Adaptive Project Strategies for Accelerating Permanent-Quality Post-Disaster Housing in Indonesia

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ABSTRACT

As a nation highly vulnerable to natural disasters, Indonesia faces a recurring challenge in providing timely post-disaster housing. The current paradigm is predominantly reactive, with all processes (from planning and procurement to construction) commencing only after a disaster has occurred. In-depth analysis reveals that the critical bottleneck is not the physical construction itself, but the lengthy and bureaucratic preparation phase, which can consume over half of the total project timeline. This systemic delay, caused by procurement procedures, land acquisition challenges, and resource mobilization, directly prolongs the suffering of survivors in temporary shelters and impedes socio-economic recovery. This issue highlights a fundamental gap between the potential of technical solutions, such as modular construction, and the reality of rigid and reactive project delivery systems. Comparative case studies of adaptive modular projects in the Netherlands underscore that successful implementation depends less on technological sophistication and more on the alignment of the socio-technical system, including workflows, organizational structures, and stakeholder coordination. In Indonesia, this misalignment is exacerbated by a public procurement framework ill-suited for urgency, forcing a difficult choice between slow, standard procedures and high-risk, less accountable emergency measures.

In response to these challenges, this research aims to formulate an integrated and proactive project delivery framework for post-disaster housing in Indonesia. This framework is designed to bridge the socio-technical gap by synergizing two key elements: a preparedness-based procurement strategy and adaptive modular building technology featuring Design for Disassembly (DfD) principles. The primary objective is to shift the paradigm from "rebuilding after disaster" to "ready to build when disaster strikes," thereby drastically reducing the time from an emergency declaration to the provision of dignified housing. Employing a qualitative and iterative Design-Based Research (DBR) methodology, this study reconstructs existing workflows from case studies in Lumajang and Central Sulawesi to identify critical bottlenecks and accelerators, while drawing on international best practices to design an implementable solution for the Indonesian context. This research establishes a foundational project delivery framework, using the case studies not to represent a monolithic Indonesia, but as samples to develop a universally applicable paradigm. The framework is inherently adaptive to the nation's heterogeneity by design. In practice, its governance model can adjust to varying levels of community resilience, empowering self-reconstruction where feasible. Similarly, its construction methods can be tailored to specific disaster impacts, accommodating everything from light renovations to the complex, large-scale relocations required in cases like Palu.

The proposed solution is a proactive, closed-loop system centered on a Framework Agreement established pre-disaster. During the preparedness phase, the government conducts an open tender for a multi-year agreement with a panel of pre-qualified contractors and modular manufacturers. These partners are then mandated to produce and stockpile standardized, permanent-quality modular components in strategic regional warehouses. When a disaster occurs, the government can immediately activate a contract (call-off) with a partner from this panel, bypassing the need for a new, lengthy tender process. Ready-to-use components are dispatched to the affected site, allowing for the rapid construction of permanent-quality temporary shelters within weeks. Once the emergency phase concludes and long-term housing solutions are in place, these modular shelters are systematically disassembled. The components are then inventoried, inspected, and returned to the regional warehouses, becoming a national asset ready for deployment in future disasters.

The implementation of this framework would yield transformative benefits by fundamentally shifting the time and complexity burden from the critical post-disaster period to the more stable pre-

disaster phase. The proposed framework's primary trade-offs are the upfront investment in stand-by components and their associated logistical management costs. These are accepted costs within any preparedness strategy, reframing the challenge as providing 'living space security' for disaster victims. While the substantial long-term gains in rapid socio-economic recovery would require a dedicated cost-benefit model to formally quantify, the strategic value lies in shifting from reactive expenditure to a predictable investment in national resilience. For survivors, this translates to faster access to safe, healthy, and dignified housing. For the government, it establishes a more predictable, accountable, and cost-effective long-term response system. For the construction industry, it drives standardization, innovation in modular technology, and creates a more resilient supply chain. This research asserts that accelerating post-disaster housing is not merely a technical challenge but a strategic and systemic one. By adopting a proactive procurement framework integrated with adaptive modular technology, Indonesia can fundamentally enhance its disaster response capabilities, moving from a cycle of reactive improvisation to a structured, sustainable, and truly resilient system of preparedness.

Keywords: *Disaster Preparedness, Post-Disaster Housing, Modular Building, Adaptive Building, Procurement Strategy, Framework Agreement*