there, it's complete"*. The hurdle, therefore, is not the absence of regulation but ensuring it is applied with consistency and confidence at the local level.

In conclusion, when placed on the framework's spectrum, the preparedness for Regulation is in the upper-middle. The framework describes this middle tier of preparedness as the stage where "standing procurement templates are placed in law," which is a prerequisite for a proactive system (Bang, 2021). The successful use of the LKPP emergency procurement regulation in Lumajang aligns perfectly with this description. The project's regulatory readiness was far more advanced than the less-prepared state of simply having risk assessments without legal mechanisms to act on them. However, it does not reach the most-prepared "anticipatory / adaptive" tier, where a large share of decisions is legally pre-authorized and automatically triggered upon a disaster declaration (Alexander et al., 2007). The fact that implementers still feel hesitant and that the project required strong top-down leadership to proceed indicates the system is not yet seamlessly integrated, placing it in the upper-middle range of preparedness.

f) Funding

The funding approach for the Lumajang project was entirely reactive, relying on post-disaster national budget allocations rather than pre-arranged financial instruments. While a mechanism existed to procure payment after the work was completed, the absence of ready, upfront capital meant that the project had to proceed without a secured budget. This placed the immediate financial burden on the contractors and represents a low level of financial preparedness according to the framework.

The interviews confirmed that at the project's inception, there was no pre-allocated budget. The project official confirmed this lack of upfront capital, stating, *"That event was unforeseen, so regarding the budget and everything else, there was nothing at all. It was all still up in the air"*. The Director of Special Housing further detailed this reactive process, explaining, *"when we carry out disaster response, especially with a direct appointment mechanism, there is definitely no budget yet"*. He further explained, *"it has to be self-financed. Meaning they have to carry out the construction first, using their own capital first, and then after the construction is completed... and there is an audit... only then are they paid"*, then elaborates that payment will go through a specific national budget article known as BA-BUN (Bagian Anggaran Bendahara Umum Negara). This mechanism, managed by the Ministry of Finance, ensures that funds do not have to be shifted from the ministry's existing budget. A direct consequence of this reactive funding model was that the contractors had to be fully self-financed, bearing the entire upfront cost of construction.

This dependency on the state budget is a known limitation that the government is actively trying to address by developing alternatives like a disaster pooling fund and insurance. A BNPB official confirmed this strategic direction, *"...we are currently developing ways so that we no longer depend on the APBN-APBD (national and regional state budgets), but where can alternative financing come from? That is what is being developed..."*.

When placed on the framework's spectrum, the preparedness for Funding is on the far-left side (least prepared). The framework defines this end of the spectrum as relying on reactive, ex-post financing such as "budget reallocations, donor aid," or "post-disaster borrowing" (Villacin, 2017). The approach used in Lumajang, which depended entirely on a future allocation from the national budget that was "still up in the air" at the project's start, is a clear example of this least-prepared state. The project's reliance on post-event budgeting and contractor self-financing confirms a lack of a prepared financial strategy.

g) Projects & Programmes

The preparedness for the Lumajang project, from a project delivery perspective, was characterized by a programmatic approach on the owner's side, combined with a traditional collaboration model for execution. The government prepared a comprehensive master plan and utilized standardized designs, which provided a clear foundation for the work. However, the contractual relationship with the builders was a simple "Build-only" model, which represents a low level of collaborative preparedness according to the framework.

Before engaging contractors, the government agencies undertook significant preparatory work to structure the program. This involved a collaborative effort among different government directorates to develop a detailed site master plan. The project was then strategically divided to enhance manageability and speed. The project official explained, *"at the technical level, we collaborate with other Directorate Generals such as Cipta Karya, Bina Marga, and Water Resources. We then prepare a master plan for the area, including how the housing site plan will be arranged, the clean water channels, and other aspects"*. This programmatic approach, where the owner defines the overall structure before execution, provided a clear and organized basis for the construction phase. Then, the project's acceleration was heavily dependent on the use of a pre-existing, standardized housing design (RISHA typology). Because the design was already complete, a more collaborative or integrated contract was deemed unnecessary. The project official confirmed this, stating, *"Not a design and build. So it's just the build and its supervision... the design already exists. For our designs, there are already typologies"*. This "Build-only" model is a traditional procurement route where the contractor is responsible only for executing a finished design. An official from the Directorate of Special Housing confirmed that this was considered the optimal approach, *"If we use the current standard, meaning using the special housing typology that we have prepared, it seems already optimal, the house typology is already there... you just have to use it"*. This model limits the contractor's role, with no integration in the upfront planning or design process, let alone be ready with unforeseen risks.

When placed on the framework's spectrum, the preparedness for Projects & Programmes is on the left side, leaning slightly towards the middle. The framework places traditional non-integrated contracts on the left (less prepared) and highly collaborative and flexible models like Project Alliances (PA) or Framework Agreements (FA) on the right (more prepared), as the latter are better suited for handling uncertainty and promoting efficiency (Mosey, 2019). The "Build-only" contract used in Lumajang is a classic traditional model, placing it on the left side of this spectrum. It compensates slightly towards the middle only because of the significant preparatory work done by the owner's side, such as developing a master plan and using a standardized design. This provided a structured foundation that prevented the project from being entirely ad-hoc, but the contractual mechanism itself lacked the integration and shared-risk principles of more advanced and collaborative models.

The post-disaster housing project in Lumajang represents a case of successful reactive execution rather than proactive preparedness. Although the project achieved fast delivery, this relied on strong political support, emergency regulations, and fortunate conditions such as donated land. These factors helped officials address challenges in an emergency. When assessed using the preparedness framework, the project shows uneven readiness, with strengths in operations and regulations compensating for gaps in long-term planning and pre-positioned resources.

In conclusion, the Lumajang project shows that fast action is possible through strong leadership and emergency tools, but this approach is not easily repeated or fully resilient. As a project official noted, long-term improvement requires moving from reactive response to proactive capacity-building. Future preparedness should prioritise land banks for relocation and pre-arranged funding tools that provide immediate financial access.

4.3.3 Central Sulawesi Post-Tsunami Housing

Post-disaster housing in Central Sulawesi marks several milestones. Firstly, it become the first relocation project that fully designed to meet Build Back Better principle. Secondly, it scale is massive, covering 3 municipalities with over 5000 units built from 9 construction projects. Moreover, it was the first time that the World Bank loan used to post-disaster reconstruction in Indonesia, which then provided legacy for other reconstruction afterwards.

Overall, the project was highly reactive, with most preparations and problem-solving happening after the disaster. It consistently falls on the least-prepared side of the framework, with some

reactive adaptations moving it slightly toward the middle in a few areas. The detail of each aspect are elaborated as follows.

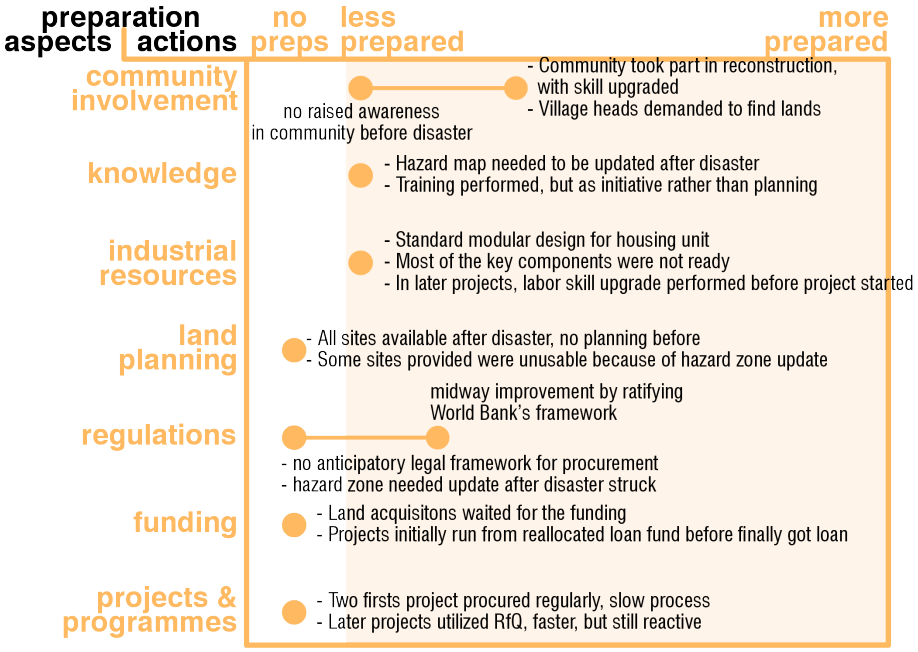

Figure 4.3.3: preparation aspects of the Central Sulawesi Post-Tsunami Housing projects

a) Community Involvement

Community involvement in the Central Sulawesi post-disaster housing project was a complex and defining feature of the recovery effort. The relationship between project implementers and the affected population was not one of pre-planned partnership but of reactive engagement that unfolded after the catastrophe. This dynamic created a powerful dual narrative. On one hand, it exposed a fundamental lack of preparedness which led to significant delays and disputes. On the other hand, it highlighted adaptability of both the community and project officials who navigated challenges to ultimately complete the project.

The initial lack of preparedness manifested as significant friction and misalignment between the project and the community. Local residents expressed deep skepticism towards the chosen construction technology, with the project manager recalling them asking, *"If this is earthquake-resistant, why is it assembled with bolts?"*. This resistance was coupled with a strong preference for local employment, as the project manager further noted, *"the community did not want outside workers, they wanted to be the ones working there"*.

Despite these challenges, the project also showcased adaptability. In response to the technology skepticism, officials implemented a successful public outreach program that improved disaster awareness and facilitated acceptance. To address the demand for local labor despite a skills gap, project leaders adopted a flexible policy to "mix" the workforce, pairing skilled external workers with local trainees. The community also demonstrated cooperative adaptability. In the early stages, the government purchased land via community, as the project manager elaborates, *"the regency governments usually asked village heads to find available community lands for huntap, so they mobilized village heads to find suitable plots from residents. The search process was quick"*. This mid-project adaptation from bottom-up proved essential for navigating the project's complex social landscape.

In conclusion, the Central Sulawesi experience offers a lesson on the role of community in disaster recovery. The project's significant delays underscore the high cost of entering a recovery effort without a prepared and empowered community. As BNPB officials noted, *"community preparedness in Indonesia is still focused on saving lives, with planning for asset recovery*

remaining very, very far off". Yet, the project also proves that post-disaster adaptability, while less efficient, is a vital component of success.

b) Knowledge

Preparedness in the aspect of knowledge for the Central Sulawesi post-disaster housing project was defined by a gap from both end of the preparedness. While national agencies possessed advanced technical expertise in disaster risk management, this knowledge was not effectively embedded at the local level prior to the event. This disconnect created critical operational gaps at the project's outset, necessitating a difficult and prolonged process of reactive learning and adaptation. The project's journey highlights a systemic divide between high-level policy knowledge and on-the-ground implementation capacity, a central challenge in Indonesia's disaster management landscape.

The initial state of the project demonstrated a low level of knowledge preparedness, placing it in the "less prepared" category of the framework. This was most evident in two critical failures. First, the local government made land acquisition decisions without being synchronized with updated hazard assessments, with the project manager stating, *"In some cases, the local government had already purchased the land, but after we checked, it turned out the area was categorized as a red zone, meaning unusable"*. Second, a technological skills gap meant the local workforce was unfamiliar with the chosen RISHA construction method. This inefficiency, as noted by the project manager, *"local workers, however, needed three days to complete one unit, compared to one day for an experienced labor"*. These gaps in practical and technical knowledge created immediate and significant delays.

In response to these initial failures, project stakeholders engaged in reactive knowledge building to bridge the gaps. To overcome the workforce skills deficit, project consultants initiated an informal training program, as elaborated by the project manager, *"local communities got RISHA construction training, where they received certification and were later hired by contractors"*. At an institutional level, the Directorate of Special Housing also demonstrated an adaptive learning process. An official explained that after seeing the benefits of material availability in a subsequent disaster, a key lesson was learned and as a result, systematic "stocking began to be carried out every year" as a new preparedness policy.

This project underscores the persistent knowledge divide between national agencies and local governments. BNPB officials explained that while they provide standardized risk maps and methodologies, and even when municipalities have their land zone planning, the implementation is inconsistent, as stated by BNPB official, *"building shouldn't allowed there. So why did it get built there? That becomes another challenge"*. The core issue is translating data into action. A BNPB official articulated this gap by stating that for local governments, the question is, *"'okay, there is this information, there is this warning, so what now?' The 'so what now?' part is still our homework"*. This reveals a deep challenge in ensuring that advanced national knowledge leads to effective local preparedness.

In conclusion, the project was launched from a position of significant knowledge unpreparedness at the operational level. The success it eventually achieved was not due to pre-existing local capacity but rather to the resourcefulness of officials and communities who learned and adapted on-ground.

c) Industrial Resources

The management of industrial resources for the Central Sulawesi housing project reveals a dual narrative. The project was launched from a volatile environment with almost no prior preparation of its material, labor, or contractor supply chains. This initial state of unpreparedness created bottlenecks that significantly delayed construction. However, faced with these immense challenges, project stakeholders demonstrated remarkable adaptability, developing on-the-ground solutions and catalyzing long-term, more sustainable community and institutional learning.

From the outset, the project's industrial resource management was reactive, placing it on the "Far Left / Least Prepared" side of the framework. This stage is defined by mid-project

improvisation. Firstly, the team faced a severe material shortage as a national construction boom, as the project manager illustrates, *"The most challenging parts during construction were material and manpower. Especially in 2023–2024 when the national construction activity was at its peak. Projects like IKN (Indonesia's new capital) were starting, and many projects were running everywhere. Even materials were being sourced from here (Central Sulawesi) for IKN, which drove up local prices and created supply issues."* This issues alone can explain how industrial readiness is needed for preparedness.

Despite these significant initial setbacks, the project became a crucible for adaptive problem-solving and positive change. One of the most important adaptations was the initiative to train the local workforce. Responding to community demands and a clear skills deficit, contractors provided on-the-job training, developing local capacity while completing the project, as elaborated by the project manager, *"One program involved RISHA construction training for the local population, where they received certification and were later hired by contractors"*. Furthermore, this experience of material scarcity directly trigger a major improvement in national policy. An official from the Directorate of Special Housing explained that, *"Learning from that experience, that RISHA and RUSPIN can indeed accelerate post-disaster housing construction, stocking began to be carried out every year"*, institutionalizing a key lesson from the crisis.

In conclusion, the project's experience with industrial resources offers a powerful lesson in the dual nature of disaster recovery. The initial lack of preparation created predictable and costly delays, confirming the framework's assertion that a ready supply chain is essential for rapid reconstruction. However, the project was not defined by its initial failures but by its eventual adaptations. The resourcefulness shown in training local labor and the strategic wisdom to transform operational challenges into a national stockpiling policy highlight that even the most unprepared situations can foster resilience and drive systemic improvement.

d) Land Planning

Land planning for the Central Sulawesi housing project was a failure in its preparedness because it contributes for the multi-year reconstruction timeline. The entire process of securing viable land for relocation was initiated reactively after the disaster, exposing deep systemic weaknesses in local and national governance. However, within this narrative of unpreparedness, an important example of effective, on-the-ground adaptation emerged through community engagement. This contrast between the failure of formal systems and the success of informal problem solving offers a key lesson for future disaster recovery efforts.

From the perspective of the framework, the project's land planning maps directly to the "Far Left / Least Prepared" category. The ideal state of preparedness involves having pre-identified, hazard-assessed land banks ready for immediate use, as described by framework sources that advocate for hazard-aware planning and pre-identified sites to be in place before an event (Charoenkalunyuta et al., 2011; Unger, 2019). The reality in Central Sulawesi was the opposite. The project manager identified the land issue as the "biggest obstacle," a problem so profound that the final parcels of land were only acquired in late 2023, five years after the event. The problem worsen because systemically, the municipality is the sole party responsible for the land, as BPB official said, *"BNPB is not authorized to finance land acquisition. This is often a problem"*. Moreover, as the project manager recalls, *"In some cases, the local government had already purchased the land, but after we checked, it turned out the area was categorized as a red zone, meaning unusable."* This unpreparedness led to cascading failures that forcing the search to restart, prolonging the recovery effort. This ad-hoc process was further complicated by local government financial shortfalls and bureaucratic hurdles, confirming a complete absence of a prepared land strategy.

Despite the systemic failures, a positive takeaway was the adaptive strategy used for the land search itself. In the absence of a formal land bank, the local government turned to existing community structures to accelerate the process, through mobilizing village heads. The project manager notes that *"the regency governments usually asked village heads to find available community*

lands for huntap, so they mobilized village heads to find suitable plots from residents. The search process was quick. The procurement process was what took time". This bottom-up approach proved to be an effective adaptation, demonstrating that leveraging local community networks can be a powerful tool to overcome inertia in a crisis.

In conclusion, the delays caused by the land acquisition crisis in Central Sulawesi validate the framework's emphasis on pre-disaster land planning as a cornerstone of rapid recovery. The project's experience serves as a warning about the consequences of neglecting this crucial aspect of preparedness. However, the successful use of village heads to identify land shows that even within a failing system, adaptive measures can provide a critical lifeline. This highlights that while formal, top-down preparedness is the ideal, fostering strong community networks that can be mobilized for informal problem solving is an invaluable strategy.

e) Regulations

The regulatory environment in the Central Sulawesi post-disaster housing project illustrates a transition from bureaucratic constraint to effective and adaptive governance. The project was initially launched under regular regulations that were misaligned with the urgency in a post-disaster context. This hindered the speed of the progress. However, the project team's ability to recognize this failure and pivot to a more flexible legal framework mid-crisis proved that they are adaptable with the on-going situation. This shift showcases how regulatory flexibility, even when reactive, can be an enabler of acceleration.

The project's initial phase was defined by lack of regulatory preparedness. The team notes that *"at the beginning we used regular procurement. That itself became a problem"*. The use of inappropriate regulations fostered a climate of uncertainty and hesitation among officials due to consumed time, as noted by the official, *"I've experienced tenders taking nearly a year due to failed bidding rounds"*. An interviewee from the Directorate of Special Housing noted that without clear emergency procedures, Project Managers are often *"hesitant or afraid because they worry about making a wrong step"*, which paralyzes decision-making when speed is most critical.

The turning point came from a strategic decision to harmonize local regulations with the more flexible procurement rules of the project's international lender. The project manager explained this adaptation, *"eventually, for phase 2, we consulted with the World Bank and harmonized the procurement documents"*. This was legally justified under the established principle that when using a loan, *"As stated in Perpres [Peraturan Presiden no. 16 th 2018 tentang Pengadaan Barang & Jasa / President's Regulation nr. 16 yr. 2018 on Public Procurement], if using a loan, the lender's rules prevail"*. The impact of this regulatory shift was transformative. He adds that *"the new process allowed for expedited methods that could conclude in as little as two weeks"*. This represents acceleration compared to the previous year-long timeline.

From a national perspective, this case reflects gap in consistent implementation. An official from BNPB affirmed that Indonesia's disaster management framework is robust, stating, *"there is a regulation, there are steps, the substance is there, it's complete"*. The core challenge, the official explained, *"the homework lies in standardizing the application of these rules across local governments with widely varying capacities and political will"*. This often results in a disconnect between well-designed national policies and effective, timely action on the ground.

In conclusion, the regulatory preparedness of the project began on the Far Left / Least Prepared side of the framework but moved decisively towards the Middle / Moderately Prepared through reactive adaptation. The initial use of standard rules created a classic bottleneck, but the team's ability to adopt a fit-for-purpose legal framework was success. While the project did not benefit from the ideal of a pre-authorized, anticipatory system, the mid-crisis regulatory overhaul demonstrates a powerful capacity for institutional learning and problem-solving. It underscores that having a mechanism to legally and swiftly adapt rules is, in itself, a crucial form of preparedness.

f) Funding

The funding strategy for the Central Sulawesi housing project was entirely reactive, assembled through ad-hoc mechanisms after the disaster had already occurred. This approach created

delays and financial uncertainty, contrast to a prepared model where financial instruments are ready immediately(Ghesquiere & Mahul, 2010; Villacin, 2017). The government's mid-crisis search for funding through international loans highlights unpreparedness and time-consuming solutions when speed was needed.

Firstly, land acquisition was delegated to the local government's budget (APBD). This proved to be an immediate bottleneck, as the project manager noted that the regencies faced significant "financial" problems and lacked the resources for the large-scale land purchases required. This dependency on under-resourced local budgets, which first had to fund a land appraisal process before they could even begin purchasing land, was a primary cause of the initial project delays.

Secondly, the reactive funding approach evident during the process of securing loans from the World Bank for the reconstruction phase. The project manager notes, *"Stage one was NSUP Search, initially for slum upgrading but amended for emergency response after the 2019 disaster. We used that from 2019 to 2020. That loan closed in 2021, covering only two huntap packages: Package 1A and 1B"*. This illustrates that with no pre-arranged credit line, officials had to creatively find immediate funds while simultaneously negotiating a long-term solution. Then, he described this ad-hoc measure as, *"That's how the financing began while preparing a separate loan dedicated to Central Sulawesi's disaster recovery, called CSRRP"*. This two-step process of repurposing an old loan while negotiating a new one demonstrates a system forced to find solutions under extreme pressure.

Thirdly, from a national perspective, this reliance on post-disaster financing is a known systemic issue that Indonesian agencies are working to address. The current most effective funding was seen as BA-BUN (Budget for the National Trasurer), as noted by the official from Directorate of Special Housing, *"The most feasible option is BA-BUN. If it's BA-BUN, as long as the directive is clear, especially if came from president's order and inline with the regulations, which then reviewed by BPKP, it usually doesn't bother and can be implemented"*. However, this solution is still reactive, as it can only be triggered after disaster happen, and all the funding in the project will be performed by contractor.

The positive takeaway, however, is the strategic effort to build a more resilient system. An official from BNPB explained that a new "Pooling Fund" for disasters is being developed to provide a dedicated, off-budget source of financing. Although still in its early stages, the fund is designed to have ready capital that can be deployed quickly, representing a major positive step towards proactive financial preparedness for the future.

In conclusion, the funding preparedness of the Palu project maps directly to the Far Left / Least Prepared side of the framework. The project's reality of relying on insufficient local budgets and hastily arranged international loans aligns perfectly with the "Reactive/ex-post" stage. There was a complete absence of the pre-arranged financial instruments that the framework identifies as essential for a rapid response. However, the project's difficult experience underscores the importance of the positive changes now underway, showing a clear institutional desire to move towards a more prepared model with future solutions like the Pooling Fund.

g) Projects & programmes

The project delivery model for the Central Sulawesi reconstruction was conventional and non-integrated, representing a significant missed opportunity for acceleration. Rather than utilizing a prepared and flexible programme designed for the uncertainties of a post-disaster environment, the project was executed using a standard, linear approach. This method proved slow and worsen the emergency situation. The interviews reveal a clear understanding among stakeholders of the delays this caused, as well as the institutional barriers that prevent the adoption of more agile, collaborative project delivery frameworks.

The project was executed through a fragmented structure where key government agencies worked in silos rather than under a unified programme. The contract itself was standard, with the project manager confirming, *"the procurement rules were adapted from the world bank as loan provider, while in terms of contract execution, everything else remained standard"*. At the inter-agency level, BNPB's role was primarily financial and coordinative, not operational. In

addition to that, there was a clear post-mortem recognition from the project team that this conventional approach was a major source of delay. The project manager, reflecting on the lengthy timeline, powerfully articulated the value of a more prepared model. When asked how much time could have been saved if contracts had been established pre-disaster through a framework agreement, he stated with certainty, *"Clearly more than 50%. I've experienced tenders taking nearly a year due to failed bidding rounds"*. This direct testimony from the person responsible for project delivery is the strongest possible evidence of the opportunity that was lost by not having a prepared programme in place.

The reluctance to adopt more advanced, collaborative models roots from significant institutional barriers. An official from the Directorate of Special Housing expressed that within the current paradigm, the existing build-only contract is seen as "already optimal". When presented with the idea of a more complex, multi-party contract that would integrate different government bodies and suppliers into one team, he immediately identified the core challenge as *"how to unify different priority and interests of each party, as they have different budget, agenda, and leader?"*. This highlights how a siloed work culture hinders the adoption of the integrated project delivery models that are essential for complex crises.

In conclusion, the preparedness of the Palu project in the aspect of Projects and Programmes maps directly to the Far Left / Least Prepared side of the framework. The project's reliance on a traditional, sequential tender process stands in stark contrast to the framework's ideal of using flexible and collaborative models like Framework Agreements or Project Alliances. There was no pre-disaster agreement with contractors, no shared governance structure among stakeholders, and at that time, no available agile mechanism to initiate work quickly. This fundamental lack of a prepared project framework was a critical failure that prevented the rapid mobilization necessary for an effective disaster response.

The Central Sulawesi post-disaster housing project was fundamentally unprepared, operating in a reactive state that perfectly illustrates the challenges described in the lowest tiers of the preparedness framework. The project's multi-year timeline was not an accident but a direct consequence of systemic failures to prepare in advance across nearly every aspect, most critically in Land Planning, Funding, and Projects & Programmes. These areas were started from scratch after the disaster, triggering predictable and cascading delays. The project manager himself wraps the project up by stating, "There were two main causes of delay: land acquisition and construction procurement itself."

However, the project can also be narrated by mid-crisis adaptation. The eventual success in delivering thousands of homes was not due to the initial plan but to the resourcefulness and flexibility of the officials and communities involved. They demonstrated an ability to learn, adapt regulations, create informal solutions, and solve complex problems under limitation. This gives the project a crucial dual narrative: it is both a case study in the high cost of unpreparedness and a lesson in the immense value of institutional and community adaptability.

4.3.4 Insight from Practices

Based on the case studies and the preparedness framework, current practices for highly urgent projects reveal an uneven profile, marked by a significant gap between operational execution and strategic readiness. While projects are often delivered quickly, this is achieved through reactive problem-solving and large-scale mobilization, not through proactive and systematic preparation. Technical and industrial capacities are generally more advanced, while foundational aspects that require long-term governance, such as land planning, funding, and community engagement, remain critically underdeveloped.

Three aspects in the case studies align with the more prepared side of the framework, mainly due to strong technical expertise and operational capacity, which can be seen in figure 4.3.4. The Wuhan hospital projects institutionalized disaster risk reduction knowledge by applying lessons

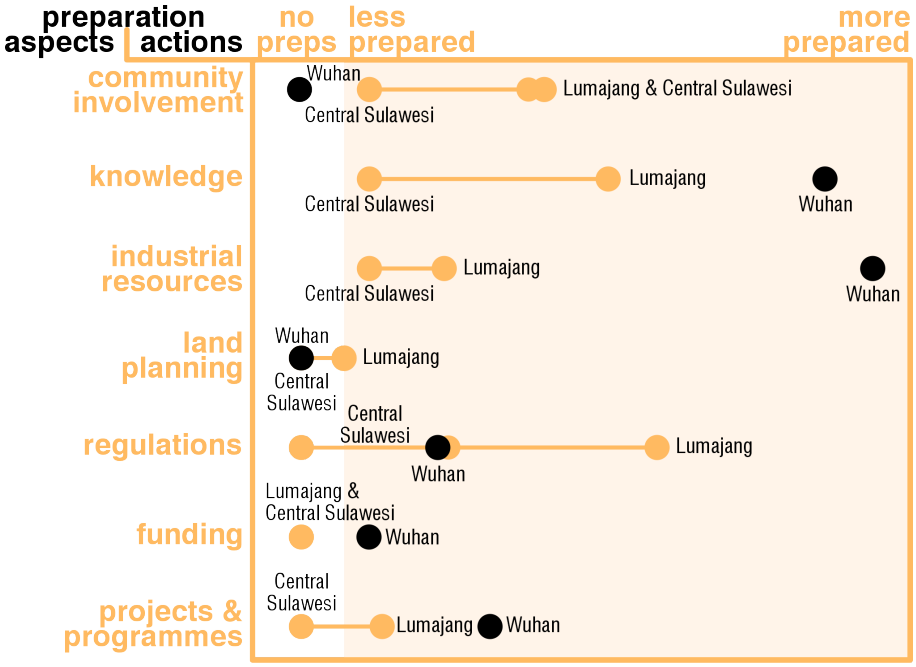

Figure 4.3.4: preparation aspects of combined studied cases

from the 2003 Xiaotangshan Hospital, showing a mature system where preparedness is embedded in permanent structures (Coppola, 2015). These projects also demonstrated advanced use of industrial resources, supported by China's robust supply chains and adaptive methods like reverse design, which reflect the "Integrated" and "Optimised" stages of the framework with real-time tracking and coordinated systems (Grest et al., 2020). Similarly, the Lumajang housing project applied an emergency procurement regulation (Perka LKPP No. 13/2018), allowing direct contractor appointments without public bidding. This represents the "institutions and budget" stage, where legal instruments and pre-approved mechanisms enable rapid implementation beyond basic risk awareness (Bang, 2021).

In contrast, four aspects remained underdeveloped across all cases, reflecting a reliance on reactive responses after disasters occur, as presented in figure 4.3.4. Land planning was consistently rated as "no preparation" or "least prepared," lacking hazard-aware spatial planning and pre-identified relocation sites, which the framework defines as essential for proactive governance (Charoenkalunyuta et al., 2011; Unger, 2019). Funding mechanisms were also weak, depending on post-event reallocations or emergency loans, a reactive approach that sits at the lowest preparedness level in the framework, far from ex-ante financial strategies designed for immediate response (Ghesquiere & Mahul, 2010). Community involvement was minimal, with communities engaged late as labor instead of being empowered to lead planning and recovery, falling short of the ideal state where communities play a central role from the outset (Davidson et al., 2007). Procurement models in Indonesian projects remained rigid, relying on traditional contracts, while Wuhan's projects, although slightly more advanced, still lacked collaborative arrangements. The framework recommends flexible models like Framework Agreements and Project Alliances to manage uncertainty and foster early cooperation (Mosey, 2019).

These findings highlight projects and programmes, which act as the link between foundational systems and operational capacity, remain in a transitional state, performing below the level of knowledge and industrial resources. Another finding is a persistent gap where technical capacity, especially in knowledge and industrial resources, enables fast execution on the ground, yet is undermined by weak foundational preparedness in governance, planning, and community engagement. This disconnect reveals missed opportunities in project governance, where operational capacity is not fully translated into efficient and timely project outcomes, slowing

down the overall recovery process.

4.4 Answering Sub-Research Question 2: Practice Gap

Based on a comparison of the three case studies with the preparedness framework, it is now possible to answer the sub-research question 2, *"To what extent do recent urgent projects being prepared, and what are the gaps between theory and practice?"*. Projects and programmes that act as the link between foundational systems and operational capacity remain in a transitional state, revealing that there is a missed opportunities in project governance. Moreover, there are three aspects related to technical knowledge and industrial execution that lean towards being more prepared, while another four that require long-term strategic governance and pre-arranged administrative systems consistently lean towards being less prepared. On operational capacity, this disconnect translates into inefficiency and prolonged project outcomes, and ultimately, slows down the overall recovery efforts.

Chapter 5 Procurement Strategy Design

This chapter presents the design and construction phase of the study, following the Design-Based Research approach proposed by McKenney and Reeves (2019). It addresses Sub-Research Question 3, *"What procurement strategy design is suitable to improve the current state of preparedness in post-disaster projects?"*, by developing a procurement strategy that aims to improve preparedness in urgent infrastructure projects. Building on the findings from Chapter 4, which identified the key preparedness aspects, current practices, and their gaps as the baseline, this chapter reconstructs existing workflows to identify accelerating and dragging sequences. These insights are then used to design a proposed workflow that seeks to enhance project initiation and reduce delivery delays. To ensure practical implementation, this chapter also specifies the requirements and conditions needed to apply the proposed strategy. As part of the DBR process, the output of this chapter serves as an initial solution, which still requires validation and refinement through stakeholder feedback in the next phase.

5.1 Current Practices

5.1.1 Lumajang Post-Mount Semeru Eruption Housing

This section reconstruct the post-disaster housing project workflow in Lumajang, East Java. It highlights notable pressure points that shaped the overall implementation. These points include project initiation, relocation land availability, emergency procurement and its trade-off, pre-stock RISHA material, and construction phase. These pressure points are critical sequences or decisions that significantly affected one or more of the following: procurement speed, project management and governance, risk exposure for stakeholders, and the overall duration of the project. A comprehensive, detailed reconstruction of the entire project workflow is provided separately in Appendix .4.

a) Project Initiation

When Mount Semeru's eruption was formally declared as emergency status, the project team could invoke Indonesia's special emergency procurement rule. The project officer recalled, *"at that time we used the Head of LKPP Regulation No. 13 of 2018 … because this is an emergency response, the procurement can be a Direct Appointment."* The Directorate of Special Housing confirmed how decisive that switch was, *"In Lumajang the mechanism was direct appointment … this was very influential in accelerating the implementation of the work"*. However, the same official also flagged the regulation clarity on the ground, *"perhaps, from the regulatory side, it could be more detailed. It needs to be explicitly stating that the mechanism can use direct appointment because many project managers hesitate, afraid of making a mis-step"*. Project officer added that certainty came not only from the legal trigger but also from pre-existing hazard intelligence, *"if you look at the BNPB map, it's [existing affected villages were] a red zone … the relocation land is about six kilometres away, lower than the village and further from the summit"*. Because the hazard map had already earmarked a safe, *"green-zone"* parcel, land search and due-diligence could start immediately, followed by the fast-track procurement window.

Relating to the preparedness, fast-track procurement sequence in Lumajang Project relates closely to regulations and knowledge, particularly from experts and government. Interviews and document analysis rate Lumajang's regulatory readiness as upper-middle: emergency

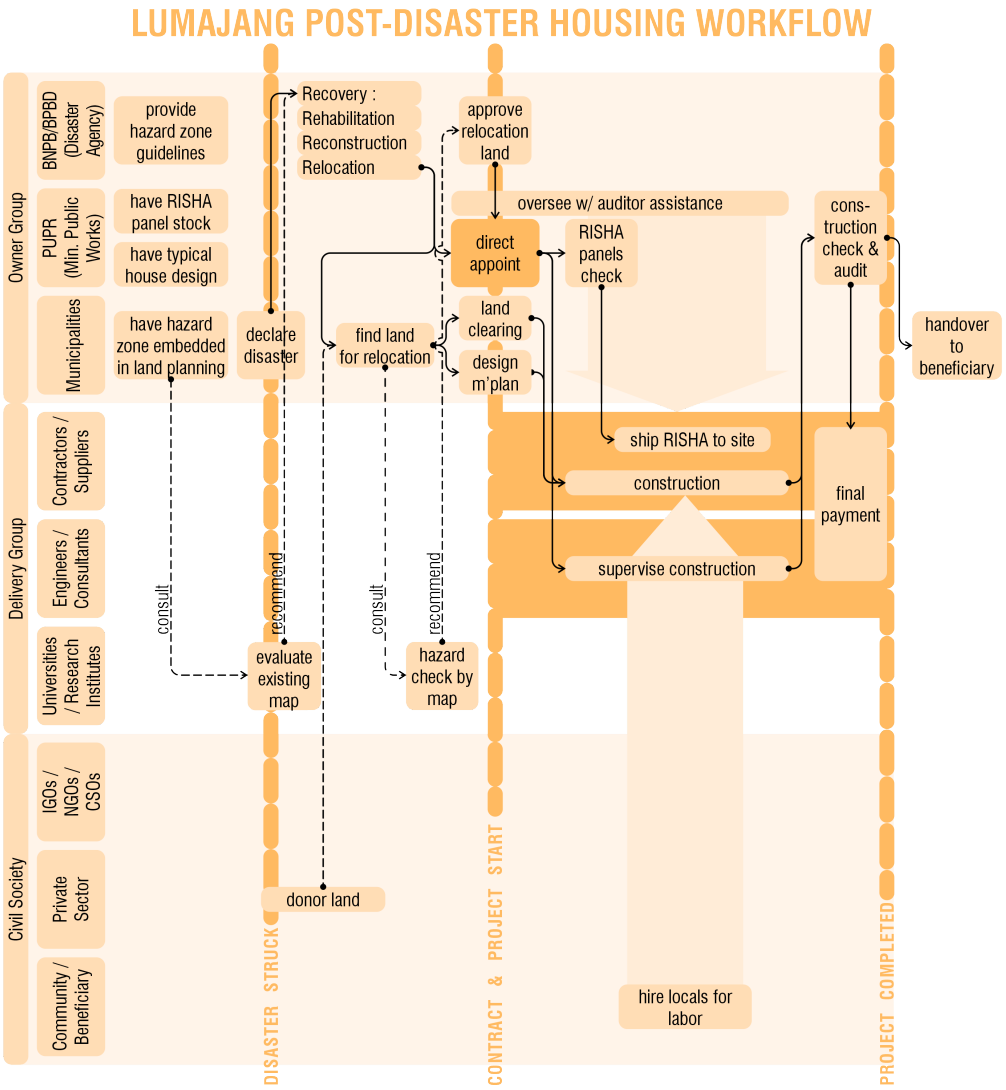

Figure 5.1.1: the workflow of the Lumajang Post-Eruption Housing projects

clauses were already "placed in law" and could be activated quickly, yet they were not fully anticipatory or automatic, as staff still needed top-down reassurance before acting. In other words, the project benefited from moderate-to-high regulatory preparedness. In Bang (2021)'s terminology, the project had already reached the "templates embedded in law" stage, giving teams permission to bypass ordinary tendering. This is already far better than relying on generic rules. However, it is still short of the "most-prepared" state where direct-appointment authority would trigger automatically with no hesitation, which described by Alexander et al. (2007) where emergency procurement pathways are automatic and universally understood. From the knowledge perspective, the availability of hazard maps that quickly evaluated right after the disaster reflect to what Oyao et al. (2015) and Seifi et al. (2019) highlight: experts and universities can contribute to the DRR by developing policies, in this case, available hazard map.

b) Relocation Land Availability

The second pressure-point in Lumajang was relocation-land availability. Time mattered at this point because every downstream activity had to wait until one parcel was both administratively and technically *"clean and clear"*. In practice, the search began only after the Semeru eruption. *"The Bupati also came down directly, and finally, the Bupati got the land"*, a project officer recalled, stressing the ad-hoc hunt that ended with a donated plantation plot. Local officials then rushed through the paperwork, *"the local government handled the administrative side to ensure the land*

was 'clear and clean'", while the technical team *"checked it from a technical perspective, like the topography and all sorts of things"*. a BNPB officer saw the vulnerability in this sequence, *"...to provide land clearing and land for the local government is a problem in itself..."*, warning that buying land before a disaster is often viewed as *"wasteful"*. They urged jurisdictions to keep a short-list ready so that *"when a disaster occurs, the scope of checking is narrower"*. Even the project team's own lesson-learned echoes that gap, *"It really goes back to the regional policy to have already prepared land for relocation far in advance... a stock of land"*.

Within the study's seven-aspect framework, relocation land availability relates closely to land planning and funding. Lumajang project, then, demonstrates the least-prepared end of that spectrum. While ideal readiness calls for a register of pre-vetted, hazard-safe sites embedded in the cadastre long before any eruption (Charoenkalunyuta et al., 2011; Unger, 2019), it happened exactly the opposite when the Lumajang team started from "zero land bank," scrambling after the event, although a project officer claimed that, "there had already been a plan to grant the land to the local government, since it was an old plantation, ... the disaster simply accelerated the implementation of that plan". The episode also touches the aspect of funding because no relocation land was budgeted ex-ante, the regency relied on a donated parcel, and any purchase would have triggered the same cash-flow crunch already flagged under self-finance contracts. In preparedness terms, both Land Planning and Funding were therefore low, creating a bottleneck that senior politics and private generosity happened to break open, but that cannot be guaranteed next time.

c) Emergency Procurement and Its Trade-Off

Responding to the Semeru-eruption housing crisis, the Ministry of Public Works activated the emergency-procurement clause that allows a direct appointment of contractors even before funds are appropriated. *"When we undertake disaster response, especially with a direct-appointment mechanism, there is definitely no budget available yet"*, Directorate of Special Housing officer said. Because the treasury line (BA-BUN) can only reimburse after all paperwork clears, the contractors had to self-finance the entire build, he added, *"it has to be self-financed. They construct first with their own capital, and after the construction is completed ... and there is an audit, only then are they paid"*. Throughout that process the state auditor was embedded as a gatekeeper. A second official explained that, even before BA-BUN money is released, he added more, *"the project file must be reviewed by BPKP. If the presidential directive is clear and BPKP signs off, payment can go ahead"*. In practice, the auditor's early and continuous presence reduces ex-post findings, yet every draft BoQ, variation order, or payment certificate must cycle through BPKP review. Project officer described the burden as, *"sometimes their cash flow is also limited, especially local contractors who don't have money, because you can't build if you don't have funds. Not everything can be done on credit"*.

The procurement sequence of Lumajang project therefore links most strongly to the industrial-resources and projects & programmes aspects. From the perspective of Industrial resources (Contractor premium), contractors carry 100% of up-front cost plus liquidity risk, so they price an implicit surcharge or selectively refuse work (Tammineedi, 2010). In Lumajang the risk was absorbed only because state-owned builders had deep balance sheets. This is why this area labeled as reactive or "less prepared": because risk-sharing was not pre-negotiated and the burden simply shifted to the market. From the perspective of projects & programmes, the owner used a traditional build-only contract, with no framework agreement or alliance was in place to streamline cashflow and governance (Mosey, 2019; D. H. T. Walker, 2015). Consequently, every payment milestone still required case-by-case audit sign-off, stretching the schedule. This is why this area mapped to left-of-centre: because traditional contract chosen as "the design was already there, you just have to use it". In both pillars the pressure point came from low ex-ante preparation: no standing risk-sharing mechanism with builders and no pre-authorised payment workflow within a collaborative contract.

d) Pre-Stock RISHA Material

Long before the Semeru eruption, the Directorate of Special Housing had already filled several

regional depots with modular RISHA panels. That decision proved decisive once Lumajang went on emergency footing. an officer from Directorate of Special Housing stated, *"Learning from the previous disaster, we saw that RISHA and RUSPIN really do speed up post-disaster housing… so every year since then stockpiling has been carried out, purely for preparedness"*. the project officer also added, *"For our RISHA components the Directorate normally has them ready. We just pulled stock from several provinces at that time"*. Because panels were on the shelf, the contractors could mobilise as soon as land cleared, without waiting for factories or tenders. In effect, a manufacturing lead time of months collapsed into a trucking lead time of days. It lowered the *"self-finance"* burden into a purely logistic capability, as the panels owned by ministry were free to use. However, a challenge appeared nearing the site, as recalled by project officer, *"the access for mobilising everything, both equipments and materials, was only one entry lane. That's what made us conduct traffic engineering"*. Moreover, the capacity of the logistics was deemed low, as illustrated by an officer from Directorate of Special Housing, *"RISHA panels are heavy, one container holds just three units, and shipping to remote sites are tough"*.

Relating to the preparedness, having pre-stock RISHA then shipping them to the site relates closely to Industrial Resources, especially technological mastery and logistics & supply-chain network. from the perspective of technological mastery, the usage of pre-stock RISHA was an effort in the mid-spectrum of the preparedness because RISHA is a codified, bolt-together system, where contractors only need to build standard typology. In this spectrum, technology standardised and there was desire for efficiency and waste reduction (Grest et al., 2020). Then in logistics & supply-chain network, stock lay in West Java and Surabaya were close enough for quick haulage. howver, the single-lane site road still caused ad-hoc traffic engineering. This made this area was mixed prepared: upstream supply was ready, but last-mile logistics remained reactive.

e) Construction Phase

While the construction phase was quick due to delivery in 100 days, several challenge persisted: the sudden need of massive number of skilled construction labor. This circumstance was revealed by project officer, *"Yes, in the beginning, there was a shortage [of skilled labour]"*. To tackle the issue, the solution was a deliberate mix of imported specialists and paid local residents, project officer put it, *"…we also empowered the community on how to assemble RISHA. So while they worked, they were also taught directly"*.

This sequence relates closely to the industrial resources, particularly labour & experts, and community involvement. from labour & experts perspective, local workers first needed on-site training to assemble the unfamiliar system. This made them less prepared, as skill surge was improvised, therefore placing this sub-aspect on the left side of the framework, inline with elaboration by Resende et al. (2023): labour and volunteer efforts are informal, untrained, and reactive. Then from community Involvement perspective, it was a low-to-moderate preparedness, as locals were invited as labour, which was an important social risk buffer, but only after design and siting decisions were locked in. The framework classifies this as "mobilised labour, not co-design", echoing arguments by Davidson et al. (2007) that genuine resilience requires community participation from project inception.

In conclusion, The Lumajang post-disaster housing project was driven by two well-prepared enablers and three under-prepared bottlenecks. Well prepared enablers include project initiation and pre-stock of RISHA components, while under prepared bottlenecks were relocation-land search & clearance, emergency procurement trade-off, construction-phase labour & last-mile logistics. Together they explain why procurement could start in days, yet the team still wrestled with ad-hoc decisions, cash-flow strain and mid-project improvisation.

What the case shows was that the project accelerated rapidly where templates, stock and data already existed. These areas are closely relate to Regulations, Knowledge, upstream Industrial resources, inline with the conclusion from the previous chapter. On the other hand, it dragged wherever assets, money or skills had to be created on the fly, which closely relate to land planning,

funding, labour/logistics in industrial resources, and community involvement. Additionally, while the collaboration type of the project successfully delivered the project quickly, it still cycled through bilateral paperwork rather than a multi-party risk-sharing board. Therefore, it still can be improved to exploit current preparedness enablers and reduce bottlenecks.

5.1.2 Central Sulawesi Post-Tsunami Housing

The post-disaster housing reconstruction in Central Sulawesi marked by challenges and crucial lessons. While the full workflow is complex, several key sequences of events, or pressure points, were pivotal in shaping the project's timeline, governance structure, and risk profile for all stakeholders involved. These sequences, detailed below and illustrated by fig 5.1.2, highlight the friction points and adaptive strategies that defined the five-and-a-half-year effort. Each pressure point is analyzed in relation to the preparedness framework to understand how the level of readiness in key areas contributed to the project's outcomes. A more detailed reconstruction of the entire project workflow, however, including all planning, procurement, construction, and delivery steps, is provided separately in Appendix .5.

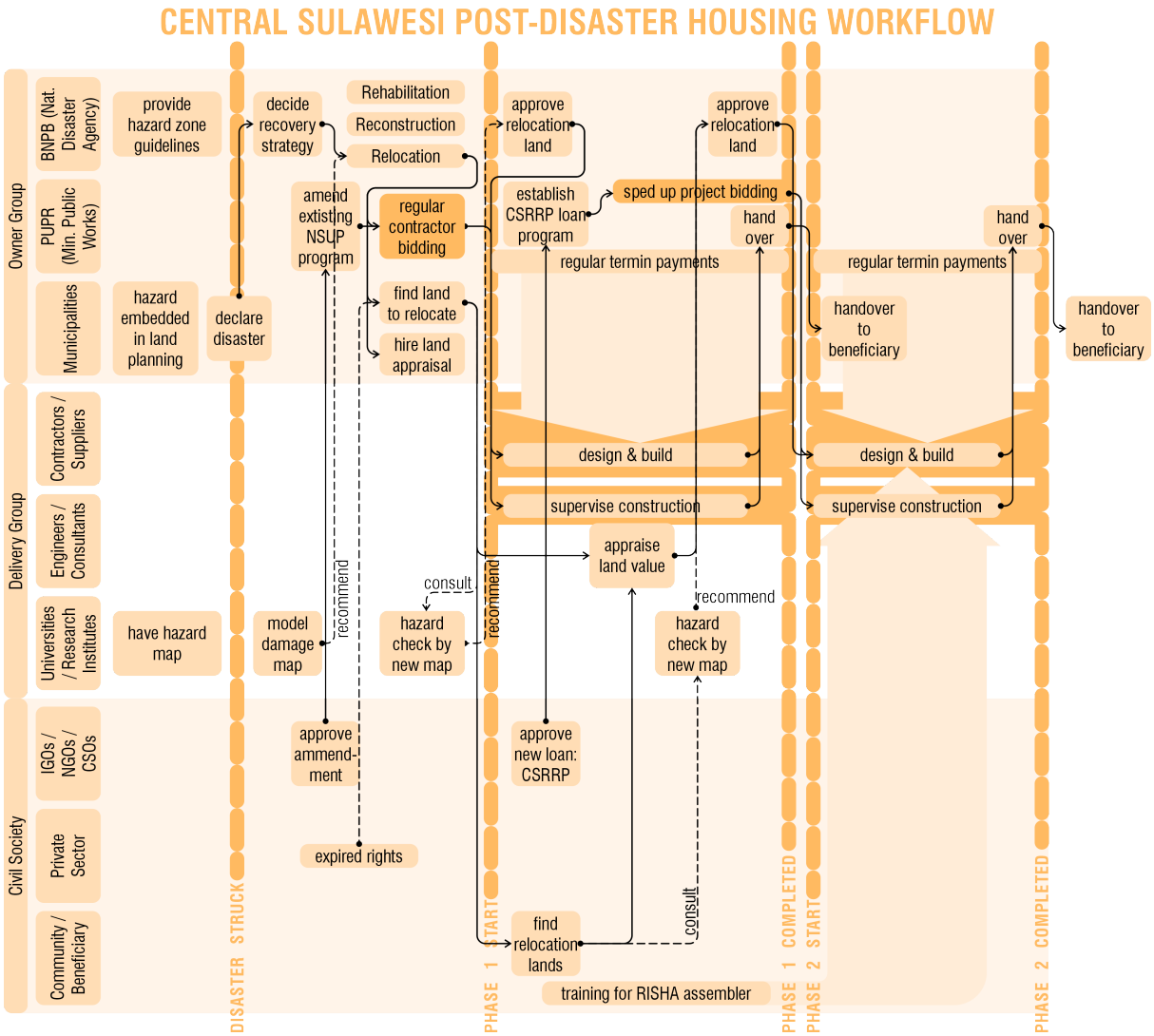

Figure 5.1.2: the workflow of the Central Sulawesi Post-Disaster Housing projects

a) Land Acquisition and Technical Vetting Deadlock
The process began with local governments attempting to secure land, but this was immediately

complicated by a lack of ready-to-use public land and insufficient funding at the municipal level. This created a cycle of rework in some land parcel, as the project officer explained, *"in some cases, the local government had already purchased the land, but after we checked, it turned out the area was categorized as a red zone, meaning unusable. After the disaster, we updated the disaster maps, but sometimes these weren't synchronized with the land acquisition process at the local government level. So in 2019–2020, we had to synchronize first, then proceed with land acquisition"*. This sequence reveals a major governance gap: local government who responsible for land procurement and BNPB/PUPR as verifier were not operating in lockstep. The result was wasted time, misallocated funds, and a significant delay before any construction could even be considered. This issue was acknowledge by project officer, stating *"the main challenge here initially was the land issue. That was the biggest obstacle. Why did it take so long in Central Sulawesi? The first problem was land. After the disaster in early 2019, land acquisition only succeeded in two locations... construction only started in 2020"*. This deadlock was a direct result of low preparedness across three interconnected aspects: Land Planning, Knowledge, and Funding. From land planning perspective, the project began with effectively no preparedness in land planning. The ideal state, as outlined by the framework, involves proactive measures like maintaining a register of pre-identified safe relocation sites and establishing a fit-for-purpose cadastre long before a disaster (Charoenkalunyuta et al., 2011; Unger, 2019). The reality in Palu was the opposite: the search for land was entirely reactive, initiated only after the disaster. From the perspective of knowledge, it revealed that the disconnect between land purchasing and hazard assessment highlights a critical knowledge gap between national and academics to local government. While national agencies and academics possessed advanced hazard data, this knowledge was not institutionalized in a way that guided local government actions. This failure to translate high-level knowledge into on-the-ground practice aligns with the "less prepared" state, where risk information exists but is not integrated into decision-making processes (Coppola, 2015). From funding perspective, the inability of municipalities to fund land acquisition underscores a lack of financial preparedness, as they relied on post-disaster funding streams which were slow and uncertain. This situation reflects the least prepared tier of the financial readiness framework, which depends on ad-hoc budget reallocations rather than ex-ante instruments like contingency funds or dedicated reserves (Ghesquiere & Mahul, 2010; Villacin, 2017).

b) Evolution of Procurement: From Regular Tenders to Harmonized Rules

Initially, the project relied on standard government procurement procedures, which slow for an emergency context. A project officer recalls this, *"actually, at the beginning we used regular procurement. That itself became a problem. For example, for Huntap work package 1A, we conducted a full tender, which took quite some time"*. This initial approach created unnecessary pressure for the project team, which then led to a pivotal shift in governance. The successful *"harmonization"* of procurement rules allowed the project to bypass regulations for more agile methods. It acknowledge by LKPP Representative, *"for procurements funded by loans or grants, our regulations do allow room to follow the rules of the loan or grant provider"*. However, the accelerated procurement could potentially possessed conflicting principle, as it limiting competition, leading to legal issue. A project officer explained, *"We requested to increase the RfQ (Request for Quotation) threshold from IDR 2.5 billion to IDR 70 billion. After their approval, we could package many RfQ tenders that fit the project's urgency... That's why the prosecutor's office eventually got involved. It was seen as a market limitation"*.

The pivot in procurement strategy between phase 1 and phase 2 in Central Sulawesi projects reflects a journey from low to moderate preparedness in the aspects of Regulations and Projects & Programmes. From regulations perspective, the initial reliance on standard procurement rules, which caused year-long delays, indicates a low level of regulatory preparedness. The system lacked an anticipatory legal framework with pre-authorized emergency procedures. The shift to harmonized rules was a reactive adaptation, not the execution of a pre-planned strategy. While effective, this mid-crisis negotiation falls short of the ideal "anticipatory adaptive" system where emergency triggers are embedded in law to automatically activate streamlined processes (Alexander et al., 2007). Additionally, from projects & programmes

perspective, the use of a traditional, non-integrated tender process for the first packages demonstrates a lack of preparedness in programme governance. The framework for collaboration models shows that such rigid approaches are ill-suited for the uncertainty of post-disaster contexts (Mosey, 2019). The eventual move to a faster, but still reactive, RfQ process was an improvement. However, it was not as proactive and flexible as other collaboration types like Framework Agreement or Project Alliance which characterizes a highly prepared state. The project manager's reflection that pre-agreed contracts could have saved "more than 50%" of the time reflected this gap.

c) Funding Mechanisms

The project's funding was not secured through a single and straightforward mechanism. The initial phase was financed by amending an existing World Bank loan for slum upgrading program. This condition explained by project officer, *"In 2019, there was an addendum to the existing loan contract for the NSUP (National Slum Upgrading Program)... that loan was amended into NSUP Search, covering emergency response for Central Sulawesi... We used that from 2019 to 2020"*. This ad-hoc start highlights the lack of a ready-to-deploy financial instrument for large-scale reconstruction. The project's full-scale continuation establishing by dedicated loan program (CSRRP). This two-stage funding process created distinct project phases, each with its own rules and complexities. The reliance on foreign loans also introduced stringent documentation requirements, such as the Land Acquisition and Resettlement Action Plan (LARAP), which further influenced the project timeline, as explained by project officer, *"The World Bank requires that physical construction or tendering can only proceed once the land is fully clean and clear. So we prepared the LARAP document... which is more complex than conventional processes"*.

This sequence is a clear illustration of low preparedness in the Funding aspect. The entire financial strategy was reactive and ex-post. The need to amend an unrelated loan and then negotiate a new one demonstrates the absence of a pre-arranged financial strategy. This approach aligns perfectly with the "Reactive / ex-post" category in the financial preparedness framework, which relies on slow and uncertain mechanisms like post-disaster borrowing (Ghesquiere & Mahul, 2010; Villacin, 2017). A prepared system would have ex-ante instruments like contingent credit lines or national disaster reserve funds ready for immediate disbursement to avoid delays and administrative burdens in the midst of a crisis.

d) Clash Between Technology and Local Reality

RISHA (a prefabricated housing system) technology was chosen to accelerate construction. However, its effectiveness was hampered by a lack of local capacity and unexpected supply chain disruptions. Project officer recalled it, *"many communities resisted bringing in external workers. In many locations, residents refused to allow outsiders to work. So we were forced to use local labor, which slowed things down"*. This situation forced them to improvise by train them mid-project. Furthermore, the national construction boom, particularly the development of the new capital city (IKN), created a nationwide shortage of materials and labor, directly impacting the Palu project. Project officer explained that as, *"The most challenging parts during construction were material and manpower... Even materials were being sourced from here (Central Sulawesi) for IKN, which drove up local prices and created supply issues"*.

This clash indicated low preparedness in Industrial Resources and Community Involvement. From industrial resources perspective, the project suffered from a lack of readiness in two key subsectors. First, the shortage of skilled local workers for RISHA assembly indicates a low maturity in the Labour & Experts continuum, where a trained and ready workforce is not available (Resende et al., 2023). The mid-project training was a reactive solution to this gap. Second, the material shortages caused by the national construction boom reveal a supply chain that was not resilient or prepared for demand shocks, placing it at the lower end of the "Logistics & Supply Chain Network" maturity model (Grest et al., 2020). Then, from community involvement perspective, the resistance to external workers and skepticism toward new technology were symptoms of a lack of early community engagement. A prepared approach, as defined by the framework, involves co-designing recovery solutions with the

community to build trust and ensure buy-in (Davidson et al., 2007; Katoh & Misumi, 2024). By not involving the community in the decision-making process for labor and technology, the project encountered friction that could have been mitigated through proactive, participatory planning.

To conclude, the Central Sulawesi post-tsunami housing programme pivoted on a small set of decisive sequences. One sequence ultimately benefited from a rising level of preparedness, while three others remained bottlenecks. One sequence that accelerated was the procurement sequences, which went from regular tenders to a harmonised emergency rule-set. The remaining three sequences were dragging the overall project. They are Land-acquisition & technical-vetting deadlock, funding mechanisms through fragmented grants / loans & late addenda, and clash between RISHA technology and local reality. Together they explain why the project's headline targets were eventually met but only after several pauses, work-arounds and scope trims.

The case shows that less preparedness would eventually fruit into dragging construction phase. Sequences like ad-hoc land acquisition, ex-post funding, and untrained labor, and community rejection happened with close relation to low preparedness in knowledge, land planning, funding, industrial resources, and community involvement. On the other hand, effort to accelerate the project through changing procurement method happened with close relation to regulations and projects & programmes.

5.2 Current Practices Review and Proposed Strategy

The analysis of the Lumajang and Central Sulawesi projects reveal four clusters of sequences that consistently define project speed: fast-track procurement and pre-stocked industrial inputs as accelerators, while the lack of a ready land bank and ex-ante funding instruments as primary drags. The proposed strategy is designed to institutionalize the accelerators and address the procurement-related bottlenecks. It focuses on elements within the direct control of the project's implementing stakeholders, in this case the Ministry of Public Works and Housing and its contractors and consultants. Therefore, the systemic challenges of land acquisition and high-level funding mechanisms, which fall outside this scope, are acknowledged as critical but separate issues to be addressed at a broader governmental level. Accordingly, this section proposes a strategy shift from a reactive, single-project paradigm to a proactive, programmatic approach built on a Framework Agreement. This model reframes post-disaster reconstruction to preparedness building. To maintain a practical focus, this and the following section discuss only the basic framework agreement, outlining its improved workflow and requirements. More complex arrangements like framework alliances, which outlined as more collaborative by the framework, can be developed upon this foundational design in the future.

The proposed strategy operates at the strategic level, reframing post-disaster reconstruction from a reactive, single project view into a continuous and manageable program. The core of this strategy is the Framework Agreement, which establishes a long-term, relational partnership with a panel of expert firms before a disaster struck. This proactive stance is made possible by the flexibility nature of a Framework Agreement, which contrasts with the strict nature of traditional procurement that can only be initiated after a disaster. Unlike a rigid, single-project contract requiring all details to be known upfront, a framework is designed for situations where the details can be defined later (Albano & Nicholas, 2016). It allows critical clauses such as the precise location, the volume of houses, and the exact project start time to be defined only when they are needed after a disaster strikes, all within a pre-agreed master contract. This flexibility is what allows the public entity to be fully prepared for an uncertain event. This partnership model is then designed to overcome the further limitations observed in the case studies by systematically building industrial and community capacity.

Moreover, preparedness tasks can also be integrated into the partnership like management of materials

Table 5.1: Comparison of current practices and the proposed strategy

Points	Lumajang	Central Sulawesi	Proposed
STRATEGIC APPROACH			
Project View	Single Project	Single Project	Multiple Projects
Paradigm	Reactive	Reactive	Proactive
Form of Collaboration	Transactional (Building Contract)	Transactional (Building Contract)	Relational Partnership (Framework Agreement)
Collaboration Flexibility	Rigid	Rigid	Flexible
TACTICAL APPROACH			
Procurement Time	After Disaster	After Disaster	Before Disaster
Governing Regulation	Emergency	Regular	Regular
Procurement Method	Direct Appointment	Open Procedure	Open Procedure
Project Delivery Method	DBB (Design-Bid-Build)	DBB (Design-Bid-Build)	to be determined per project, preferably Integrated DB

and community capacity building. A key component of this partnership is the proactive management of critical materials. The Lumajang case proved that pre-stocking prefabricated RISHA panels was a ”decisive” accelerator that ”collapsed a manufacturing lead time of months into a trucking lead time of days”. The proposed strategy would formalize this by contractually requiring framework partners to maintain a rolling stock of these components, avoiding the supply shortages and price spikes that hampered the Central Sulawesi reconstruction. Another key component of the partnership is the integration of capacity building. Instead of relying on improvised, on-site training for skilled labor after construction has already begun, the framework makes this a programmed activity. Partners can be contractually required to train local communities during the post-disaster, pre-reconstruction phase, building a skilled workforce before the main build and moving beyond the ”mobilised labour, not co-design” model observed in the Lumajang project.

This strategic shift enables a more flexible and controlled set of execution tactics. Current procedures are options between Open Procedures and Direct Appointments under emergency rules. In Central Sulawesi, Open Procedures were too slow, while in Lumajang, emergency rules exposed contractors to high risk, including full pre-financing and complex audits before payment. The proposed use of a Framework Agreement resolves this tension. It secures a partner panel through regular Open Procedures, allowing fast response without leaving standard regulations. The pre-agreed terms reduce financial risks for contractors and replace reactive audits with a streamlined payment system. It also offers tactical freedom to select the most suitable Project Delivery Method, such as Integrated Design-Build to ensure efficient execution in every project.

5.3 Procurement Strategy Design

The proposed workflow begins with shared initial steps that apply to both in-situ rehabilitation and reconstruction as well as relocation scenarios. Regardless of the recovery strategy chosen later, the process starts with a structured preparedness phase during normal conditions, followed by a standardized call-off procedure once a disaster is declared. These steps are designed to address key weaknesses in current practices, especially regarding contractor readiness, material availability, audit exposure, and procurement speed.

The workflow starts with a Framework Agreement established through a regular, open, and competitive tender that appoints a panel of contractors and construction-management firms for three years. Unlike current practices where each post-disaster project begins with a new emergency contract or direct appointment after the disaster, this tender is conducted under normal conditions.

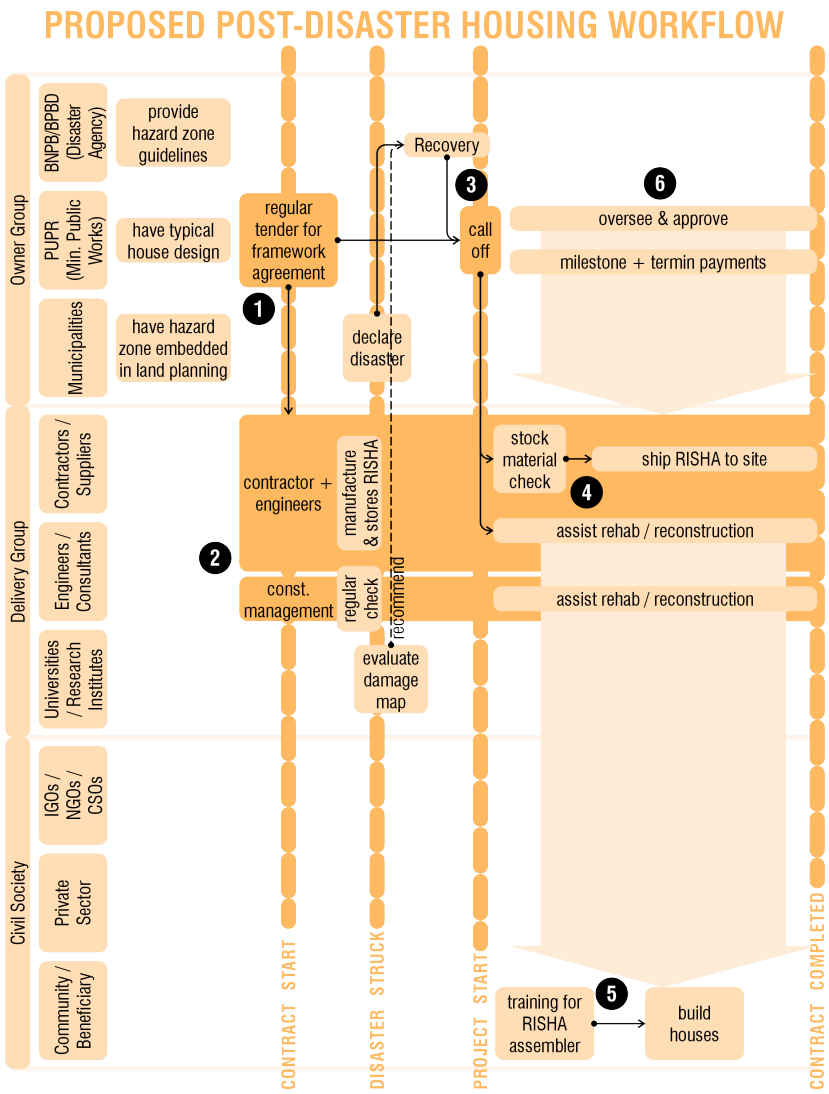

Figure 5.3.1: the proposed workflow of post-disaster Housing project in Indonesia using framework agreement

This allows the procurement committee to focus on process quality without the pressure of emergency conditions. The three-year contract period reflects current strategic programs, such as those regulated by Peraturan LKPP 8/2021, though this duration may be refined through future studies. To ensure collaborative and efficient project delivery, it is preferred that the reconstruction projects are delivered by integrated design and build, although details of each project can be determined later. To accommodate that, contractors are required to include engineers and designers who will act as planners within their teams. These teams may be formed by individual companies, joint operations, or consortiums, to allow the decision on risk-sharing fully calculated by market actors. This sequence is presented as number 1 in the workflow chart in figure 5.3.1.

Once appointed, contractors and construction-management firms begin preparedness tasks. Contractors manufacture and stock RISHA panels in approved warehouses, while construction-management firms conduct scheduled quality checks and submit digital stock reports. Both tasks are covered within the framework agreement, providing incentives for early efforts. This setup improves on current practices, where contractors self-finance early works and add premiums to mitigate risks of late payments and audit exposure. Moreover, the current approach fragments responsibilities by making RISHA panel availability the client's obligation. By integrating production and storage within the contractors' scope, the workflow reduces risks for both client and partner,

while enhancing efficiency by aligning these continuous tasks. This sequence is the number 2 of the chart in figure 5.3.1.

When a disaster occurs, the municipality declares the emergency, followed by the Directorate of Special Housing issuing an immediate call-off within the existing framework agreement. A mini-competition among the prequalified contractors quickly confirms price and schedule, typically within days. The winning contractor then signs a project contract with the regional project manager and can immediately access the stocked RISHA panels. This sequence eliminates the need to draft new contracts, negotiate prices, and verify contractor capacity after each disaster, which often delays housing delivery under current practices. Furthermore, audit risks are reduced, as the direct appointment is executed within a predefined framework, with documentation completed upfront rather than retrospectively. The application of open procedure in the beginning also remove the heavy audit involvement experienced in Lumajang. This is sequence number 3 in the workflow chart in figure 5.3.1.

After these initial stages, the Disaster Agency selects one of three recovery strategies: rehabilitation, reconstruction, or relocation. Rehabilitation addresses minor to moderate damage, focusing on building repairs, while reconstruction is intended for houses that need to be rebuilt. Both strategies are executed in-situ, meaning work is done on the original site. Relocation, on the other hand, is a specific form of reconstruction where the site changes, moving communities to new locations due to safety or other considerations. These strategies define the two main operational scenarios: in-situ rehabilitation or reconstruction, and relocation. Because of different nature in the construction location, there will be several differences in technical level of reconstruction, as outlined in table 5.2.

Table 5.2: Differences of reconstruction scenarios

	In-situ Rehabilitation & Reconstruction	**Relocation**
Reconstruction start	after beneficiary list issued	after relocation land approved
Contractor responsibility	- community technical assistance - material provision	- community training - full constructing service
Construction management responsibility	technical assistance (if called-off)	supervise construction
Community involvement	as self constructor	hired as labor

The two scenarios, while originating from the same framework, diverge significantly in their project triggers, stakeholder roles, and construction models. The first key difference is the project start trigger. For in-situ rehabilitation and reconstruction, work can begin as soon as the disaster agency issues a definitive list of beneficiaries, which confirms which existing properties are eligible for the program. In contrast, the relocation scenario has a longer preliminary phase, as construction can only commence after a suitable and legally approved parcel of land is secured. These different triggers lead to distinct operational models. The in-situ scenario functions as an assisted self-build program where the community leads as the ”self-constructor”. Here, the contractor’s role is primarily supportive, focusing on material provision and technical assistance to empower homeowners. Conversely, the relocation scenario uses a contractor-driven model. The contractor provides a full constructing service, while community members participate as hired labor. Consequently, the role of the construction management firm adapts to each case: providing targeted technical assistance if needed in the in-situ model, and performing full construction supervision in the relocation model. This sequence is presented as number 4 and 5 in the workflow chart in figure 5.3.1. Despite these operational differences, a crucial similarity lies in their financial governance. Both scenarios utilize the same project management approach where payments are tied to the completion of pre-defined project milestones, ensuring consistent oversight regardless of the construction method, as presented as number 6 in the workflow chart in figure 5.3.1..

5.4 Answering Sub-Research Question 3: Framework Agreements as Strategy for Preparedness

This chapter sought to answer the research question: *"What procurement strategy design is suitable to improve the current state of preparedness in post-disaster projects?"*. The analysis of current practices in the Lumajang and Central Sulawesi reconstruction projects revealed a consistent pattern: projects were accelerated by pre-existing enablers like fast-track procurement rules and pre-stocked materials, but were consistently dragged by systemic bottlenecks, including reactive land acquisition, ad-hoc funding mechanisms, and a high-risk audit interface.

Based on these findings, the most suitable procurement strategy is one that institutionalizes the accelerators and systematically addresses the core, procurement-related bottlenecks. This is achieved by shifting from a reactive, single-project paradigm to a proactive, portfolio-based approach centered on a Framework Agreement that is competitively tendered in advance of any disaster. This design mainly aimed to improve the current state of preparedness in the scope of reconstruction projects both in strategic and tactical levels. In strategic level, it reframes post-disaster reconstruction as a continuous, manageable program built on a long-term, relational partnership with expert firms. In tactical level, the Framework Agreement resolves the critical dilemma between slow but compliant regular tenders and fast but high-risk emergency appointments. However, it is important to acknowledge that broader systemic challenges, such as national land banking and the establishment of ex-ante funding instruments, remain critical external factors that require a separate, broader government response, therefore had not addressed yet in project arrangement.

Chapter 6 Feedbacks & Evaluation

This chapter presents the evaluation and reflection phase of the study, following the Design-Based Research (DBR) approach proposed by McKenney and Reeves (2019). It aims to answer Sub-Research Question 4, *"How can the proposed procurement arrangement for urgent projects be evaluated and refined for practical implementation?"* Building on the procurement strategy developed in Chapter 5, this chapter explores how the design performs when consulted with relevant stakeholders. As outlined in Chapter 3, these stakeholders include government officials, practitioners, and experts involved in post-disaster housing projects. Their feedback provides insights into the strengths, weaknesses, and potential obstacles of the proposed design. The feedback gathered in this phase serves as the basis for evaluating the practicality of the strategy and identifying areas for refinement. It helps assess whether the design is feasible to implement under real-world constraints, or whether further modifications are needed. As DBR is an iterative process, the findings in this chapter may inform future cycles of improvement, moving the proposed procurement strategy closer to practical readiness and policy application.

6.1 Feedbacks

Stakeholders generally appreciated the proposed procurement strategy and expressed strong support for its core design. Feedback from implementing officials, technical directorates, the national disaster agency, and the procurement authority affirmed the practical value of using a framework agreement to enhance post-disaster preparedness, its potential to reduce delays, simplify project management, and improve risk handling. Alongside this support, they also provided constructive feedback that directly affects the proposed workflow and highlights areas for future refinement.

Firstly, community engagement should consider the ethics of post-disaster training. While the proposal included a formal training program for RISHA assembly to empower local residents, the Project Officer for the Lumajang project cautioned that this could be counterproductive if implemented too soon after disaster. He highlighted the ethical sensitivities of engaging a community still processing trauma, stating, *"It's plausible... But realistically, in a disaster situation, especially in the first week or even the first month, the community's trauma is still present... To follow up within a week by immediately educating the community about work... I think that would be very difficult... It's not ethical either"*. He suggested a more effective approach is to wait for the community to show readiness, noting, *"Once their trauma starts to subside... they will need to work again, they will need money again. They will be interested on their own"*. On the other hand, the Palu Project Officer confirmed that structured training was effective, stating, *"So we trained the community to be able to do RISHA construction, then they received certification, and then they could work for the contractor"*. These feedback provides a tension between the need of the training and the ethics to do it. Literature on community-based recovery provides view, emphasizing that community empowerment must respect the pace of the affected population (Davidson et al., 2007) while a fixed training schedule might treat community members as a labor source rather than as recovery partners, which goes against the idea of active community planning (Katoh & Misumi, 2024).

Secondly, there is a need for post-disaster site verification for in-situ reconstruction. According to BNPB officer, while the proposed workflow accelerates material deployment, the representative warned that land safety cannot be assumed, even on existing plots, due to secondary disaster impacts. As he explained, *"The uniqueness of disasters in Indonesia is that there are often many secondary disasters... For example, in an earthquake... it turns out there are ground cracks... As a result, even though it's the same post-earthquake location, this plot of land cannot be built on, while another plot might still be buildable"*. This feedback underscores a crucial detail within the Land Planning aspect. While the focus is often on securing new land for relocation, the safety and viability of existing plots for in-situ reconstruction

is equally vital, as disasters can fundamentally alter local geography and geology (Unger, 2019). This highlights that risk assessment must be a continuous, adaptive process. Consequently, the in-situ reconstruction workflow must be updated to include an explicit Beneficiary Eligibility and Site Safety Verification step.

Thirdly, there is plan for centralized disaster pooling fund. This policy can potentially further improve preparedness. A BNPB officer noted that such a fund would likely operate differently from the standard state budget (APBN), suggesting it could finance innovative approaches that the APBN cannot cover. She clarified the likely structure, stating, *"What I've gathered about the pooling fund and financing scheme is that it's more in the form of insurance, not savings... When you pay the premium annually... if there's no disaster, you can't claim it; that money is gone"*. This feedback directly impacts the Funding and Regulations aspects. A centralized, ex-ante instrument like a pooling fund aligns perfectly with the "more prepared" end of the funding framework, which advocates for risk-transfer mechanisms to provide immediate liquidity and avoid the slow post-disaster financing (Ghesquiere & Mahul, 2010; Villacin, 2017). Its successful implementation would require significant regulatory development to create an "anticipatory adaptive" system where emergency procedures are pre-authorized (Alexander et al., 2007).

Challenge also persist, as multi-stakeholder collaboration is not addressed in the proposed procurement strategy. The Directorate of Special Housing officer emphasized that the proposed workflow is highly effective for projects managed by a single entity but faces significant challenges in multi-stakeholder environments. He noted that, *"very tough challenge... to synchronize the timeline of one directorate general with another"*. It happened because different agencies have competing priorities. Another question raised was, *"how to unify the different interests of each party, considering they have different leaders and different agendas?"*. The proposed workflow cannot address this issue yet, as it uses a Framework Agreement between single project client with several contractors, not multiple stakeholders. This collaboration is already more flexible than traditional contracts but still employs less stakeholders than a full Project Alliance (Albano & Nicholas, 2016; Mosey, 2019).

Finally, one barrier to implement the proposed strategy is the lack of a standard guideline. The representative from the Public Procurement Authority (LKPP) confirmed that a framework agreement for construction is legally possible but noted that a standard template does not yet exist, placing the responsibility for development on the implementing agency. He stated, *"Regarding the model itself, a model for a volume-based contract has not yet been created. To meet the needs on the ground, the existing standard contract can be adjusted to create a new one"*. This is a key implementation detail for the Regulations aspect. While the legal pathway exists through an "innovation clause", the lack of a standardized template from LKPP creates a practical issue. The proposed strategy must therefore has prerequisite: the Ministry of Public Works and Housing (PUPR) must develop a bespoke framework agreement template.

In conclusion, while the proposed strategy received strong support in principle, several critical details must be addressed to ensure its effectiveness in real-world application. Refinements from ethical, technical, financial, institutional, and legal perspective could form the next steps of the framework agreement model implementation.

6.2 Evaluation

This section evaluates the state of preparedness under the proposed procurement strategy by applying the framework introduced in Chapter 4. The goal is to measure if the proposed solution have gained improvement against the baseline. In addition to the comparation, this analysis also integrates feedback from relevant stakeholders to add contextual notes and practical considerations. The improvement of the preparedness are briefly presented to figure 6.2.1. The biggest expected improvement are gain in two direct aspect: industrial resources and projects & programmes, while

other aspects are expected to gain slightly or none. In broader context, it benefits both for the client and the partners.

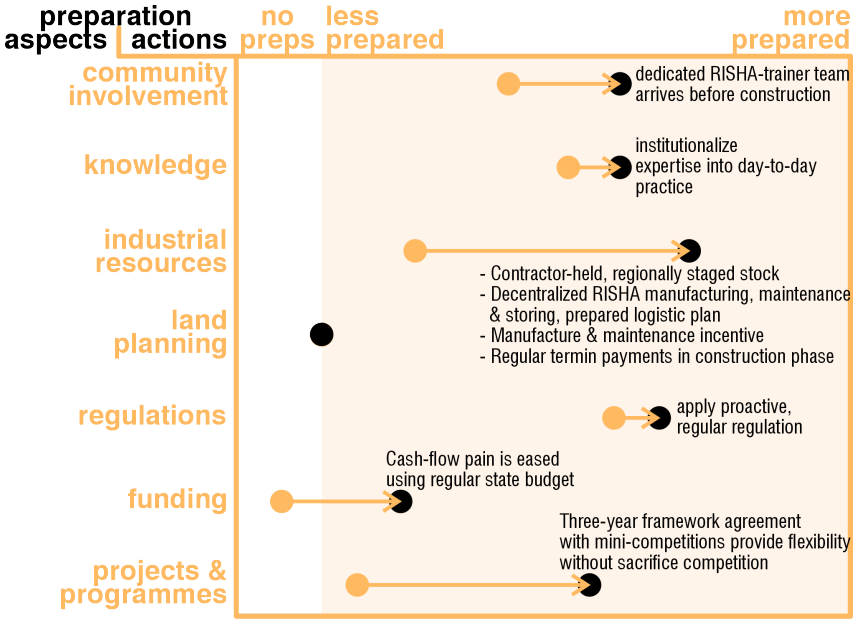

Figure 6.2.1: impact of the proposed procurement strategy to the preparedness

From the perspective of resonstruction projects, the proposed procurement strategy improves Industrial Resources aspect with the biggest gain, from less-prepared to more-prepared, compared to the baseline. In the baseline, while both the studied case demonstrated less-prepared states, their approaches to industrial resources were contrast. Lumajang case enjoyed a ministry-owned RISHA stock nearby but relied on improvised trucking and contractor self-finance model while Central Sulawesi case conducted without panel stock, unprepared labor, and dragging bureaucracy. Both cases reflect limited pre-positioning and ad-hoc logistics denote a less-prepared state (Resende et al., 2023). The proposed procurement strategy improve this aspect by requiring contractor to manufacture and store RISHA panels in decentralized depots, provide logistics plan and engineers as construction assistants while construction-management firm conducts scheduled panels inspections. Additionally, regular milestone and termin payments are applied to replace the self-finance model. These measures shift preparedness from a reactively mobilized stock to a proactive system of distributed workload from time and location perspective, corresponding to the more-prepared stage of the framework where supply chains are integrated and resilient (Grest et al., 2020). Statement from Director of Special Housing officer who explained that the provision of the RISHA panel has been implemented indicates that this institution is ready for the system.

The second improved aspect compared to the baseline is Projects & Programmes. On the baseline side, both cases were less-prepared because of reactive contracting methods. The Lumajang project used a traditional Design-Bid-Build where the ministry provided the design coupled with a build-only contract, which reflects a siloed work culture. Central Sulawesi eventually used an integrated design-and-build in an integrated contract, but its initial regular procurement consumed nearly a year. The proposed strategy improves current approach by pairing an integrated design-and-build PDM inside a Framework Agreement collaboration that competitively tendered in a regular basis before a disaster to allow for rapid call-offs once an emergency is declared. This shifts preparedness to the more flexible and collaborative side of the framework, as Framework Agreements are specifically designed to manage the uncertainty inherent in urgent projects (Mosey, 2019). The legal feasibility of this is supported by an LKPP representative, who confirmed that Indonesian regulations now permit framework contracts for construction. By pre-establishing terms and responsibilities, the model reduces the adversarial dynamics and operational hesitation seen in the baseline cases, fostering a

more trust-based partnership (Albano & Nicholas, 2016). A Central Sulawesi project officer gave a feedback by estimating that such a pre-arranged contract could have saved ”more than 50%” of the project's preparation time. It is worth to note, however, that the proposed strategy has not yet reached the fully multi-party alliance stage that collaborative, flexible, and integrated, as explained both by Mosey (2019) and D. H. T. Walker (2015), that envisioned as “most prepared”.

Next to measured improvements, feedbacks from stakeholders reveal several critical refinements, future opportunities, and potential barriers for the proposed procurement strategy that can be inputs for future iterations. regarding community involvement, Lumajang project officer advised that formal pre-construction training could be insensitive to a grieving community, suggesting the current practice of allowing residents to voluntarily seek employment is more ethical and effective. Another feedback to the workflow comes from BNPB officer who warned that for in-situ reconstruction, secondary disaster might impact existing land, necessitate a final safety check. A list of beneficiary eligibility from BNPB can be issued before materials are delivered to individual plots. Looking forward, the planned national pooling fund for disasters presents a major opportunity to create a more integrated recovery efforts, improving preparedness from both funding and regulatory perspectives. On the other hand, Directorate of Special Housing officer questioned the effectiveness of proposed strategy in multiple government bodies collaboration scenario, limiting the use-case of the design. Finally, a representative from the public procurement authority (LKPP) highlighted a key implementation barrier: while framework agreements are permissible, detailed regulations do not yet exist. This requires the implementing ministry to develop its own technical guidelines, a process that demands considerable institutional effort and willingness.

In conclusion, significant improvements are expected to apply to two aspects: industrial resources and projects & programmes. Other aspects are impacted minor by the proposed strategy with land planning impacted none. Next to that, feedbacks from stakeholders also reveal several critical refinements, future opportunities, and potential barriers for the proposed procurement strategy. Overall, while the proposed strategy shows improvement in preparation, it represents only the first iteration and still has room for further development.

Table 6.1: Benefit Comparison between Current Practices and Proposed Procurement Strategy

	Lumajang	Central Sulawesi	Proposed	Benefit
panels manufacturing volume	small batch	small batch	large batches	- economic of scale - lower cost
risk of wasted panels	in single project	in single project	in multiple projects / portfolio	less risk of waste
panels' role in construction phase	De-coupled, panels manufacturing are outside project timeline	Coupled, any delay in the factory directly delays the on-site work	De-coupled, panels manufacturing are outside project timeline	guaranteed availability
panels owner	client	contractor	contractor	Efficient mutual risk management
project administration vs execution	coupled, procurement then execute	coupled, procurement then execute	de-coupled, administration is separated than execution	efficient administration

From the broader perspective, the application of Framework Agreement creates a strategic, long-term partnership that offers significant mutual benefits by shifting the perspective from a single project to a whole portfolio view, as presented in table 6.1. As a purchasing arrangement, it is designed to de-couple the thick, upfront project administration from the execution of individual projects, significantly improving procedural efficiency by reducing the high transaction costs and time associated with repetitive procurement. This allows partners to move from inefficient, small-batch manufacturing for single projects to large-batch production for the entire portfolio, yielding significant economies of scale and lower costs. This portfolio approach also introduces a more sophisticated model for

managing critical materials. By having the contractor own the panel stock, the financial burden and logistical risks of managing inventory are transferred from the public entity, reflecting a deeper collaborative partnership. This simultaneously mitigates the risk of wasted panels common in single projects, as any surplus from one build can be allocated to the next in the series. Crucially, this strategy de-couples the panel manufacturing timeline from the on-site construction phase, ensuring a guaranteed availability of critical components and preventing factory delays from impacting site work. This ”win-win” dynamic is made possible because the agreement provides partners with the certainty of future orders, which lowers their commercial risk and allows for appropriate investment, ultimately resulting in better value for the client (Albano & Nicholas, 2016).

6.3 Answering Sub-Research Question 4: Improved Preparedness with Foreseen Barriers

Answering the sub-research question 4, *”How can the proposed procurement arrangement for urgent projects be evaluated and refined for practical implementation?”*, the proposed procurement arrangement demonstrates measurable improvement in preparedness, especially in two key aspects: industrial resources and projects & programmes.

Industrial resources benefit from a shift toward a proactive system, supported by decentralized RISHA panel depots, scheduled inspections, trained construction assistants, and milestone-based payments that replace the burdensome self-finance model. On the other hand, projects and programmes show progress through the use of integrated design-and-build contracts with additional scope of manufacturing and storing prefab panels that nested within framework agreements. Fundamentally, this framework-based approach delivers tangible benefits by de-coupling critical processes: it separates the thick upfront administration layer from project execution to improve efficiency, and separates material manufacturing from the on-site construction timeline to guarantee availability and yield economies of scale. These upgrades move both key aspects to the more-prepared side of the framework. Other aspects also improve slightly while land planning remains unchanged.

Feedback from stakeholders directly informs refinements in community involvement and land. Despite these improvements, barriers remain. The strategy is limited to the mandate of a single client entity and does not yet address the complexities of multi-agency coordination. Moreover, while the legal basis for framework agreements exists, the absence of detailed regulations requires the ministry to develop its own technical guidelines, posing a significant implementation challenge. In summary, the proposed procurement strategy improves the state of preparedness, but it remains limited by regulatory and inter-agency barriers, and has not yet reached the fully more prepared state.

Chapter 7 Conclusion and Discussion

7.1 Conclusion

This research set out to answer the main research question, *"How can procurement strategy improve the current state of preparedness to accelerate Post-Disaster Housing Delivery in Indonesia?"* The study followed an iterative process grounded in the Design-Based Research (DBR) methodology refering to McKenney and Reeves (2019). It began by identifying the key aspects of disaster preparedness through literature review and framework analysis. A case study of post-disaster housing projects was then examined to assess which preparedness aspects were lacking or underperforming. These gaps served as the basis for reconstructing existing workflows, which helped confirm sequences that were either bottlenecks or worth retaining. The proposed procurement strategy was then developed specifically to address these issues. This strategy was further refined through stakeholder consultation and evaluated against a preparedness framework. The findings of this process now provide the foundation for answering the main research question. The following subsections outline each step in this process, culminating in the conclusion as well as answering the main research question.

7.1.1 Answering sub-Research Question 1-4

This subsection answers the four sub-research questions that guide this study. It begins by defining the key aspects of preparedness for post-disaster projects, followed by an assessment of their current state in recent urgent projects, the proposed procurement strategy to address existing gaps, and the evaluation of this strategy for practical implementation.

The first sub-research question, *"What aspects define disaster preparedness for post-disaster projects, and how can the level of preparedness within them be assessed?"*, is answered by synthesizing a preparedness framework from existing literature. The framework identifies seven critical aspects: community involvement, knowledge, industrial resources, land planning, regulations, funding, and projects and programmes. Each aspect is mapped on a continuum from no preparation, which reflects reactive and fragmented actions, to full readiness, which reflects proactive, integrated, and adaptive systems. Full preparedness is achieved when all seven aspects align to create a resilient ecosystem capable of responding to and transforming future shocks.

The second sub-research question, *"To what extent do recent urgent projects being prepared, and what are the gaps between theory and practice?"*, is addressed through three case studies. The findings show a divide where technical knowledge, industrial resources, and regulatory frameworks are more advanced, while governance and long-term systems are lacking. Knowledge is well-institutionalized, as seen in the replication of Xiaotangshan Hospital's design for Huoshenshan and Leishenshan. Industrial resources are strong in China's supply chains and reverse design capabilities. Regulations, such as Lumajang's use of Perka LKPP No. 13/2018 for direct appointments, show readiness. Conversely, land planning is reactive, with site acquisition only beginning after disasters. Funding depends on post-crisis reallocations or loans, lacking ex-ante instruments. Community involvement remains minimal, with communities engaged late as laborers. Projects and programmes are rigid, with no adoption of collaborative contracts like Framework Agreements or Alliances. The findings indicate a reliance on technical execution while systemic aspects remain underprepared, highlighting the need for a shift from reactive capacity to anticipatory readiness.

The third sub-research question, *"What procurement strategy design is suitable to improve the current state of preparedness in post-disaster projects?"*, is answered by proposing a strategy that formalizes existing accelerators and resolves procurement bottlenecks. The strategy moves from a reactive, single-project approach to a proactive, portfolio-based system using a Framework Agreement tendered in advance. At the strategic level, it establishes long-term partnerships with expert firms, turning reconstruction into a continuous program. At the tactical level, it balances compliance and speed by eliminating the dilemma between slow tenders and high-risk emergency appointments. However, broader systemic issues, such as national land banking and ex-ante funding instruments, remain outside the scope of this procurement arrangement and require separate policy interventions.

The fourth sub-research question, *"How can the proposed procurement arrangement for urgent projects be evaluated and refined for practical implementation?"*, is answered by assessing the improvements achieved through the proposed strategy. The arrangement improves preparedness in industrial resources by decentralizing RISHA panel depots, introducing scheduled inspections, training construction assistants, and implementing milestone-based payments. Projects and programmes improve through integrated design-and-build contracts that include manufacturing and storage within framework agreements, enabling rapid mobilization through pre-tendered call-offs. The framework-based approach delivers tangible benefits by de-coupling critical processes like upfront administration and separates material manufacturing from the on-site construction. These upgrades move both key aspects to the more-prepared side of the framework. The strategy is limited by the scope of a single client agency and does not address multi-agency coordination complexities. Although the legal basis for framework agreements exists, the lack of detailed technical regulations requires the ministry to create specific guidelines, posing a significant challenge. Overall, the proposed strategy advances preparedness but is still constrained by regulatory and inter-agency barriers, preventing it from reaching a fully prepared state.

7.1.2 Answering the Main Research Question

Finally, answering the main research question, *"How can procurement strategy improve the current state of preparedness to accelerate Post-Disaster Housing Delivery in Indonesia?"*, the evaluation shows that a pre-disaster framework agreement for integrated design-and-build with prefabricated RISHA manufacturing, stock, and logistic plan can lift preparedness where it matters most for urgent housing programmes. Industrial resources move from reactive to proactive: technology know-how is embedded in standing contracts; regional stock and verified logistics shorten lead times; factory output is secured up front; local labour is trained early; and the liquidity premium that contractors usually add is removed.

The proposed strategy of applying framework agreement in post-disaster projects improves preparedness in two aspects of preparedness: industrial resources and projects and programmes. These gains confirm literature that links collaborative procurement to faster mobilisation, better risk allocation and lower prices in construction delivery (Mosey, 2019; D. H. T. Walker, 2015). Beyond project speed, a collaborative strategy benefits the partners themselves. Evidence on risk-sharing agreements shows that pre-negotiated rates and joint continuity planning reduce the price premiums contractors charge and secure capacity when disaster strikes (Adeniyi et al., 2018; Tammineedi, 2010). Additionally, contractual flexibility helps create incentives for cooperative behavior and allows the project team to respond effectively to unforeseen events (Xu et al., 2022). Limits remain, however, as land banks and rapid public-finance instruments sit outside PUPR's mandate, the strategy cannot yet shift those preparedness scores. Future work should couple the framework with a national relocation cadastre and the forthcoming disaster pooling fund to close the remaining gaps.

7.2 Discussion

Findings from the application of framework agreement for post-disaster housing projects aimed to contribute to existing knowledge and highlights the practical implications of the proposed procurement strategy in several key areas. This study connects theory to practice by showing that a collaborative, framework-based procurement strategy can improve preparedness. It bridges high-level disaster risk reduction principles with the complex realities of project delivery, confirming and extending insights from existing literature. The strategy operationalizes paradigm shifts in public procurement by moving from fragmented to integrated systems (Lenferink et al., 2013), shifting focus from outputs to outcomes, and adopting flexible over rigid contracts (Mosey, 2019). The framework agreement that applied in this study is a known method to achieve flexibility, enabling ready-stock critical materials, and better risk-sharing in uncertain situations (Albano & Nicholas, 2016).

Firstly, flexibility nature of framework agreement is exploited to tackle uncertainty. While many solutions exist, few match the adaptability of framework agreements. Though typically used for simple, repeatable items (Balcik & Ak, 2014; Eyo, n.d.), modern construction methods like Design for Manufacture and Assembly (DfMA) allow housing to be treated as mass-manufactured items (Kieran & Timberlake, 2004), making this procurement model highly suitable for urgent housing projects. Secondly, the strategy also offers a practical way to implement the ”Build Back Better” principle from the Sendai Framework for Disaster Risk Reduction (SFDRR) (United Nations, 2015). By requiring contractors to manufacture, stock, and plan logistics before a disaster, it invests in supply chain resilience and addresses industrial bottlenecks that hindered past recovery efforts (Amaratunga & Haigh, 2011). Additionally, pre-agreed rates and continuity plans reduce contractor premiums and secure capacity during emergencies (Adeniyi et al., 2018; Tammineedi, 2010).

From broader preparedness perspective, the findings underscore the significance of moving from a reactive to a proactive stance on the disaster management continuum (Bosher et al., 2021), which reflected by the improved industrial resources preparedness. While case studies revealed Indonesia's strong reactive capacity, its proactive systems are underdeveloped, particularly in land and finance. The proposed procurement strategy acts as a powerful lever to advance this shift within infrastructure delivery by creating a structured and anticipatory system. This reduces reliance on the ad-hoc improvisation that characterized past successes but cannot be scaled or relied upon for future, potentially larger, crises (Oloruntoba et al., 2018). This proactive posture is also relevant for other time-sensitive, strategic infrastructure projects where urgency is a key variable (Schexnayder & Anderson, 2010).

However, the strategy's limitations reveal the need for systemic reform. Persistent gaps in land and funding show that procurement reform alone is insufficient. Full resilience requires coupling this procurement model with governance reforms, such as establishing a national relocation cadastre and activating the disaster pooling fund. This study demonstrates that while strategic procurement is an effective tool, it must be part of a coordinated, multi-sector effort to embed preparedness across all levels of governance (Bosher & Chmutina, 2017).

7.2.1 Final Assumptions

The conclusions of this study are based on several methodological and analytical assumptions that define its scope and limitations. Several assumed conditions include similarity of perspective across stakeholders, generalisation of the case studies, consistent interpretation of regulations and documents, direct causal link between preparedness and project outcomes, and accuracy in stakeholder accounts. Firstly, the study assumes that the perspectives of national-level stakeholders, including policymakers from PUPR, BNPB, and LKPP, as well as client-side project officers, are representative of broader stakeholder views. Due to access and time constraints, operational stakeholders, such as municipalities and contractors or suppliers, were not interviewed. The

research assumes that these unrepresented stakeholders would find the proposed procurement strategy feasible and beneficial, although this remains a significant limitation and a key area for future research. Second, the analysis of current practices is drawn from two major Indonesian post-disaster housing projects, Lumajang and Central Sulawesi, and one international benchmark. The study assumes that the bottlenecks, such as land acquisition and funding delays, and enablers, like emergency regulations, observed in these cases reflect systemic issues rather than unique, locally specific conditions. This generalization assumes that the findings apply to other urgent reconstruction projects in Indonesia. Third, the research assumes that the interpretation of official regulations, project reports, and stakeholder descriptions accurately represents practical, on-the-ground implementation. It presumes that informal practices or regional variations in applying these rules do not significantly alter existing workflows in ways that would challenge the study's conclusions. Fourth, the study's analytical framework assumes a direct relationship between preparedness in the seven identified aspects and project efficiency. Higher readiness in areas like Industrial Resources or Regulations is assumed to accelerate project delivery, while lower readiness causes delays. Although this assumption is strongly supported by literature and case evidence, it simplifies the complex reality where factors such as political leadership or secondary disasters may also impact project outcomes. Finally, the research assumes that the interviewed stakeholders provided accurate and candid accounts of events, challenges, and decision-making processes. It presumes that their testimonies are not significantly biased by personal, professional, or institutional interests that could distort the representation of facts.

7.2.2 Recommendations

Based on the findings, this study offers several recommendations for practice and future research to strengthen the proposed procurement strategy and enhance preparedness for urgent projects in Indonesia and beyond. The seven-aspect preparedness framework developed in this research is a strong tool for assessing and improving readiness, but it should remain adaptable. Disaster management continues to evolve with new approaches and technologies (Sawalha, 2023), so the framework must be regularly reviewed and updated with lessons from future urgent projects to stay relevant and effective.

Although this study focuses on post-disaster housing, the principles of preparedness and the proposed procurement strategy are applicable to other urgent infrastructure projects. Projects driven by strategic needs, such as aging infrastructure risks or shifting political mandates, face similar time pressures (Schexnayder & Anderson, 2010). The time-scale quadrant model (Wearne, 2002) helps classify such projects. Policymakers and practitioners in Indonesia are encouraged to apply the preparedness framework and consider the framework agreement model for large, time-sensitive infrastructure projects to improve efficiency and reduce delays.

While the procurement strategy in Section 5.2 provides a foundation, several components are presented as initial examples and require further research for full application. Future studies should develop detailed, context-specific elements of the framework agreement. This includes mapping regional demand and capacity to define geographic scopes, modeling expected unit ranges per call-off, determining optimal engineer-to-house ratios for supervision, and specifying contractor stock-readiness obligations. Such research is essential to refine the strategy and ensure its practicality.

Procurement reform within a single ministry, though impactful, cannot fully achieve preparedness. Persistent gaps in regulations, funding, and land planning highlight the need for integrated governance reform. Other national and local agencies should pursue parallel efforts, such as establishing a national relocation-land bank, activating the disaster pooling fund for rapid ex-ante financing, and creating pre-authorized regulatory triggers for emergency actions. True systemic resilience requires coordinated efforts from all stakeholders to embed preparedness within governance structures (Bosher & Chmutina, 2017).

Finally, to validate and refine the strategy's broader applicability, future research should adapt and pilot the model in diverse contexts. This could involve applying the strategy to other infrastructure types, such as schools, clinics, and transportation, or testing it in different geographic and governance environments outside Indonesia. These studies would provide valuable insights and strengthen the global understanding of managing urgent projects and building disaster resilience.

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Appendices

.1 Project Lifecycle Frameworks

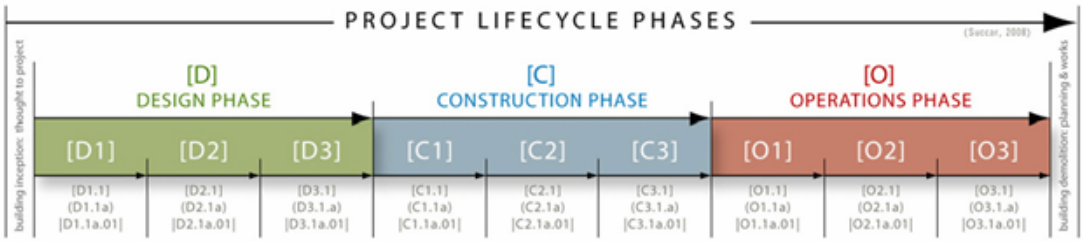

Figure .1.1: Project Life Cycle Framework by Succar (2009)

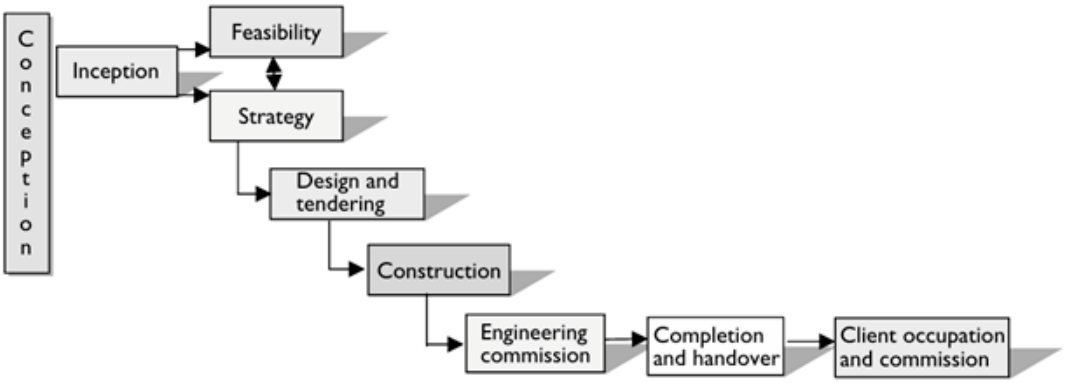

Figure .1.2: Project Life Cycle Framework by Fewings (2005)

.2 Disaster Literacy

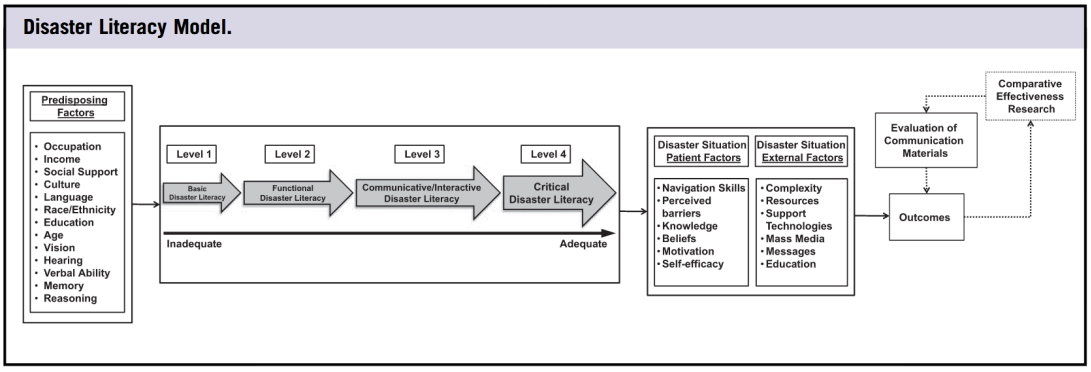

Figure .2.1: Disaster literacy, as proposed by Brown et al. (2014)

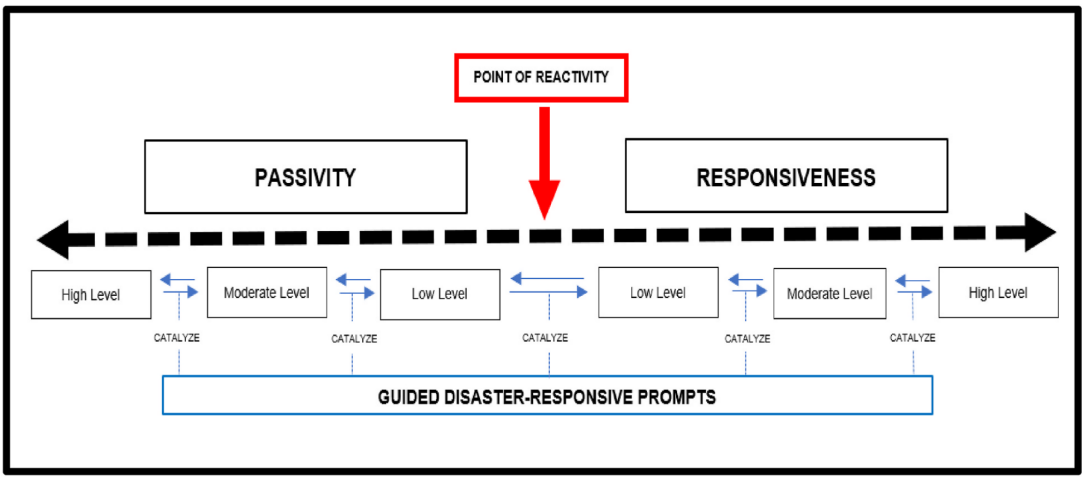

Figure .2.2: Passivity-Responsiveness in Disaster Awareness (Gallego & Tejero, 2023)

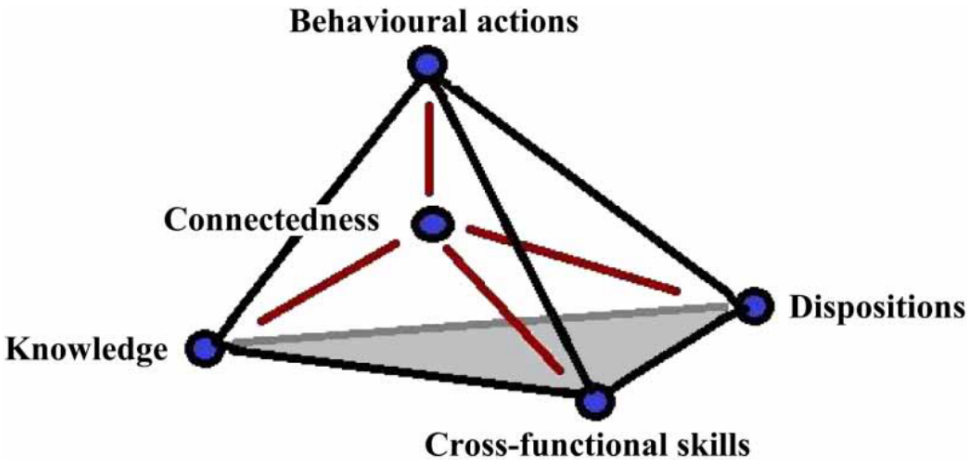

Figure .2.3: Five competences indicators in Disaster Management (Oyao et al., 2015)

.3 Interview Questions

Table 1: Interview 1 – Understanding Current Practice: Questions and Answer Guidance

No.	Question	Answer Guidance (What to Look For)
	Part A – Respondent Profile	
A1	Describe your current role and organisation.	Understand their position in the disaster reconstruction value chain; whether policy-maker, contractor, community member, etc.
A2	How long have you worked in post-disaster reconstruction or related fields?	Years of experience, number of relevant projects, or functional roles in previous efforts.

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No.	Question	Answer Guidance
A3	Which recent reconstruction projects have you been involved in and in what capacity?	Specific project names, disaster type, responsibilities, and scale of involvement.
A4	At what stage(s) of the project life-cycle do you normally participate?	Planning, procurement, implementation, or monitoring phase participation.
Part B – Framework Aspect Exploration		
1	How and when were communities engaged in the last project?	Look for specific mechanisms: town halls, village heads, participatory mapping; timing; influence on design or location.
2	What disaster-related knowledge was available?	Use of guidelines, maps, BIM tools, standard designs, training, or technical support.
3	How did you source contractors, materials, and equipment?	Insight into supply chains, framework contracts, price issues, logistics problems, or surge mechanisms.
4	How was land acquisition and governance managed?	Steps to identify, secure, and approve land; legal conflicts; tenure data; agency roles.
5	Which regulations affected speed the most?	Procurement laws, building codes, emergency decrees, audit procedures, and exemptions.
6	What types of funding instruments were used?	State budget, contingency reserves, donor funds, insurance; timing of disbursement and cash-flow issues.
7	How were lessons from past disasters reused?	Presence of learning mechanisms, knowledge bases, coordination offices, integrated plans.
Part C – SWOT & Risk Mapping (Repeat per Framework Aspect)		
S	Strengths – What worked well?	Look for internal success factors: tools, resources, networks, trust, policies.
W	Weaknesses – What slowed things down?	Internal bottlenecks: poor systems, limited capacity, conflicting mandates, etc.
O	Opportunities – What could improve future practice?	Mention of tools, reforms, digital systems, decentralisation, partnerships.
T	Threats – What could derail future efforts?	External risks: conflict, political resistance, legal disputes, social tension.
Part D – Wrap-Up		
D1	If you could change one thing in the preparation phase, what would it be?	Concrete priorities; helps identify perceived leverage points.
D2	Anything we haven't covered that you consider critical?	Explore new ideas not covered by the framework.
D3	May we contact you again to discuss the procurement proposal?	Confirm re-engagement and preferred contact method.

Table 2: Interview 2 – Validation of Procurement Strategy: Questions and Answer Guidance

No.	Question	Answer Guidance (What to Look For)
Part A – Respondent Profile Update		
A1	Have there been changes to your role since our last conversation?	Confirm continuity, new responsibilities, or job change.
A2	Have you been involved in additional reconstruction projects?	Capture new experience that might colour their validation input.
Part B – Aspect-by-Aspect Evaluation		
1	Does the strategy give communities sufficient voice?	Timing, depth, and tools for participation; relevance to their past experience.
2	Will the strategy address the knowledge gaps you mentioned?	Training, data-sharing, decision-support tools, technical support contracts.
3	Are supplier surge options and contracts realistic?	Consider market readiness, contractor incentives, inflation risks.
4	Does it accelerate land release without compromising tenure?	Tenure verification, land audits, land pooling, or compensation tools.
5	Are proposed regulatory flexibilities legally feasible?	Legal basis, emergency use clauses, or required amendments.
6	Does the funding approach solve early cash-flow issues?	Layered instruments, advance payment, disbursement triggers, and incentives.
7	Will KPIs and feedback loops work in practice?	Data collection feasibility, cross-agency sharing, monitoring capacity.
Part C – Feasibility & Risk		
C1	What strengths will help the proposal succeed?	Strong alignment with current mandates, tools, or donor support.
C2	What weaknesses or blind spots exist?	Unrealistic assumptions, capacity gaps, unclear responsibilities.
C3	What opportunities could enhance impact?	Emerging policies, donor interest, new tech, governance reforms.
C4	What risks could block implementation?	Institutional resistance, legal friction, budget inflexibility.
C5	What sequencing or timeline do you suggest?	Quick wins, preconditions, phased approach, pilot scope.
Part D – Closing		
D1	On a scale of 1–5, how confident are you in the proposal? Why?	Score + qualitative reasoning (feasibility, impact, alignment).

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No.	Question	Answer Guidance
D2	What support would your organisation need to implement it?	Training, budget, policy updates, legal backing.
D3	Any final advice for refining the proposal?	Final feedback, creative input, cautionary notes.

.4 Lumajang case Workflow Reconstruction

The following workflow is constructed based on a synthesis from regulatory frameworks including Presidential Regulation No. 16 of 2018 and LKPP Regulation No. 13 of 2018 and firsthand accounts from key stakeholders involved in the post-disaster housing project in Lumajang, East Java. By aligning procedural mandates with practical execution, this workflow aims to support the analysis in section 5.1.2 by illustrating how planning, procurement, construction, and delivery were actually carried out under emergency conditions. The workflow chart presented in this appendix aligns with Figure 5.1.1 with the addition of numbered phases. These numbers correspond directly with the step-by-step explanations provided in the table that follows, offering further detail on the tasks, actors involved, and supporting regulatory and empirical evidence.

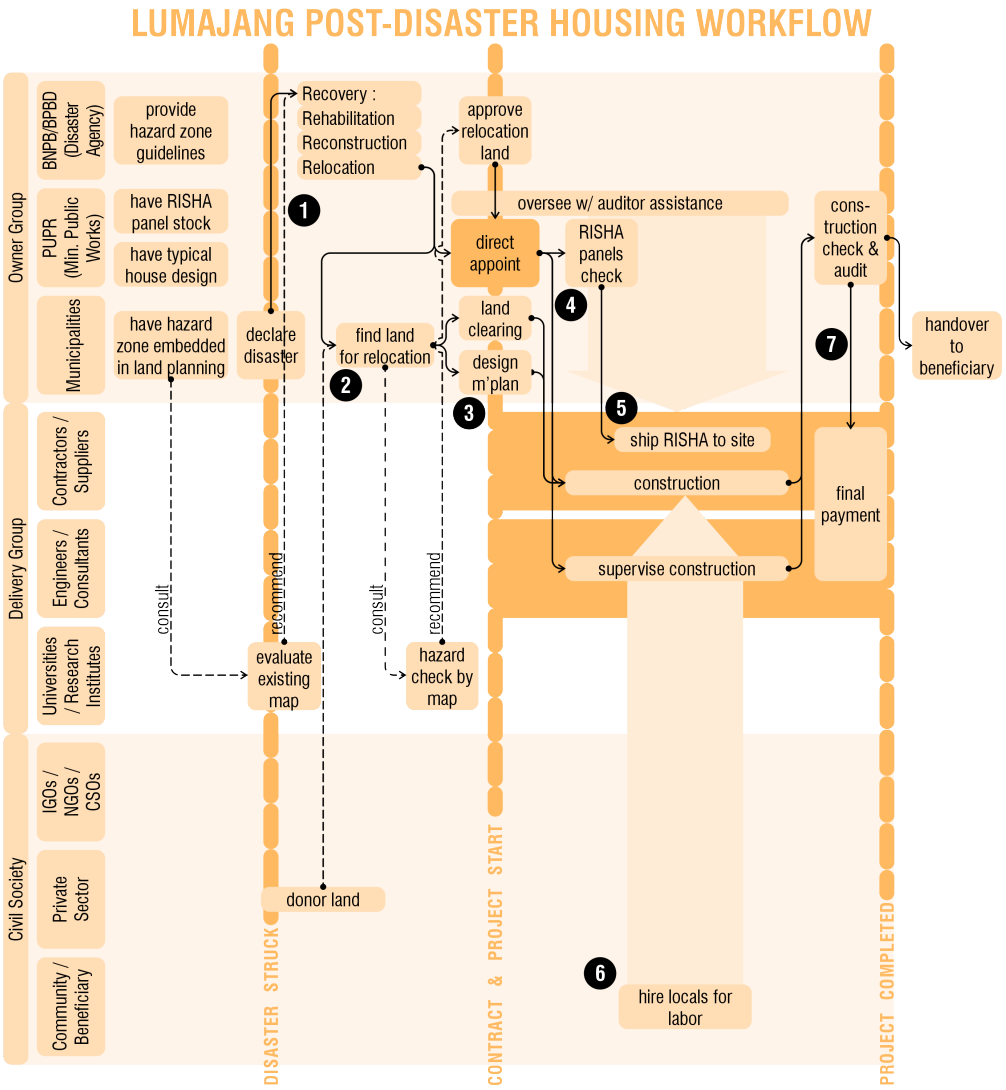

Figure .4.1: numbered workflow of Lumajang post-disaster housing project

Table 3: Detailed workflow of Lumajang Post-Disaster Housing project

Workflow Phase, Tasks & Actors	Interview Evidence	Regulation Base
1. Disaster Declared & Relocation Ordered • **Tasks:** BPBD drafts disaster-status letter; BNPB confirms emergency period; Presidential visit triggers relocation. • **Actors:** BPBD, BNPB, President, PUPR	*"There was a letter stating the area is still under an emergency-response period; with that in hand we may use LKPP's emergency-procurement rule."* – Project Officer *"After the President's visit and BNPB labelled the site a red zone, relocation became mandatory."* – Project Officer	**Pres. Reg. 16/2018 Art. 59(1)–(5):** PPK may directly appoint nearest capable provider in emergency.

Workflow Phase, Tasks & Actors	Interview Evidence	Regulation Base
2. Land Secured, Cleared, and Verified • **Tasks:** District head secures 81 ha estate plot; BNPB verifies site; Pemda performs land clearing. • **Actors:** Municipality, BNPB, PUPR	*"The Regent obtained an 81-hectare plot; the county handled all the donation paperwork and earth-works within two weeks."* – Project Officer *"Lumajang moved faster because funds were larger and the local government was very eager."* – BNPB Officer	**LKPP Reg. 13/2018 Art. 6(2):** Identify needs and analyse available resources before procurement.
3. Integrated Planning & Master-plan Finalised • **Tasks:** Municipality hired consultant to design masterplan with input from all Directorate General of the ministry that involved (housing, utilities, roads, water resources). • **Actors:** PUPR, Municipality	*"Master plan was designed by the municipality together with us (ministry), based on our typical designs."* – Project Officer *"We produced one master-plan with Cipta Karya (utilities), Bina Marga (road), and Water-Resources"* – Project Officer *"Designs were ready-made RISHA typologies, so the contract covers only build & supervision."* – Project Officer	**Pres. Reg. 16/2018 Art. 18(1):** Planning includes needs, items, method, schedule, and budget.
4. Emergency Procurement & Contract Award • **Tasks:** PPK issues SPPBJ/SPMK; direct appointment; BPKP reviews paperworks. • **Actors:** PUPR, BPKP, Contractor, Construction Management	*"Since the beginning we involved BPKP... there was document reviews and final audit too."* – Project Officer *"Typically, the SPP is signed by the Director once the site is clear and the contractor is ready."* – Project Officer *"Procurement used direct appointment; we still used unit-price build-only contract."* – Project Officer *"Since the beginning we involved BPKP... there was document reviews and final audit too."* – Project Officer	**Pres. Reg. 16/2018 Art. 59(5):** Direct appointment permitted. **LKPP Reg. 13/2018 Art. 6(3):** Emergency flow: SPPBJ → site → SPMK → work → audit → handover.
5. Readiness Resources: RISHA Stock & Logistics • **Tasks:** Use RISHA stock from national depots; inspect quality; prepare crews. • **Actors:** PUPR, Contractor	*"RISHA and RUSPIN proved faster, so annual stocking was already done for that project at regional depots."* – Dit. Special Housing Officer *"Our team checked RISHA stock in Lombok; inspection is unpaid, only mobilisation is reimbursed."* – Project Officer *"Panels came overland from Java; easier than remote NTT."* – Dit. Special Housing Officer	**LKPP Reg. 13/2018 §2.1.2:** Resource availability analysis is part of emergency planning.

Workflow Phase, Tasks & Actors	Interview Evidence	Regulation Base
6. Construction & Workforce Engagement • **Tasks:** Project Constructed; crews coordinated; locals trained and involved. • **Actors:** Contractor, Community, Construction Management, PUPR	*"The key was matching material flow and crews so no panel sits idle."* – Lumajang PPK *"We brought skilled applicators... while working, they trained the local residents."* – Project Officer	**Pres. Reg. 16/2018 Art. 17(2):** Supplier must meet quality, schedule, and quantity.
7. Inspection, Audit & Final Payment • **Tasks:** CM and PUPR inspect final product; BAST signed; BPKP audits; treasury pays. • **Actors:** Construction Management, Contractor, BPKP, PUPR	*"Audit happens twice: early review and final audit before payment."* – Project Officer *"However, there's a note to consider: since this is done quickly, accountability becomes necessary. So, where does the accountability lie? In the end, there will be what's called a post-audit. It's to ensure what was done in the field, how much was done, and in what form. This is what the audit will cover."* – LKPP officer	**LKPP Reg. 13/2018 §2.2.8–2.2.9:** BAST (Minutes of Handover) precedes payment; audit mandatory. **Pres. Reg. 16/2018 Art. 57–58:** Itemised hand-over to PPK (Commitment Making Officer) and KPA (Authorized Budget User).

.5 Central Sulawesi case Workflow Reconstruction

The following workflow is constructed based on a synthesis from regulatory frameworks, in this case Presidential Regulation No. 16 of 2018, and firsthand accounts from key stakeholders involved in the post-disaster housing project in Central Sulawesi. By aligning procedural mandates with practical execution, this workflow aims to support the analysis in section 5.1.1 by illustrating how planning, procurement, construction, and delivery were actually performed. The workflow chart presented in this appendix aligns with Figure 5.1.2 with the addition of numbered phases. These numbers correspond directly with the step-by-step explanations provided in the table that follows, offering further detail on the tasks, actors involved, and supporting regulatory and empirical evidence.

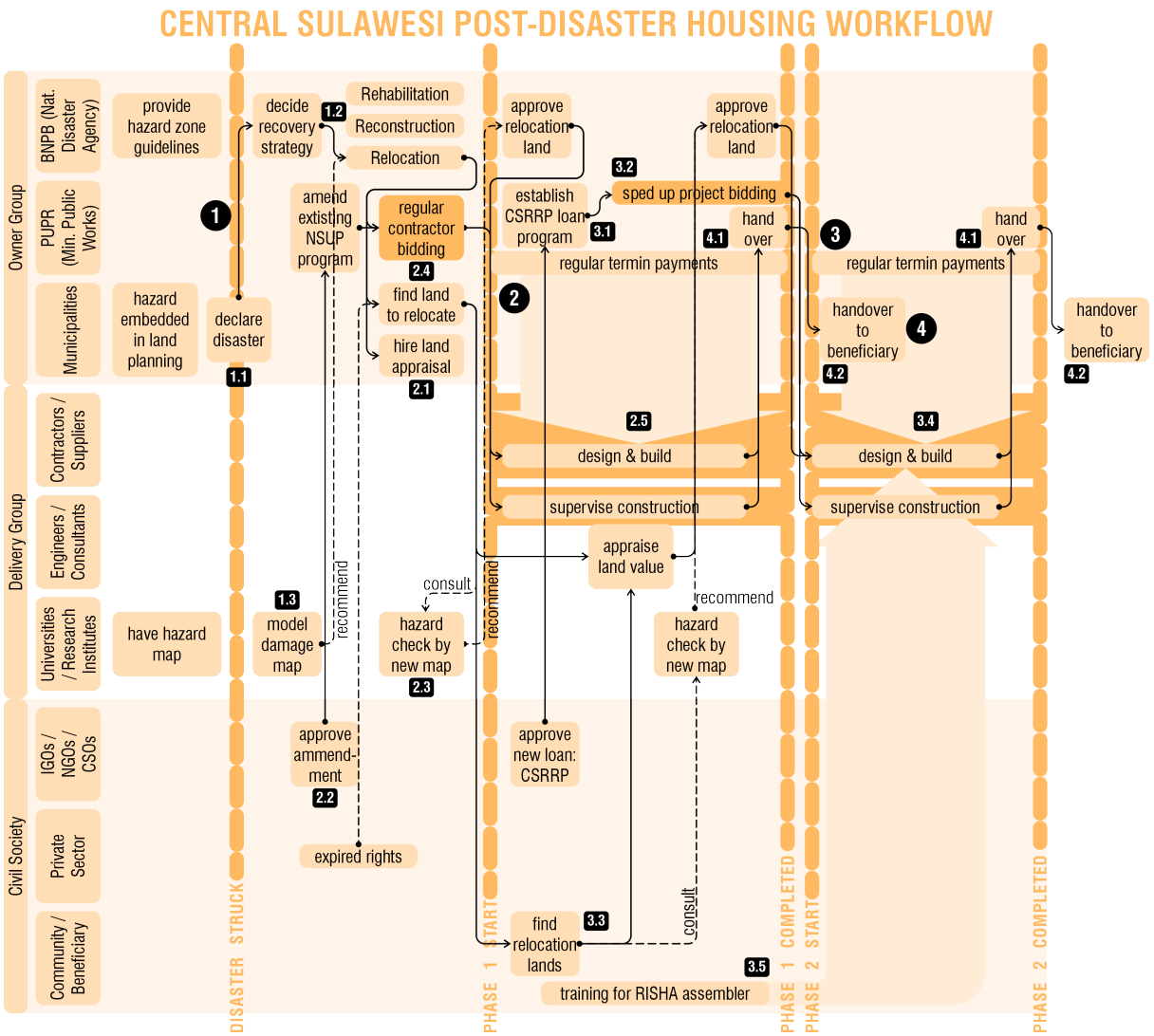

Figure .5.1: numbered workflow of Central Sulawesi post-disaster housing project

Table 4: Detailed workflow of Central Sulawesi Post-Disaster Housing project

Workflow Phase, Tasks & Actors	Interview Evidence	Regulation Base
PHASE 1: DISASTER EVENT & EMERGENCY RESPONSE (2018)		

Workflow Phase, Tasks & Actors	Interview Evidence	Regulation Base
1.1 Task: Declaration of Disaster Status Following the 2018 earthquake, tsunami, and liquefaction events, a state of emergency was established. **Actors:** Central Government, Provincial Government.	**Directorate of Special Housing Representative:** *"For the disaster in Palu, it was an earthquake, which then triggered a tsunami and liquefaction ... The Ministry of Public Works and Housing (PUPR) acted on the basis of a Presidential Instruction—specifically, the Presidential Instruction on the acceleration of post-disaster recovery in Central Sulawesi."*	**Art. 59 (2) a, c** of Presidential Regulation No. 16 of 2018 defines a state of emergency to include natural disasters and damage to infrastructure that disrupts public services. **Art. 59 (3)** stipulates that the declaration of a state of emergency is carried out in accordance with statutory regulations.
1.2 Task: Response to Recovery Phases Initial response focused on search, rescue, and restoring critical access and services. The disaster management agency led this phase, with other ministries in support roles. **Actors:** BNPB (lead), Ministry of PUPR (Cipta Karya, Bina Marga, SDA).	**Project Officer, Palu,** *"The emergency stage is handled by BNPB (National Disaster Management Agency). So during the rehab-rekon (rehabilitation and reconstruction) stage, it was under PUPR (Ministry of Public Works and Housing)."* **Directorate of Special Housing Representative:** *"During the initial disaster response, the Directorate General of Housing did not immediately start housing construction, because other sectors more related to the emergency response entered first, such as Cipta Karya (Directorate General of Human Settlements), then Bina Marga (Directorate General of Highways) for access, and also SDA (Directorate General of Water Resources) for drinking water."*	**Art. 59 (1)** states that handling a state of emergency is for the safety and protection of the public and must be carried out immediately. **Art. 59 (4)** clarifies that this stage includes the emergency response and the transition to recovery phases. Detailed handling in this phase is regulated by BNPB.
1.3 Task: Initial Hazard & Damage Assessment Academics and experts, who had prior knowledge of the region's geological risks, were involved in assessing the impact and updating hazard maps. **Actors:** Academics, Experts, BNPB.	**BNPB Representative 1:** *"Actually, there were already many maps from academics. So, yes, many maps from academics, but there are also times when we, as the national government, assess a region based on whether the local government has already created a disaster risk map or not. So even if there are maps from academics, we still look at the official map from the local government."* **BNPB Representative 1:** *"And because there were many types of disasters at that time, namely earthquake, tsunami, and liquefaction, the experts who came down to evaluate were also varied."*	While not explicitly detailing post-disaster hazard assessment, the regulation's emphasis on proper planning (**Bab IV Perencanaan Pengadaan**) implies the necessity of such technical assessments to inform reconstruction. Detailed handling in this phase is regulated by BNPB.

Workflow Phase, Tasks & Actors	Interview Evidence	Regulation Base
PHASE 2: RECONSTRUCTION UNDER LOAN AMENDMENT (2019 - 2021)		
2.1 Task: Land Acquisition (Round 1) Local governments began acquiring land for permanent housing. This sequence got delayed due to a combination of funding shortages, limited available land in Palu City, and complex land rights (HGU/HGB - Right to Cultivate/Build) in the regencies. **Actors:** Municipalities (Palu, Sigi, Donggala), Provincial Government.	**Project Officer, Palu,** *"The main challenge here initially was the land issue. That was the biggest obstacle... After the disaster in early 2019, land acquisition only succeeded in two locations... The land acquisition period was quite long."* **Project Officer, Palu,** *"In Palu City, land is definitely limited. In the regencies, the problem was more financial... Back then, it led to a gubernatorial policy where the Governor of Central Sulawesi financed land purchases for permanent housing in Donggala Regency."*	**Art. 61 (1) d** notes that land acquisition is exempted from this regulation as it is governed by other specific regulations ("governed by other laws and regulations"), in this case, by the Ministry of ATR/BPN.
2.2 Task: Securing Initial Funding via Loan Amendment To initiate reconstruction, an existing World Bank loan for the National Slum Upgrading Program (NSUP) was amended. This became the funding source for the first two housing packages (1A and 1B). **Actors:** Central Government, Ministry of PUPR, World Bank.	**Project Officer, Palu,** *"In 2019, there was an addendum to the existing loan contract for the NSUP (National Slum Upgrading Program)... that loan was amended into NSUP Search, covering emergency response for Central Sulawesi... We used that from 2019 to 2020. That loan closed in 2021, covering only two huntap (permanent housing) packages: Package 1A and 1B."*	**Art. 64 (1)** allows for project arrangements to follow the terms of a lender if they differ from the Presidential Regulation.
2.3 Task: Land Suitability Synchronization Several plots of land purchased by local governments was later found to be in newly designated "red zones." This required a synchronization effort between the updated disaster maps and the local government's acquisition plans. **Actors:** PUPR, Local Government, BNPB.	**Project Officer, Palu,** *"In some cases, the local government had already purchased the land, but after we checked, it turned out the area was categorized as a red zone, meaning unusable. After the disaster, we took a look to the updated the disaster maps, but sometimes these weren't synchronized with the land acquisition process at the local government level."* **BNPB Representative 1:** *"disaster risk evaluation is conducted after a disaster occurs. The decision-making is then based on the results of that evaluation... it's usually in the form of a recommendation. The recommendation from this evaluation becomes the basis for selecting relocation areas."*	This synchronization is not explicitly detailed in the regulation but is an essential part of the Commitment-Making Official's (PPK) duty to establish technical specifications and a contract framework under **Art. 11 (1) b, c, d**. Detailed handling in this phase is regulated by BNPB.

Workflow Phase, Tasks & Actors	Interview Evidence	Regulation Base
2.4 Task: Construction Procurement (Stage 1) Procurement for the first two housing packages (1A and 1B) was conducted using a regular tender process. **Actors:** PUPR, Potential Contractors and Construction Managements.	**Project Officer, Palu,** *"Actually, at the beginning we used regular procurement. That itself became a problem. For example, for Huntap (permanent housing) work package 1A, we conducted a full tender, which took quite some time. The same for package 1B... That's one of the lessons learned: disaster response shouldn't follow such long procurement timelines."* **Directorate of Special Housing Representative:** *"in Palu, the mechanism used was a tender, if I'm not mistaken it was international bidding, because the budget also used funds from a foreign loan".*	**Art. 38** outlines the standard methods for selecting construction providers, which includes Tender. **Art. 50** details the steps of a standard tender/selection process.
2.5 Task: Phase 1 Construction & Challenges Construction began in 2020 on the two sites with clear land titles. The housing technology used was RISHA (a type of instant housing), with some components repurposed from the Lombok disaster stockpile. The prolonged delays led to public protests. **Actors:** Contractors & Construction Managements (SOEs), PUPR, Community.	**Project Officer, Palu,** *"construction only started in 2020 in just those two locations."* **Project Officer, Palu,** *"One location did use Lombok stock early on in 2020, but only that one site."* **Project Officer, Palu,** *"They refused the technology by saying, "If this is earthquake-resistant, why is it assembled with bolts?" They were afraid that bolts might loosen or vibrate during future earthquakes.*	**Art. 17** holds the Provider (contractor) responsible for contract execution, quality, and timelines.
PHASE 3: RECONSTRUCTION UNDER DEDICATED CSRRP (2021 - 2024)		
3.1 Task: Establishing Dedicated Funding and Harmonizing Rules A dedicated loan, the Central Sulawesi Rehabilitation and Reconstruction Program (CSRRP), was established. To accelerate the process, procurement rules were officially harmonized between the World Bank and LKPP (Public Procurement Authority). **Actors:** LKPP, World Bank, PUPR.	**Project Officer, Palu,** *"From 2021-2022 onward, we used the dedicated CSRRP loan... we consulted with the World Bank and harmonized the procurement documents... This harmonization was agreed upon between LKPP and the World Bank, resulting in a dedicated bidding document for this loan."* **LKPP Representative:** *"The rules follow the lender. And that is indeed regulated. The only slight problem at that time was that LKPP needed to harmonize the rules."*	**Art. 64 (1)** is the key enabler: "Procurement of Goods/Services for activities funded by foreign loans or foreign grants shall be subject to the provisions as stipulated in this Presidential Regulation, **unless stipulated otherwise in the foreign loan agreement or foreign grant agreement**".

Workflow Phase, Tasks & Actors	Interview Evidence	Regulation Base
3.2 Task: Accelerated Procurement using World Bank Methods The project shifted to faster procurement methods like Request for Quotation (RfQ). The project team successfully negotiated to increase the RfQ threshold to IDR 70 billion, allowing for a limited tender process that invited a shortlist of pre-qualified companies. This approach, however, later drew scrutiny for limiting market competition. **Actors:** PUPR Project Team, World Bank Procurement Team.	**Project Officer, Palu,** *"We requested to increase the RfQ threshold from IDR 2.5 billion to IDR 70 billion. After their approval, we could package many RfQ tenders that fit the project's urgency."* **Project Officer, Palu,** *"The process involved a long list of all companies with relevant experience... After narrowing it down to a shortlist, we invited selected companies to join the limited tender."* **Project Officer, Palu,** *"That's why the prosecutor's office eventually got involved. It was seen as a market limitation."*	The use of specific World Bank methods is permissible under **Art. 64 (1)**. Domestic regulations offer similar accelerated methods like **Penunjukan Langsung** (Direct Appointment) for "specific circumstances" under **Art. 38 (1) c** or **Tender Cepat** (Fast Tender) for pre-qualified companies under **Art. 38 (1) d**. Detailed handling in this phase is regulated by World Bank as lender.
3.3 Task: Land Acquisition (Round 2) & Documentation Land acquisition continued gradually. A key requirement for World Bank-funded packages was the preparation of a complex Land Acquisition and Resettlement Action Plan (LARAP) before tendering could begin. **Actors:** Local Government, PUPR, World Bank.	**Project Officer, Palu,** *"Land acquisition was gradual: when land was ready, we started working."* **Project Officer, Palu,** *"The World Bank requires that physical construction or tendering can only proceed once the land is fully clean and clear. So we prepared the LARAP document (Land Acquisition and Resettlement Action Plan), which is more complex than conventional processes."*	This documentation is a lender requirement, permissible under **Art. 64**. The domestic process of land acquisition itself is outside the scope of this regulation.
3.4 Task: Phase 2 Construction & Challenges The main construction phase faced significant hurdles, primarily with the supply of materials and skilled labor. **Actors:** Contractors, Sub-contractors, Local Labor.	**Project Manager, Palu on Materials:** *"The most challenging parts during construction were material and manpower... Even materials were being sourced from here (Central Sulawesi) for IKN (the new capital city), which drove up local prices and created supply issues."* **Project Manager, Palu on Labor:** *"We struggled to find skilled workers at that time... RISHA (a type of instant housing) isn't commonly used here... Furthermore, many communities resisted bringing in external workers... So we were forced to use local labor, which slowed things down."*	**Art. 17 (2)** outlines the Provider's responsibility for contract execution, which includes managing labor and materials to meet quality and time requirements. These challenges highlight supply chain risks that are critical to project outcomes.

Workflow Phase, Tasks & Actors	Interview Evidence	Regulation Base
	Project Officer, Palu, *"we explained that this disaster project had already been delayed, causing public demonstrations and unrest."*	
3.5 Task: Community Involvement To overcome the labor shortage and local resistance, informal training programs were initiated to certify local workers in RISHA construction. Formal community outreach was also conducted as per World Bank standards. **Actors:** Construction Management Consultants, Contractors, Community.	**Project Officer, Palu,** *"It was organized by the construction management consultants — not officially, but as an initiative. We programmed community training for RISHA construction, anticipating the large number of upcoming projects."* **Project Officer, Palu,** *"the consultants... were hired... to handle community outreach and awareness-raising activities."* **Project Officer, Palu,** *"If we brought in workers from Java, one RISHA house could be built in a single day. Local workers, however, needed three days to complete one unit. So although the technology is considered "appropriate," it's not necessarily suitable for the local workforce. That became our PR (pekerjaan rumah / homework)."*	This practice aligns with the principles of **Art. 4 (c)** on increasing the participation of small businesses and local communities and **Art. 68** on Sustainable Procurement, which includes social aspects like community empowerment.
PHASE 4: PROJECT COMPLETION & HANDOVER (2024)		
4.1 Task: Finalizing Construction and Handover to Beneficiaries The physical construction of all 5,598 housing units was completed and handed over to the community beneficiaries. **Actors:** Contractors, Construction Management, PUPR.	**Project Officer, Palu,** *"It's completed. The huntap (permanent housing) is fully finished."* **Project Officer, Palu,** *"For the community, it's done"*.	**Art. 57** outlines the process for the handover of work, where the Provider submits a written request upon 100% completion, followed by an inspection and the signing of a Handover Report (Berita Acara Serah Terima).
4.2 Task: Final Asset Handover (Administrative) The final administrative process of handing over the assets to the local government remains ongoing, complicated by the varied sources and legal statuses of the land used for the project. **Actors:** PUPR, Municipalities.	**Project Officer, Palu,** *"What remains are asset-related administrative matters... for the local government it's still in process."* **Project Officer, Palu,** *"Here, some of the land is owned by the local government... There are also lands that came from expired HGU (Right to Cultivate)... community-owned land, and land obtained through the land consolidation mechanism."*	**Art. 58** states that after the PPK receives the work, the PPK hands over the assets to the PA/KPA, who then has the PjPHP/PPHP conduct a final administrative examination. This marks the final step in the project lifecycle from a procurement standpoint.

.6 Proposed Procurement Strategy Specification

This specifications and requirements are 5 designed to support the proposed workflow detailed chapter 5. Several of the proposed elements such as incentive schemes, engineer deployment scales, or regional scopes are provided as indicative examples. These should be refined through future context-specific studies, considering that procurement strategies require comprehensive dataset, robust modelling, and alignment with national and regional practices as well as desired policy goals. The details of the procurement strategy specifications are as follows:

a) **Procurement-structure overview.**
The housing programme is procured as a *construction service* through a regular open tender that culminates in a *framework agreement*. Contracts last up to three years and mandate an *integrated design-build* delivery method that also covers modular prefab manufacturing and panel storage.

b) **Supplier arrangement.**
Each framework panel may host (i) a consortium of a general contractor and a licensed modular supplier, (ii) a joint operation of the same parties, or (iii) a single general-contractor entity. Call-offs are awarded either by simple rotation or by a rapid mini-competition among eligible framework contractors.

c) **Technical scope and triggers.**
Before any call-off, contractors manufacture RISHA panels under licence and keep them in certified storage while a construction-management firm performs periodic quality checks. *When a disaster strikes*, the path splits: – For in-situ rehabilitation, stored panels are re-verified, shipped, and installed with on-site assistance from 10–20 deployed engineers (roughly one engineer per 30 houses). – For relocation, the same re-verification and shipping occur, but the contractor also prepares a relocation masterplan and dispatches a smaller trainer team (about 2–3 engineers) to instruct local builders.

d) **Construction-management framework contract.**
A separate framework secures construction-management services. Its scope covers panel inspections before call-off and full supervision (quality, safety, schedule) once a project is activated. Fees follow Indonesia's national professional-rate guidance and are paid on a time-basis, with bidders encouraged to propose digital monitoring tools that improve transparency.

e) **Contractual end conditions.**
Any prefab panels still meeting specification revert to government ownership and may be reassigned to other housing programmes. Panels near their storage-life limit can be called off early or repurposed, and active storage leases likewise transfer to the state.

f) **Geographic scope (indicative).**
Because Indonesia is a vast archipelago, the framework is divided into seven macro-regions: Greater Sumatra, Greater Java, Greater Kalimantan, Greater Sulawesi, Lesser Sunda Islands, Greater Maluku, and Greater Papua. It is intended to balance coverage, logistics, and access for small and medium-sized firms. Exact boundaries and regional quotas will be refined through future spatial-demand studies.

g) **Governance structure.**
The Ministry of Public Works & Housing owns the framework; the Directorate of Special Housing handles framework awards and call-offs; a Regional Project Manager signs and manages each site-specific contract; and a framework-based construction-management firm delivers independent technical QA. If an extreme "black-swan" disaster exceeds framework capacity (e.g. 2004 Aceh), the Ministry can invoke an exceptional national procurement route.

h) **Incentives and payment terms.**
Contractors work on a cost-plus basis with a verified-cost mark-up of about 15 Construction progress triggers *termin* payments, while design, manufacturing, storage, and training are settled on pre-defined milestones (e.g. design approval, panel batch completion, engineer deployment). Construction-management fees are time-based; all parties observe a standard six-month defect-liability period after handover.

i) **Strategic notes and future considerations.**
Municipalities, BNPB, and BPBD coordinate policy but are not direct signatories; a future framework-alliance model could formalise their role. Environmental and social safeguards sit at programme level, while the prefab approach inherently reduces on-site waste and accelerates delivery.

j) **Future research needed.**
Key gaps include regional demand and capacity mapping, expected unit ranges per call-off, optimal engineer-to-house ratios under varying site conditions, and contractor stock-readiness obligations. Addressing these will sharpen the framework's realism and resilience.

The strategy map above provides a structured yet flexible scaffold for rapid, high-quality post-disaster housing delivery. By linking contractual design, technical readiness, and governance in a single specification, it translates workflow principles into actionable procurement rules that ready for refinement once detailed regional data and modelling results are available.