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**OFF-SITE CONSTRUCTION AS AN ENABLING MECHANISM IN
MEGA-PROJECT DEVELOPMENT: A MODEL FOR THE
ENTREPRENEURIAL BUSINESS DEVELOPER INTERMEDIARY
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Abstract: Off-site construction (OSC) offers well-established advantages in productivity, quality, and sustainability; however, its strategic adoption in public-private partnership (PPP) mega-project development remains limited, particularly in emerging economies. This paper argues that the primary constraint is institutional and governance-related rather than purely technological or financial, specifically the absence of a boundary-spanning intermediary capable of translating OSC value propositions into PPP-compatible structures. Drawing on stakeholder theory, institutional theory, and transaction cost economics, the study introduces the Entrepreneurial Business Developer Intermediary (EBDI) as this missing governance actor. Using a qualitative, theory-driven single-case study of the Niamey International Airport PPP in Niger, the paper triangulates AfDB project documentation, institutional records, OSC literature, policy benchmarks, and one expert interview with a senior contractor representative. The analysis identifies institutional barriers to OSC adoption, characterises the EBDI's intermediation functions, and develops the **EBDI-OSC Enablement Model**. The model articulates three interdependent enabling mechanisms: opportunity framing, which positions OSC as an investable proposition; stakeholder alignment, which secures coordinated multi-actor commitment across fragmented public-sector counterparties; and delivery structuring, which embeds OSC within contractual and procurement frameworks. The project documentation reports an estimated 18% reduction in the construction programme; however, this figure is treated as project-reported and not independently audited. The paper develops a mechanism-based governance framework to enable industrialised construction in complex PPP environments and argues that effective advisory mandates must extend beyond financial restructuring to encompass construction innovation and supply-chain integration.

Keywords: off-site construction; public-private partnership; mega-project development; EBDI; boundary-spanning intermediary; governance.

1 INTRODUCTION

Off-site construction (OSC) encompasses various forms of prefabrication, modular construction, and factory-based production. It is closely related to Design for Manufacture and Assembly (DfMA), but the two terms are not interchangeable. **DfMA** is a broader design philosophy and methodology that seeks to optimise design for efficient manufacturing, logistics, and assembly, whereas OSC is a delivery pathway for implementing DfMA principles within industrialised construction systems. OSC is therefore considered a key component of construction industrialisation (Goulding et al., 2015; Lawson et al., 2014). Its role in improving productivity, quality, and sustainability has become increasingly important in the construction

industry (Wuni and Shen, 2020; Li et al., 2020). The strategic significance of OSC is most evident in mega-project development (**MPD**), where long timescales, multi-agency decision-making, and high coordination demands create persistent challenges for productivity and delivery (Flyvbjerg, 2017; Farmer, 2016; Davies et al., 2017).

Despite its documented advantages, OSC is applied inconsistently across mega-projects delivered through PPPs. In many cases, OSC is adopted reactively in response to schedule pressure, scope complexity, or the inability of traditional methods to deliver the required product, rather than proactively as part of an early strategic governance plan. This pattern is particularly evident in emerging economies, where fragmented supply chains, procurement processes that favour cast-in-place delivery, and resistance from institutional authorities may hinder early OSC integration (Pan et al., 2012; Blismas et al., 2006).

However, these descriptions focus on symptoms rather than the underlying governance structure that allows them to persist. The central argument of this research is that institutional and governance-related issues are the primary obstacles to the strategic adoption of OSCs in PPP mega-project development. Existing work on PPP governance, innovation intermediation, and stakeholder coordination has not yet identified a single actor capable of translating OSC value propositions into PPP-compatible structures during the early stages of the mega-project development lifecycle (**MPDL**), when path dependencies are formed and innovation opportunities may be lost. To address this gap, the paper conceptualises the Entrepreneurial Business Developer Intermediary (EBDI) as a boundary-spanning actor operating at the public-private-supply chain interface. Unlike an innovation champion, technology broker, systems integrator, or PPP transaction adviser, the EBDI combines governance mediation, entrepreneurial opportunity framing, and construction innovation structuring across the phases in which OSC commitments are institutionalised or lost.

This paper explains how a structured EBDI function facilitates the strategic adoption of OSC within PPP mega-project governance. The article has three objectives: (i) to identify the institutional barriers to OSC integration in PPP mega-project development; (ii) to describe the EBDI's intermediation functions across the public, private, and supply-chain interfaces; and (iii) to outline the governance mechanisms through which the EBDI embeds OSC commitments from conceptualisation through to financial structuring. The contribution is both theoretical and practical. Theoretically, the paper develops a mechanism-based governance construct that integrates stakeholder theory, institutional theory, and transaction cost economics. In practice, it provides PPP units, sponsors, and project-preparation facilities with guidance on expanding advisory mandates beyond financial structuring to include construction innovation, supply-chain engagement, and contractual embedding. The remaining sections review related studies, explain the case methodology, present the EBDI-OSC Enablement Model, discuss the Niamey International Airport case, and conclude with a discussion of limitations and future research opportunities.

2 REVIEW OF RELATED STUDIES

The literature review comprises three stages. In the first stage, the review will assess research on the potential benefits and barriers to OSC implementation. The second stage will relate these barriers to the complexity of governance issues surrounding PPP mega-project development. Finally, the review will attempt to identify a gap in the boundary-spanning intermediary among the various stakeholders, which would form the basis for an EBDI.

2.1 OSC Benefits and Adoption Barriers

Off-site Construction (OSC) is widely regarded as highly effective in enhancing productivity, quality and sustainability in the construction industry. For example, it delivers faster construction timeframes than traditional on-site methods; provides a higher level of quality control; and offers a better safety record (Goodier and Gibb, 2007; Luo et al., 2015). Recent reviews report that OSC provides the greatest benefits when used on large-scale, repetitive projects, and that its adoption depends on the maturity of the supply chain; the involvement of contractors at the earliest stages of the construction process; the adoption of platform standards; and the application of DfMA principles during the early design phase (Goulding et al., 2015; Lawson et al., 2014; Wuni and Shen, 2020; Li et al., 2020).

Although OSC and DfMA offer significant benefits for mega-project development, substantial barriers remain to their widespread adoption. The literature describes these barriers primarily as institutional and governance-related rather than purely technical. They cluster into three groups: supply-chain and standardisation barriers, including fragmentation and inconsistent specifications; contractual and procedural barriers, including procurement documents that incentivise cast-in-place systems and inhibit early DfMA integration; and regulatory barriers, including local content requirements that may restrict the importation of prefabricated components in some developing countries (Pan et al., 2012; Blismas et al., 2006; Dubois and Gadde, 2002). These barriers occur at organisational, project, and institutional levels and cannot be overcome by technical readiness alone. OSC therefore requires a supporting governance structure that enables DfMA principles, supplier input, and contractual commitments to be integrated early enough to influence project definition.

2.2 PPP Mega-Project Development Governance and Innovation Adoption

Due to the multi-level governance structures in PPP mega-projects, there are obstacles to their adoption, as multiple levels of government and the private sector must align their objectives through a long-term contract (Grimsey and Lewis 2004). Three theories demonstrate the complexity of this task. First, stakeholder theory (Freeman 1984) argues that the issue is how to align the various actors. Next, institutional theory shows that there are pressures to use conventional means for default procurement due to isomorphism (DiMaggio and Powell 1983; Scott 2014). Last, transaction cost economics (TCE) illustrates that uncertainty before entering a contract, as well as incomplete contracts, discourage the adoption of innovative practices despite the lifetime benefits derived from this (Hart 2003; Locatelli et al. 2017).

The literature reveals an overall trend: most projects fail because of problems arising in the early stages of project development, before a design philosophy, procurement strategy, or delivery approach has been established through contract (Flyvbjerg 2017; Davies et al. 2017). Another source of complexity when examining projects in developing countries is that most public-sector entities do not act as single entities; decision-making typically involves multiple parties (e.g., the sponsoring agency, the Ministry of Finance, and a regulatory body), each with divergent mandates, risk tolerances, and other considerations. This fragmentation creates governance challenges for the adoption of OSC; for example, a construction methodology decision made by one agency may align with that agency's objectives and expectations, yet still require approval from another agency before execution can proceed. The PPP governance literature provides no insight into this multi-nodal alignment problem in relation to construction innovation.

2.3 Boundary-Spanning Intermediation: The Missing Construct

The adoption of innovation in construction is shaped by organisational, institutional, and cultural factors. Rogers (2003) identifies change agents as facilitators of diffusion, while Aldrich and Herker (1977) and Williams (2002) identify boundary-spanners as actors who connect institutional domains, translate knowledge, and manage interorganisational relationships. In construction, such actors are important because project organisations are fragmented and coordination across phases is often weak (Winch, 2014). Nevertheless, existing roles cover only part of the function required for OSC adoption in PPP mega-project development. Innovation champions usually support internal advocacy; technology brokers facilitate technical transfer; systems integrators coordinate components during delivery; and PPP transaction advisers primarily support financial close. None of these roles combines public-private governance mediation, entrepreneurial opportunity structuring, supply-chain innovation, and contractual embedding across the MPDL decision points where OSC is adopted or abandoned. The EBDI construct addresses this gap by integrating these partial roles into a single boundary-spanning governance function. **Table 1** shows that the EBDI is distinguished from adjacent constructs.

Table 1: Distinguishing the EBDI from adjacent constructs

Role	Primary Focus	Project Phase	Boundary-Spanning?	PPP-Specific?	OSC Enablement?
Innovation champion	Internal advocacy	Implementation	No	Rarely	Implicit
Technology broker	Technology transfer	Design	Partial	No	Technical only
Systems integrator	Component coordination	Delivery	No	Sometimes	Operational
PPP transaction advisor	Financial close	Procurement	Partial	Yes	No
EBDI	Governance + opportunity framing + OSC embedding	Conceptualisation to Financial Structuring	Yes (public-private-supply chain)	Yes	Explicit and strategic

3 METHODOLOGY

This section outlines the research design, data sources, interview strategy, documentary analysis procedure, coding approach, and validation logic used to examine the EBDI-OSC Enablement Model. **Figure 1** summarises how the research aim, qualitative single-case design, triangulated evidence base, and three theory-driven analytical mechanisms were linked together.

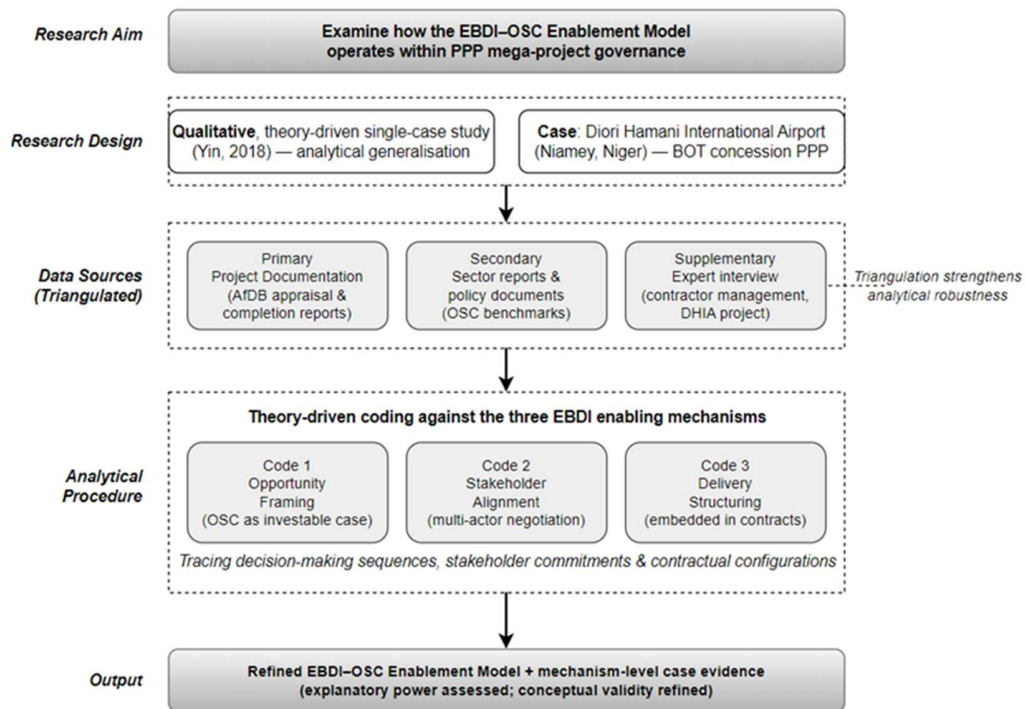


Figure 1: Research Methodology Framework

3.1 Research Design and Data Sources

This research employs a qualitative, theory-driven single-case study to examine the governance mechanisms that support OSC integration in the development of PPP mega-projects. The single-case design is appropriate because the purpose is analytical generalisation and theory refinement rather than

statistical generalisation (Yin, 2018). The Diori Hamani International Airport (**DHIA**) PPP in Niger was selected because it offers an information-rich case in which OSC was selectively adopted within a fragmented institutional environment, a PPP financing structure, and a landlocked logistics context. These characteristics make the case suitable for examining how an EBDI-type function may enable or constrain OSC adoption under complex governance conditions.

Data were triangulated across four sources. The first comprised AfDB project appraisal and completion reports, institutional records, and publicly available project documents. The second comprised sector reports, OSC benchmarks, and policy documents providing contextual evidence on OSC performance and adoption conditions. The third comprised academic literature on OSC, PPP governance, innovation intermediation, stakeholder alignment, institutional theory, and transaction cost economics. The fourth was a supplementary expert interview with a senior contractor representative involved in the contractor's management context, used to clarify the practical challenges of OSC delivery in a landlocked environment. The interview was not treated as statistically representative; rather, it served as contextual validation of the documentary interpretation. Quantitative outcomes, including programme reduction estimates, are therefore reported as stated by the project and not independently audited.

3.2 Analytical Procedure

The analysis followed a theory-driven coding procedure. The three mechanisms of the EBDI-OSC Enablement Model - Opportunity Framing, Stakeholder Alignment, and Delivery Structuring - served as initial analytical codes. Evidence from documents, the literature, and the expert interview was then examined to trace: (i) how OSC was framed as a financial and programme-risk proposition; (ii) how public, private, regulatory, and supply-chain actors were aligned; and (iii) how OSC decisions were embedded within procurement, contractual, and governance arrangements. Triangulation was achieved by comparing documentary evidence with literature-based expectations and expert interpretation. The purpose was not to prove causal attribution or quantify OSC performance, but to assess whether the model provides a plausible explanatory framework for understanding how OSC was enabled within PPP governance.

4 THE EBDI-OSC ENABLEMENT MODEL

The EBDI-OSC Enablement Model conceptualises governance transformation as an orchestrated process led by a boundary-spanning intermediary. The model draws on three theoretical perspectives: stakeholder theory, which positions the EBDI as a stakeholder orchestrator (Freeman, 1984); institutional theory, which positions the EBDI as an institutional entrepreneur challenging isomorphic procurement defaults (Scott, 2014); and transaction cost economics, which positions the EBDI as a mechanism for reducing ex-ante uncertainty and the coordination costs associated with innovation adoption (Hart, 2003).

Figure 2 shows that the EBDI operates at the interface of public sponsors, PPP units, regulatory authorities, private investors, contractors, consultants, funders, and OSC suppliers. The model is operational rather than merely conceptual: it shows how the EBDI moves OSC through a sequence of decision points, from technical option to investable proposition, to stakeholder commitment, to contractual obligation. This process is most critical during conceptualisation and financial structuring, when design assumptions, risk allocation, procurement documentation, and supply-chain commitments remain adjustable. The three mechanisms - opportunity framing, stakeholder alignment, and delivery structuring - operate iteratively and concurrently. Opportunity framing converts technical potential into an investable case; stakeholder alignment secures coordinated commitment among actors with different mandates; and delivery structuring embeds those commitments in procurement and contract documents. Triangulating project reports, OSC literature, and expert interview evidence strengthens the analytical validity of the interpretation, while all performance data are treated as indicative rather than causal evidence.

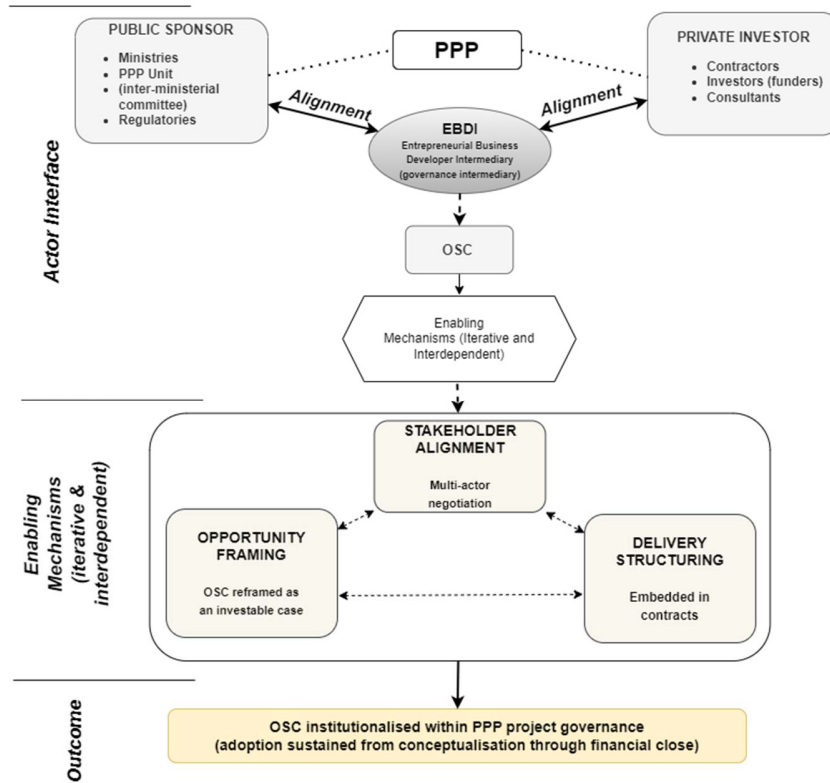


Figure 2: Conceptual Model of EBDI-Enabled OSC Adoption in PPP Mega-Project Developments

4.1 Opportunity Framing

Opportunity framing translates the technical value of OSC into economic, programme-risk, and financeable terms that decision-makers and financiers can use in PPPs. The EBDI develops lifecycle cost logic, risk-adjusted return arguments, and programme-risk narratives that demonstrate how prefabrication and DfMA-informed design can reduce construction uncertainty. This matters because lenders in project finance structures are concerned with completion risk, cost escalation, and delay exposure. The literature identifies a knowledge gap between technical and financial decision-makers as a major barrier to OSC adoption (Pan et al., 2012; Blismas et al., 2006). Without opportunity framing, OSC may be technically understood but financially invisible, failing to enter the decision-making process early enough to reduce ex-ante uncertainty (Hart, 2003).

4.2 Stakeholder Alignment

Aligning stakeholders is a key management function that addresses institutional resistance to collaboration among actor groups with different objectives and risk profiles (i.e., public sponsors (government) are primarily concerned with cost certainty and political visibility; private investors are mainly concerned with their financial returns and the distribution of risk between the parties; suppliers of OSC products and services are most focused on standardisation and early commitment to the design of their products and services; while regulators are almost entirely focused on compliance and safety). The EBDI addresses these issues through boundary-spanning negotiations (Williams 2002) that create and broker value propositions developed jointly by all stakeholders, and through contractual agreements that address stakeholder-specific needs. In the context of PPP mega-projects, this function is even more difficult because the public-sector counterparty is a fragmented inter-ministerial structure, and OSC adoption requires that the public-sector owner and the private-sector Contractor have made a co-produced

commitment to bilateral support for OSC, which neither can achieve alone. If local content regulations are in effect, the EBDI must also identify lawful paths to compliance rather than circumvent them.

4.3 Delivery Structuring

The formal governance architecture of a project, encompassing delivery structuring and the documentation associated with procurement, contracting, supply chain specifications and logistics planning, embeds OSC commitments made during the concept phase. Without this mechanism, OSC commitments made during the concept phase are susceptible to specification reassertion, reverting to conventional procurement defaults under pressure to standardise documentation (Pan et al. 2012). Thus, delivery structuring serves as a lock-in mechanism for the EBDI's ongoing participation from the concept phase through to the project's financial closure. This longitudinal relationship distinguishes the EBDI from shorter-term transaction advisors, who are typically limited to the financial structuring phases of a transaction. The three mechanisms function as a governance system rather than as three separate interventions. Actor commitments cannot be mobilised by opportunity framing without alignment; specification reassertion cannot be avoided without alignment, and delivery structuring has no institutional legitimacy to overcome conventional procurement defaults when there is no prior opportunity framing and alignment. Empirical evidence on the interdependence of these mechanisms is examined in **Section 5**.

5 CASE STUDY: NIAMEY INTERNATIONAL AIRPORT

5.1 Project Overview

AfDB documentation released in 2018 and 2022, including project appraisal and completion reports, was used as a descriptive source to identify the project's financial structure, institutional arrangements, advisory functions, and reported outcomes. Blended financing comprised AfDB debt, private equity, and a government subordinated loan. The government project-preparation advisory function was engaged from the conceptualisation phase and, although not formally defined as an EBDI, exhibited several EBDI-type functions: financial structuring, translation of construction innovation, design standardisation, and supply-chain engagement. Project documentation reports an estimated 18% time saving in construction duration (AfDB, 2022, as project-reported). This figure is consistent with broader OSC benchmark ranges but is not independently audited and cannot be attributed solely to OSC, as OSC was applied selectively and accounted for only a limited share of the total project cost. The figure is therefore treated as indicative evidence of reported project performance, not as proof of causal impact.

5.2 Opportunity Framing in Practice

The government project preparation agency's mediator reassured public sponsors and equity investors by translating prefabricated roof trusses and modular service pods into lifecycle cost and programme risk models. OSC was redefined as an effective risk-mitigation tool and shown to reduce completion risk in the construction process, thanks to the use of prefabrication and DfMA principles, which lenders typically charge a premium for in project finance. Lifecycle cost models provided further justification by demonstrating cost savings from modular construction, thereby reducing total financing costs during the BOT period. This simplification was instrumental in ensuring that OSC was included in the project brief from the very beginning of the feasibility process, rather than the historical practice of considering OSC only after schedule overruns.

5.3 Stakeholder Alignment in Practice

The government project-preparation agency facilitated alignment among several actor groups in a deliberate sequence: regulatory compliance first, bilateral owner-contractor commitment second, and investor assurance third. This sequencing prevented any single actor's concerns from blocking subsequent commitments. The greatest challenge to OSC adoption was ensuring compatibility with Niger's local content requirements and with similar regulatory expectations in other contexts where import restrictions and domestic sourcing priorities affect prefabrication decisions. In response, a phased local

content strategy was developed through engagement with relevant ministries. This allowed the conditional use of specialised imported components while creating a pathway for progressive local supply-chain development. The case, therefore, suggests that EBDI-type intermediation does not avoid regulation; rather, it translates innovation into a lawful, sequenced, and institutionally acceptable pathway.

Early contractor engagement reduced uncertainty about design intent and delivery capability before procurement, thereby moving OSC from a possible design option to a contractual commitment. This reduced ex-ante transaction costs and mitigated supply-chain risk by documenting manufacturing capacity for investors and lenders. Early supplier involvement also enabled DfMA principles to inform design standardisation and supply-chain readiness. However, interview evidence qualifies this interpretation: OSC was selectively applied to passenger boarding bridges (see **Figure 3**), and similar OSC use did not continue consistently across later projects. The senior contractor representative identified logistics complexity and transport costs as major constraints, particularly because Niger is landlocked. Prefabricated components required sea transport followed by long-distance inland trucking. This finding supports the transaction cost economics framing: even where governance mechanisms work, logistics and coordination costs may reduce the attractiveness of OSC in subsequent projects.

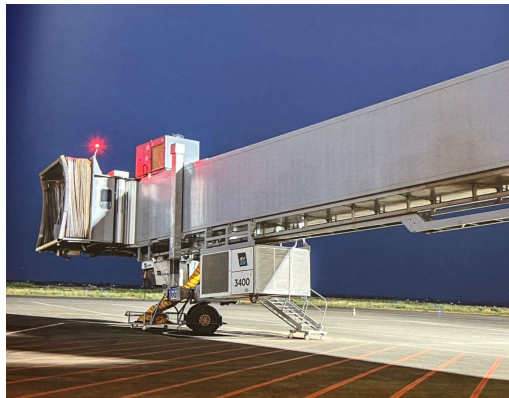


Figure 3: OSC passenger boarding bridges, DHIA project. OSC application in landlocked logistics

5.4 Delivery Structuring in Practice

The project's formal governance framework for OSC commitments was applied across all decision-making phases. Procurement documentation referenced specifications for prefabricated roof trusses and modular service pods; supply chain logistics were contracted; and performance standards for factory-made components were set out in the project's technical schedule. There were multiple revisions to the contract documents during the project's structuring period, with continued oversight from the Agency advisor, thereby maintaining the OSC decisions made early in the project, when those decisions are most susceptible to changes in specifications (Pan et al. 2012). Thus, the delivery structuring served as a lock-in mechanism that preserved early OSC decisions when they were most vulnerable to change.

5.5 Mechanism–Outcome Synthesis

Table 2 summarises the links between each EBDI mechanism and activities, governance outcomes, and project outcomes in the Niamey case. The case supports the model's primary proposition: structured intermediation can support OSC adoption in PPP mega-projects through three interdependent mechanisms. Opportunity framing helped OSC enter the feasibility and investment logic; stakeholder alignment created multi-actor legitimacy; and delivery structuring protected OSC decisions through procurement and contract documentation. The mechanisms are mutually reinforcing rather than sequentially isolated. Framing without alignment would not secure commitment; alignment without contractual structuring would not prevent specification reversal; and structuring without prior framing and legitimacy would lack institutional support.

Table 2: Empirical Mapping of EBDI Mechanisms to Governance and Project Outcomes

Mechanism	EBDI Activity	Governance Outcome	Project Outcome
Opportunity Framing	Lifecycle cost modelling; OSC reframed as lender risk-reduction instrument	OSC included in project brief at feasibility stage; early sponsor and investor acceptance	Prefabrication adopted prior to procurement; improved bankability
Stakeholder Alignment	Phased local content pathway; bilateral owner–contractor commitment; PPP committee coordination	Regulatory constraints resolved; multi-actor commitment secured pre-procurement	All actors committed to OSC delivery before financial close
Delivery Structuring	OSC embedded in procurement documents and contracts; performance standards defined	Commitments formalised in contractual and governance structures; protection against specification reversion	Prefabricated systems retained throughout delivery; ~18% programme reduction (project-stated)

6 DISCUSSION

6.1 Theoretical Contributions

The EBDI–OSC Enablement Model contributes to three literatures simultaneously. First, it advances stakeholder theory from a diagnostic to an operational framework: the EBDI is positioned as an active orchestrator of stakeholders, not only identifying stakeholder interests but also intervening to align them, including within the fragmented public-sector counterparty. The Niamey case demonstrates that bilateral owner–contractor commitment to OSC adoption is co-produced and must be actively brokered, thereby extending stakeholder theory's reach to structured intermediation as a governance mechanism (Davies et al. 2017).

Secondly, the theoretical model enhances institutional theory by introducing the concept of an institutional entrepreneur (DiMaggio and Powell, 1983). The EBDI operates within legally binding rules rather than relying solely on informal conventions or norms to effect institutional change. The example from Niamey demonstrates that local content laws will require entrepreneurship-by-compliance, and that compliance will require identifying lawful pathways for development, such as adopting a phased approach to the framework rather than directly challenging the local content law's provisions.

Thirdly, the model extends transaction cost economics to the study of construction innovation in PPP development. The EBDI reduces ex-ante transaction costs by improving information quality, clarifying risk allocation, converting technical uncertainty into financeable assumptions, and embedding innovation commitments in enforceable contract language (Hart, 2003). This addresses a problem widely recognised in the PPP innovation literature: innovation may be desirable at the lifecycle level, but it is often excluded when uncertainty, incomplete contracting, and fragmented decision-making make it difficult to finance or procure (Osei-Kyei and Chan, 2015). The model therefore shifts analysis from asking only why innovation fails to asking how it can be structurally enabled within PPP governance systems.

6.2 Practical Implications

The practical implication is that the scope of the advisory mandate is a primary design factor for PPP units, infrastructure ministries, project-preparation facilities, private developers, and sponsors. If the advisory mandate is limited to financial close, construction innovation may be too late to influence design parameters, procurement strategy, or supply chain readiness. The EBDI function should therefore be authorised from conceptualisation through to financial structuring, and should explicitly include construction innovation, supply chain engagement, lifecycle value assessment, regulatory sequencing, and contractual embedding. The Niamey case suggests that early EBDI-type involvement can help retain

OSC through procurement, whereas late involvement is unlikely to overcome path dependencies already embedded in documentation and institutional commitments.

6.3 Limitations

This study has limitations. First, it is based on a single case in the Sahel region, so its findings should be treated as analytically transferable rather than statistically generalisable. Second, causality cannot be established, as donor pressure, political will, project-financing conditions, contractor capability, and logistics constraints may also have influenced outcomes. Third, the study relies partly on project-reported performance data, including the 18% programme reduction, which was not independently audited. Fourth, publicly available documents do not reveal all internal decision-making processes among public sponsors, investors, contractors, and suppliers. Finally, transferability depends on context. In developed economies, EBDI-type functions may already be partially embedded in formal advisory, procurement, or innovation-management systems. In emerging economies, the EBDI role may be more visible and necessary, as institutional fragmentation, regulatory negotiation, and logistical constraints are often more pronounced. Future comparative research should test where the model is most applicable and where different governance arrangements may be required.

7 CONCLUSION

This paper reframes OSC adoption in PPP mega-project development as a governance challenge rather than a primarily technological one. Three interrelated findings emerge from the Niamey International Airport case. First, OSC adoption is structurally constrained when no boundary-spanning intermediary exists to translate technical value into PPP-compatible governance commitments. Second, an appropriately mandated EBDI-type function can help overcome this constraint by connecting public sponsors, private investors, contractors, regulators, and suppliers during early decision-making. Third, structured intermediation across opportunity framing, stakeholder alignment, and delivery structuring is a necessary enabling condition for strategic OSC integration. These mechanisms operate as an integrated governance system rather than as separate interventions.

Future studies should examine the EBDI model using larger comparative samples across regions, procurement systems, and institutional settings. Practical attention should focus on differences between developed and emerging economies, the role of logistics and local content regulation, and the specification of EBDI-type functions as explicit deliverables in PPP project-preparation plans. The EBDI can be understood as a missing governance element in mega-project development: its absence limits the institutionalisation of infrastructure innovation, particularly where traditional advisory roles do not integrate construction technology, project finance, regulation, and supply-chain strategy.

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