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PPP Solutions for prefabricated modular housing in post-conflict Syria

Master's thesis in Design and Construction Project Management

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PPP Solutions for prefabricated modular housing in post-conflict
Syria

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Finally, I dedicate this thesis to all those who have sacrificed their lives and livelihoods for the freedom and future of Syria. May their courage continue to inspire efforts toward sustainable reconstruction, justice, and dignity for all Syrians.



Mohamad Hani Alsalkini

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Abstract

Syria's prolonged conflict has left over one-third of its housing stock damaged or destroyed and displaced more than 13 million people. Traditional reconstruction methods are too slow, costly, and institutionally demanding for Syria's current fragile context. This thesis explores the potential of combining Public-Private Partnerships (PPPs) with modular prefabricated housing as a feasible solution for large-scale, affordable housing delivery in post-conflict Syria.

The study employs a qualitative methodology based on a systematic literature review and six semi-structured interviews with stakeholders from development institutions, the private sector, academic researcher, NGOs and International banking institutions. It identifies a key research gap in integrating PPP financing with modular construction technologies in fragile states.

Findings show that modular housing offers significant benefits, including speed, cost-efficiency, reduced labor needs, and quality control. However, its application in Syria faces multiple barriers, high capital costs, cultural resistance, legal ambiguity, and weak institutional capacity. The research shows that context-adapted PPP frameworks, utilizing tools such as Islamic finance instruments (e.g., *Ijara*, *Istisna*), minimum revenue guarantees, and lifecycle-based blended financing, can help mitigate these risks.

The thesis proposes a pilot PPP model to be implemented on secure, state-owned land in relatively stable areas like Aleppo or Homs countryside. The model emphasizes phased implementation, local authority engagement, and transparent governance.

Key words: Public-Private Partnership (PPP), Modular Housing, Post-Conflict Reconstruction, Syria, Affordable Housing, Islamic Finance

PPP-lösningar för prefabricerade modulbostäder i det postkonfliktuella Syrien

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Sammanfattning

Det långvariga kriget i Syrien har lett till att över en tredjedel av landets bostadsbestånd har förstörts eller skadats, och mer än 13 miljoner människor har fördrivits. Traditionella metoder för återuppbyggnad är för långsamma, kostsamma och institutionellt krävande för Syriens nuvarande sköra situation. Denna avhandling undersöker potentialen i att kombinera offentlig-privata partnerskap (PPP) med modulära prefabricerade bostäder som en genomförbar lösning för storskalig och prisvärd bostadsförsörjning i det postkonfliktuella Syrien.

Studien använder en kvalitativ metodologi baserad på en systematisk litteraturöversikt och sex semistrukturerade intervjuer med intressenter från utvecklingsinstitutioner, privat sektor, akademiska forskare, ideella organisationer och internationella finansiella institutioner. Den identifierar ett viktigt forskningsgap i hur PPP-finansiering kan integreras med modulära byggtekniker i sårbara stater.

Resultaten visar att modulbostäder erbjuder betydande fördelar, såsom snabbhet, kostnadseffektivitet, minskat behov av arbetskraft och högre kvalitetskontroll. Samtidigt finns det flera hinder för tillämpning i Syrien, inklusive höga kapitalinvesteringar, kulturellt motstånd, rättslig osäkerhet och svaga institutionella strukturer. Forskningen visar att kontextanpassade PPP-ramverk, som använder verktyg såsom islamiska finansinstrument (t.ex. Ijara, Istisna), minimala intäktsgarantier och livscykelbaserad blandfinansiering, kan bidra till att mildra dessa risker.

Avhandlingen föreslår en pilotmodell för PPP som kan implementeras på säker, statligt ägd mark i relativt stabila områden som landsbygden kring Aleppo eller Homs. Modellen betonar successiv implementering, delaktighet från lokala myndigheter och transparent styrning.

Nyckelord: Offentlig-privat partnerskap (PPP), modulbostäder, återuppbyggnad efter konflikt, Syrien, prisvärda bostäder, islamisk finansiering

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List of Acronyms

Table 1, List of Acronyms Used in the Study

Acronym	Full Term
ADB	Asian Development Bank
BIM	Building Information Modeling
BOT	Build-Operate-Transfer
DBFO	Design-Build-Finance-Operate
DSCR	Debt Service Coverage Ratio
EDGE	Excellence in Design for Greater Efficiencies
ICIEC	Islamic Corporation for the Insurance of Investment and Export Credit
IDP	Internally Displaced Person
IFC	International Finance Corporation
IFI	International Financial Institution (e.g., World Bank)
Ijara	Islamic lease-to-own financing structure
Istisna	Islamic project financing contract with phased payments tied to construction milestones
KSA	Kingdom of Saudi Arabia
LGS	Light Gauge Steel
MCS	Monte Carlo Simulation

MIGA	Multilateral Investment Guarantee Agency
MRC	Maximum Revenue Cap
MRG	Minimum Revenue Guarantee
NGO	Non-Governmental Organization
PPP	Public-Private Partnership
QSAND	Quantifying Sustainability in Aftermath of Natural Disasters
ROA	Real Options Analysis
SPV	Special Purpose Vehicle
SROI	Social Return on Investment
Sukuk	Sharia-compliant investment certificates (Islamic bonds)
Takaful	Islamic cooperative insurance model
UN-Habitat	United Nations Human Settlements Programme
UNHCR	United Nations High Commissioner for Refugees
VGF	Viability Gap Funding
Waqf	Islamic endowment system
WB	World Bank

1. Introduction

This chapter lays the groundwork for the study by contextualizing Syria's acute housing crisis in the aftermath of prolonged conflict and displacement. It outlines the limitations of conventional reconstruction methods and presents the rationale for exploring modular prefabricated housing through Public-Private Partnership (PPP) frameworks. The chapter further identifies the research gap, defines the study's objectives, and formulates the central research question. In doing so, it frames the academic, practical, and policy significance of investigating PPP-based modular housing solutions tailored to Syria's unique post-conflict challenges.

1.1. Background: Syria's Post-Conflict Housing Emergency

Fourteen years of armed conflict have left Syria with one of the critical housing emergencies of the modern era. A World Bank (2017) damage assessment estimates that more than one-third of the national housing stock is either partially damaged or completely destroyed, with urban centres such as Aleppo, Homs and Eastern Ghouta suffering destruction rates that in some districts exceed 50 percent. Compounding this physical destruction is a massive displacement crisis: over 13 million Syrians, both refugees and internally displaced persons, have been forced from their homes (UNHCR, 2024).

Governance fragmentation drained public finances, and severely destroyed infrastructure now holds back any large-scale, state-led reconstruction effort (Kwaylih et al., 2023). Consequently, the housing deficit cannot be bridged by conventional public procurement or traditional on-site construction alone.

1.2. Why PPP-Based Modular Housing in Post-Conflict Syria

Rebuilding post-conflict Syria presents an extraordinary housing challenge. Conventional rebuilding methods, already slow and capital-intensive in stable contexts, face acute logistical, financial and human-resource constraints in Syria. Any viable solution must therefore deliver housing at speed and scale while remaining cost-effective, culturally appropriate, and institutionally feasible. Identifying such a delivery mechanism, and tailoring it to Syria's post-conflict realities, constitutes the central research problem.

One pathway attracting increasing attention is modular prefabricated housing. Although its technical merits are examined in detail in Section 2.2, It is important to highlight that factory-built units can be transported and assembled rapidly, reduce reliance on scarce skilled labor, and perform well in resource-constrained settings. Yet technical promise alone is insufficient. Successful uptake also requires a financing and governance framework that can mobilize capital, share risk equitably, and ensure transparent oversight, hence the relevance of PPPs.

Internationally, PPPs have become a preferred instrument for delivering public infrastructure and affordable housing in post-disaster or low-income contexts, complementing tools such as bond financing, land-use incentives and real-estate investment trusts (Jones, 2007; Lawson et al., 2009; Whitehead, 2007). Their effectiveness in balancing efficiency and public accountability is well documented (Mazouz et al., 2008; Xu et al., 2012).

Countries such as India integrated PPPs into its urban-housing policy to balance cost and quality objectives (Sengupta, 2006). Nigeria has likewise utilized PPP schemes to accelerate the delivery of low-income housing (Adegun & Taiwo, 2011). In the United States, the HOPE VI program, launched in 1992, used PPP structures to renew distressed public-housing developments (Zhang, 1996). Canada followed suit in 2000 with the “Let’s Build” initiative, which broadened private participation in affordable-housing provision (Griffin, 2003). Ireland has relied on PPP arrangements for social-housing regeneration since 2000 (Norris & O’Connell, 2010), while the Queensland Government in Australia adopted a PPP framework in 2001 specifically to enhance value-for-money in housing delivery (Susilawati & Armitage, 2004). These models underscore the adaptability of PPPs in aligning public objectives with private-sector expertise, a trait particularly relevant to Syria, where coordinated, scalable, and financially sustainable housing solutions are urgently required (Kwaylih et al., 2023).

These global experiences highlight the adaptive potential of PPP models. However, their integration with modular housing technologies in post-conflict environments such as Syria remains underexplored, a gap this study seeks to address.

1.3. Research Gap

The literature on PPPs in housing concentrates on financing and governance arrangements built around traditional, labor-intensive construction, whereas research on modular prefabricated systems emphasizes speed and resource efficiency, typically in short-term relief projects. Rarely are these two parts brought together into a single model that can both mobilize capital and deliver rapid, factory-built units. This gap is particularly evident in post-conflict Syria, where extraordinary housing destruction and mass displacement intersect with deep fiscal and institutional fragility, making it difficult to rely on purely public or donor-led solutions, while the urgency of delivering fast, low-labor shelter adds further pressure for innovative approaches. Existing studies therefore fall short on two fronts at once: they neither integrate PPP financing with modular technology nor adapt that integration to Syria's distinctive reconstruction view. The present study fills this dual gap by exploring the best practice PPP, modular framework solutions applicable to Syrian constraints and by outlining a pilot project that demonstrates how these solutions could function under real-world conditions.

1.4. Research Objectives

- To find the best and most relevant solutions and framework approaches in PPP adapted to the institutional, financial, and socio-political constraints of post-conflict Syria for the delivery of modular prefabricated housing.
- To translate this framework into an implementable pilot project that demonstrates how modular technology and PPP mechanisms can be integrated to meet urgent housing needs in fragile contexts.

1.5. Research Aim and Question

This study aims to identify feasible and effective PPP frameworks for delivering affordable modular housing in post-conflict Syria and to propose a small-scale pilot project that translates these frameworks into a realistic implementation scenario. The pilot design serves as a conceptual demonstration of how PPPs could be mobilized for reconstruction under Syria's financial, institutional, and socio-cultural constraints. . Hence, the study addresses the following research question:

What PPP frameworks are most feasible and effective in delivering affordable modular housing in post-conflict Syria, and how can they be utilized through a pilot project model that accounts for financial, institutional, and socio-cultural constraints?

1.6. Research Significance

This study grows out of a personal conviction: rebuilding Syria after years of conflict is not just an engineering challenge but a moral duty. As a Syrian architect, I see housing as a basic right and a first step toward restoring dignity for displaced families. The project therefore sets out to craft a practical, affordable pathway, grounded in public-private partnerships and modular construction, that can help people return home quickly and safely. Choosing modular housing was itself based on a moral purpose. Factory-built units can be delivered and assembled far faster than conventional buildings, easing the pressure on communities that have waited years for a stable roof. But the research doesn't only focus on speed, but also attempts to find a best solutions to provide homes in reach financially. Throughout the thesis, affordability and accessibility are treated as non-negotiable principles so that the benefits of reconstruction do not flow only to those with the greatest means.

Academic contribution. By binding together two fields that rarely meet, PPPs and modular housing in fragile states, this study offers a fresh conceptual template for scholars of reconstruction. The pilot blueprint adds a concrete case that other war-torn countries can adapt.

Practical contribution. For builders, investors, and Non-Governmental Organizations (NGOs), the proposed partnership framework sets out a scalable, cost-controlled pathway to shelter provision. It details risk-sharing clauses, funding mechanisms, and transparency measures that encourage private participation without sacrificing public oversight.

Policy relevance. The findings give Syrian decision-makers and their international partners, an evidence-based guide to structuring PPPs for housing recovery. Clear governance steps, financing routes, and accountability tools can streamline future modular-housing programmes across crisis-affected regions.

1.7 Disposition

Figure 1 below presents an overview of the study's structure, outlining the key components of the literature review, methodology, data analysis, discussion, and research implications. This visual representation helps clarify the logical flow and interconnectedness of each chapter.

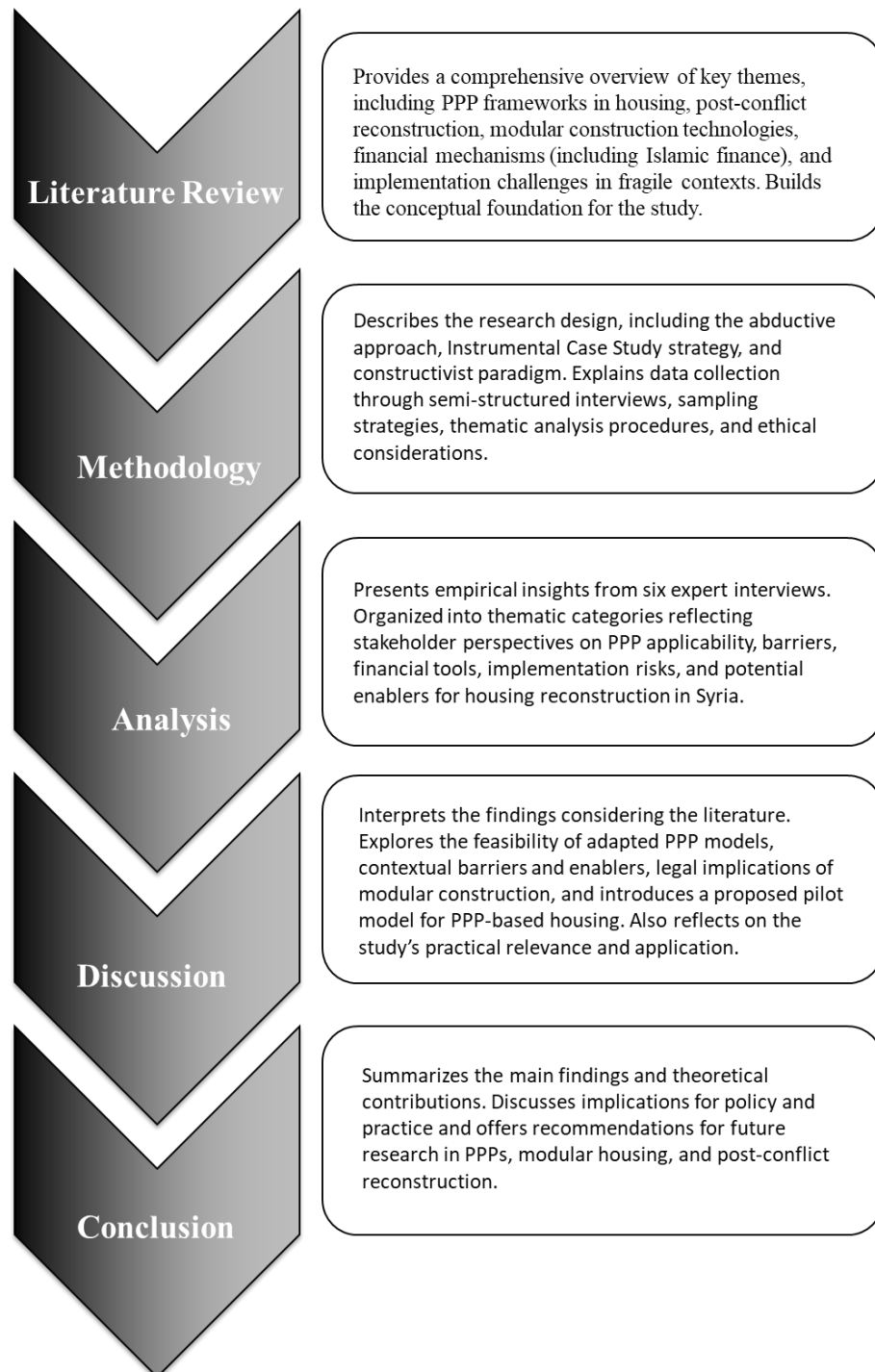


Figure 1: overview of the study's structure

2. Literature Review

This chapter explores the existing body of knowledge on PPPs and modular prefabricated housing in post-conflict reconstruction contexts. It begins by identifying the benefits and implementation challenges of PPP frameworks in affordable housing delivery, with a focus on institutional capacity, financial risks, and stakeholder coordination. A diverse set of international case studies is examined to highlight the various PPP models and their adaptive features. The second part of the chapter shifts to modular prefabricated housing, analyzing its advantages in speed, cost-efficiency, environmental sustainability, and design flexibility, while also acknowledging key constraints such as cultural acceptance, logistical complexity, and governance gaps. The final sections synthesize financing mechanisms and sustainability strategies, including blended finance, Islamic tools, risk mitigation models, and lifecycle-based approaches.

2.1. Public-Private Partnership (PPP) Solutions for Post-Conflict Housing

2.1.1. Benefits of PPPs in Housing

PPPs are widely recognized as a strategic approach to addressing housing deficits, particularly in urban and post-conflict contexts, by leveraging combined resources and expertise (Jones, 2007; Lawson et al., 2009; Whitehead, 2007). A primary benefit is the increase in housing supply, especially in regions like Tanzania and Malaysia, where government subsidies and favorable policies have enabled PPPs to deliver affordable housing projects at scale (Kavishe, et al., 2018 ; Kavishe et al., 2018). These partnerships enhance efficiency and innovation by integrating private-sector technical expertise in construction and project management, which accelerates delivery and improves quality, particularly critical in post-conflict reconstruction where speed and sustainability are prioritized (Kavishe et al., 2018; Alteneiji, Alkass, & Abu Dabous, 2021; Madden, 2011). Resource mobilization is another key advantage, as PPPs pool public and private funds, overcoming budgetary constraints in post-conflict or disaster-affected areas, thereby accelerating infrastructure rebuilding (Alteneiji et al., 2021; Vahdatmanesh et al., 2022; Kwaylih et al., 2023).

PPPs also distribute risks between sectors, with mechanisms like minimum revenue guarantees (MRGs) and maximum revenue caps (MRCs) mitigating financial uncertainties for private investors, while governments provide land and regulatory support (Alteneiji et al., 2021; Mottaeva, 2018; Vahdatmanesh et al., 2022). Community engagement ensures cultural appropriateness and long-term viability, as seen in projects where resident participation reduces opposition and aligns outcomes with local needs (Madden, 2011; Kwaylih et al., 2023). Long-term contracts under PPP frameworks sustain investment and maintenance, addressing systemic issues like supply chain bottlenecks and material shortages, as demonstrated in China’s centralized infrastructure development (Mottaeva, 2018; Chang et al., 2010).

In post-disaster or conflict zones, PPPs integrate market flexibility with government oversight, balancing donor management and local industry integration to reduce aid dependency, as seen in Indonesia and Australia, where insurance mechanisms and financial incentives accelerated housing recovery (Chang et al., 2010). Specific to Syria, PPPs mobilize technical and financial resources for large-scale shelter needs, introducing innovative construction methods and community-driven designs to address cultural diversity amid displacement (Kwaylih et al., 2023).

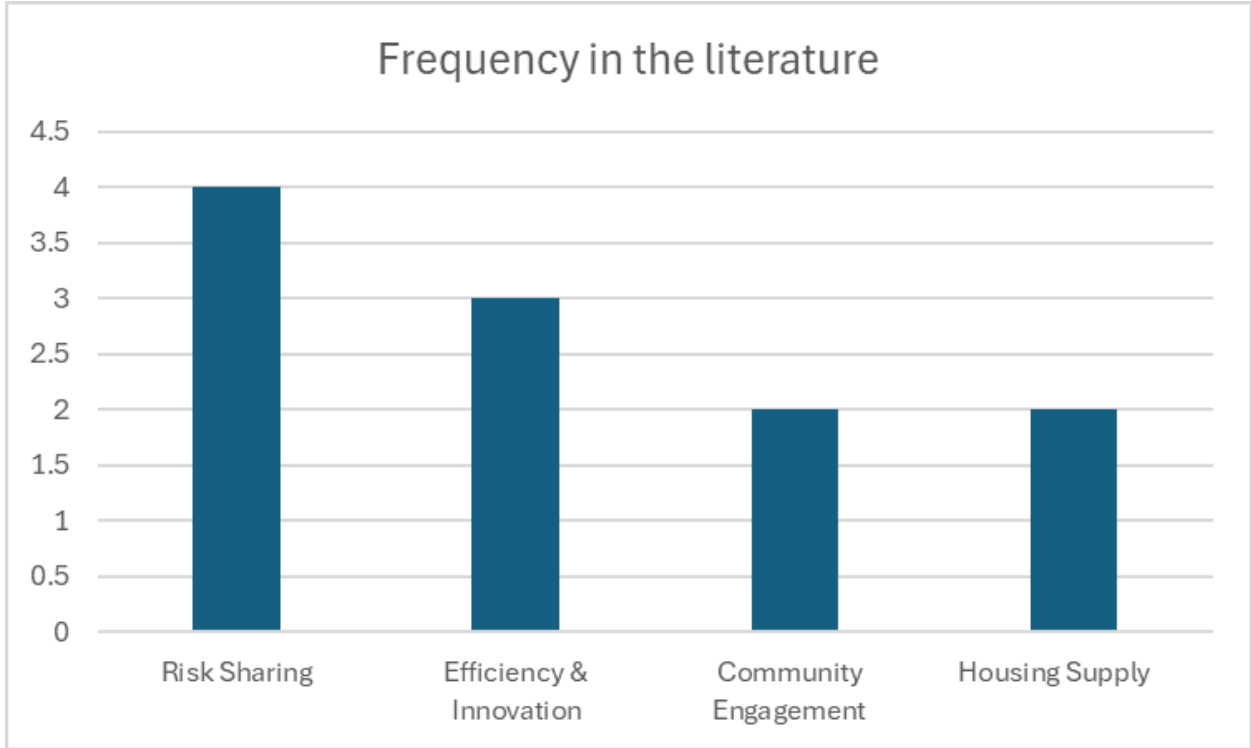


Figure 2: Key benefits of PPPs reported in housing construction.

The figure shows the number of times each benefit was mentioned across the reviewed literature, based on nine selected sources

2.1.2 Challenges and Solutions in PPP Housing Projects

2.1.2.1 Institutional and Capacity-Related Challenges

In many developing or post-conflict regions, a persistent challenge in PPP implementation lies in the limited technical and institutional capacity of public Authorities. Officials often lack the training to negotiate complex PPP contracts or manage multi-stake holders frameworks effectively.

Kavishe et al., (2018) identify these skill gaps as a leading cause of poor project design and implementation in approximately forty percent of the literature reviewed. Addressing this challenge demands targeted, context-specific capacity-building programs that improve legal literacy and negotiation competence among public actors.

(Kavishe et al., 2018, p 217.)

A related issue is conceptual ambiguity surrounding PPP terminology. Misunderstandings about procurement mechanisms or risk-sharing responsibilities often lead to inefficiencies and stakeholder misalignment (Mottaeva, 2018). Without a shared understanding of basic concepts, collaboration becomes more fragile.

Another critical barrier is the weakness or absence of enabling legal frameworks. Around 35% of studies cite the lack of robust contractual and regulatory infrastructure as a root cause of disputes, delays, and investor hesitancy (Kavishe et al., 2018; Mottaeva, 2018). Formalizing legal procedures through standardized policies and regulatory guidance could help clarify roles, improve transparency, and protect stakeholders (Kavishe et al., 2018).

Moreover, ineffective project preparation, particularly in feasibility and risk analysis, frequently disturb outcomes. Mottaeva (2018) argues that many PPP failures stem from unrealistic expectations during the design phase, which could be mitigated through more careful commercial and technical assessments.

2.1.2.2 Financial and Risk Management Challenges

Financial constraints are among the most commonly cited barriers to PPP success in housing. High procurement costs and the misrepresentation of financial capacity by some private actors were mentioned in approximately 35% of studies (Kavishe et al., 2018). Competitive tendering, coupled with third-party audits and strict pre-qualification protocols, can mitigate these risks and foster transparency.

Poorly defined risk-sharing mechanisms also generate uncertainty, especially in fragile contexts. In roughly 20% of the literature, disputes are linked to imbalanced risk allocations that fail to reflect the unique vulnerabilities of post-conflict or post-disaster environments (Kavishe et al., 2018; Vahdatmanesh et al., 2022). In such cases, governments may need to absorb political or macroeconomic risks, while private entities manage performance-related risks (Alteneiji et al., 2021). Tools like Minimum Revenue Guarantees (MRGs) and Real Options Analysis (ROA) have been proposed to stabilize returns and improve risk modeling (Vahdatmanesh et al., 2022).

In addition, the long-term nature of housing PPPs, particularly in post-conflict settings, can discourage private investment due to interest rate volatility and economic unpredictability. Alteneiji et al. (2021) suggest that government guarantees, tax incentives, or subsidized loans could reduce investor exposure. Creative instruments such as land swaps or deferred tax credits have also been used to improve affordability and project viability (Madden, 2011).

2.1.2.3. Operational and Logistical Barriers

In fragile or post-disaster regions, operational barriers such as resource shortages and disrupted supply chains are frequent. For example, in China, state-imposed price controls on building materials discouraged private-sector participation, while in Indonesia, donor-driven imports led to inflation and logistical delays (Chang et al., 2010). Alternatives like Land Readjustment (LR) models, which allow developers temporary access to land in exchange for infrastructure delivery, offer more flexible financing options (Vahdatmanesh et al., 2022). Equally important is strengthening local capacity to minimize reliance on international aid (Chang et al., 2010).

Regulatory challenges also hinder effective delivery. In Australia, overly stringent post-disaster construction standards raised costs unnecessarily, whereas in Indonesia, underregulated NGO

efforts led to inconsistent quality and inefficiencies (Chang et al., 2010). A flexible but enforceable PPP framework is needed to balance quality control with market responsiveness.

2.1.2.4 Social and Governance Challenges

Cultural misalignment, lack of community engagement, and governance fragmentation pose further obstacles. Roughly 25% of studies cite community opposition and mistrust as significant contributors to project delays or failures (Kavishe et al., 2018; Madden, 2011). Participatory design strategies that engage residents early in the planning process, such as those piloted in Syria, help reduce resistance and foster ownership (Madden, 2011; Kwaylih et al., 2023).

Weak coordination among stakeholders, particularly in post-conflict zones like Syria, often leads to fragmented implementation and misaligned objectives. Kwaylih et al. (2023) highlight the need for integrated PPP models that support environmental, social, and economic goals, especially in displacement contexts.

The over reliance on external aid is also considered a structural vulnerability . Donor-driven approaches, despite its benefits in emergencies, can marginalize local industries and undermine long-term resilience. As observed in Indonesia, imported materials and labor bypassed local systems, raising costs and reducing sustainability. Strengthening domestic supply chains and investing in human capital is essential for self-sufficient housing systems (Chang et al., 2010).

2.1.3 Case Studies and Examples

Public-private partnerships (PPPs) in housing take a wide range of forms. Looking across international cases and in an attempt to categorize them by partnership type rather than geographical border makes their underlying logic much clearer, and help us understand the different diversified forms. A first category is the finance-only model, where the private sector's role is limited to arranging and servicing loans while the state bears affordability. Dubai's Mohammed Bin Rashid Housing Establishment (MBRHE) illustrates this approach: its Al Yusr Initiative outsources every stage of loan administration to commercial banks, "loan outsourcing, where private banks manage the entire financing process, including disbursement, repayment collection, and follow-up operations for loans with terms of up to 25 years" (Alteneiji et al., 2021). Banks absorb risks for credit, funding, operational, and interest-rate risks, while the government pre-pays the present value of future profits, which "reduces financial burdens on low-income beneficiaries" (Alteneiji et al.,

2021). Islamic funding tools such as *Ijara* and *Takaful* keep the scheme culturally aligned. Between 2014 and 2018 the initiative financed 309 homes, 7 percent of all loans, but “the long-term nature of the loans (25 years) has discouraged broader participation in the program” (Alteneiji et al., 2021). Sharjah’s Directorate of Housing forged a similar 2011 alliance with Emirates Islamic Bank: interest-free loans up to AED 800,000, payable over 25 years, “significantly improve affordability for low- and middle-income families” (Alteneiji et al., 2021). Here the bank assumes “funding availability, operational efficiency, potential fraud incidents, and currency fluctuation risks,” while the public side covers “beneficiary payment defaults, changes in interest rates and potential impacts of legal or regulatory reforms” (Alteneiji et al., 2021); While Islamic instruments (*Istisna*, *Ijara*) ensure religious compliance.

A second category consists of delegated-private management models in which the state keeps ownership but transfers day-to-day operations. France relies on private operators to handle maintenance and tenant services, a design that “emphasizes efficiency without full privatization, ensuring public accountability” (Mottaeva, 2018). The Netherlands goes further by converting the public enterprise into a joint-stock company: the government retains governance control, private investors track profit, and in theory “housing projects balance commercial viability with social objectives” (Mottaeva, 2018).

A third variant is full privatization under public oversight. The United Kingdom has transferred both ownership and management of substantial amounts of public housing to private landlords; the state’s role is now reduced to just enforcing rules, “focusing on enforcing quality standards and tenant protections” (Mottaeva, 2018).

Some PPPs hinge on formal revenue- and risk-sharing devices. After Iran’s 2019 Golestan floods, Real Options Analysis (ROA) weighed trinomial lattice scenarios for housing reconstruction PPPs that include “Minimum Revenue Guarantees (MRGs)” and “Maximum Revenue Caps (MRCs).” MRGs “protect private investors by compensating them when revenue falls below a set threshold,” whereas MRCs allow governments “to claim excess revenue above a predetermined cap,” delivering “flexibility in uncertain post-disaster conditions by balancing risks and benefits for both parties” (Vahdatmanesh et al., 2022). That can be the fourth type and a process of the well-known PPP model as BOT (Build operate transfer).

In a fifth framework, Cross-subsidy housing mechanism utilizes profits from market-rate developments to finance affordable units, creating a self-sustaining delivery model. Malaysia exemplifies this approach by redirecting surpluses from high-income housing projects toward low-income supply, while supplementing this with "government-backed loans targeting economically disadvantaged groups" (Kavishe et al., 2018). This integrated strategy facilitates large-scale affordable housing provision without compromising financial viability, effectively balancing market incentives with social welfare imperatives. Critically, the model sustains "affordability and social equity" (Kavishe et al., 2018) through redistributive financing rather than relying solely on public subsidies. Such market-steered interventions demonstrate how policy architecture can align profit motives with equitable urban development objectives.

Where regulatory barriers are the main constraint, institutional flexibility proves decisive. Kolkata's PPPs in India overcame "outdated legislation (e.g., rigid land-use laws) and high taxes on construction materials" by adopting "localized regulatory adjustments (e.g., streamlined approvals) and strong government prioritization of housing as a public good" (Kavishe et al., 2018), achieving moderate success despite structural hurdles.

On the other hand, projects that lack supportive institutional and legal frameworks are often at risk of failure, regardless of their financial or technical potential. The case of Tanzania clearly illustrates how structural deficiencies can undermine PPPs. As Kavishe et al. (2018) observe, Tanzania's housing PPPs have largely stalled due to a combination of factors: vague and inconsistent legal provisions (e.g., unclear contract terms), weak project oversight (e.g., long delays in approval processes), and limited competition among private sector participants. These deficiencies have not only hindered project implementation but also discouraged sustained private involvement. A similar pattern can be seen in Russia, where the existence of formal PPP legislation and dedicated coordination centers has not been sufficient to ensure success. According to Mottaeva (2018), a major barrier lies in the "terminological uncertainty," where imprecise legal definitions lead to confusion about roles and responsibilities between public and private actors. This lack of clarity continues to stall project uptake. Meanwhile, Russia's rapidly aging housing infrastructure compounds the urgency of intervention, as it contributes significantly to environmental degradation through outdated systems and inefficient energy consumption (Mottaeva, 2018).

Post-disaster housing programmes tend to follow one of three distinctive models. China's 2008 Wenchuan earthquake response exemplifies a centrally managed, state-funded approach: the

government imposed price ceilings and coordinated logistics to stabilise markets, yet those same controls encouraged “material overproduction” when demand forecasts proved inaccurate (Chang et al., 2010). Indonesia’s reconstruction after the 2004 tsunami illustrates a donor-driven model: international NGOs financed and supervised much of the rebuild, importing scarce materials to accelerate progress; however, this influx pushed up prices, created delivery bottlenecks, and exposed “logistical bottlenecks and skilled labour gaps,” delaying completion (Chang et al., 2010). Australia’s recovery from the 2009 bushfires represents a market-led, insurance-based strategy: private insurers released payouts that attracted developer capital, but the introduction of stricter post-fire building codes “raised costs, reducing affordability” for affected households (Chang et al., 2010). These cases show how important is the choice of funding and governance mechanism, state budgets, donor aid, or private insurance, and how each impact both the speed of reconstruction and its long-term housing affordability.

The United States case studies documented by Madden (2011) illustrate a wide spectrum of context-sensitive public–private-partnership frameworks whose outcomes were strongly correlated with the degree of risk allocation transparency and the effectiveness of community engagement strategies, and shared information. The first model, a land-swap design–build–finance–operate agreement (DBFO), moved an affordable-housing project from a contaminated parcel to clean public land; by bundling land acquisition, design, financing, construction and long-term operation in a single contract, the developer met LEED-Silver standards and “addressed environmental concerns and gained community support” (Madden, 2011). The second, a phased-relocation lease–operate framework, erected an on-site “holding house” so residents could remain in their neighbourhood during redevelopment, with lease payments released only when construction milestones were verified, an arrangement that preserved social networks and attracted new investment (Madden, 2011). A third initiative employed a performance-based service lease for supportive housing: a nonprofit developer provided units, meals and counselling to chronic inebriates and received outcome payments from public-health agencies once detox admissions fell, ultimately “reducing detox admissions by 90 per cent and saving taxpayer costs” (Madden, 2011). The fourth case adopted a community-engaged design–build contract in which neighborhood charrettes gave residents veto power over massing and façade options; after several design rounds the partners “revised plans to improve functionality and aesthetics, and secured approval through collaborative engagement” (Madden, 2011). Fifth, a nonprofit–for-profit co-development framework resolved a design stalemate when the commercial partner “organised site visits and co-designed a context-

sensitive solution,” balancing market feasibility with social aims (Madden, 2011). Not every experiment succeeded: a grant-bridging concession collapsed after a nonprofit concealed information about a gap-closing grant, trust evaporated, and “no housing units were built” (Madden, 2011); likewise, a negotiated-sale public–private partnership foundered when rigid bargaining positions forced the parties to “return a one-million-dollar grant and abandon the project” (Madden, 2011).

Before setting the earlier case studies against the formal PPP categories shown in the next table, it helps to anchor the discussion in two practical frameworks that give any housing partnership a clear sustainability checklist. The first is the *Quantifying Sustainability in the Aftermath of Natural Disasters (QSAND)* tool, created by the Building Research Establishment for the International Federation of Red Cross and Red Crescent Societies. QSAND scores a project on basics such as how well the site is planned, how efficiently it uses water and energy, and whether the design supports long-term community well-being; in short, it turns the broad idea of “build back better” into a set of points that can be written directly into a PPP tender. Kwaylih et al. (2023) argue that the same checklist “could be adapted for use in PPPs to ensure a comprehensive approach to sustainable housing solutions in post-conflict settings like Syria,” allowing a government to make payment to a private partner dependent on meeting each QSAND target. The second reference point is the Shelter Cluster’s principle that “a shelter is more than a roof.” Its seven recommended solutions push developers to involve local residents in design, rely on familiar building methods, and set out neighbourhood space in a way that supports daily life after a crisis. These steps, again noted by Kwaylih et al. (2023), can be turned into contract clauses, whether the deal is a build-operate concession, a simple management lease, or a finance-only arrangement, so that community participation and locally sourced materials are not optional extras but conditions for getting paid.

Table 2, the classification of PPP model types according to the literature

Case Type	International Classification	Examples	Key Features
Finance-Only PPP	Service Contract / Financial Intermediation PPP	Al Yusr (Dubai), DH, EIB (Sharjah)	Bank handles only financing and repayment; no construction or ownership.
Delegated Management with Public Ownership	Management Contract / Lease-Operate	France, Netherlands	Private party operates service; public sector retains asset ownership.
Full Privatization with Oversight	Divestiture	United Kingdom	Private entity owns and operates; public only regulates.
Revenue and Risk-Sharing	Concession / BOT	Iran (Real Options Analysis)	Private sector shares revenue risk; often uses MRGs/MRCs.
Cross-Subsidy + Public Loans	Public Finance Initiative / Cross-Subsidy PPP	Malaysia	Government profits from high-end units subsidize low-income housing.
Regulatory Adjustment Enabled PPP	Policy-Enabled PPP Framework	India (Kolkata)	PPP success depends on legal/tax reform and facilitation.
Institutionally Constrained PPP	Failed PPP / Pre-PPP Procurement	Tanzania, Russia	Weak laws, mismanagement, or institutional gaps prevent implementation.

Post-Disaster Housing PPP	Emergency / Reconstruction PPP	China, Indonesia, Australia	Short-term, flexible PPPs for disaster housing recovery.
Innovative or Mixed-Form PPP	Design-Finance-Operate / Community PPP	United States (various cases)	Hybrid or ad-hoc partnerships with strong local adaptation.

2.2. Modular Prefabricated Housing in Post-Conflict areas

2.2.1. International Guidelines on Post-Disaster Housing Reconstruction

International organizations such as FEMA and Oxfam have established guidelines for post-disaster housing reconstruction. FEMA (2005) defines "shelter" as temporary dwellings and "housing" as permanent dwellings that include physical, social, and administrative infrastructure (Gunawardena et al.). Oxfam (2003) emphasizes the importance of integrating local capacities and ensuring that housing solutions are culturally appropriate and sustainable (Gunawardena et al.). Oxfam also recommends pre-emptive strategies such as matching technology to local capacity, setting realistic project schedules, and building model houses to provide a clear understanding of the final product (Gunawardena et al.).

2.2.2. Modular Prefabricated Housing Advantages for Post-Conflict Reconstruction

- *Time Efficiency and Rapid Deployment*

Modular construction methods demonstrate unparalleled speed advantages, completing projects 45-50% faster than traditional construction (Lawson et al., 2012; Veiskarami, 2020). This is achieved through simultaneous off-site manufacturing and on-site preparation, as exemplified by the Wolverhampton student residence project which achieved a 45% reduction in construction time (Lawson & Ogden, 2007), and the 25-storey Wolverhampton student housing completed in just 27 weeks - half the estimated time for conventional construction (Lawson et al., 2012 as cited in Gunawardena et al.). Because modular construction streamlines the entire building process, projects

finish significantly quicker. This makes it especially valuable after conflicts, offering displaced families the rapid housing solutions they desperately need. (Gunawardena et al.)

- *Cost-Effectiveness and Economic Advantages*

The economic benefits of modular construction are substantial, offering approximately 20% overall cost savings (Veiskarami, 2020). These savings result from multiple factors including an 83.2% reduction in construction waste compared to conventional methods (Loizou et al., 2021), with specific projects documenting waste levels as low as 9 kg per unit versus the industry average of 10-13% wastage (Lawson & Ogden, 2007). Additional cost efficiencies stem from reduced labor requirements and minimized on-site construction errors (Veiskarami, 2020), making modular solutions particularly advantageous in resource-limited post-conflict scenarios.

- *Environmental Sustainability and Energy Efficiency*

Modular construction demonstrates superior environmental performance with 43% lower CO₂ emissions than traditional building methods (Veiskarami, 2020). The approach enhances sustainability through reusable and relocatable unit designs (Gunawardena et al.) while achieving exceptional energy efficiency, as evidenced by air leakage rates below 2 m³/m²/hr (Lawson & Ogden, 2007).

- *Quality Assurance and Safety Features*

The controlled factory environment of modular construction ensures higher quality outcomes with greater precision and fewer defects (Loizou et al., 2021). Safety is significantly enhanced through specialized fire-resistant materials and reduced on-site accident risks (Veiskarami, 2020).

- *Design flexibility*

Modular solutions offer exceptional design versatility, accommodating customized architectural requirements (Gunawardena et al.) and allowing seamless transition from temporary to permanent housing configurations (Veiskarami, 2020). The integrated nature of modular components simplifies on-site assembly (Gunawardena et al.), effectively addressing common post-conflict challenges including skilled labor shortages and infrastructure damage.

Table 3. Functional Advantages of Modular vs. Traditional Construction for Post-Conflict Reconstruction

Feature	Modular Construction	Traditional Construction	Advantage
Construction Speed	45-50% faster completion	Standard timelines	Rapid rehousing implementation
Cost Efficiency	20% overall cost reduction	Higher construction costs	Budget optimization
Material Waste	83.2% less waste generated	Significant material wastage	Sustainable resource use
Quality Control	Factory-controlled precision	Weather-dependent outcomes	Consistent quality assurance
Design Flexibility	Reconfigurable unit designs	Fixed structural solutions	Adaptable housing solutions
Safety Performance	Reduced on-site accident risks	Higher accident rates	Enhanced worker protection
Environmental Impact	43% lower CO ₂ emissions	Standard carbon footprint	Climate-friendly construction
Labor Requirements	Reduced staffing needs	Labor-intensive processes	Efficient resource allocation

Note. Quantitative figures (45 – 50 % faster completion, 20 % overall cost reduction, 83.2 % less material waste, 43 % lower CO₂ emissions) are taken from the studies cited in the text above; qualitative advantages are the author’s synthesis of that same evidence. All percentages compare modular with equivalent conventional-construction baselines.

2.2.3. Affordability and Accessibility

1. *Affordability Considerations*

Modular prefabricated housing offers a viable solution for affordable housing in post-conflict reconstruction, although it involves important financial considerations. As a central concept in policy development, housing affordability directly relates to an individual's ability to cover homeownership costs, with prefabricated buildings (PBs) positioned to offer cost-effective solutions through efficient construction technologies (Ammari & Roosli, 2024). However, financial challenges persist, particularly in developing regions where governments often lack sufficient resources to address housing crises independently, necessitating public-private collaboration (Ammari & Roosli, 2024).

The perception of cost savings with prefabrication remains mixed. While some stakeholders question whether PBs offer significant cost advantages over traditional methods (Sholanke et al., 2019 as cited in Ammari & Roosli, 2024), modular construction demonstrates clear financial benefits through mass production efficiencies. Though initial investments may be 2% higher than conventional construction, modular methods deliver 39% greater turnover and 43% higher Internal Rate of Return (Rogan et al., 2000 as cited in Gunawardena et al.). Additionally, the controlled factory environment minimizes the impact of material and labor cost fluctuations common in prolonged reconstruction projects (Weerakoon et al., 2007 as cited in Gunawardena et al.).

3. *Accessibility Advantages*

Modular construction stands out as a powerful way to boost housing access in difficult post-conflict settings, and its impact can be understood through two linked dimensions. First, every successful scheme hinges on firm, well-designed government backing. Without policies that open up financing channels, many initiatives remain stalled; “limited availability of bank loans or public support currently impedes many housing projects,” a gap that calls for targeted programmes and incentives (Ammari & Roosli, 2024). In the same vein, Venkatesh et al.’s (2003) idea of *facilitating conditions* reminds us that technology adoption, including prefabricated housing, flourishes only when “adequate technical and infrastructural support” is in place (Ammari & Roosli, 2024). Second, modular methods deliver clear logistical and labour advantages that translate directly into greater accessibility. Units can be transported and installed even where road access is poor; the Little Hero

project in Melbourne, completed on a narrow inner-city street, illustrates this flexibility (Gunawardena et al.). On site, labour needs are minimal: local volunteers, given only brief training, can handle “basic assembly tasks,” a crucial advantage when skilled trades are scarce (Gunawardena et al.). Speed is an additional benefit; construction times drop by “over 50 % compared to traditional methods” (Lawson et al., 2012, as cited in Gunawardena et al.). Taken together, strong governmental facilitation and the inherent logistical efficiency of modular construction create a complementary pathway for delivering housing quickly, even in the most challenging post-conflict landscapes.

Table 4 Affordability and Accessibility Comparison of Modular and Traditional Housing in Post-Conflict Contexts

Category	Modular Prefabricated Housing	Traditional Construction	Post-Conflict Advantage
Affordability	2% higher initial cost but 39% greater ROI	Lower upfront costs	Better long-term value
Financing	Requires public-private partnerships	Conventional financing models	Enables projects in resource-poor areas
Accessibility	Installable in constrained spaces	Needs substantial site access	Works in damaged urban areas
Labor Requirements	Minimal skilled labor needed on-site	Skilled labor intensive	Overcomes workforce shortages
Cost Stability	Resistant to material/labor cost fluctuations	Vulnerable to market changes	More predictable budgeting

Note. Quantitative figures (2 % higher initial cost, 39 % greater ROI, ≥ 50 % faster completion) are taken from the studies cited in the text above; qualitative ratings are the author’s synthesis of that evidence. Percentages are expressed relative to conventional-construction baselines.

2.2.4. Challenges and Constraints of Modular Prefabricated Housing in Post-Conflict Reconstruction

Despite its technical advantages and long-term efficiency, modular prefabricated housing encounters a wide range of challenges when applied in post-conflict reconstruction contexts. These challenges span financial and economic barriers, cultural resistance, technical limitations, governance and institutional weaknesses, as well as gaps in local workforce capacity and construction knowledge. The following sections explore each of these constraints in detail, drawing on examples from both literature and post-crisis case studies.

Modular prefabricated housing faces significant financial hurdles in post-conflict implementation. The high initial capital requirements for establishing prefabrication plants present a major obstacle, particularly in developing nations where government budgets are already strained (Ammari & Roosli, 2024). While modular construction offers long-term cost benefits, the substantial upfront investment needed for manufacturing facilities and transportation logistics often proves prohibitive in resource-constrained environments (Loizou et al., 2021). Economic volatility further complicates matters, as inflation and material price fluctuations can dramatically impact project budgets over time (Weerakoon et al., 2007 as cited in Gunawardena et al.). Transportation costs alone may account for 13% of manufacturing efforts, with modules sometimes requiring transport over 300 km distances (Lawson & Ogden, 2007).

Beyond financial limitations, cultural acceptance also presents an alarming barrier. Deep-rooted perceptions continue to hinder widespread acceptance of prefabricated housing solutions. Negative associations stemming from historical failures in prefabrication create persistent cultural resistance to these innovative construction methods (Ammari & Roosli, 2024). Many communities maintain a perception of modular housing as temporary or inferior quality, often associating it with emergency shelters rather than permanent dwellings (Veiskarami, 2020). Public misunderstanding deepens when few people grasp how far modern prefabrication has progressed or what advantages it offers (Ammari & Roosli, 2024).

In addition to financial and social constraints, modular housing in post-conflict contexts also encounters technical and logistical challenges that limit its scalability. Structural limitations are prominent: modular systems encounter height restrictions, with load-bearing modules typically

capped at 4-8 stories and corner-supported variants requiring additional structural reinforcement to reach 15+ stories (Lawson & Ogden, 2007). In post-conflict cities, where the demand for compact, high-density housing is both immediate and acute, these limitations impose the most severe consequences. Transportation also presents serious difficulties. Moving modular units to disaster-affected areas presents numerous logistical hurdles. Specialized transport equipment is often required to handle module size and weight, while damaged infrastructure in conflict zones further complicates delivery (Loizou et al., 2021). Environmental factors during transit, including vibration and weather exposure, also risk damaging components (Veiskarami, 2020). Furthermore, The need for standardization in modular production inevitably limits architectural creativity (Veiskarami, 2020). Many architects lack sufficient knowledge about modular construction processes, leading to designs that may not be optimally suited for prefabrication methods (Veiskarami, 2020).

Equally important are the institutional and governance challenges that surround the implementation of modular solutions. Effective deployment of modular housing solutions requires robust institutional support that is often lacking in post-conflict scenarios. The absence of well-defined government policies and financial mechanisms has notably hindered prefabricated housing development in contexts like post-2006 Libya (Ammari & Roosli, 2024). Many reconstruction efforts suffer from inadequate planning expertise and poor stakeholder coordination, resulting in delays and inefficiencies (Oxfam, 2003 as cited in Gunawardena et al.). Resource availability presents another critical constraint, with material shortages, skilled labor deficits, and limited production facilities all potentially disrupting projects (Yan et al., 2011 as cited in Gunawardena et al.).

Finally, even when financial, cultural, and technical challenges are addressed, modular housing efforts in post-conflict zones are frequently held back by workforce limitations and knowledge gaps. While modular construction reduces on-site labor requirements compared to traditional methods, it still demands specialized skills for proper assembly and integration (Loizou et al., 2021). Post-conflict regions frequently lack local expertise in modular techniques, potentially necessitating the importation of skilled workers at additional cost. The unfamiliarity with prefab methods seeps into both the drafting room and the build phase; when those involved do not fully grasp the process, projects often stumble and under-deliver (Ammari & Roosli, 2024).

Table 5 Comparative Analysis of Key Challenges and Constraints of Modular Prefabricated Housing in Post-Conflict Reconstruction

Challenge Category	Specific Constraints	Impact Level	Potential Mitigation Strategies
Financial	High initial investment costs	High	Public-private partnerships, phased implementation
Cultural	Negative perceptions of prefabrication	Medium	Demonstration projects, public education campaigns
Technical	Height restrictions, design limitations	Medium	Hybrid construction approaches, architect training
Logistical	Transportation difficulties, damaged infrastructure	High	Localized production facilities, modular component optimization
Governance	Lack of supportive policies	High	Policy reform initiatives, international technical assistance
Workforce	Skills shortages	Medium	Local training programs, simplified assembly designs

Note. Summary prepared by the author from Ammari & Roosli (2024), Loizou et al. (2021), Lawson & Ogden (2007), Veiskarami (2020), Gunawardena et al. (2011), and Oxfam (2003). Impact-level ratings (High/Medium) were assigned by the author based on the severity and frequency of language used in the cited studies.

2.3 Funding Mechanisms in PPP Housing Projects

2.3.1 Blended Finance and Lifecycle Models

Public-Private Partnership (PPP) housing projects require robust and diversified financing strategies capable of sustaining long-term commitments while addressing contextual risks. The lifecycle financing model, one of the most widely recognized in this context, structures funding across project phases to minimize risk exposure at any single stage. As Khmel & Zhao (2016) outline, a phased approach funds the design stage through sponsor equity, followed by bank loans or bonds financing implementation and operations. Government subsidies often stabilize long-term revenue streams, particularly in social housing projects with modest commercial returns. This lifecycle approach mitigates financial risks and aligns public and private stakeholder interests throughout the project timeline (Khmel & Zhao, 2016).

Blended finance extends this model by strategically combining public and private capital sources to enhance project resilience. Gabrielli et al. (2024) demonstrate this through a scheme involving a Ministry of Education grant, a private real estate fund (Erasmus), and a 75-year lease structure. This configuration distributes risks and rewards to incentivize private participation while maintaining public oversight. In post-conflict settings, where market volatility and institutional fragility prevail, blended finance provides a strategic pathway to attract capital without overburdening public budgets. The flexibility of integrating grants, equity, and long-term lease income enables adaptability to unexpected disruptions.

However, overreliance on single funding sources, especially public subsidies, threatens project sustainability. Sweden's experience with sustainable housing initiatives reveals this vulnerability: projects stalled or were canceled when subsidies were withdrawn due to shifting political priorities or budget constraints (Mattsson et al., 2022). This underscores the need to design financing strategies that remain viable amid policy changes. Truly resilient PPP models must embed financial diversity as a core principle, balancing multiple funding streams and contingency planning.

2.3.2 Islamic Finance Instruments

Islamic finance instruments offer culturally compatible, interest-free alternatives to conventional housing finance, particularly in Muslim-majority regions like the Middle East. These tools are

increasingly integrated into PPP housing frameworks where religious principles prohibit debt-based financing. As highlighted by Alteneiji et al. (2019), the UAE has institutionalized Sharia-compliant finance through initiatives like *Al Yusr* and the *Sheikh Zayed Housing Program*, embedding these instruments into national housing policy. This aligns with Mottaeva's (2018) findings on the role of ethical finance in enhancing social sustainability in housing projects.

Ijara (lease-to-own) enables incremental property acquisition under Sharia law, with financial institutions retaining ownership until lease terms conclude. The UAE's standardized 25-year Ijara agreements provide affordable homeownership pathways while ensuring lender stability (Alteneiji et al., 2019). Similar structures are noted by Shi et al. (2019) in their analysis of risk-sharing models for low-income housing.

Istisna addresses construction financing through project-based contracts, where banks fund development in phases tied to milestones. This avoids interest while easing liquidity pressures (Alteneiji et al., 2019). Akomea-Frimpong et al. (2023) further validate such phased disbursement models as effective for mitigating financial risks in PPP projects.

Takaful (cooperative insurance) replaces conventional premiums with mutual risk-sharing. In UAE PPPs, it covers construction delays or defaults, aligning with Islamic ethics (Alteneiji et al., 2019). Akomea-Frimpong et al. (2023) emphasize similar cooperative mechanisms as critical for long-term cost efficiency.

Combining Islamic instruments with public subsidies amplifies their reach. The UAE's *Sheikh Zayed Housing Program* merges grants with Sharia-compliant financing to serve lower-income groups (Alteneiji et al., 2019). Mattsson et al. (2022) corroborate this, demonstrating how hybrid PPP models improve scalability without compromising financial viability.

2.3.3 Green Concessional Finance

In settings where borrowing is expensive and economies are fragile, green and concessional financing act as pivotal devices that make sustainable-housing PPPs feasible. By offering easier credit terms, well-aimed subsidies, and risk-sharing structures, these mechanisms cut costs for developers and households alike. Ghana provides a good example: where the state working with development partners, rolled out low-interest “green” loans for energy-efficient homes, priced far below the prevailing commercial rates of 27–35 percent. This initiative secured access for low-

income buyers, particularly young families and informal-sector workers who normally cannot secure standard mortgages (Akomea-Frimpong et al., 2024).

Adegun and Taiwo (2011) arrive at a similar conclusion for Nigeria: scarce formal credit is one of the toughest obstacles private developers face, especially when delivering low-income units. Without accessible funding channels, the private participation disappears and the supply diminishes or stalls. Their work underscores the need for subsidized-credit components in any public-private formula, further echoing the Ghanaian evidence that concessional instruments can unlock hidden demand in weak financial systems.

One notable design strength of such PPPs is their ability to stabilize cash flows over time. Prolonged concession periods reach 30 to 75 year, spread capital recovery across decades, keeping rents affordable. When those concessions pair with inflation-indexed tariffs or lease rates, private returns stay insulated from macro-volatility. Akomea-Frimpong et al. (2024) note that these protections are necessary in economies vulnerable to inflation, where currency swings, or sudden subsidy cuts scare investors.

Even so, success is only possible with well-functioning institutions and proper governance. Absent transparent oversight, soft loans can be misallocated and guarantees can expand public liabilities. Akomea-Frimpong et al. (2024) recount instances where weak supervision led to delays and overruns, reinforcing the need for integrated controls: transparent procurement, performance-linked disbursements, independent audits, and clearly defined exit paths. Adegun and Taiwo (2011) likewise highlight how overlapping mandates and lax enforcement in Akure undercut PPP viability and deter long-term capital.

2.3.4 Diversified Financial Instruments

Using several financing methods inside PPP housing schemes is vital to limit risk and keep projects stable, especially in volatile or institutionally weak markets. Instead of depending on one source of money, successful PPPs weave together long-term loans, short-term credit lines, leasing options, and supplier credit so the project can cover cash needs as they shift. Khmel and Zhao (2016) note that this blended model, which joins long-term capital for construction with short-term working-capital loans, creates a buffer that softens demand shocks such as lower occupancy or late rent. Layering finance in this way lets the project keep sufficient liquidity through every stage of operation and gives managers room to act when surprises occur.

One notable structural advance in the housing-PPP arena is the growing use of project-finance frameworks. In this setup, lenders are repaid solely from the cash that the housing development itself will generate, which isolates the project's risk inside its own boundaries. Unlike corporate finance, where repayment depends on the sponsor's broader credit profile and balance sheet, project finance enables private developers to secure funding without endangering the rest of their assets. This ring-fenced design is especially attractive for housing PPPs expecting steady income from rents or service charges. As Khmel and Zhao (2016) explain, such an arrangement achieves the limited-recourse environment investors seek, capping liability at the project level and thus reducing perceived exposure while expanding access to capital. Xu et al. (2020) add that project finance encourages strong financial discipline and transparency, both of which are key when courting international investors in higher-risk contexts.

A second avenue for widening funding options involves equipment leasing, letting sponsors obtain cranes, forklifts, or even prefabricated modules through stepped instalments rather than one large expense. By matching repayments to the project's income timeline, leasing lowers the capital problem that often hinders early progress. In parallel, supplier-credit arrangements postpone payment for materials and specialist services, relieving day-to-day cash-flow strain while construction is underway. Khmel and Zhao (2016) note that such tools are vital in settings where scarce liquidity can terminate a scheme before hand-over. Echoing this view, Xu et al. (2020) show that leasing and deferred-payment facilities markedly ease the financial burden on developers in the opening stages, a benefit even more pronounced where modular or prefabricated solutions are used within PPP structures.

A lease-and-develop arrangement is an easing approach for buying land load, Gabrielli et al. (2024) outline: In settings where budgets are tight, whether because resources are scarce or the country is emerging from conflict, buying land can drain the public purse. The state keeps legal title to the site but grants long-term development rights to private partners. This shift places the up-front capital risk on the private side while letting the public sector protect land that has strategic value. By sidestepping large land purchases, governments can steer limited funds toward infrastructure or affordability support. A multi-decade lease also pushes developers to build for durability and to maintain the asset, so public oversight and private performance naturally align.

Designing a diversified finance package is more than mixing tools; it hinges on timing each instrument with project milestones, projected cash flows, and the motives of every actor involved.

When that composition is right, PPP housing schemes can ride out financial shocks and stretch money further. Xu et al. (2020) emphasize that layered financial structures, when sequenced to align with each phase of the project, spread risk more evenly among stakeholders and ensure continuity by keeping all actors engaged throughout the implementation. In this light, financial diversification moves from a plain safety net to a cornerstone of resilient housing delivery in challenging contexts.

2.3.5 Innovative Mechanisms

When standard funding paths prove inadequate in societies recovering from conflict or facing fiscal instability, emerging tools like blockchain-enabled crowdfunding can step in to raise capital for housing PPPs. By collecting modest sums from many backers, among them members of the diaspora, impact-oriented investors, and development agencies, these digital platforms support dispersed, bottom-up financing. A notable illustration is the Dumai Port City housing initiative, documented by Berawi et al. (2020). In that project, 59% of the budget came from a private developer while the remaining 41% was gathered through the crowd. The blended model produced an internal rate of return of 15.54 %, well above its weighted average cost of capital of 8.77 %, underscoring the sound financial prospects of this strategy. Xu et al. (2015) further affirm that non-traditional funding models can increase investor engagement when paired with credible risk-sharing mechanisms and adaptive structuring.

Hybrid PPP financing models are most effective when structured to reflect the varied risk appetites and incentives of stakeholders, especially during the early stages of project development. Akomea-Frimpong et al. (2024) emphasize that blended finance arrangements gain traction when tailored to align with each actor's confidence levels and expected returns. In particular, stakeholder-specific structuring is crucial in post-conflict and fragile contexts, where uncertainty is high and private actors require assurance that risk is equitably shared. Monte Carlo Simulation (MCS) and Net Present Value (NPV) tools have been used in some cases to design such financing packages, although their application depends on the availability of reliable data and modeling capacity. When matched properly, these instruments help achieve financial feasibility without overburdening any single party.

Blockchain infrastructure, particularly Ethereum-based smart contracts, has emerged as a key driver of these financing schemes. Such contracts execute payment terms automatically, keep every

transaction visible on a shared ledger, and trim administrative effort. In fragile governance contexts, this transparency controls opportunities for fraud or diversion of funds, thereby making the mechanism more acceptable to the public. It also boosts investor assurance through continuous, real-time insight into construction milestones, spending flows, and eventual returns. Xu et al. (2015) likewise observe that investor confidence rises when modelling tools project outcomes under multiple scenarios, aligning expectations with performance checkpoints, a goal that blockchain's open architecture fulfills in practice. Berawi et al. (2020) also affirm that transparency and automation serve as key attractions for global investors seeking oversight in politically sensitive environments.

Although the preceding advantages are compelling, practical adoption still encounters obstacles. Xu et al. note that gathering dependable probabilistic data in emerging economies is rarely straightforward, a shortfall that can erode the credibility of simulation findings. In a similar path, Berawi et al. (2020) warn that regulatory ambiguity, modest digital literacy, and the price volatility typical of cryptocurrency markets impose serious limits on the growth of blockchain solutions across developing nations. Akomea-Frimpong et al. (2024) add that digital investment platforms require parallel institutional reforms to gain legitimacy and user trust in fragile or low-governance settings.

Even so, blockchain-enabled crowdfunding shows clear promise for post-conflict rebuilding. The model can engage Syrian diaspora investors, many are eager to support reconstruction efforts but remain cautious due to unclear processes and inadequate institutional safeguards. By offering tokenized stakes or dividend-sharing rights anchored to tangible housing units, these platforms align social goals with financial returns and broaden the base of participants. Xu et al. (2015) likewise emphasize that overlooked groups, such as young graduates in China, need PPP designs that fit their financial capacities and housing preferences. Their findings reinforce the idea that diaspora and other niche investor segments are more inclined to commit when financing structures reflect both their social motives and economic expectations. Akomea-Frimpong et al. (2024) argue similarly that inclusive financial instruments expand the engagement of non-traditional actors in early-stage PPPs when framed within familiar, accessible interfaces.

Adopting these financing tools opens a path around long-standing barriers to capital, fragile credit markets, weak banking networks, and political turbulence. Instead of waiting for large institutional loans or government subsidies, project sponsors can draw on a dispersed pool of global investors

and deliver socially focused housing projects through lean, technology-driven vehicles. Xu et al. (2015) note that where strong financial ecosystems are absent, innovative structures create a negotiation space that balances risk between public and private actors, bypassing rigid traditional pipelines. Likewise, Akomea-Frimpong et al. (2024) argue that lasting PPP results emerge when financing tools are matched to each project phase's cash flow and risk level, evidence that blockchain mechanisms can adapt to shifting needs throughout a reconstruction project's life cycle. Xu et al. (2015) additionally highlight that decentralized financial mechanisms reduce entry barriers for capital and align particularly well with projects that lack upfront institutional guarantees.

2.3.6 Risk Mitigation Tools

Effective risk mitigation is fundamental to the success of PPP housing projects, particularly in fragile or uncertain environments. Among the most widely used instruments are Minimum Revenue Guarantees (MRGs), which serve to reduce demand-side risk by assuring private investors a baseline level of income regardless of actual market uptake. This mechanism helps bridge the confidence gap that often prevents private capital from entering the affordable housing sector. In Ghana, for instance, MRGs were deployed in the water sector to offset low bill collection rates and public resistance to privatization, enabling continued service provision while securing investor interest (Ameyaw & Chan, 2017). To avoid creating excessive fiscal burdens, these guarantees were structured with performance-based triggers, where payouts were linked to measurable service targets such as quality standards or geographic coverage (Ameyaw & Chan, 2017). This performance-conditioning ensured accountability while limiting government exposure to inefficient spending.

The application of MRGs in Ghana's housing sector further demonstrates their versatility. A PPP initiative delivering 5,000 housing units combined MRGs with tax exemptions, creating a hybrid risk-sharing framework that provided early-stage financial predictability while gradually phasing out guarantees as market demand stabilized (Ameyaw et al., 2017). Similarly, Nigeria's toll road PPPs employed capped MRGs covering only 70–80% of projected revenues, providing sufficient risk coverage for investors without exposing the public budget to open-ended liabilities (Opawole & Jagboro, 2017). However, these examples also highlight the limitations of MRGs when used in isolation. Taiwan's high-speed rail project, for example, lacked complementary hedging

instruments to buffer against foreign exchange volatility, which ultimately led to project failure and a costly government bailout (Ni et al., 2016).

A more dynamic approach to risk valuation is offered by the Real Options Approach (ROA), which views uncertainty not merely as a liability, but as an opportunity to enhance strategic flexibility. Shi et al. (2019) illustrate this in the Chongqing Public Rental Housing project in China, where the ROA model enabled investors to assign value to managerial decisions such as deferring construction phases, expanding capacity in response to rising demand, or abandoning unviable stages. The application of ROA added over 464 million CNY in option value to the project, improving its total investment profile and raising private sector participation by more than 80% (Shi et al.). The authors also note that ROA facilitated more productive negotiations between the public and private partners, as it clarified potential outcomes under different demand scenarios, a valuable feature in post-conflict settings where uncertainty is high and conditions evolve rapidly.

Another and increasingly influential tool in PPP risk mitigation is the dual-return investment model, which evaluates projects not only on their financial metrics but also on their social and environmental performance. Gabrielli et al. (2024) applied this model in the Santa Marta housing project, where conventional discounted cash flow (DCF) analysis was supplemented with Social Return on Investment (SROI) indicators such as improved energy efficiency, expanded housing access, and neighborhood revitalization. By translating social impact into quantifiable economic value, the model helped attract impact-driven investors like the Erasmo Real Estate Fund. Gabrielli et al. (2024) further explain that SROI metrics were instrumental in overcoming investor skepticism, particularly around low-income housing, by offering a tangible basis for assessing “softer” outcomes within a rigorous financial framework. This model was further reinforced through long-term leases (up to 75 years) and risk guarantees from multilateral institutions such as the World Bank, enabling risk-averse investors to participate with greater confidence in complex urban redevelopment.

2.3.7 Capital Engagement and Implementation

Engaging private capital effectively in PPP housing projects requires not only financial incentives, but also carefully structured implementation frameworks that balance risk, return, and public interest. One of the central variables in this balancing act is the ratio of private to total investment (K), which determines how much financial responsibility, and associated risk, is accepted by private

actors. An emerging body of literature suggests that when private sector contributions fall within the 35–60% range, project success rates increase significantly while maintaining fiscal safeguards for public partners (see also Section 2.3.1).

However, private capital is rarely mobilized without robust risk-sharing mechanisms and institutional guarantees. Khmel and Zhao (2016) emphasize that investors in infrastructure-heavy sectors like housing are particularly sensitive to long payback periods and high upfront costs. As a response, PPP models increasingly incorporate government-backed credit lines or insurance instruments to attract private lenders. In Sharjah, UAE, for example, the Emirates Islamic Bank provided AED 1 billion in interest-free loans to the Directorate of Housing, backed by a government-supported risk-sharing framework that reassured lenders while meeting social housing goals (Altenetji et al., 2019).

Beyond financial guarantees, projects must also offer strategic advantages or “win-win” conditions, such as long-term leaseholds, priority development zones, or exclusivity rights, these leaseholds justify private investment in non-commercial segments. Some PPPs have adopted dual-return valuation frameworks that incorporate both traditional financial indicators and social performance metrics, helping to attract impact-oriented investors in low-income housing segments. As Mottaeva (2018) notes, integrating ethical and social considerations into investment evaluation improves alignment between public welfare objectives and private capital expectations, especially in housing markets where financial returns alone may not justify investment.

Implementing such models at scale also requires adaptable governance structures. In the Russian context, Vasilyeva (2018) highlights how project mass strategies, such as pooling smaller municipal concessions into bundled portfolios, allow public authorities to scale impact while attracting institutional investors like pension funds. Inter-municipal concessions, standardized “box” models, and subsidized interest rates via national banks (e.g., Sberbank) have all proven effective in supporting PPPs under 50 million rubles, which otherwise struggle to reach critical mass.

At the institutional level, collaborative governance arrangements ensure that financial mechanisms translate into successful delivery. The Al Yusr initiative in the UAE demonstrates how outsourcing loan administration to private banks, while retaining public oversight, can reduce government operational burdens and increase efficiency (Altenetji et al., 2019). This division of labor allows

each actor to focus on core competencies: policy development and beneficiary targeting for public agencies, and financial servicing and collections for banks.

Stakeholder alignment is the final and often overlooked support of effective PPP implementation. Altenetji et al. (2019) stress that engaging financial institutions must be complemented by partnerships with capable developers to ensure physical delivery of housing. Moreover, successful projects are often underpinned by social capital, trust, leadership alignment, and shared objectives, that allow public and private actors to navigate complexity and adapt to emerging challenges. Mattsson et al. (2022) identify knowledge transfer, trust-building, and governance flexibility as three resilience enablers essential to long-term sustainability.

The diversity of financing tools outlined across this chapter illustrates that no single instrument is sufficient to meet the complex demands of PPP housing in fragile contexts. Instead, multi-instrument approaches, tailored to the local institutional, financial, and social environment, appear most effective. The following comparative matrix summarizes the core functional strengths of each tool to guide strategic combinations in project design.

2.3.8 Comparative Evaluation of Financing Tools

To better compare the varied financing tools examined across sections 2.3.1 to 2.3.6, the following table summarizes their relative strengths across four core functions: risk reduction, investor appeal, support for social objectives, and liquidity enhancement, simplifying scoring format to highlight strategic complementarities among tools.

The numerical values assigned to each financing tool (0 = low, 1 = moderate, 2 = high) were based on how strongly the literature associated that tool with each function. A score of 2 was given when the tool's primary design or purpose directly targeted the function (e.g., MRGs for risk reduction). A score of 1 was assigned when the tool supported the function but was not primarily designed for it. A score of 0 indicates that the tool lacked direct relevance to the given function in the reviewed studies.

Table 6: Comparative Assessment of PPP Housing Financing Tools Across Key Functional Criteria

Financing Tool\ Function	Risk Reduction	Investor Appeal	Social Objectives	Liquidity Support
Lifecycle Financing	1	1	0	1
Blended Finance	1	1	1	0
Ijara / Istisna	1	1	1	1
Takaful	1	0	1	0
Green Loans	1	1	1	1
Project Finance	1	1	0	1
Blockchain Crowdfunding	1	1	1	1
MRG (Min. Revenue Guarantee)	2	2	1	0
Real Options Approach	1	1	0	0
SROI	0	1	2	0

2.4 Financial sustainability in PPP Housing Projects

Financial sustainability in PPP housing projects is not achieved through a single financial mechanism or isolated intervention. Rather, it emerges from the interplay of multiple dimensions, each addressing different sources of financial risk and resilience. Figure 3 illustrates a conceptual framework comprising five interdependent components, lifecycle financing and risk management, risk allocation, analytical tools, policy support, and institutional frameworks, which together enable a more adaptive and stable financial structure throughout the project lifecycle.



Figure 3: Interdependent Components of Financial Sustainability in PPP Housing Projects

2.4.1 Risk Management Systems for Long-Term Viability

Robust, long-term finances in housing PPPs rarely arise by chance; they depend on a funding plan that develops alongside the project. During the initial idea and design phase, typically less than five percent of total cost, capital is supplied mainly by sponsor equity, often backed by public grants.

This early blend absorbs risk without straining the balance sheet (Khmel & Zhao, 2016). As construction starts and spending speed up, the focus of funding shifts. Senior debt, chiefly bank loans, takes the lead, while a layer of mid-level debt fills the gap so the debt-to-equity mix remains near 70:30, a ratio considered wise for social infrastructure (Khmel & Zhao, 2016). Once occupancy stabilizes and cash flows become reliable, long-term tools, bonds, asset-backed securities, or sukuk, replace costly construction loans with funding that matches the project's income profile (Khmel & Zhao, 2016).

This staged pathway reflects Lawson et al.'s (2009) model for affordable housing finance, which recommends moving from upfront public support to institutional refinancing channels. These channels unlock long-term private funds and give early investors clear exit routes. Arranging capital in this sequence is more than bookkeeping. Linking each type of finance to a specific project milestone lowers the chances of cash shortfalls and sudden interest-rate shocks. Xu et al. (2020) show that phase-matched finance cuts default risk in volatile markets. Likewise, Akomea-Frimpong et al. (2024) find that layered structures improve bankability because investors can judge and price risk step by step instead of all at once. Lawson et al. (2009) add that early equity and grants, followed by institutional funds during operation, draw long-term capital on better terms.

However, lifecycle planning alone is not enough. Housing PPPs also face shifting macro-economic conditions. The 2008 global financial crisis, for example, exposed how swings in bond markets can stall traditional infrastructure finance. To counter this threat, Khmel and Zhao (2016) introduced an adaptive funding algorithm that, in real time, ranks potential capital sources by cost, availability, and preset risk thresholds. Continuous re-optimization of the funding mix helps projects stay financially steady when markets fluctuate.

Evidence from Akomea-Frimpong et al. (2024) reinforces this view. Their data show that PPPs most capable of withstanding shocks are those whose financing plans can be swiftly adjusted, allowing them to absorb economic blows and preserve investor confidence, especially in fragile or post-conflict environments.

To further enhance stability, financial structures must be designed to minimize the likelihood of mid-project renegotiations. Even the most carefully scoped PPPs can end up back at the negotiating table when costs, risks, or revenue forecasts shift mid-stream. To avoid this, Khmel and Zhao (2016) recommend a "typical financial strategy": a mutually established framework of boundaries, debt

caps, minimum coverage ratios, and calibrated government guarantees, fixed before contract signing. These components, as outlined in the literature, play a vital role in anchoring financial predictability. Debt caps limit overleveraging and protect project solvency, while minimum coverage ratios, such as the debt service coverage ratio (DSCR), ensure that income consistently exceeds debt obligations, maintaining bankability even in downturns. Calibrated guarantees from the public sector, tied to clear conditions like revenue shortfalls or macroeconomic shocks, distribute risk without exposing the government to open-ended liabilities. These boundaries narrow the range of acceptable revisions and make later negotiations more predictable. Mazouz et al. (2008) echo the point, showing that early, transparent rules on financing and risk sharing cut disputes, reduce renegotiation

Still, even the most robust financial models require active participation from the public sector to ensure long-term project viability. Private capital, by itself, rarely secures the economic health of housing PPPs; the public sector must absorb part of the risk to keep projects affordable and fundable. Tools such as early-stage capital injections, minimum-revenue guarantees, and targeted user subsidies reduce uncertainty and fill funding gaps that private finance alone will not close (Khmel & Zhao, 2016). Practical evidence supports this view. In the UAE, the government lightens monthly mortgage burdens by pre-paying interest costs, making homes more attainable (Altenetji et al.). The Mohammed bin Rashid Housing Establishment (MBRHE) follows a comparable model, covering bank profit margins upfront so eligible families can meet lower instalments. In Lagos, Nigeria, authorities supply land, core infrastructure, and direct subsidies to attract private developers into the affordable housing market (Ibem, 2011).

As PPPs in housing increasingly aim to deliver both financial and social value, public agencies are also called upon to define how impact is measured. Gabrielli et al. (2024) propose proxy indicators, shorter commute times or dynamic local economies, to capture community benefits. In post-conflict settings, metrics such as reduced informal settlements or expanded service access help justify continued investment. Mattsson et al. (2022) reinforce the argument: sustainable housing PPPs thrive when tangible social gains accompany sound financial performance.

Table 07 below provides a comparative overview of conventional and sustainable financing strategies across each project phase, summarizing how tailored instruments enhance financial continuity, risk control, and investor confidence throughout the PPP housing lifecycle.

Table 7: Comparison of Conventional and Sustainable Financial Tools by Project Phase in PPP Housing

Project Phase	Conventional Financing	Sustainable Financial Tools	Sustainable Financial tool Objective	Supporting Reference
Concept & Design	Government budget or early public loan	Sponsor Equity Public Grants	Absorb early-stage risk without adding debt burden	Khmel & Zhao (2016); Lawson et al. (2009)
Construction	Single large up-front loan	Staged Financing Debt Layering Maintain 70:30 debt-equity ratio	Reduce upfront capital load and align financing with construction progress	Khmel & Zhao (2016); Xu et al. (2020); Lawson et al. (2009)
Operation	Continuation of initial high-interest loan	Institutional Refinancing (e.g., bonds, sukuk) Revenue-aligned finance tools	Lower long-term interest costs and match cash flow timing	Khmel & Zhao (2016); Lawson et al. (2009)
Exit / Transition	No structured exit mechanism for investors	Exit Pathways (share sale, public transfer, refinancing) Investor transition tools	Enable capital recycling and attract institutional investors	Lawson et al. (2009); Akomea-Frimpong et al. (2024)

2.4.2 Risk Allocation and Management Strategies

Financial sustainability in PPP housing projects rests on more than capital-raising tactics; it also requires a balanced, efficient division of risks. A well-defined sharing scheme matches each threat to the party best placed to handle it, bolstering investor confidence and trimming the chances of disputes or renegotiations.

A practical example of thoughtful risk positioning comes from the United Arab Emirates. Under the Developers' Housing (DH) program, end-user default risk stayed with the developers, while the Emirates Investment (EI) entity absorbed the financial burden, operational oversight, and wider exposures such as currency shifts and fraud prevention (Altenetji, Alkass, & Abu Dabous, 2019). By letting each actor tackle the challenges it understands best, the scheme delivered 1,237 dwellings, about 15 percent of all government housing subsidies issued during that period. This result echoes Mazouz et al.'s (2008) view that risk assignments should follow technical and managerial capacity. Whether in stable or fragile settings, institutional clarity reduces uncertainty, limits renegotiations, and underpins long-term project continuity (Mattsson et al., 2022).

By contrast, the Mohammed bin Rashid Housing Establishment (MBRHE) adopted a different stance, placing most financial and operational liabilities, credit default and funding risks, on private banks. Although this strategy conserved public resources, it raised participation barriers, especially under extended uncertainty (Altenetji et al., 2019). In comparison, the DH model attracted more private interest because macroeconomic risks such as interest-rate swings were shouldered by the government, while default risk was shared with private parties. Ameyaw et al. (2017) confirm that excessive, unmitigated risk transfer discourages private involvement and weakens financial sustainability.

In the broader literature, Khmel and Zhao (2016) emphasize that risk allocation should be an intentional process grounded in comparative advantage. Their findings show that risk containment is more effective when embedded within the structure of the Special Purpose Vehicle (SPV), where contractual boundaries isolate project risks from broader sponsor liabilities. This legal and financial separation makes PPPs more attractive to private investors by ensuring that long-term risks, such as revenue shortfalls, are clearly delineated and, when appropriate, guaranteed by the public sector.

Even with carefully assigned risks, housing PPPs must retain the agility to absorb unforeseen funding shocks. Madden (2011) recounts instances in which developers tapped internal reserves to keep projects moving when expected tax-credit finance failed to appear. In parallel, project sponsors pursued policy advocacy, pushing to revise subsidy allocation formulas, such as adding neighbourhood-revitalisation criteria, to secure alternative support (Madden, 2011).

2.4.3 Analytical Tools

Accurate financial planning in housing PPPs requires more than structured funding models or balanced risk allocation. It also relies on the use of analytical tools that can simulate uncertainty, forecast financial outcomes, and support evidence-based decision-making. In contexts marked by market volatility or incomplete data, such as post-conflict environments, these tools become essential for safeguarding long-term financial sustainability.

One of the most widely used tools in this regard is Monte Carlo simulation. Modern housing PPP finance now leans on advanced analytics to map and soften risk. Chief among these tools is Monte Carlo simulation, prized for variables that swing widely, rental demand, construction-cost inflation, and the like (Xu et al., 2015). In practice, practitioners run roughly 10,000 trials, feeding the model probability distributions for each key input, for example, rental growth set at a 10 percent mean

with a ± 5 percent standard deviation to mirror market volatility. By letting each parameter roam across its full range, sponsors generate probability curves for outcomes such as net present value or internal rate of return, then judge how often target thresholds are met. Ameyaw et al. (2017) confirm that Monte Carlo, paired with fuzzy-logic techniques, sharpens risk control in PPPs with layered financial exposure.

However, a persistent hurdle in applying such simulations is the thin archive of historical data needed to shape reliable distributions. This scarcity forces analysts to blend empirical shortcuts with expert insight. Xu et al. (2015), for instance, surveyed 530 recent university graduates about rental preferences to stand in for a deeper market time series, thus grounding demand forecasts when hard data were missing. Likewise, Ameyaw et al. (2017) note that, in data-sparse settings, seasoned judgment and stakeholder inputs enrich simulation inputs and improve risk assessments for complex PPP ventures.

Alongside Monte Carlo simulation, Real Options Analysis (ROA) has emerged as a powerful complementary approach to traditional discounted cash flow analysis, particularly valuable for its ability to quantify the value of managerial flexibility in uncertain environments (Shi et al., 2019). This analytical framework explicitly values strategic options such as the ability to abandon projects (typically modeled with 60% recovery of sunk costs) or defer investment decisions during unfavorable market conditions. When combined with government support mechanisms like 40% capital cost subsidies, ROA can significantly reduce financial strain on private partners (Shi et al., 2019). Vahdatmanesh et al. (2022) demonstrate how ROA enables PPP actors in post-disaster housing to delay, revise, or abandon commitments as uncertainty unfolds, providing a quantifiable framework for managing downside risks while preserving upside potential. However, practical implementation faces several challenges including data limitations, particularly the need to estimate volatility parameters (σ) using proxy data from commodity housing markets when project-specific information is unavailable, and the inherent simplifications required in financial models which often exclude complex factors like tax implications and multifaceted market dynamics (Shi et al., 2019). Ongoing methodological refinements, including the incorporation of additional option types like minimum return guarantees and improved volatility estimation techniques, continue to enhance the practical utility of ROA for infrastructure investment decisions (Shi et al., 2019).

To enhance the practical application of these tools, integrating simulation with valuation frameworks such as Net Present Value (NPV) provides a more comprehensive financial picture. Long-term financial health in housing PPPs relies on methods that link valuation theory to the messy realities of the market. Net Present Value (NPV) still serves as the cornerstone, discounting future cash flows, rent, maintenance, land costs, into their worth today. Xu et al. (2015) strengthen NPV by applying Monte Carlo simulation across a 30-year concession period. Running thousands of trials captures shifts in occupancy and rental yields, letting sponsors test how fragile, or robust, their numbers are. Ameyaw et al. (2017) back this approach, noting that stochastic models fine-tune risk-sharing rules and bring them closer to real project conditions.

Used together, NPV, Monte Carlo, and Real Options Analysis (ROA) form a layered toolkit that guides choices from early feasibility checks to ongoing performance reviews. In uncertain or fragmented markets, this combination deepens the analytical base for investment and helps partners place risk and capital where they fit best.

2.4.4 Policy Support Mechanisms

While financing tools and risk-sharing arrangements form the technical backbone of PPP housing projects, public policy support plays an equally vital role in ensuring financial sustainability. Strategic interventions by government entities can reduce project risk, enhance bankability, and create conditions that attract private investment, especially in socially targeted or high-risk environments.

One of the most direct forms of public support involves financial incentives such as land grants, capital injections, and tax breaks ease the initial cost load for private investors. These tools are especially useful in PPPs focused on affordable or socially inclusive housing. Evidence from transport projects shows the scale of impact: in highway PPPs, public subsidies averaged 11 % of total costs and sharply lowered private exposure (Khmel & Zhao, 2016). A parallel pattern appears in housing; Xu et al. (2015) point to land-cost subsidies that make projects viable by cutting the capital barrier to entry. Lawson et al. (2009) add that timed public support can play a catalytic role. Early inputs, such as grants or public land, strip out key risks and make later institutional funding more likely.

In addition to these upfront incentives, governments frequently lean on indirect guarantees to steady project cash flows and close affordability gaps. Instruments such as Minimum Revenue Guarantees

(MRGs) promise a floor for income if occupancy or rental receipts slip below forecasts, while Viability Gap Funding (VGF) tops up returns so that socially affordable rents still Meet the lowest acceptable return for investors. The Santa Marta experience in Colombia shows how this works in practice. There, the Ministry of Education financed subsidized housing for displaced families, letting private builders stay involved without giving up expected margins (Gabrielli et al., 2024). In vulnerable markets, this targeted assistance often determines whether a project stagnates or succeeds in both providing housing and remaining financially viable.

This approach is consistent with the typology developed by Mazouz et al. (2008), who highlight contingent guarantees as a way to smooth revenue swings. Likewise, Ameyaw et al. (2017) report that contracts featuring VGF or MRGs draw more private bidders, especially for social-infrastructure projects facing uncertain demand.

Beyond financial incentives, Lasting success in housing PPPs relies not only on policy tools or finance, but also on solid institutional architecture. These frameworks spell out the rules, workflows, and coordination channels that guide risk sharing, allocate duties, and keep projects on track. In fragile or transitional settings, where regulations shift and governance is fragmented, strong, coherent institutions become even more vital.

To foster such stability, governments must adopt comprehensive policy frameworks that combine regulatory clarity, financial incentives, and inter-agency coordination. In high-risk or post-conflict regions, these packages offset weak credit systems and underdeveloped planning. A broad mix, tax relief, soft-rate loans, longer concession windows, and pinpointed subsidies, has consistently lowered risk and strengthened PPP balance sheets (Akomea-Frimpong et al., 2023).

Supporting this process further, The Financial Risk Management Maturity Model (FRMMM) maps a four-step path for public bodies, moving from basic, ad-hoc routines to fully optimised systems (Akomea-Frimpong et al., 2023). As agencies climb this ladder, they become better able to fold tools such as Minimum Revenue Guarantees and project-specific guarantees into a broader governance framework, giving them a more refined grip on financial risk. Mazouz et al. (2008) echo this logic, stressing that policy maturity and clear internal roles within the public sector are vital for keeping projects on course. Their PPP typology shows that if performance standards and risk tools are not clearly set, gaps between agencies can weaken coordination and disrupt implementation.

Finally, regulations themselves must evolve to meet new demands. Rigid or outdated regulations can stall PPP implementation, especially in emerging or post-crisis housing markets. In China, Xu et al. (2015) report that standard affordable-housing rules excluded young graduates, who nonetheless had clear housing needs. By loosening eligibility criteria and inviting private developers, PPPs supplied a more flexible delivery pathway. This adaptability yields two main gains: it enlarges the pool of beneficiaries, capturing groups like young professionals and informal-sector workers, and it taps the efficiency and innovation of private builders, who often meet demand more effectively than public systems alone.

Mattsson et al. (2022) underline that integrating resilient, market-responsive business models into PPP frameworks depends on supportive governance. Swedish experience shows that adaptive policy tools, inter-agency collaboration, and dynamic oversight mechanisms are vital for embedding both financial and social sustainability in housing PPPs, particularly under conditions of uncertainty or rapid change.

3. Methodology

This chapter outlines the methodological framework adopted to explore PPP-based modular housing solutions for post-conflict Syria. It begins by describing the systematic literature review approach that informed the study's conceptual and analytical foundation. The chapter then explains the research philosophy, highlighting the abductive logic of inquiry and the constructivist paradigm that guided data collection and interpretation. A qualitative Instrumental case study was employed to capture context-specific insights, with data gathered through semi-structured interviews with purposefully selected stakeholders. The chapter also details the procedures for data collection, thematic analysis, and ethical considerations. Finally, it discusses the study's limitations and presents strategies used to ensure credibility, dependability, and transferability of findings in a fragile research setting.

3.1. Literature Review Methodology

The research process began with a systematic and iterative review of existing literature, following Snyder's (2019) framework for rigorous literature reviews in research. The primary aim of this phase was to map the theoretical foundations and empirical evidence concerning PPP frameworks,

prefabricated modular housing technologies, and their potential application in post-conflict or fragile environments. This foundational work was crucial for establishing the study's conceptual framework and for refining the specific research questions and empirical approach.

The literature review adopted a structured methodology, drawing inspiration from the principles outlined in the PRISMA framework (Moher et al., 2009) as recommended by Snyder (2019) for systematic reviews. The researcher performed extensive searches across several major academic databases, including Scopus, ScienceDirect, and Google Scholar. These searches utilized specific combinations of keywords connected by Boolean operators (AND, OR), consistent with Snyder's (2019) guidelines for transparent search strategies. Search terms encompassed phrases such as "Public-Private Partnership" combined with "housing" and "post-conflict," alongside related terms like "modular housing," "PPP financing models," "Islamic finance," and "affordable housing governance." To capture practical insights and policy perspectives, relevant grey literature from key institutions such as the World Bank, United Nations Human Settlements Programme (UN-Habitat), and the European Investment Bank was also systematically examined, following Snyder's (2019) recommendation to include diverse source types.

The selection of literature followed defined inclusion and exclusion criteria, a key component of rigorous literature reviews according to Snyder (2019). Sources were included if they addressed PPP frameworks within housing or broader infrastructure projects, demonstrated relevance to developing nations or post-conflict settings, involved prefabricated or modular construction methods, or offered practical policy recommendations or case study evidence. Literature was excluded if it lacked empirical grounding or practical applicability, focused exclusively on sectors unrelated to housing (such as transportation infrastructure), or presented purely theoretical discussions without connection to implementation challenges.

Data extracted from the selected literature underwent thematic synthesis, an approach Snyder (2019) identifies as particularly valuable for interdisciplinary research. Key findings and concepts were systematically grouped into coherent thematic areas, including governance frameworks for

PPPs, models for sharing financial risks, technical and economic feasibility assessments of modular construction, and socio-political considerations pertinent to fragile contexts. The insights derived from this comprehensive review directly informed the development of the interview guide and the initial structure for coding the empirical data.

3.2. Research Approach and Design

This study employed an abductive logic of inquiry, which lies between deductive reasoning (testing existing theories) and inductive reasoning (deriving theory solely from data). The initial research design was shaped by existing theoretical insights related to PPP implementation, post-conflict reconstruction, and modular housing systems. However, rather than strictly testing predefined hypotheses, the study allowed theoretical concepts to evolve iteratively in response to empirical data. This dynamic interplay between theory and field observations enabled a more grounded and context-sensitive understanding of the research problem, particularly within the unique post-conflict conditions of Syria.

Abduction was deemed particularly appropriate given the complexity and unpredictability that characterise fragile settings. The researcher entered the field with sensitizing concepts (Blumer, 1954), which offered initial guidance without constraining interpretation. These concepts were applied flexibly, enabling the study to respond to emerging themes and contradictions in stakeholder narratives. As Timmermans and Tavory (2012) emphasize, abductive reasoning is especially valuable in qualitative research aimed at theoretical refinement when existing models fail to explain empirical anomalies, precisely the challenge encountered in this study.

Although the empirical scope of this study is limited and does not include diverse data sources such as documents or field observations, the research adopted a case-oriented logic due to the bounded, real-world nature of the topic. As Creswell (2013) explains, case study research involves in-depth exploration of a bounded system situated within a contemporary context. In this study, the case is defined as the Syrian post-conflict housing environment, bounded by geography, timeframe, and policy relevance.

While the study does not follow the full procedural rigor of a traditional case study, such as prolonged engagement, multi-source triangulation, or participant observation, it is aligned with

what Creswell (2013) defines as an instrumental case study. In this type of design, the case is not studied for its own sake, but to gain insight into a broader issue: the feasibility and stakeholder perceptions of PPP-based modular housing in fragile settings. Similarly, Yin (2009) describes exploratory case studies as useful tools for developing initial understanding of complex and understudied issues, which fits the goals of this research.

The study is further grounded in a constructivist paradigm, which holds that reality is co-constructed through individual experiences and social interactions. According to Creswell (2013), this worldview emphasizes the subjective meanings people assign to their lived realities, shaped by cultural and historical contexts. In this case, the constructivist lens guided the interpretation of how different stakeholders perceive, experience, and engage with PPP frameworks in Syria's reconstruction landscape.

Although countries like Iraq, Libya, and Lebanon may offer comparable post-conflict scenarios, this study deliberately employs a single-case design focused on Syria. This decision reflects the need for contextual depth and is shaped by practical constraints related to data access, feasibility, and the relative scarcity of Syria-specific academic literature on PPPs. Instead of aiming for generalizable findings, the study seeks to build an initial, empirically grounded framework based on stakeholder perceptions, one that may inform future comparative research across fragile contexts.

3.3. Research Process and Data Collection

This section outlines how I selected participants, conducted interviews, and prepared the data for analysis.

3.3.1 Sampling Strategy and Participant Selection

A purposive sampling strategy was employed to identify individuals with substantial experience in PPPs, housing development, or reconstruction policy, particularly within the Syrian context. A total of six participants were selected from public agencies, private sector firms, and non-profit organizations operating in the built environment. This approach aimed to ensure the inclusion of professionals whose roles and expertise positioned them to provide informed and contextually grounded insights relevant to the research topic.

Participants were identified through a combination of professional networks and direct outreach, based on their relevance and potential contribution. As Merriam and Tisdell (2016) explain, purposive sampling is especially appropriate when the goal is to develop an in-depth understanding by engaging individuals who are particularly knowledgeable about the phenomenon under investigation.

Table 8: Overview of Interview Participants: Roles, Organizational Affiliation, and Interview Logistics

ID	Title	Organization			Interview		
		Name	Location	Type	Date	Duration	Platform
P1	Shelter providing specialist Engineer	Takaful Alsham NGO organization	Syria - Turkey	Non Governmental Organization (NGO)	09/05/2025	40 mins	Microsoft Teams
P2	Senior urban and housing specialist	World Bank	USA	international financial institution (IFI)	06/05/2025	45 mins	Microsoft Teams
P3	CEO	Modular Buildings manufacturing Company	Riyadh - KSA	Private company	21/04/2025	25 mins	Microsoft Teams
P4	Real Estate developer	Real Estate company	UAE	Private company	07/05/2025	55 mins	Microsoft Teams
P5	PHD researcher in Islamic funding Mechanisms For infrastructure reconstruction in Syria	Islamic university of Madinah	Madinah - KSA	Academic organization	06/04/2025	45 mins	Microsoft Teams
P6	Real estate developer and regional planner	Syrian engineers association for reconstruction	Istanbul - Turkey	NGO	15/05/2025	45 mins	Microsoft Teams

3.3.2 Data Collection Techniques

I conducted semi-structured interviews as my primary data collection method, a technique widely used in qualitative research for balancing consistency and adaptability (Galletta, 2013). This format allowed me to explore complex themes across interviews while maintaining enough flexibility to follow participants' narratives. I prepared an interview guide with open-ended questions and often followed up with spontaneous, probing questions to delve deeper into specific points.

All interviews were conducted via teams, lasting between 45 and 60 minutes. With participant consent, I recorded each session and later transcribed the recordings myself. This early interaction with the data helped me begin the familiarization process while ensuring transcription accuracy.

3.3.3 My Role as Researcher

During interviews, I saw my role as a facilitator and co-interpreter of meaning. I focused on creating a safe space where participants felt comfortable sharing openly. I used active listening and allowed for pauses or clarifications to encourage honest, detailed responses.

Throughout the process, I remained reflexive about my own position, including my background, assumptions, and potential influence on the data. I took field notes during and after interviews to capture additional observations and contextual details that later supported analysis.

3.3.4 Data Management and Security

All data, including audio files, transcripts, and field notes, were stored securely on an encrypted Google Drive folder accessible only to me. Each participant was assigned a unique anonymized code to protect their identity. The master list linking these codes to real names was stored separately in a password-protected file.

3.3.5 Data Preparation

Once the interviews were transcribed, I carefully reviewed the transcripts to ensure accuracy and clarity. This process also served as the starting point for familiarizing myself with the data. I read through each transcript multiple times to understand the narratives and begin identifying initial ideas and patterns.

All coding and categorization were done manually, using color-coded highlights and notes in Word documents. This hands-on approach allowed me to stay close to the material, engage deeply with participant voices, and reflect on emerging meanings in real time. Field notes were also revisited during this phase to enrich understanding and interpretation.

3.4 Data Analysis

The data were analyzed using thematic analysis, following the six-phase approach developed by Braun and Clarke (2006), and further operationalized through the practical framework suggested by Maguire and Delahunt (2017). This framework provided a step-by-step guide that helped ensure systematic coding and coherent theme development, particularly useful given the exploratory nature of the study. I applied an inductive strategy, allowing themes to emerge directly from participants' narratives without imposing predefined categories.

I carried out the entire analysis process manually. After transcribing the interviews myself, I read through each transcript several times to become deeply familiar with the content. I used color highlights, margin notes, and coding by hand to identify repeated patterns, meaningful quotes, and emerging concepts. This helped me stay closely connected to the data and reflect critically on what participants were expressing.

Themes were then grouped and refined to ensure they accurately represented the core issues discussed, especially those related to PPP mechanisms, affordability, and housing in fragile contexts like Syria. Field notes were also used throughout the process to support interpretation and maintain a sense of context.

This method allowed for a flexible, personal, and reflective approach to understanding the data, which was essential given the complexity and sensitivity of the topic.

3.4.1 Instrumental Case Study: Research Phases

While this study does not fully adhere to traditional case study protocols such as prolonged fieldwork or document analysis, it adopts an instrumental case study design (Creswell, 2013) to explore a broader issue, PPP-based modular housing in post-conflict Syria, through a context-bounded inquiry guided by Merriam and Tisdell's (2016) flexible framework, flexible, exploratory manner. The inquiry progressed through iterative phases of design, data collection, organization,

analysis, and interpretation. The “case” was bounded by its thematic focus (PPP models for prefabricated housing), geographical scope (Syria), and analytical purpose (exploring stakeholder perceptions on cost, accessibility, and financing strategies).

The process was iterative and reflexive, combining insights from participants with existing theories about PPPs. Both inductive and deductive thinking shaped the final themes.

3.4.2 Benefits of the Instrumental Case Study Design

Adopting an instrumental case study design enabled a rich and situated understanding of a complex real-world problem. Rather than testing generalizable hypotheses, this approach facilitated the exploration of how policy concepts such as PPPs are perceived and negotiated within the lived experiences of actors operating in Syria’s post-conflict housing sector. By anchoring the analysis in a bounded and context-specific setting, the study generated insights that are both conceptually relevant and practically grounded.

This perspective aligns with Merriam and Tisdell’s (2016) emphasis on the value of studying a phenomenon within its real-life context, especially when the boundaries between the phenomenon and its setting are not clearly defined. While the study did not involve multiple sources of data typical of full-scale case study methodology, it was still able to capture the nuances of stakeholder experiences through semi-structured interviews and iterative reflection.

When combined with thematic analysis, this case-oriented lens allowed me to identify broader patterns while also giving space to individual narratives, thus amplifying diverse voices across sectors. The outcome was a set of findings that reflect both systemic challenges and human perspectives on housing reconstruction in fragile contexts.

3.4.3 Challenges and Limitations

Although the case-oriented, qualitative approach proved valuable for generating context-sensitive insights into PPP-based housing in post-conflict Syria, several methodological challenges and limitations arose throughout the study.

A primary limitation was the small sample size ($n = 6$), which constrained the diversity of stakeholder representation across sectors. However, in line with the goals of qualitative inquiry, the focus was on analytical depth rather than statistical generalization. As Merriam and Tisdell (2016)

argue, the strength of such designs lies in their capacity for transferability through rich, contextualized understanding rather than numerical breadth.

Another challenge stemmed from varying levels of participant familiarity with modular housing systems. Some interviewees expressed doubts regarding their applicability or sustainability, often reflecting limited exposure to recent innovations. To address this, their perspectives were situated alongside evidence from academic literature and input from more technically informed participants. This strategy contributed to triangulation by comparing views across diverse sources and knowledge domains (Braun & Clarke, 2006).

Accessing insights from Syrian governmental stakeholders posed a significant constraint. Given the ongoing political instability and restricted communication channels, direct interviews with public officials were not feasible. To mitigate this gap, the study incorporated perspectives from NGO representatives and international institutions such as the World Bank, who maintain working relationships with public entities and could reflect on institutional dynamics and policy orientation.

In addition, the political fluidity in Syria during the research period introduced temporal complexity. Developments such as the formation of a new government and discussions around sanctions relief shifted the context in real time. To maintain relevance, the research framework was kept adaptive, allowing for the integration of such changes into the interpretation of findings when appropriate.

Finally, researcher subjectivity remains an intrinsic element of qualitative research. Despite efforts to reduce bias through reflexivity, iterative coding, and constant engagement with both data and theory, interpretations were inevitably shaped by the researcher's positionality. A transparent and self-reflective stance was maintained throughout, as recommended by Sayer (2011), to enhance the credibility and analytical integrity of the study.

3.5 Research Quality

3.5.1 Credibility

To ensure the credibility of the study, several qualitative strategies were employed to accurately represent participants' perspectives. As defined by Guba and Lincoln (1982), credibility refers to the extent to which research findings reflect participants' actual experiences rather than being shaped by the researcher's personal biases or assumptions. In this study, credibility was supported

through careful transcription, reflexive engagement with the data, and validation strategies, including member checking and partial triangulation.

Triangulation in the context of qualitative research, refers to the use of multiple perspectives, sources, or methods to validate findings and improve their trustworthiness (Merriam & Tisdell, 2016). was pursued by comparing responses across participants representing different sectors and perspectives. Although the study relied primarily on semi-structured interviews, variation in stakeholder roles and backgrounds enabled cross-verification of insights and patterns. This reduced the risk of single-source bias and contributed to a more balanced and grounded interpretation of the findings. Merriam and Tisdell (2016) note that triangulation enhances the alignment between research interpretations and real-world conditions by confirming emerging themes through multiple lenses. Such strategies were particularly critical in a sensitive and politically charged environment like post-conflict Syria, where stakeholder narratives may diverge or reflect institutional interests.

3.5.2 Transferability

Transferability refers to the extent to which the findings of a qualitative study can be applied to other settings or contexts (Guba & Lincoln, 1982). Unlike statistical generalizability in quantitative research, qualitative studies aim for analytical generalization, which depends on providing rich and detailed accounts that allow readers to determine whether the insights are relevant to their own contexts (Merriam & Tisdell, 2015). In this study, transferability was supported by offering thick descriptions of the Syrian context, including participant backgrounds, contextual conditions, and the themes that emerged from the data. These details enable readers to evaluate the potential applicability of the findings to other post-conflict or housing-related environments.

3.5.3 Dependability

Dependability refers to the consistency and reliability of research findings over time and across similar conditions (Guba & Lincoln, 1982). To ensure dependability in this study, a clear and detailed audit trail was maintained throughout the research process. This included systematic documentation of interview protocols, coding strategies, theme development, and analytical decisions. Ongoing reflexivity also played a central role in maintaining transparency and coherence, helping to ensure that interpretations remained closely tied to the data rather than personal assumptions.

3.4.4 Confirmability

Confirmability refers to the degree to which the findings of a study are shaped by the participants' responses rather than researcher bias, motivation, or interest (Guba & Lincoln, 1982). In this study, confirmability was supported through systematic documentation of all methodological decisions, a transparent coding process, and the use of direct quotations from participants to substantiate thematic interpretations. These strategies aimed to ensure that the results reflect the participants' perspectives and experiences, rather than being influenced by the researcher's personal worldview.

3.6 Ethical Considerations

Ethical integrity was a core concern throughout the research process, particularly given the sensitive nature of the study context and the potential vulnerability of participants. Informed consent was obtained from all participants prior to the interviews. Each individual was provided with clear information about the study's purpose, their right to withdraw at any time, and how the data would be used. Consent was granted either verbally or in writing, depending on participant preference and context.

To protect anonymity, all identifying information was removed from transcripts and replaced with pseudonyms or generic role descriptions. Data was securely stored in password-protected files, and only the researcher had access to the raw materials. Confidentiality was maintained throughout the research process, including during data analysis and the reporting of findings.

Given the politically complex nature of the Syrian context, particular care was taken to avoid any disclosures that could compromise participants' safety or professional standing. Ethical approval for the study was obtained from the relevant academic authority, and the study followed the ethical guidelines outlined by the Swedish Research Council (2017).

Throughout the process, reflexivity was practiced to ensure that ethical decisions were not static but adapted to each stage of the research. This included being sensitive to power dynamics in the interview setting and remaining open to participants' comfort levels and preferences regarding communication and disclosure.

Interviews were conducted through a secure online platform (Microsoft Teams), with a focus on digital privacy. The use of AI tools such as ChatGPT was limited to minor grammar corrections, following institutional ethical guidelines to preserve the originality of participants' contributions.

3.7 Limitations and Delimitations

3.7.1 Limitations

This study was limited by its small sample size and the reliance on remote interviews, which may have constrained the richness of interpersonal communication and reduced opportunities for observational insight. While most participants spoke freely, some responses may have been shaped by their institutional affiliations or organizational interests. Representatives from private firms, NGOs, or international agencies may have emphasized positive aspects of their own approaches while downplaying challenges, in a form of social desirability or strategic positioning. Interpretive bias is also inherent in qualitative analysis, though reflexivity and structured coding were used to mitigate its effects.

3.7.2 Delimitations

The research was intentionally focused on PPP models for prefabricated housing in Syria, and only included stakeholders directly involved in this area. Other housing strategies or countries were outside the scope. While comparative cases from similarly fragile states such as Iraq or Lebanon could offer valuable insights, the study prioritised depth over breadth to allow for detailed contextual analysis. Furthermore, there is limited academic and institutional literature specifically addressing PPPs in Syria, particularly within the domain of post-conflict reconstruction. As a result, the literature review incorporated global PPP experiences from both developed and developing countries to identify adaptable models. The study also centred on stakeholder perceptions rather than project outcomes or quantitative indicators, reflecting its qualitative, exploratory design. Future research is encouraged to expand on this foundation through cross-country comparisons and empirical testing of the proposed framework.

4. Analysis

This chapter presents the empirical findings derived from six semi-structured interviews conducted with stakeholders engaged in PPP initiatives relevant to the Syrian post-conflict context. The analysis is organized thematically around three core dimensions: the design and feasibility of PPP frameworks, the barriers and constraints to their implementation, and the key enablers and strategic recommendations for scaling such models. By integrating participants' insights with existing literature, the chapter highlights both convergences and contextual divergences, offering a grounded and nuanced understanding of how PPP-based modular housing can be adapted to fragile and resource-constrained settings like Syria.

4.1 Participants profile

This study draws on six semi-structured interviews conducted between April and May 2025 with key stakeholders involved in post-conflict housing and PPP initiatives. The participants represent a diverse mix of institutional affiliations, professional backgrounds, and geographic locations:

- **P1:** Shelter Engineer at a Syrian NGO operating cross-border from Turkey.
- **P2:** Senior Urban and Housing Specialist at the World Bank, USA.
- **P3:** CEO of a modular building manufacturing company based in Riyadh, KSA.
- **P4:** Real Estate Developer based in the UAE.
- **P5:** PhD researcher specializing in Islamic finance for reconstruction at the Islamic University of Madinah.
- **P6:** Regional Planner and member of the Syrian Engineers Association for Reconstruction, based in Turkey.

The sample reflects a deliberate effort to include both practitioners and policy experts from public, private, academic, and NGO sectors, with direct relevance to Syria's reconstruction landscape. Interviews ranged from 25 to 55 minutes, and all were transcribed and thematically analyzed.

4.2 Empirical findings and analysis

4.2.1 PPP Framework Design and Feasibility

The findings under Theme 1, PPP Framework Design and Feasibility, demonstrate a high degree of alignment with existing literature, while also revealing notable contextual innovations suited to the Syrian post-conflict landscape. Across interviews, participants described a diverse range of PPP

models, some of which reflect internationally established frameworks, while others represent adaptive mechanisms that challenge conventional assumptions in the literature.

For instance, P1's reference to a *Cash-for-Shelter Hybrid Model*, where “families receive phased financial support to build their own homes,” offers a community-led semi-PPP approach that departs from highly formalized partnerships emphasized in most studies. While the literature stresses institutional capacity and legal frameworks as prerequisites for effective PPPs (Kavishe et al., 2018; Mottaeva, 2018), the empirical data suggests that hybrid models, combining humanitarian oversight with self-construction, may be more feasible in fragile governance settings like Syria. These models not only reduce costs, as P1 estimated a 15–20% saving, but also enhance cultural relevance and local empowerment, a dimension often underdeveloped in mainstream PPP discourse.

Similarly, the interviews affirmed the value of *land-based PPP models*, a well-supported strategy in the literature (Alteneiji et al., 2021; Gabrielli et al., 2024). P2's emphasis on using government-provided land with basic infrastructure reflects a pragmatic solution where capital is scarce, but land is available, a condition common in post-conflict settings. This model minimizes barriers for private investment and aligns well with case studies like Sharjah and Malaysia, which successfully leveraged public land to catalyze affordable housing development.

The role of international institutions like the IFC, as discussed by P2, also echoes the literature's call for blended and diversified financing, particularly in post-disaster contexts where national financial systems are weak (Khmel & Zhao, 2016; Vahdatmanesh et al., 2022). Yet, unlike the purely financial lens dominant in the literature, the interviewees placed emphasis on incremental and prefabricated solutions supported by donor partnerships, adding operational depth to existing financial models.

P3 introduced insights on technical feasibility through the use of hybrid prefabrication techniques that combine LGS and hot-rolled steel. These approaches reinforce the literature's emphasis on modular construction's speed and cost efficiency (Gunawardena et al., 2011; Loizou et al., 2021), but go further by highlighting contextual trade-offs such as on-site vs. off-site assembly, details that are largely absent from generalized academic accounts. The mention of pilot projects as a tool to

test feasibility aligns with Oxfam's recommendations for demonstration units (Gunawardena et al.), reinforcing the practicality of phased, small-scale experimentation before full-scale rollouts.

In terms of legal and structural design, P4's interpretation of Dubai's 99-year lease model exemplifies the kind of long-term arrangements discussed in literature like Mottaeva (2018) and Alteneiji et al. (2021). However, the insight that the government in Dubai "facilitates but does not fund" contradicts much of the PPP literature that assumes substantial government financial participation is necessary to de-risk projects (Xu et al., 2015; Madden, 2011). This shows how regulatory facilitation alone, if backed by investor trust, can mobilize housing development without straining public budgets, a relevant lesson for Syria's constrained fiscal environment.

Further, P5's proposal of a *Modernized Waqf Model*, where investors receive profits for five years before transferring ownership to a charitable trust, offers a culturally grounded financial tool that is largely overlooked in mainstream PPP literature. While Alteneiji et al. (2021) and others acknowledge Islamic financing methods like murabaha or ijara, the waqf-based mechanism represents a more sustainable and socially embedded model that integrates religious values with commercial logic. This divergence suggests that PPP frameworks in Muslim-majority post-conflict settings should not just adapt Western models, but also innovate based on local ethical and cultural systems.

P5 and P6 also noted the use of *Islamic financial instruments* like sukuk and share-based waqf certificates, as well as the Turkish model of shared public-private ownership through institutions like TOKİ and Emlak Konut. These findings align with the literature's emphasis on inclusive planning and risk allocation (Gabrielli et al., 2024; Khmel & Zhao, 2016), while demonstrating how localized institutional frameworks can embed social equity goals, such as mandating a percentage of affordable units, into master planning agreements.

In conclusion, while the literature offers valuable foundations on PPP design and performance in stable contexts, it often falls short in addressing the specific institutional fragilities, financial uncertainties, and cultural complexities of post-conflict zones. This analytical gap is directly confronted in the empirical findings presented above, which reveal how feasible PPP frameworks for Syria must diverge from conventional models.

The findings in this section address the first part of the research question regarding the most feasible and effective PPP frameworks for Syria's post-conflict housing. Across the interviews, hybrid PPP models combining delegated private management with revenue guarantees (as seen in P2 and P4) emerged as the most contextually adaptable, offering a balance between institutional feasibility and private-sector engagement. Participants emphasized that models involving shared operational control and conditional risk-sharing can function even under weak central governance, especially if implemented in geographically contained areas.

4.2.2 Barriers and Constraints

The second theme, Barriers and Constraints, reveals the multidimensional challenges that hinder the effective implementation of PPP frameworks in Syria's post-conflict housing sector. While existing literature comprehensively identifies legal, institutional, financial, and social barriers to PPP success in developing and fragile states (Kavishe et al., 2018; Mottaeva, 2018; Vahdatmanesh et al., 2022), the interview data deepens this understanding by unpacking how these obstacles interact and manifest under Syria's volatile political and infrastructural context.

Legal ambiguity emerged as a central constraint. As the World Bank expert (P2) pointed out, "*issues like land use and ownership are deeply rooted in local legal frameworks,*" a notion repeated by P6, who emphasized the difficulty of establishing property rights in informal settlements or areas with destroyed records. This finding aligns strongly with the literature, which notes that a lack of legal clarity leads to procurement delays, undermines investor confidence, and increases project risks (Mottaeva, 2018; Kavishe et al., 2018). However, unlike general calls for legal reform in the literature, the interviewees suggest a more targeted, area-specific regulatory approach as a pragmatic short-term strategy, a distinction that reflects the need for contextual flexibility over system-wide repair in unstable environments.

In addition to legal uncertainty, Syria's fragmented and often decentralized governance structure creates further confusion. As P2 noted, "*a systemic approach might not work,*" suggesting that multiple regulatory bodies operating without coordination contribute to unpredictability. This reflects Madden's (2011) critique of poorly coordinated PPP governance and supports Kavishe et al.'s (2018) observations on the risks posed by overlapping institutional mandates. In Syria's case, the absence of a unified public authority capable of structuring and enforcing PPP contracts

represents a major deterrent for private investors, particularly in the absence of enforceable dispute resolution mechanisms.

Administrative inefficiencies also emerged as a critical challenge. P1 reported that “syndicate approval and municipal permits delay work by 30%,” demonstrating how slow bureaucratic procedures introduce uncertainty and discourage long-term planning. The literature acknowledges this issue but often overlooks how these delays intersect with broader institutional distrust. For instance, P2 stated that “developers prefer short-term engagements unless trust is established,” highlighting the relational nature of PPPs, especially in post-conflict contexts where contracts are perceived as unreliable or politically vulnerable.

A recurring theme was the weakness of public data systems. P2 noted the difficulty of implementing subsidies when “*income or land records are unclear,*” a challenge that exceeds financial design and touches on basic operational viability. This aligns with Khmel and Zhao’s (2016) emphasis on the importance of reliable databases in project feasibility and risk modeling. In the absence of such data, it becomes difficult to apply sophisticated tools like Monte Carlo simulations or Real Options Analysis (ROA), which are often promoted in PPP design literature but remain inapplicable in information-scarce settings like Syria.

Economic barriers were also widely discussed. P1 highlighted the limited repayment capacity of low-income families, while P5 warned that “*loan-based models often impose high repayment burdens.*” These insights resonate with the literature on financial risk and affordability (Alteneiji et al., 2021; Madden, 2011), but empirical data also suggests that PPP models must incorporate more flexible financial instruments such as *incremental ownership*, *rent-to-own structures*, or *Islamic microfinance tools* to avoid excluding vulnerable populations. Without these, PPP housing initiatives risk deepening socioeconomic divides rather than bridging them.

P5 further pointed to the long-term sustainability issues of traditional waqf projects, noting that “*they often fall into neglect after 5–10 years.*” This underscores the need to modernize religious endowment models by integrating commercial logic and management structures, a gap largely unaddressed in conventional PPP literature. Reformulating waqf within PPP frameworks could

offer an ethically grounded, and financially sustainable, alternative in Muslim-majority post-conflict settings.

From a technical and industrial standpoint, barriers included infrastructure and labor shortages, in addition to low awareness of alternative construction methods. P3 noted that “lack of awareness of LGS among engineers” and preference for concrete hinders the adoption of prefabrication, while also pointing to broader issues like unreliable electricity and weak industrial support. These insights extend Gunawardena et al.’s (2011) findings by identifying not just cultural resistance, but also systemic knowledge gaps within the engineering profession. The absence of local training and exposure to modular systems hampers technological transfer and limits scalability.

Further complicating matters is the lack of institutional expertise in PPP design and management. Unlike more developed contexts where public authorities have specialized PPP units, most Syrian agencies lack familiarity with lifecycle costing, risk allocation models, and contractual structuring. This emphasizes Kavishe et al.’s (2018) observation that weak public capacity is a leading cause of PPP underperformance in developing countries.

Political risk was another consistent concern. P4 stated, “*in Syria, the risks are higher due to political instability and lack of enforceable regulations.*” This not only affects investor confidence but also complicates risk-sharing arrangements. Even instruments like Minimum Revenue Guarantees (MRGs), widely recommended in the literature (Ameyaw & Chan, 2017), lose effectiveness when governments lack fiscal stability or legal enforceability. In such cases, international guarantees, such as those offered by the World Bank or Islamic Development Bank, may be needed to attract private participation.

A further institutional gap concerns the lack of effective dispute resolution mechanisms. While several participants referred to general mistrust between public and private actors, the literature underscores that successful PPPs require strong arbitration frameworks and enforceable contracts. Without these legal conditions, long-term PPPs are unlikely to survive the political and economic instability inherent in post-conflict settings.

Finally, sociocultural constraints emerged as a subtle but powerful barrier. As P6 warned, *“resistance from local populations, especially if resettlement leads to downsizing or loss of land,”* can ruin even financially and technically possible projects. This dimension is sometimes underplayed in PPP literature, which often prioritizes cost-effectiveness and risk management over community perceptions. But in Syria, where land carries deep social and familial value, such oversights can trigger significant criticism, undermining the legitimacy and uptake of PPP initiatives.

The analysis of barriers reflects the complex financial, institutional, and socio-cultural constraints highlighted in the second part of the research question. The most pressing obstacles included weak regulatory infrastructure, land tenure ambiguity, and public mistrust. These findings underline the need to tailor PPP frameworks to operate at local or municipal levels, reduce legal risk through state-owned land, and integrate community engagement to mitigate cultural resistance.

In conclusion, the empirical findings reinforce many of the structural barriers documented in global PPP literature but also expand the discussion by emphasizing local data weaknesses, cultural resistance, infrastructural shortages, and the lack of PPP-specific institutional knowledge. The Syrian context demands more than the replication of generic PPP models, it calls for deeply contextualized frameworks that account for legal fragility, economic instability, knowledge gaps, and social sensitivities. Without addressing these interlocking constraints, even the most promising PPP concepts risk early collapse.

4.2.3 Enablers and Recommendations

The third theme, Enablers and Recommendations, shifts the focus from identifying barriers to exploring strategic pathways for unlocking the potential of PPPs in Syria’s post-conflict housing. While the literature outlines basic enabling conditions such as legal clarity, risk-sharing instruments, and community participation (Alteneiji et al., 2021; Gabrielli et al., 2024; Kavishe et al., 2018), the empirical findings enrich this foundation with context-specific, actionable recommendations drawn from regional analogues, Islamic finance, institutional learning, and operational insights.

Institutional modification emerged as a foundational enabler. P1 encouraged for a *single-window clearance system* to streamline approvals and simplify coordination across multiple agencies: “*I propose a ‘single window’ to simplify procedures.*” This confirms best practices in centralized PPP units used in emerging markets to reduce fragmentation and improve accountability (Vahdatmanesh et al., 2022). However, simplifying procedures is insufficient without capacity-building programs that equip public sector officials with the technical, legal, and financial expertise needed to manage PPP contracts. As noted by Kavishe et al. (2018), a lack of institutional competence is one of the key reasons for PPP failure in fragile states. In the Syrian context, donor-backed technical assistance programs or partnerships with regional PPP units, like those who established in Egypt, Jordan, and Saudi Arabia within the ministry of investment, these units could accelerate public capacity without awaiting full government reform.

P2 further suggested *geographically ring-fenced PPP zones*, citing Egypt’s successful zoning policies: “*Ring-fenced geographic zones with clear rules helped development.*” These zones allow for localized PPP reform in otherwise fragmented legal systems. This approach aligns with literature that recommends experimental governance through special economic or reconstruction zones to attract investment while limiting systemic risk (Kavishe et al., 2018).

Technical readiness and cost-efficiency were emphasized by P3, who highlighted the scalability and affordability of prefabricated systems: “*The steel structural system is 10–15% cheaper than traditional concrete structures.*” He also stressed precision in factory-cut routing: “*Sockets and pipes are cut in the factory,*” reducing on-site labor and rework. These insights reinforce existing findings on modular efficiency (Gunawardena et al., 2011; Loizou et al., 2021), but go further by offering specific production capacity for them: “*Output ranges between 5 to 10 tons per day, where 18–25 kg of steel needed per m².*” These figures underscore the system’s industrial feasibility, especially when paired with local supply chain development, a strategy that reduces logistics costs and also supports job creation and economic recovery, as noted in Ammari & Roosli (2024).

P3 also pointed to the importance of donor alignment and phased implementation, suggesting feasibility studies and pilot projects as entry points: “*A feasibility study would be prepared and submitted to potential donors.*” This reflects Oxfam’s (2003) guidance on “demonstration units” and aligns with Vahdatmanesh et al.’s (2022) recommendation to mitigate perceived risks through

proof-of-concept phases. However, as P3 noted, this also requires improvements in “*power availability, local awareness, and cost minimization,*” highlighting the need for enabling infrastructure and public engagement strategies to support technical uptake.

From a financial governance perspective, P4 underscored the value of legal guarantees, visibility, and public control mechanisms in building developer trust: “*The system supports developer trust through legal guarantees, project visibility, and public control mechanisms.*” He also referenced the use of secure holding accounts, a common practice in Gulf-based PPPs: “*Developers are usually required to place deposits in secure holding accounts.*” These tools mirror Ameyaw & Chan’s (2017) recommendations for guarantee-systems to ensure accountability and prevent misappropriation.

P4 proposed allocating a share of housing units to address affordability, “*10–15%*”, to low-income groups, with rent tied to income. He also introduced a *savings-based finance model* where “*someone contributing \$50/month*” could accumulate equity for down payments. These models expand on the literature’s discussions of inclusionary zoning and microfinance (Gabrielli et al., 2024), offering culturally and economically appropriate strategies for Syria’s distressed middle-and lower-income groups.

P5 introduced a transformative enabler: Islamic finance and waqf-linked housing models. He proposed that “*zakat funds can be directed toward endowment (waqf) projects,*” emphasizing models where “*ownership stays within the project, profits are reinvested, and there is no interest.*” This confirms the relevance of Sharia-compliant instruments like *murabaha* and *ijara* (Alteneiji et al., 2021), while extending the framework through value-generating commercial waqf. Citing Al Rajhi Foundation’s model, “*invested in a commercial tower and used the income to fund microloans for interest-free loans for women entrepreneurs*”, P5 demonstrated how real estate-linked waqf can sustainably finance housing or livelihood support. Importantly, such models can be encouraged by *Takaful-based insurance schemes*, which offer interest-free risk pooling, further aligning with Syria’s cultural and religious environment.

On the urban scale, P6 emphasized the need for master-planned, integrated development: “*Functional and geographic integration between cities is key to sustainability.*” Drawing from

Turkish and Gulf experience, he outlined a model where governments provide master plans and then invite developers to operate within predefined rules:

“The master plan is typically provided by the public authority or a managing body like Emlak Konut. The land is divided and allocated to various companies who then develop it under specific design and planning standards. Developers operate independently but within the guidelines. (P6)”

He also noted hybrid allocation strategies: *“Part of the new development is allocated back to the original residents while the rest is sold for profit.”* These insights support the Shelter Cluster’s holistic approach to urban renewal (Kwaylih et al., 2023) and align with Gabrielli et al.’s (2024) advocacy for long-term urban management frameworks that prevent uncertain, uncoordinated development.

To further enhance the conditions necessary for successful PPP implementation, it is essential to explore complementary support mechanisms. First, diaspora investment platforms, including crowdfunding models and diaspora bonds, can mobilize Syrian expatriate capital for housing, confirming Berawi et al.’s (2020) findings on blockchain-enabled real estate investment. Second, partial risk guarantees from institutions like MIGA or the Islamic Development Bank could offer protection against political risks, addressing a major constraint highlighted by P4. Third, blockchain-based registries can enhance transparency in unit allocation, land ownership, and expenditure tracking, an approach gaining power in post-conflict contexts like Georgia and Kenya. Moreover, enabling frameworks must include digirove cost estimation and reduce construction waste, while the use of sustainability tools such as Quantifying Sustainability in Aftermath of Natural Disasters (QSAND), or Excellence in Design focal innovation and environmental resilience. Implementing Building Information Modeling (BIM) can impr Greater Efficiencies (EDGE) can enhance energy performance and attract green financing. These align with Gunawardena et al. (2011) and Veiskarami (2020), who highlight the role of modular technologies in reducing carbon footprints and enhancing building quality.

Finally, community engagement and social communication are critical enablers. Public resistance to modern construction techniques, like LGS, can be mitigated through targeted awareness campaigns and participatory design. Gender-sensitive outreach can also expand access to housing finance and increase uptake among marginalized groups. As Madden (2011) notes, projects with

inclusive community involvement tend to avoid the delays and failures associated with top-down planning.

The enablers identified in the interviews reflect a comprehensive shift from reactive solutions to proactive systems-building. They complement and expand on the academic literature by embedding technical, financial, cultural, and social considerations into PPP design. The Syrian context demands a multi-layered enabling environment, one that merges regulatory simplification, Islamic finance, local production, digital tools, donor alignment, and urban planning under a coherent vision. Through such integrative and context-sensitive strategies, PPPs can move from conceptual promise to scalable, resilient housing solutions for post-conflict recovery.

These operational recommendations serve not only as theoretical propositions but advances answers to the research question. They illustrate how PPP frameworks can be implemented through a context-sensitive pilot model that addresses Syria's specific financial, institutional, and socio-cultural constraints. Interview insights emphasize starting with geographically stable zones, leveraging state-owned land to avoid legal disputes, and activating donor-supported risk-sharing mechanisms to incentivize early-stage investment. In doing so, the findings shift the discussion from abstract feasibility to grounded implementation, offering a strategic blueprint for how PPP housing schemes can be piloted under real-world post-conflict conditions.

Taken together, the results presented in Chapters 4.2.1–4.2.3 deliver a coherent response to the research question. The data point toward blended PPP format, combining delegated private management with conditional revenue guarantees, as the most workable solution in Syria's post-conflict setting. Such hybrids keep private exposure within acceptable limits, rely on phased lease arrangements that match cash-flow realities, and maintain a clear role for public oversight. When these elements are assembled in a confined, peri-urban pilot zone, where land tenure is uncontested and basic governance functions still operate, the likelihood of early success rises markedly. Deploying donor-backed guarantees, concessional green loans, and Islamic finance windows further buffers investors against macro-economic volatility while aligning projects with local norms. In short, the evidence suggests that Syria does not need entirely new PPP paradigms; it needs context-specific adaptations of proven models, calibrated to its legal fragility, fiscal uncertainty, and diverse social fabric.

5. Discussion

This chapter interprets and contextualizes the empirical findings in light of the research objectives and relevant literature. It explores how the insights generated from the interviews contribute to a deeper understanding of PPP feasibility, design considerations, and implementation challenges for post-conflict modular housing in Syria. The discussion is structured around five core dimensions: the suitability of different PPP models, the institutional and technical barriers to their adoption, the enabling factors that can support implementation, the contractual implications of integrating modular technologies, and a detailed pilot framework proposed to test the concept in a real-world setting. By linking participant perspectives with theoretical frameworks, the chapter bridges the gap between academic discourse and practical policy innovation, offering a grounded roadmap for future application.

5.1 PPP Framework Design & Feasibility

The findings suggest that rigid or highly formalised PPP structures may not suit Syria's fragmented and fragile governance environment. Instead, hybrid or semi-formal models such as the cash-for-shelter scheme and the modernised waqf approach provide more context-appropriate alternatives. These frameworks are flexible, adaptable, and responsive to the urgent housing needs of displaced populations. They also offer cost advantages and enable local participation. Importantly, they allow for incremental formalization, starting from community-led initiatives under donor or municipal oversight, then transitioning toward more structured partnerships as institutional capacity grows. This gradual approach reflects the principle of institutional layering and offers a more realistic entry point for PPPs in fragile contexts, compared to traditional top-down concession models. It also broadens the scope of PPP theory by integrating culturally embedded financial tools such as Islamic finance and community-managed land use, which are rarely addressed in Western-centric literature.

One key insight that emerges is the potential of establishing geographically ring-fenced PPP zones, dedicated urban or outskirts urban areas governed by simplified rules and streamlined procedures. These zones, inspired by Egypt's new towns model and Jordan's special economic zones, could serve as protected laboratories for piloting housing PPPs. Their stability arises not just from geographic boundary, but also from legal clarity, centralized control, and strategic selection of relatively secure land. By protecting pilot initiatives from the uncertainties of national law and political interference, these zones provide an enabling space for experimentation, donor

engagement, and risk sharing. Within such a framework, housing solutions can evolve in response to real-time feedback, rather than being constrained by outdated national regulations.

5.2 Barriers & Constraints

The barriers identified highlight how the absence of clear land ownership records, weak administrative coordination, and legal ambiguity severely limit the implementation of housing PPPs in Syria. These institutional gaps are further combined by socio-cultural sensitivities around land loss, population displacement, and housing scale down. The lack of public trust in long-term contracts, paired with a weak financial system, makes traditional housing finance models ineffective. Conventional loan-based structures impose high repayment burdens on already vulnerable households, while Islamic microfinance and waqf-based schemes may offer culturally acceptable, non-interest-bearing alternatives that align with local values and reduce financial strain. These instruments also allow for more flexible repayment arrangements, community involvement, and long-term sustainability, making them both more inclusive and better adapted to Syria's current socio-economic realities and institutional capacities.

Additionally, Syria's technical readiness for housing PPPs remains limited. A strong preference for traditional concrete, low awareness of systems like light gauge steel (LGS), and fragmented supply chains have slowed the adoption of innovative methods. These issues are partnered by poor infrastructure, unreliable electricity, high transport costs, and a shortage of skilled labor. To mitigate these risks, participants proposed establishing small-scale fabrication workshops near project sites to reduce logistical strain and accelerate placement. A phased construction approach, starting with pilot units, can lower technical risk and provide hands-on training. Integrating BIM can also improve efficiency by minimizing waste, streamlining procurement, and aligning designs with local capabilities. These strategies offer a realistic pathway for scaling innovation in a fragile context.

Another critical constraint is investor risk perception. Political instability, legal uncertainty, and the lack of enforceable contracts significantly deter private sector participation. To mitigate this, international de-risking instruments such as partial risk guarantees (PRGs) from Multilateral Investment Guarantee Agency (MIGA), or Islamic Corporation for the Insurance of Investment and Export Credit (ICIEC), can be employed. These guarantees offer protection against compulsory acquisition, currency conversion limitations, and civil disturbances, enabling the issuance of sukuk or diaspora bonds at reduced risk premiums. These tools are underutilized in current PPP literature but may prove essential in post-conflict environments where investor trust is a real issue.

5.3 Enablers & Recommendations

The enabling factors identified point toward a new governance design that balances regulatory innovation, financial creativity, and social inclusion. Simplified procedures such as one-stop-shop administrative units can accelerate implementation, especially within ring-fenced PPP zones. Regulatory stability is further reinforced through legal guarantees, transparent dispute mechanisms, and secure financial structures like secure holding accounts.

From a financial perspective, community-based financing models such as savings-linked rent-to-own schemes and commercially secured waqf projects offer feasible alternatives to traditional mortgages. Islamic finance instruments, murabaha, sukuk, and zakat-based revolving funds, provide culturally acceptable mechanisms that can be tailored to Syria's largely unbanked population. Diaspora capital can be mobilized through blockchain-based crowdfunding platforms and diaspora bonds to provide transparency and increase investor confidence, particularly when backed by international guarantees to even bypass domestic financial challenges.

Technological enablers must also be addressed. Investing in local LGS fabrication and training workshops can activate domestic supply chains while reducing dependence on imports. Adopting BIM and digital twins allows for better cost control, payment scheduling, and donor monitoring. These systems can create accountability and real-time performance tracking, which is essential for attracting institutional capital. Finally, social enablers, such as gender-sensitive outreach, community dialogue, and participatory planning, can reduce opposition, build local ownership, and ensure that housing solutions are both inclusive and resilient.

5.4 Contractual Implications of Modular Construction in PPP Housing Projects

Integrating modular prefabricated housing into a public-private partnership (PPP) arrangement reshapes the contract landscape in ways that distinguish sharply from conventional construction schemes. In traditional PPPs, payment certificates and risk transfers are tied to milestones achieved on-site. Under a modular regime, however, the bulk of value creation shifts upstream to the factory floor. That shift obliges the public partner (or donor) to commit funds earlier and to renegotiate how design, production, transport, and assembly risks are apportioned. Because manufacturing

risks are front-loaded, the payment calendar must be reorganised around factory outputs rather than site progress.

Standard PPP templates rarely capture the particularities of off-site production, external quality audits, long-haul logistics, and rapid installation. This study therefore advocates contract structures that are inherently phased, such as *Istisna'a-Ijara* hybrids in Islamic finance, which release instalments against verified factory completions while preserving the public partner's oversight. Governance provisions likewise require adjustment: factory-stage inspections, detailed logistical planning, and clauses that accommodate tolerances and lead-times specific to prefabrication.

With these legal and operational adaptations in place, modular construction ceases to be a mere technical add-on and becomes integral to the PPP bargain, delivering the speed, scalability, and transparency essential to housing recovery in post-conflict Syria.

5.5 Proposed PPP Pilot Model for Post-Conflict Syria

In response to the complex institutional, financial, and technical challenges identified throughout this study, this research proposes a structured pilot model to test the feasibility of PPPs in delivering affordable modular housing in post-conflict Syria. Rather than attempting a national-scale implementation of a PPP framework, an approach that would be incompatible with Syria's current post-war fragmentation and limited institutional stability, the proposed pilot seeks to test the operational dynamics of PPPs within a contained, low-risk environment. The selected location for implementation should be on secure, state-owned land within a relatively stable area, such as the Aleppo or Homs countryside, where there is some form of functioning local authority. This choice reflects multiple necessities: the need to minimize legal disputes arise from fragmented property records (Kavishe et al., 2018), to enable local coordination without central government dependence, and to follow international best practices observed in post-disaster contexts such as Australia and Indonesia, where modular housing pilots were implemented in geographically ring-fenced zones specifically selected for their relative security and administrative feasibility (Loizou et al., 2021; Chang et al., 2010). Using state-owned land also allows the pilot to bypass complicated land acquisition processes, which have been flagged in the literature and in participant interviews as one of the primary barriers to project implementation in post-conflict settings (Kwaylih et al., 2023).

The housing typology proposed for the pilot is based on modular Light Gauge Steel (LGS) construction, which offers significant advantages in post-conflict scenarios. As detailed in Section (Veiskarami, 2020; Lawson et al., 2012; Gunawardena et al., 2019), LGS systems allow for rapid, dry construction that is 45–50% faster than conventional methods, with far lower levels of material waste and emissions (Lawson et al., 2012; Veiskarami, 2020). These systems also support cost savings of approximately 20% and produce units that are both energy-efficient and customizable (Gunawardena et al.). Such features are essential in Syria’s current landscape, where materials are expensive, skilled labor is scarce, and environmental infrastructure is weak. Moreover, modular units can be pre-manufactured outside conflict zones and transported to site in flat-pack form, facilitating delivery even in logistically constrained areas, a logistical feature highlighted as critical in post-disaster reconstruction projects globally (Gunawardena et al.). From a socio-cultural standpoint, the modular nature of LGS systems allows for flexibility in spatial planning and facade customization, which helps mitigate the negative perceptions that communities may associate with prefabricated housing, as documented in Section 2.2.4 (Kwaylih et al., 2023; Gunawardena et al., 2019) and supported by participants who noted the importance of cultural adaptation in housing design (P2, P5).

The pilot is limited to 15–25 housing units, a number carefully chosen to strike a balance between operational manageability and evaluative depth. This scale enables full oversight within the constraints of Syria’s limited administrative capacity, while also producing sufficient data for assessment and future replication. Importantly, this scale is grounded in international precedent: the LEED housing pilot project in the United States began with a similar number of units (20–30) to assess neighborhood-scale sustainability before committing to larger programs (Madden, 2011), and the Australian bushfire modular response focused on clusters of 10–20 units to manage delivery and gather feedback prior to national expansion (Loizou et al., 2021). Attempting a larger scale in the Syrian context without prior testing would not only increase exposure to financial and technical risk, but could undermine credibility if results are not delivered on time or within budget.

In terms of delivery mechanism, a short-term Build-Operate-Transfer (BOT) contract structure of 5 to 7 years is recommended. This model allows a private or hybrid developer to finance, build, and operate the housing for a defined period, collecting lease payments under agreed terms, before transferring ownership or control to the public sector or end users. The rationale behind this format draws on successful regional examples, such as the Mohammed Bin Rashid Housing Establishment

(MBRHE) in Dubai and the Directorate of Housing (DH) in Sharjah, both of which used variations of the BOT model to balance public oversight with private efficiency (Alteneiji et al., 2021). In those cases, the government provided either upfront subsidies or guarantees, while private partners assumed responsibility for financing and operations. Such models are particularly well-suited for Syria's post-conflict conditions, where the public sector lacks capacity to lead large-scale delivery but can play a supportive role in providing land, basic infrastructure, and regulatory facilitation.

The financing strategy for the pilot is designed to blend Islamic finance with diaspora capital in order to align with both cultural expectations and practical constraints. Drawing on insights from both literature and interview findings (Sections 2.3.2 and P5), the model integrates *waqf*-based housing endowments and *sukuk*-style bonds as key funding channels. These tools are well-established in the region and offer ethical, risk-sharing mechanisms which can Utilize inactive funds while fostering public trust. Lease-to-own (*Ijara*) contracts provide an affordable path to homeownership while avoiding interest-based mechanisms, which may be socially or religiously unacceptable in certain Syrian communities. As documented in the UAE models, such instruments have proven effective when paired with government guarantees or price stabilization tools (Alteneiji et al., 2019). Additionally, political risk insurance from institutions such as the Multilateral Investment Guarantee Agency (MIGA) or the Islamic Corporation for the Insurance of Investment and Export Credit (ICIEC) can be explored to protect external investors against forced land acquisition, conflict recovery, or currency inconvertibility. A local holding account would serve as a risk mitigation tool to control cash flow and prevent diversion or misuse of funds, which several participants (P3, P5) noted as a concern in previous housing initiatives.

The governance structure is designed around a multi-stakeholder Steering Committee, comprising representatives from the public sector, private developer, NGO partner, and donor or financier. Each actor would have a clearly defined role: the public authority would provide land and infrastructure; the developer would oversee construction and short-term operations; the NGO would facilitate community engagement, including participatory design sessions, beneficiary selection, and household-level training; and the donor or financial sponsor would provide oversight and payment control. This three-party structure is directly inspired by the Al Yusr initiative in Dubai, which successfully reduced administrative burdens and enhanced delivery efficiency by delegating each function to a capable actor within a shared accountability framework (Alteneiji et al., 2019). To ensure transparency and reduce the potential for ownership disputes, a blockchain-based

housing registry would be established to record lease agreements, payments, and transfer of ownership, responding directly to institutional weaknesses in land administration identified by Kavishe et al. (2018) and reiterated by participants who raised concerns about institutional trust and data integrity in post-conflict Syria (P1, P4)..

Finally, the pilot would be evaluated through a two-step assessment process, at six months and one year post-occupancy. Evaluation metrics would include construction cost per square meter, delivery timeline, occupancy and satisfaction rates, and stakeholder coordination effectiveness. Data would be collected through field surveys, interviews, and document reviews, and the results used to determine whether the model can be scaled to larger districts or adapted based on emerging needs. In this way, the proposed pilot serves as a shelter solution and a practical diagnostic mechanism, a controlled test of financial, institutional, and technical feasibility in a highly fragile, post-conflict environment. The ultimate objective is to move beyond abstract frameworks and create a replicable, evidence-informed PPP model that can be tailored to the evolving realities of Syria's housing recovery.

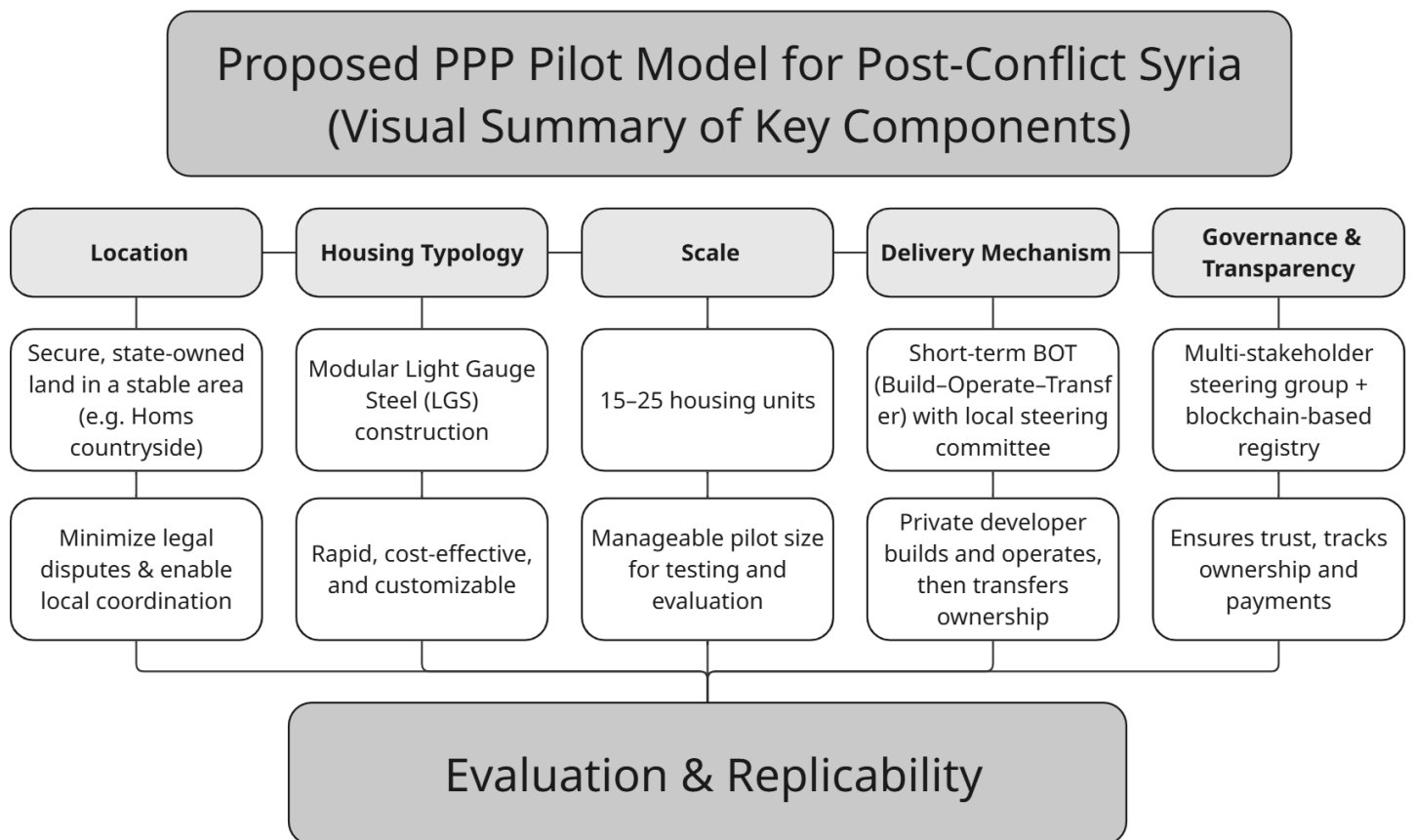


Figure 4: Visual Diagram of the Proposed PPP Pilot Model for Post-Conflict Syria

This diagram summarizes the five key components of the pilot framework—including location, housing typology, scale, delivery mechanism, and governance structure, proposed to test the feasibility of PPP housing solutions in Syria.

Table 9: Rationale for pilot project Model Component Selections

Component	Justification	Reference / Evidence
Location	Chosen to minimize legal disputes and enable decentralized implementation	Kavishe et al., 2018; P1, P4
Housing Typology (LGS)	Modular LGS systems offer speed, lower emissions, and lower cost	Veiskarami, 2020; Gunawardena et al., 2019
Scale (15–25 units)	Matches successful pilot sizes in LEED (USA) and Australia; allows manageable evaluation scope	Madden, 2011; Loizou et al., 2021
Delivery Mechanism (BOT)	Regional examples (UAE) showed BOT reduces government burden and works well under short contracts	Alteneiji et al., 2021; P2
Governance & Transparency	A steering group with blockchain registry mitigates trust issues and ownership fragmentation	P1, P4; Gunawardena et al., 2019

5.6 Practical Relevance and Future Application

Together, these strategies offer a realistic pathway for scaling innovation in a fragile context. While no formal implementation has begun, the findings and proposed framework developed in this thesis are expected to inform a potential future initiative led by the researcher to pilot a PPP-based housing model in Syria. Such a project would seek to apply key principles explored in this study, including modular construction, Islamic finance instruments like waqf, and diaspora-oriented funding mechanisms. The thesis provides both a theoretical contribution and a foundation for practical application in future post-conflict reconstruction efforts by bridging academic inquiry with the researcher’s professional aspirations.

6. Conclusion

This study has explored the feasibility of applying PPP frameworks to post-conflict housing reconstruction in Syria, focusing on the interplay of institutional fragility, financial constraints, and socio-cultural sensitivities. Drawing on interview data and relevant literature, the analysis revealed that conventional PPP models must be significantly adapted to respond to Syria's fragmented governance, informal land ownership, limited legal enforceability, and the fragile economic base of its population.

The findings underscore the need for a hybrid PPP approach that blends formal regulatory elements with flexible, community-oriented models such as waqf-based finance, phased construction, and localized project governance. The potential of geographically ring-fenced PPP zones emerged as a strategic enabler, allowing for experimentation and piloting under clear rules in relatively secure areas. To address political and financial risk, instruments such as partial risk guarantees from MIGA and ICIEC were proposed, while innovative funding mechanisms, such as diaspora bonds, Islamic microfinance, and blockchain-based asset tracking, offer promising pathways to mobilize resources in a trust-deficient environment.

Moreover, technical constraints can be mitigated through decentralized fabrication, BIM-based planning, and skill-building within local supply chains. Social inclusivity, particularly through gender-sensitive outreach and community participation, is essential to ensure local legitimacy and avoid the delays associated with top-down interventions.

Importantly, this study was also driven by a personal ethical commitment to contribute to Syria's recovery through practical, inclusive, and socially just solutions. The emphasis on affordable and accessible housing reflects the belief that shelter is a fundamental right, not a privilege, and that reconstruction must prioritize the needs of displaced and vulnerable populations. Ethical principles were embedded not only in the research process, through anonymized interviews and informed consent, but also in the design of the PPP model itself, which seeks to prevent elite capture, promote transparency, and empower local stakeholders.

In sum, this research contributes both theoretically and practically to the evolving field of PPPs in fragile contexts. The proposed framework emphasizes pragmatism, local adaptability, and ethical

finance, elements that are critical not only for Syria but also for other post-conflict regions facing similar developmental challenges. Future efforts should prioritize piloting this model within a controlled test zone, enabling Syria to move from reactive housing relief toward sustainable, scalable reconstruction.

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