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Capital Project Delivery Models for High Risk Healthcare Infrastructure in Developing National Health Systems

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Abstract- High-risk healthcare infrastructure projects such as tertiary hospitals, diagnostic laboratories, trauma centers, and infectious disease facilities are critical to health system resilience in developing national health systems, yet they frequently experience cost overruns, delays, safety incidents, and performance shortfalls. Capital project delivery models strongly influence risk allocation, governance, accountability, and lifecycle outcomes, but evidence on their suitability for resource-constrained contexts remains fragmented. This paper examines capital project delivery models for high-risk healthcare infrastructure, evaluating traditional Design–Bid–Build, Design–Build, Construction Management at Risk, Public–Private Partnerships, and Integrated Project Delivery through a systems and risk-informed lens. Drawing on comparative literature, policy analysis, and documented project outcomes, the study analyzes how contractual structures, procurement timing, stakeholder integration, and financing mechanisms shape safety assurance, clinical functionality, and value for money. Particular attention is given to regulatory capacity, supply-chain fragility, skills shortages, and political economy factors that amplify risk in developing systems. The analysis demonstrates that while Design–Bid–Build offers familiarity and transparency, it often fragments responsibility and weakens early clinical integration. Design–Build and Construction Management at Risk improve schedule certainty but require robust client capability and oversight to prevent quality erosion. Public–Private Partnerships can mobilize capital and operational expertise, yet demand strong governance, realistic demand forecasting, and long-term fiscal discipline. Integrated Project Delivery, though rare in developing contexts, shows promise for complex healthcare facilities by aligning incentives, enabling early clinician engagement, and embedding safety-by-design, provided enabling legal and institutional reforms exist. The paper proposes a context-sensitive selection framework that aligns project risk profiles with delivery models, emphasizing early stakeholder integration, performance-based specifications, staged financing, and whole-life cost accountability. By synthesizing delivery-model trade-offs and contextual constraints, the study provides actionable guidance for policymakers, health planners, and development partners seeking to deliver safe, functional, and sustainable high-risk healthcare infrastructure under uncertainty. Implications include improved procurement governance, clearer risk-sharing matrices, enhanced clinical-user participation, digital project controls, and adaptive capacity-building strategies that strengthen institutional readiness, safeguard patient safety, and improve long-term operational performance across diverse epidemiological, fiscal, and sociopolitical environments while supporting transparency, accountability, resilience, scalability, and equitable access to essential health services within fragile and rapidly evolving development contexts globally.

Keywords: Capital project delivery models; Healthcare infrastructure; High-risk projects; Developing health systems; Public–private partnerships; Integrated project delivery; Risk management; Governance

I. INTRODUCTION

Capital project delivery for high-risk healthcare infrastructure occupies a critical position in the strengthening of developing national health systems, where the demand for complex facilities such as tertiary hospitals, trauma centers, diagnostic laboratories, and infectious disease units continues to rise. These facilities are not only capital intensive but also technically intricate, highly regulated, and operationally sensitive, requiring coordinated integration of clinical, engineering, financial, and governance functions (Larkins, et al., 2013, Wallerstein, Yen & Syme, 2011). In many developing contexts, healthcare infrastructure investment is driven by urgent public health needs, rapid urbanization, demographic change, and evolving disease burdens, often under conditions of constrained fiscal space and institutional capacity (Pouliakas & Theodossiou, 2013, Schulte, et al., 2015). As a result, the manner in which capital projects are delivered becomes as important as the scale of investment itself in determining whether such infrastructure achieves its intended health system outcomes.

Despite increased capital allocations to healthcare infrastructure, project performance in developing national health systems has remained inconsistent. Cost overruns, schedule delays, quality deficiencies, and safety incidents are recurrent challenges, frequently undermining public confidence and straining already limited resources. These outcomes are often linked to fragmented project delivery approaches, weak risk allocation mechanisms, inadequate early-stage planning, and limited integration of clinical end users into design and construction processes (Hill-Briggs, 2019, Index, 2016). Traditional procurement models, when applied without contextual adaptation, have struggled to manage the complexity and uncertainty inherent in high-risk healthcare projects, leading to inefficiencies and compromised functionality at commissioning and operation stages (Hale, Borys & Adams, 2015, Peckham, et al., 2017).

Governance failures further exacerbate these challenges, particularly where regulatory oversight, contract management capability, and accountability frameworks are underdeveloped. Political interference, inconsistent procurement practices, and misaligned incentives across public and private actors can distort decision-making and weaken project controls. In high-risk healthcare infrastructure, such governance gaps directly translate into patient safety risks, operational disruptions, and long-term sustainability concerns (Eeckelaert, et al., 2012, Reese, 2018).

Against this backdrop, understanding the implications of different capital project delivery models for high-risk healthcare infrastructure is essential. This study examines how alternative delivery models shape risk distribution, governance effectiveness, stakeholder integration, and lifecycle performance within developing national health systems (Ahmed, Odejobi & Oshoba, 2019, Michael & Ogunsola, 2019, Oshoba, Hammed & Odejobi, 2019). By evaluating delivery model choices through a risk-informed and systems-based perspective, the study seeks to generate evidence-based insights that can guide policymakers, health planners, and development partners toward more resilient, accountable, and effective approaches to delivering critical healthcare infrastructure (Tompa, et al., 2016, Walters, et al., 2011).

2.1. Methodology

This study adopts a structured, evidence-informed comparative methodology built around an integrated scoping review and framework synthesis to examine how capital project delivery models perform for high-risk healthcare infrastructure in developing national health systems. The approach is suitable because the topic spans governance, procurement, risk allocation, and health-system functionality, and because relevant evidence is dispersed across health systems, construction management, and digital/quality improvement literatures. The methodology begins by defining the review focus using a population–concept–context logic: the population is high-risk healthcare infrastructure (e.g., tertiary hospitals, specialized laboratories, infectious-disease and referral facilities); the concept is capital project delivery models and their risk allocation and governance implications (e.g., Design–Bid–Build, Design–Build, Construction Management at Risk, Public–Private Partnerships, Integrated Project Delivery/lean-enabled variants); and the context is developing national health systems characterized by capacity constraints, evolving regulation, and financing limitations. A priori propositions guide the synthesis: delivery models that increase early collaboration and accountability are expected to improve schedule reliability and clinical functionality under complex regulatory requirements (Barlow & Köberle-Gaiser, 2009; Khalafallah & Fahim, 2018), while models that weaken transparency or misalign incentives increase cost overrun, quality drift, and operational fragility.

Evidence is drawn purposively from the provided reference set, which is treated as the bounded corpus for analysis. To ensure coverage, the corpus is mapped into thematic evidence clusters that reflect the study's mechanisms: (i) health system access, equity, and primary care realities influencing infrastructure utilization and legitimacy (Abdulraheem et al., 2012; Browne et al., 2012; Daniel et al., 2018); (ii) procurement, contracts, collaboration, and delivery-

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model performance, including private finance and lean delivery insights (Barlow & Köberle-Gaiser, 2009; Khalafallah & Fahim, 2018); (iii) safety regulation, regulatory burden, and governance structures relevant to compliance-intensive projects (Hale et al., 2015; Rees, 2016; Reese, 2018; Tompa et al., 2016; Walters et al., 2011); (iv) supply chain and operational resilience evidence informing whole-life performance and disruption risk (Aldrighetti et al., 2019; Bam et al., 2017; Kuupiel et al., 2017; Paul & Venkateswaran, 2018; Lee et al., 2015; Lee et al., 2016); and (v) digital health, informatics, surveillance, and data-driven decision support as enablers of governance, commissioning readiness, and outcome monitoring (Asi & Williams, 2018; Atobatele et al., 2019; Car et al., 2017; Davenport & Kalakota, 2019; Desai et al., 2019; Tresp et al., 2016). The selection logic for extraction emphasizes studies that explicitly describe implementation constraints, governance mechanisms, and performance implications for complex health interventions, since these translate most directly to high-risk infrastructure delivery in resource-constrained settings.

Data extraction is conducted using a standardized template that captures both descriptive and analytic variables. Descriptive fields include setting, infrastructure type, stakeholder configuration, and delivery/procurement characteristics. Analytic fields focus on risk allocation (financial, technical, schedule, safety, and operational/whole-life risks), governance features (accountability, transparency, decision rights, conflict resolution, and regulatory engagement), and performance outcomes (cost/schedule predictability, safety incidents, commissioning readiness, clinical functionality, maintainability, and continuity under disruption). Where direct construction metrics are absent (as in many health systems and digital-health sources), inferential linkage is performed cautiously by mapping each source to the delivery-model mechanisms it most strongly informs for example, disruption modeling and stock-out reduction evidence is used to justify whole-life supply resilience requirements that delivery models must protect through contracting and commissioning plans (Aldrighetti et al., 2019; Bam et al., 2017). Quality appraisal is conducted in a fit-for-purpose manner rather than excluding studies outright: empirical rigor, contextual relevance to developing systems, and clarity of mechanism are scored to weight contributions during synthesis, recognizing that policy and implementation studies may offer high contextual validity even when not experimental.

Synthesis proceeds in two steps. First, a narrative thematic synthesis consolidates recurring causal mechanisms across the evidence clusters, emphasizing how governance capacity, regulatory maturity, and supply chain reliability condition delivery-model performance. Second, a comparative framework synthesis is used to produce a delivery-model selection and optimization matrix, aligning project risk profiles (e.g., biosafety level requirements, specialized MEP intensity, commissioning complexity, and outbreak surge needs) with delivery-model features (e.g., single-point accountability, early contractor involvement, collaborative governance, performance-based payment, and lifecycle O&M integration). This matrix is stress-tested against common developing-system constraints financing volatility, procurement fragmentation, workforce limitations, and political economy pressures drawing on health equity and system reform insights to ensure that "success" is defined not only as on-time/on-budget delivery but also as sustained service accessibility and diagnostic reliability (Abdulraheem et al., 2012; Knaul et al., 2012; Sayed et al., 2018). Finally, the study operationalizes recommendations as actionable governance and contracting controls, including risk registers tied to stage gates, compliance assurance plans, and commissioning metrics integrated into payment and acceptance decisions, consistent with the logic of safety regulation and quality improvement dissemination (Hale et al., 2015; Hearld et al., 2019).

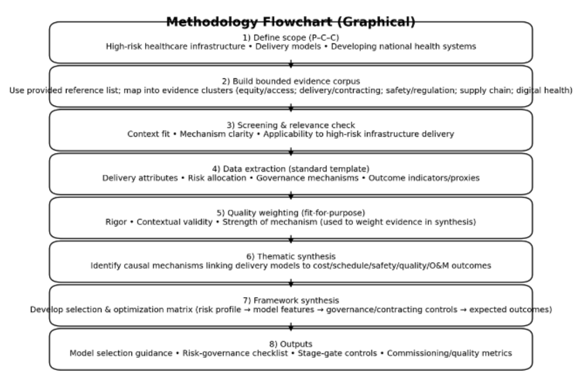

Figure 1: Flowchart of the study methodology

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2.2. Characteristics and Risk Profile of High-Risk Healthcare Infrastructure

High-risk healthcare infrastructure represents some of the most complex and risk-intensive capital investments undertaken within developing national health systems. Facilities such as tertiary referral hospitals, advanced diagnostic laboratories, trauma centers, and infectious-disease treatment and containment facilities are distinguished not only by their scale and cost, but by the degree of technical sophistication, clinical sensitivity, regulatory scrutiny, and operational interdependence embedded within their delivery and use (Martinez-Martin, et al., 2018, Rees, 2016). These characteristics create a risk profile that is fundamentally different from that of conventional public infrastructure projects and demand careful consideration in the selection and application of capital project delivery models (Ahmed & Odejobi, 2018, Odejobi & Ahmed, 2018, Seyi-Lande, Arowogbadamu & Oziri, 2018).

From a technical perspective, high-risk healthcare infrastructure is defined by dense building services, specialized engineering systems, and stringent performance requirements. Tertiary hospitals and laboratories rely on complex mechanical, electrical, and plumbing systems, including medical gas networks, redundant power supplies, high-efficiency ventilation, pressure-controlled environments, and sophisticated information and communication technologies. Infectious-disease centers and biosafety laboratories add further layers of complexity through negative-pressure isolation rooms, high-containment ventilation systems, waste decontamination infrastructure, and secure access controls (Liang, et al., 2018, Lönnroth, et a., 2015). The interdependence of these systems means that failure or underperformance in one component can cascade across the entire facility, amplifying technical risk during both construction and operation (Udechukwu, 2018). In developing national health systems, where local supply chains, technical standards enforcement, and commissioning expertise may be limited, these risks are magnified by reliance on imported equipment, fragmented contractor capabilities, and inconsistent quality assurance practices (Bradley, et al., 2017, Chopra, et al., 2019, Lee, et al., 2016).

Clinical complexity further elevates the risk profile of healthcare infrastructure projects. Unlike other capital assets, healthcare facilities are designed around highly specialized clinical workflows that directly affect patient safety, diagnostic accuracy, and treatment outcomes. Layout decisions, adjacencies between departments, patient and staff circulation routes, and infection prevention measures must be aligned with clinical protocols that may evolve during the project lifecycle (Corral de Zubielqui, et al., 2015, Diraviam, et al., 2018). In high-risk facilities such as intensive care units, operating theatres, and diagnostic laboratories, even minor design or construction errors can lead to serious clinical consequences, including cross-contamination, diagnostic delays, or medical errors (Gragnolati, Lindelöw & Couttolenc, 2013). In developing health systems, limited early engagement of clinicians in planning and design, coupled with capacity constraints among project owners, often leads to misalignment between built environments and actual service delivery needs, introducing latent clinical risks that only become apparent after commissioning.

Regulatory complexity is another defining characteristic of high-risk healthcare infrastructure. Healthcare facilities are subject to overlapping regulatory regimes covering building safety, fire protection, environmental health, occupational safety, infection control, radiation protection, and professional licensing (Ahmed & Odejobi, 2018, Odejobi & Ahmed, 2018, Seyi-Lande, Arowogbadamu & Oziri, 2018). Infectious-disease centers and laboratories must also comply with biosafety and biosecurity standards, which are often influenced by international guidelines in addition to national regulations (Main, et al., 2018, Manyeh, et al., 2019). In developing national health systems, regulatory frameworks may be incomplete, inconsistently enforced, or fragmented across multiple agencies, creating uncertainty during project delivery (Hiller, et al., 2011, Knaul, et al., 2012). Approval processes can be protracted and unpredictable, contributing to schedule delays and cost escalation. Conversely, weak enforcement may allow non-compliant construction practices to proceed, embedding long-term safety and operational risks into completed facilities. The need to navigate evolving regulatory requirements throughout design,

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construction, and commissioning significantly increases delivery risk, particularly where project delivery models do not adequately integrate regulatory engagement and compliance management. Figure 2 shows key elements and dynamics of the Healthcare Infrastructure System presented by Barlow & Köberle-Gaiser, 2009.

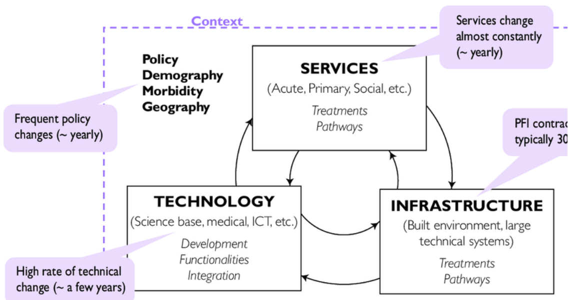

Figure 2: key Elements and dynamics of the Healthcare Infrastructure System (Barlow & Köberle-Gaiser, 2009).

Operational complexity further distinguishes high-risk healthcare infrastructure from other capital projects. These facilities must remain functional, safe, and adaptable over long operational lifespans, often under conditions of fluctuating demand, workforce shortages, and constrained maintenance budgets. Operational risk is closely linked to decisions made during project delivery, including material selection, system redundancy, maintainability, and flexibility for future expansion or reconfiguration (Beran, et al., 2015, De Souza, et al., 2016). In laboratories and diagnostic centers, operational reliability is critical, as equipment downtime or environmental control failures can disrupt diagnostic services and compromise public health surveillance. In infectious-disease facilities, operational failures can have immediate and far-reaching consequences, including disease transmission within facilities and surrounding communities (DiMase, et al., 2015, Hargreaves, et al., 2011). Developing health systems often face chronic challenges in facilities management, preventive maintenance, and asset management, which heightens the importance of delivery models that account for lifecycle performance rather than focusing narrowly on initial capital costs.

These technical, clinical, regulatory, and operational characteristics interact to create systemic risks that extend beyond individual project components. Systemic risk arises when weaknesses in governance, institutional capacity, and stakeholder coordination intersect with project complexity. Fragmented procurement processes, unclear risk allocation, and limited accountability mechanisms can exacerbate cost overruns, delays, and quality failures. Political interference, changes in project scope driven by shifting policy priorities, and unreliable funding flows further destabilize project delivery (Afriyie, 2017, Moore, Wurzelbacher & Shockey, 2018). In high-risk healthcare infrastructure, such systemic risks are particularly acute because delays or failures have direct implications for population health outcomes and public trust in health systems.

Capital project delivery models play a central role in shaping how these risks are managed or amplified. Traditional delivery approaches that separate design, construction, and operation often struggle to address the interdependencies inherent in healthcare infrastructure, leading to information silos and late-stage problem resolution. In developing national health systems, where client capacity and project management expertise may be limited, such fragmentation can result in inadequate risk anticipation and weak control over complex interfaces (Takala, et al., 2014, Wachter & Yorio, 2014). Conversely, delivery models that promote early integration of designers, contractors, clinicians, and operators have greater potential to mitigate systemic risk, provided that enabling governance structures and contractual frameworks are in place. Figure 3 shows the core principles & components for effective implementation of primary health care presented by Martins & Trevena, 2014.

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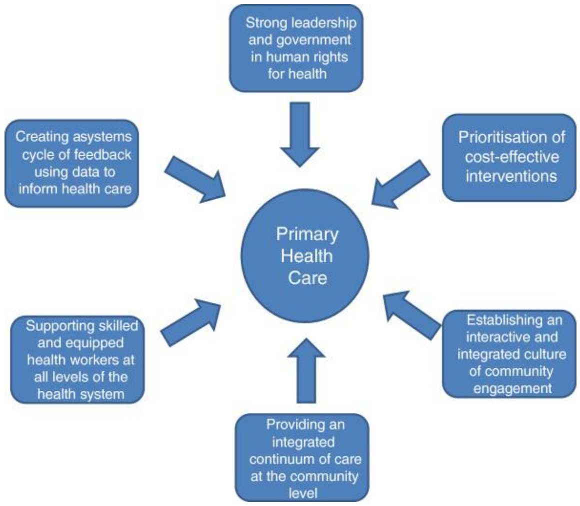

Figure 3: Core principles & components for effective implementation of primary health care (Martins & Trevena, 2014).

Understanding the characteristics and risk profile of high-risk healthcare infrastructure is therefore essential for informed decision-making in capital project delivery. These facilities demand delivery approaches that can accommodate uncertainty, integrate diverse expertise, and maintain rigorous oversight across the project lifecycle. In developing national health systems, aligning delivery models with the unique technical, clinical, regulatory, and operational challenges of healthcare infrastructure is not merely a matter of efficiency, but a prerequisite for safeguarding patient safety, protecting public investment, and strengthening health system resilience (Jilcha & Kitaw, 2017, Longoni, et al., 2013).

2.3. Overview of Capital Project Delivery Models

Capital project delivery models provide the structural and contractual frameworks through which complex healthcare infrastructure is planned, procured, constructed, and commissioned. In developing national health systems, the choice of delivery model is particularly consequential for high-risk healthcare infrastructure, where technical complexity, regulatory demands, and patient safety considerations intersect with fiscal constraints and institutional capacity limitations (Michael & Ogunsola, 2019, Nwafor, et al., 2019, Sanusi, Bayeroju & Nwokediegwu, 2019). Understanding the defining characteristics, strengths, and limitations of major capital project delivery models is therefore essential for aligning delivery approaches with the risk profile and contextual realities of healthcare projects in these settings (Kim, Park & Park, 2016, Lerman, et al., 2012).

Design–Bid–Build remains the most widely used and traditionally accepted delivery model in public-sector healthcare infrastructure. Under this approach, the project owner engages a designer to complete full design documentation before competitively procuring a construction contractor. The sequential separation of design and construction offers a clear allocation of responsibilities and is often perceived as transparent and compliant with public procurement regulations. In developing national health systems (Badri, Boudreau-Trudel & Souissi, 2018), Design–Bid–Build is commonly favored due to its familiarity, ease of regulatory oversight, and perceived fairness in contractor selection. However, for high-risk healthcare infrastructure, this model often struggles to accommodate complexity and uncertainty. The lack of contractor involvement during design can result in constructability issues, misaligned cost estimates, and late-stage design changes, contributing to cost overruns and schedule delays. Additionally, fragmented accountability between designers and contractors can weaken risk management and complicate resolution of technical and clinical interface problems (Assefa, et al., 2017, Cleaveland, et al., 2017).

Design–Build represents a more integrated approach, combining design and construction responsibilities under a single contractual entity. This model offers potential advantages for high-risk healthcare projects by enabling earlier collaboration between designers and builders, improving constructability, and shortening delivery timelines. In resource-constrained health systems, Design–Build can enhance cost and schedule certainty by transferring a greater share of delivery risk to the private sector (Brenner, et al., 2018, Van Eerd & Saunders, 2017). However, these benefits are contingent on the client's ability to define performance requirements clearly and to manage the procurement and oversight process effectively. In developing contexts, limited client capacity and weak specification development can result in quality compromises, particularly in clinically sensitive spaces where detailed functional requirements are critical (Tsui, et al., 2015, Wiatrowski, 2013). The

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emphasis on speed and cost control may also reduce opportunities for iterative clinical input unless explicitly embedded in the procurement process.

Construction Management at Risk introduces a professional construction manager early in the project lifecycle, typically during design development, who then assumes responsibility for delivering the project within a guaranteed maximum price. This model seeks to balance integration and control by preserving a separate design contract while enabling early constructability input and collaborative risk management (Aransi, et al., 2019, Nwafor, et al., 2019, Odejobi, Hammed & Ahmed, 2019). For high-risk healthcare infrastructure, Construction Management at Risk can improve cost predictability and coordination across complex systems while maintaining flexibility to incorporate evolving clinical requirements (Hearld, et al., 2019, Kwon, et al., 2018). In developing national health systems, however, successful implementation depends on the availability of experienced construction managers and robust contractual frameworks. Where market maturity is limited, the model may be challenged by unclear risk allocation, disputes over scope changes, and difficulties in enforcing performance guarantees (Balcazar, et al., 2011, Zhao & Obonyo, 2018).

Public–Private Partnerships represent a broader category of delivery models that integrate private-sector financing, design, construction, and often long-term operation and maintenance responsibilities. In high-risk healthcare infrastructure, Public–Private Partnerships are frequently promoted as mechanisms to mobilize capital, transfer risk, and leverage private-sector expertise (Aransi, et al., 2018, Nwafor, et al., 2018, Seyi-Lande, Arowogbadamu & Oziri, 2018). For developing health systems facing fiscal constraints, these models can enable the delivery of large-scale facilities that might otherwise be unaffordable. However, Public–Private Partnerships introduce significant complexity in structuring contracts, forecasting demand, and managing long-term fiscal commitments (Sarker, et al., 2018, Woldie, et al., 2018). Inadequate regulatory capacity, weak contract management, and unrealistic assumptions about utilization and revenue can expose governments to substantial financial and operational risks. Moreover, aligning private profit incentives with public health objectives requires strong governance and transparent accountability mechanisms, which are often underdeveloped in low-resource settings. Figure 4 shows positive impacts of LODS (DB) for healthcare projects presented by Khalafallah & Fahim, 2018.

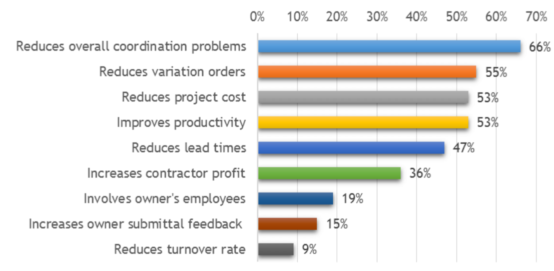

Figure 4: Positive impacts of LODS (DB) for healthcare projects (Khalafallah & Fahim, 2018).

Integrated Project Delivery represents a more collaborative and relational approach, emphasizing shared risk and reward, early stakeholder integration, and joint decision-making among owners, designers, contractors, and key users. Although still relatively rare in developing national health systems, Integrated Project Delivery offers particular promise for high-risk healthcare infrastructure due to its focus on whole-system optimization and lifecycle value. By aligning incentives and fostering trust-based collaboration, this model can address the interdependencies inherent in complex healthcare projects and support innovation in design, construction, and commissioning (Bitran, 2014, Lund, Alfers & Santana, 2016). However, Integrated Project Delivery requires enabling legal frameworks, high levels of organizational maturity, and cultural readiness for collaboration, which may be lacking in many developing contexts. Without these conditions, attempts to implement such models risk reverting to traditional adversarial practices (Akinrinoye, et al., 2015, Gil-Ozoudeh, et al., 2018, Nwafor, et al., 2018, Seyi-Lande, Arowogbadamu & Oziri, 2018).

Across all delivery models, the suitability for high-risk healthcare infrastructure in developing national health systems depends not only on inherent model characteristics but also on contextual alignment with institutional capacity, regulatory environments, and market conditions. No single model is universally optimal. Instead, effective capital project delivery requires informed selection and adaptation of delivery models to balance risk, accountability, and performance (Nwameme, Tabong & Adongo, 2018, Vilcu, et al., 2016). By understanding the defining features and trade-offs of Design–Bid–Build, Design–Build, Construction Management at Risk, Public–Private Partnerships, and Integrated Project Delivery, decision-makers can better navigate the complexities of delivering safe, functional, and sustainable healthcare infrastructure under conditions of uncertainty and constraint (Nwafor, et al., 2019, Oziri, Seyi-Lande & Arowogbadamu, 2019).

2.4. Risk Allocation and Governance Implications of Delivery Models

Risk allocation lies at the core of capital project delivery for high-risk healthcare infrastructure, shaping incentives, behavior, and ultimately project outcomes. In developing national health systems, where institutional capacity, regulatory enforcement, and fiscal resilience are often constrained, the way risks are distributed among public authorities, designers, contractors, financiers, and operators has profound implications for accountability, transparency, and decision-making (Gil-Ozoudeh, et al., 2018, Nwafor, et al., 2018, Seyi-Lande, Arowogbadamu & Oziri, 2018). High-risk healthcare facilities such as tertiary hospitals, laboratories, and infectious-disease centers are particularly sensitive to failures in risk governance because technical breakdowns, safety lapses, or operational disruptions directly affect patient outcomes and public trust (Bardosh, et al., 2017, Zulu, et al., 2014). Different delivery models embody distinct approaches to allocating financial, technical, safety, and operational risks, each with consequences that extend beyond project completion into long-term system performance.

Financial risk is often the most visible dimension of risk allocation. In traditional Design–Bid–Build models, financial risk related to cost overruns and schedule delays is largely retained by the public client, particularly where design changes, unforeseen conditions, or scope growth occur. While contractors bear risks associated with construction means and methods, the fragmented structure of this model can make it difficult to assign responsibility for cost escalation arising from design deficiencies or coordination failures. In developing national health systems, where public budgets are highly constrained, this retention of financial risk can undermine fiscal sustainability and lead to project interruptions or scope reductions that compromise clinical functionality (Badri, Boudreau-Trudel & Souissi, 2018, Kim, et al., 2016). The limited capacity of public institutions to manage complex claims and variations further weakens financial accountability under this model.

Design–Build shifts a greater share of financial and technical risk to the private sector by consolidating design and construction responsibilities under a single entity. This integration can enhance cost certainty and simplify contractual relationships, but it also concentrates decision-making power in the hands of the Design–Build contractor. In high-risk healthcare infrastructure, this shift has significant governance implications (Bayeroju, Sanusi & Nwokediegwu, 2019, Nwafor, et al., 2019, Oziri, Seyi-Lande & Arowogbadamu, 2019). While public clients may benefit from reduced exposure to cost overruns, they must rely heavily on performance specifications and oversight mechanisms to ensure quality and safety are not sacrificed in pursuit of cost control (Atobatele, et al., 2019, Didi, Abass & Balogun, 2019). In developing contexts, weak specification development and limited monitoring capacity can create information asymmetries that erode transparency and weaken accountability, particularly when clinical requirements are complex and evolving.

Construction Management at Risk represents an intermediate approach to risk allocation, with the construction manager assuming financial risk through a guaranteed maximum price while collaborating with designers and the client during preconstruction. This model allows for more balanced distribution of technical and financial risks and can improve decision-making through early identification of constructability and cost issues. For high-risk healthcare projects, the early involvement of a construction manager can enhance coordination across complex systems and support informed trade-offs between cost, schedule, and quality (Hungbo & Adeyemi, 2019, Patrick, et al., 2019). However, in developing national health systems, governance challenges arise where contractual frameworks are insufficiently clear or enforcement mechanisms are weak. Disputes over scope definition and change management can blur accountability, and without transparent cost reporting, the guaranteed maximum price may fail to deliver the intended financial discipline.

Public–Private Partnerships involve a broader and more complex allocation of risks, often transferring financing, construction, and operational risks to the private sector over long concession periods. In theory, this approach aligns incentives for lifecycle performance and relieves immediate fiscal pressure on public budgets. In practice, however, the effectiveness of risk transfer depends heavily on the capacity of public institutions to design, negotiate, and manage complex contracts (Atobatele, Hungbo & Adeyemi, 2019). In developing health systems, asymmetries in expertise between public and private partners can lead to poorly structured risk allocation, with governments retaining substantial contingent liabilities despite the appearance of risk transfer. Operational risks related to service quality, accessibility, and affordability are particularly sensitive in healthcare Public–Private Partnerships, where profit-driven incentives may conflict with public health objectives if governance and accountability mechanisms are weak (Perehudoff, Alexandrov & Hogerzeil, 2019, Wang & Rosemberg, 2018).

Integrated Project Delivery adopts a fundamentally different philosophy of risk allocation by emphasizing shared risk and reward among key stakeholders. Rather than transferring risk to individual parties, this model seeks to manage risk collectively through early collaboration, transparency, and aligned incentives. For high-risk healthcare infrastructure, such an approach can improve safety and technical performance by fostering joint problem-solving and continuous learning (Hungbo & Adeyemi, 2019). However, the governance implications are significant. Integrated Project Delivery requires high levels of trust, robust legal frameworks, and sophisticated decision-making processes that enable collective accountability. In developing national health systems, where adversarial contracting norms and institutional fragmentation are common, implementing such models presents substantial challenges. Without strong governance structures, shared-risk arrangements may lack enforceability and undermine accountability (Akinrinoye, et al., 2019, Nwafor, et al., 2019, Seyi-Lande, Arowogbadamu & Oziri, 2019).

Safety and operational risks cut across all delivery models and are particularly critical in healthcare infrastructure. Delivery models that marginalize clinical input or defer operational considerations until late in the project lifecycle tend to embed latent safety risks that are costly and difficult to address post-completion. Models that facilitate early and continuous engagement of clinicians, operators, and regulators are better positioned to manage these risks, but they also demand more inclusive and transparent decision-making processes. In developing contexts, balancing inclusivity with efficiency is a persistent governance challenge, especially under political and time pressures (Atobatele, Hungbo & Adeyemi, 2019).

Ultimately, the governance implications of risk allocation in capital project delivery extend beyond contractual arrangements to encompass institutional capacity, regulatory effectiveness, and cultural norms. No delivery model inherently guarantees accountability or transparency; these outcomes depend on how risk allocation interacts with governance systems and decision-making processes. For developing national health systems, selecting and adapting delivery models for high-risk healthcare infrastructure requires a deliberate focus on aligning risk distribution with institutional strengths, reinforcing accountability mechanisms, and ensuring that decision-making processes prioritize patient safety, public value, and long-term sustainability (Atobatele, Hungbo & Adeyemi, 2019).

2.5. Institutional Capacity and Contextual Constraints in Developing Health Systems

The performance of capital project delivery models for high-risk healthcare infrastructure in developing national health systems is deeply shaped by institutional capacity and contextual constraints. While delivery models such as Design–Bid–Build, Design–Build, Construction Management at Risk, Public–Private Partnerships, and Integrated Project Delivery each possess inherent strengths, their effectiveness depends on the maturity of regulatory frameworks, the capability of procurement institutions, the availability of skilled human resources, the stability of financing mechanisms, and the broader political economy in which projects are conceived and delivered (Pacifico Silva, et al., 2018). In developing health systems, these contextual factors often represent the most significant sources of risk, frequently outweighing technical challenges and determining whether delivery models achieve intended outcomes or exacerbate project failure.

Regulatory maturity plays a central role in shaping the feasibility and performance of delivery models. High-risk healthcare infrastructure is subject to complex regulatory requirements governing building safety, infection prevention, occupational health, environmental protection, and clinical standards. In developing national health systems, regulatory frameworks are often fragmented across multiple agencies with overlapping mandates and inconsistent enforcement. This fragmentation introduces uncertainty into approval processes, increases transaction costs, and creates opportunities for non-compliance or informal practices (Kuupiel, Bawontuo & Mashamba-Thompson, 2017). Delivery models that rely on early integration of design, construction, and regulatory engagement may struggle where approval timelines are unpredictable or regulatory interpretations change mid-project. Conversely, weak enforcement can allow substandard construction practices to proceed, embedding long-term safety and operational risks into completed facilities. The absence of standardized healthcare facility guidelines further complicates delivery, particularly for specialized infrastructure such as laboratories and infectious-disease centers, where international standards may be applied unevenly (Barrett, et al., 2019, Sqalli & Al-Thani, 2019).

Procurement capacity is another critical determinant of delivery model performance. Many public health authorities in developing countries operate under rigid procurement laws designed to ensure transparency but often ill-suited to managing complex and high-risk projects. Limited experience with alternative delivery models, weak contract management skills, and inadequate market analysis constrain the ability of public clients to select, structure, and oversee appropriate delivery approaches (Vogler, Paris & Panteli, 2018, Wirtz, et al., 2017). In such environments, Design–Bid–Build persists largely due to institutional familiarity rather than suitability for project complexity. More integrated models, such as Design–Build or Public–Private Partnerships, require sophisticated procurement processes, clear performance specifications, and robust evaluation criteria that many institutions are not equipped to develop or enforce. As a result, procurement decisions may prioritize procedural compliance over value-for-money, undermining the potential benefits of alternative delivery models (Contreras & Vehi, 2018, Dankwa-Mullan, et al., 2019).

Workforce skills and organizational capacity within both the public and private sectors further influence delivery outcomes. High-risk healthcare infrastructure demands multidisciplinary expertise spanning clinical planning, biomedical engineering, construction management, facilities operations, and regulatory compliance. In developing health systems, shortages of specialized skills are common, particularly in areas such as healthcare facility planning, commissioning, and lifecycle asset management. Public-sector project teams are often understaffed and overstretched, limiting their ability to provide effective oversight or engage meaningfully with private partners (Bam, et al., 2017, Nascimento, et al., 2017). On the private-sector side, local contractors and consultants may lack experience with complex healthcare projects, leading to reliance on foreign expertise that increases costs and coordination challenges. Delivery models that assume high levels of technical and managerial competence may therefore underperform in contexts where skills gaps are pervasive and capacity-building mechanisms are weak (Car, et al., 2017, Novak, et al., 2013).

Financing limitations represent another pervasive constraint shaping delivery model performance. Developing national health systems frequently face volatile funding flows, dependence on donor financing, and limited access to long-term capital markets. These conditions constrain the range of viable delivery models and introduce financial risks that can disrupt project execution. Public–Private Partnerships are often promoted as solutions to financing gaps, yet their success depends on predictable revenue streams, credible government commitments, and sound fiscal management. In environments characterized by macroeconomic instability, currency risk, and weak public financial management, such models may expose governments to significant contingent liabilities (Gronde, Uyl-de Groot & Pieters, 2017, Sayed, et al., 2018). Even traditional publicly funded projects are vulnerable to delays and cost escalation when budget allocations are uncertain or disbursements are irregular, undermining contractor confidence and increasing project risk across all delivery models.

Political economy factors exert a profound influence on capital project delivery in developing health systems. Healthcare infrastructure projects are often highly visible and politically salient, making them susceptible to interference, shifting priorities, and patronage. Changes in political leadership can result in project redesign, suspension, or cancellation, regardless of delivery model. Procurement processes may be influenced by non-technical considerations, compromising competition and transparency. In such contexts, delivery models that rely on long-term commitments and stable governance, such as Public–Private Partnerships or Integrated Project Delivery, face heightened risk (Mercer, et al., 2019, Meyer, et al., 2017). Conversely, fragmented delivery approaches may provide greater flexibility to accommodate political change but at the cost of efficiency and coherence. Navigating these dynamics requires delivery models that are resilient to political shifts while maintaining accountability and protecting public value.

These institutional and contextual constraints interact in ways that compound risk. Weak regulatory oversight combined with limited procurement capacity can undermine accountability, while skills shortages and financing instability amplify technical and financial risks. Delivery models cannot be evaluated in isolation from these conditions; their performance is contingent on alignment with institutional realities and the capacity of health systems to manage complexity (Bennett & Hauser, 2013, Udlis, 2011). For high-risk healthcare infrastructure in developing national health systems, effective project delivery therefore requires not only appropriate model selection but deliberate investment in institutional strengthening, capacity building, and governance reform (Mackey & Nayyar, 2017, Mohammadi, et al., 2018). Without addressing these foundational constraints, even the most sophisticated delivery models are unlikely to deliver safe, functional, and sustainable healthcare infrastructure capable of meeting growing population health needs.

2.6. Comparative Performance Analysis of Delivery Models

Evaluating the comparative performance of capital project delivery models for high-risk healthcare infrastructure in developing national health systems requires a multidimensional assessment that goes beyond initial construction outcomes. Facilities such as tertiary hospitals, advanced diagnostic laboratories, and infectious-disease centers operate at the intersection of technical complexity, clinical sensitivity, and long-term public service obligations. As a result, delivery models must be assessed against criteria that reflect not only efficiency in project execution but also safety, functionality, and sustainability over the asset lifecycle (Bam, et al., 2017, Devarapu, et al., 2019). Cost certainty, schedule reliability, safety outcomes, clinical functionality, and lifecycle value provide a robust basis for comparing how different delivery models perform under the constraints and uncertainties characteristic of developing health systems.

Cost certainty is often the primary concern for public-sector clients operating under tight fiscal constraints. Traditional Design–Bid–Build models offer apparent cost transparency at the point of contract award, as competitive tendering produces a fixed construction price based on completed designs. However, in high-risk healthcare projects, this apparent certainty frequently proves illusory (Davenport & Kalakota, 2019, Tack, 2019). Incomplete designs, evolving clinical requirements, and unforeseen site or regulatory conditions often lead to variations and claims, resulting in significant cost overruns. Design–Build models generally perform better in terms of cost predictability, as the integration of design and construction enables earlier alignment of scope, budget, and constructability (Jacobsen, et al., 2016, Polater & Demirdogen, 2018). Construction Management at Risk can also enhance cost control through early cost modeling and a guaranteed maximum price, though its effectiveness depends on transparent cost reporting and disciplined change management. Public–Private Partnerships may shift upfront cost risk away from the public sector, but they introduce long-term fiscal commitments that can obscure true costs and expose governments to contingent liabilities. Integrated Project Delivery, where implemented effectively, has demonstrated strong cost performance through shared incentives and collaborative problem-solving, though its applicability in developing contexts is limited by institutional readiness (Min, 2016, Paul & Venkateswaran, 2018).

Schedule reliability is closely linked to cost performance but is particularly critical in healthcare infrastructure, where delays translate directly into deferred health services and unmet population needs. Design–Bid–Build projects often suffer from extended timelines due to the sequential nature of design and construction and the potential for redesign during construction. Design–Build and Construction Management at Risk generally offer superior schedule performance by overlapping design and construction activities and enabling early resolution of constructability issues (Desai, et al., 2019, Khan, 2019). In developing health systems, where regulatory approvals and funding disbursements are often unpredictable, these integrated models can provide greater flexibility to manage delays. Public–Private Partnerships may deliver facilities more quickly where private partners have strong incentives to meet availability deadlines, but schedule performance can be undermined by protracted negotiations and disputes during contract development. Integrated Project Delivery emphasizes collaborative planning and real-time decision-making, which can enhance schedule reliability, though its success depends on stable governance and timely stakeholder engagement (Deshpande, et al., 2019, Stokes, et al., 2016).

Safety outcomes represent a defining criterion for high-risk healthcare infrastructure, encompassing construction safety, patient safety, and occupational health during operation. Delivery models that fragment responsibility for safety-related decisions often struggle to manage complex risk environments. Design–Bid–Build can weaken safety outcomes when designers and contractors operate in silos, limiting opportunities for safety-by-design and early hazard identification. Integrated models such as Design–Build and Construction Management at Risk allow safety considerations to be embedded earlier in the project lifecycle, improving coordination across disciplines (Aldrighetti, et al., 2019, Reddy, Fox & Purohit, 2019). Public–Private Partnerships may incentivize long-term safety performance where operational responsibilities are included, but weak regulatory oversight can undermine these benefits. Integrated Project Delivery offers the strongest alignment of safety incentives by treating safety as a shared responsibility, fostering transparency and continuous improvement. However, in developing health systems, the effectiveness of any model depends heavily on enforcement capacity and safety culture (Ahmed, 2017, Boppiniti, 2019, Perez, 2019).

Clinical functionality is a critical yet often underappreciated dimension of performance. High-risk healthcare facilities must support complex clinical workflows, infection prevention protocols, and evolving technologies. Delivery models that delay clinical input or prioritize construction efficiency over functional alignment often produce facilities that are technically complete but operationally suboptimal. Design–Bid–Build frequently performs poorly in this regard, as clinical users may have limited influence once designs are finalized. Design–Build can improve functional outcomes if performance specifications are well defined, but there is a risk that cost-driven decisions compromise clinical requirements (Roski, et al., 2019, Strusani & Houngbonon, 2019). Construction Management at Risk offers greater flexibility to incorporate clinician feedback during design development. Public–Private Partnerships may prioritize standardized designs that optimize financial performance but limit adaptability to local clinical practices. Integrated Project Delivery is best positioned to optimize clinical functionality by enabling continuous clinician engagement and iterative design refinement, though its implementation remains challenging in resource-constrained settings (Marda, 2018, Stanfill & Marc, 2019).

Lifecycle value provides the most comprehensive measure of delivery model performance, capturing not only construction outcomes but also operational efficiency, maintainability, adaptability, and long-term cost-effectiveness. Models that focus narrowly on minimizing upfront capital costs often externalize operational risks, leading to higher lifecycle costs and reduced service quality. Design–Bid–Build typically underperforms on lifecycle value due to limited consideration of operations and maintenance during design and construction. Design–Build and Construction Management at Risk can improve lifecycle outcomes if performance requirements and commissioning processes are robust (Blasimme & Vayena, 2019, Sardar, et al., 2019). Public–Private Partnerships explicitly emphasize lifecycle performance by integrating long-term operation and maintenance, but their success depends on accurate demand forecasting and strong contract management. Integrated Project Delivery, with its emphasis on whole-system optimization and shared outcomes, offers the strongest theoretical alignment with lifecycle value, though its benefits are contingent on institutional maturity (Atobatele, Hungbo & Adeyemi, 2019, Tresp, et al., 2016).

In comparative terms, no delivery model consistently outperforms others across all criteria in developing national health systems. Performance is highly context-dependent, shaped by regulatory capacity, market maturity, and governance effectiveness. Design–Bid–Build remains prevalent but is poorly suited to the complexity of high-risk healthcare infrastructure. More integrated models generally offer superior performance in cost certainty, schedule reliability, safety outcomes, and clinical functionality, but they require stronger institutional capacity to realize their potential (Hodge, et al., 2017, Shrestha,Ben-Menahem & Von Krogh, 2019). Comparative performance analysis therefore underscores the importance of aligning delivery model selection with project risk profiles and contextual realities, rather than defaulting to familiar approaches. For developing health systems, improving the performance of high-risk healthcare infrastructure delivery ultimately depends on combining appropriate delivery models with deliberate investments in governance, capacity, and long-term value creation (Goundrey-Smith, 2019, Tamraparani, 2019).

2.7. Strategic Framework for Delivery Model Selection and Optimization

Strategic selection and optimization of capital project delivery models for high-risk healthcare infrastructure in developing national health systems requires a deliberate, context-sensitive framework that aligns project risk profiles with institutional capacity, market conditions, and long-term health system objectives. Given the complexity of facilities see as tertiary hospitals, advanced laboratories, trauma centers, and infectious-disease units, no single delivery model offers a universal solution. Instead, effective delivery depends on a structured decision-making approach that integrates risk assessment, stakeholder alignment, governance capability, and lifecycle value considerations from the earliest stages of project conception (Bizzo, et al., 2019, Gatla, 2019).

At the core of such a framework is systematic identification and classification of project risk profiles. High-risk healthcare infrastructure projects differ widely in scale, technical complexity, regulatory intensity, and operational sensitivity. Projects involving high-containment laboratories or specialized diagnostic facilities, for example, present elevated technical and biosafety risks, while large tertiary hospitals introduce complex clinical workflows, extensive stakeholder involvement, and long-term operational demands. A strategic framework begins by mapping these risks across financial, technical, clinical, regulatory, and operational dimensions (Ismail, Karusala & Kumar, 2018, Mariscal, et al., 2019). This mapping allows decision-makers to distinguish between projects that require tight integration and collaborative risk management and those that may be delivered effectively through more conventional approaches. In developing health systems, where institutional capacity varies significantly across regions and agencies, this risk-based differentiation is essential to avoid overextending limited governance resources (Henke & Jacques Bughin, 2016, Holden, et al., 2016).

Early stakeholder integration forms a second pillar of the proposed framework. High-risk healthcare infrastructure involves a diverse set of actors, including policymakers, health planners, clinicians, engineers, contractors, regulators, and, in some cases, private financiers and operators. Delivery models that defer stakeholder engagement until late in the project lifecycle often encounter resistance, redesign, and performance shortfalls. A strategic framework therefore prioritizes early and continuous engagement of key stakeholders during needs assessment, functional programming, and delivery model selection (Asi & Williams, 2018, Miah, Hasan & Gammack, 2017). Clinician involvement is particularly critical to ensure alignment between built environments and service delivery requirements, while early regulatory engagement can reduce approval delays and compliance risks. In developing national health systems, structured stakeholder integration also serves as a capacity-building mechanism, enhancing shared understanding and strengthening institutional learning (Aitken & Gorokhovich, 2012, Daniel, et al., 2018).

Performance-based contracting represents a third foundational element of delivery model optimization. Traditional input-focused contracts, which emphasize prescriptive designs and lowest-cost selection, often fail to capture the outcomes that matter most in high-risk healthcare infrastructure, such as patient safety, diagnostic accuracy, and operational reliability. A strategic framework shifts the focus toward clearly defined performance outcomes that reflect both construction and operational objectives. Performance-based specifications enable flexibility in how outcomes are achieved while maintaining accountability for results (Leath, et al., 2018, Olu, et al., 2019). In Design–Build and Construction Management at Risk models, such specifications can help balance cost and quality by linking contractor incentives to measurable performance indicators. In Public–Private Partnerships, performance-based payment mechanisms can align private-sector incentives with public health goals, provided that monitoring and enforcement capacity exists. For developing health systems, adopting performance-based contracting requires investment in specification development, monitoring systems, and contract management skills, but it offers significant potential to improve delivery outcomes (Portnoy, et al., 2015, Sim, et al., 2019).

Whole-life costing and lifecycle value optimization form the fourth component of the framework. High-risk healthcare infrastructure delivers value over decades of operation, and decisions made during project delivery have lasting implications for maintenance, adaptability, and service quality. A strategic approach therefore integrates whole-life costing into delivery model selection, ensuring that upfront capital decisions reflect long-term operational and maintenance costs. Models that promote early consideration of operations, such as Construction Management at Risk, Public–Private Partnerships, and Integrated Project Delivery, are generally better positioned to support lifecycle optimization (Campbell, et al., 2019, Goel, et al., 2017). However, in developing national health systems, where data on operating costs and asset performance may be limited, implementing whole-life costing requires methodological adaptation and capacity building. Even simplified lifecycle assessments can improve decision-making by highlighting trade-offs between initial cost savings and long-term risk exposure (Browne, et al., 2012, Wallerstein, et al., 2017).

Optimization of delivery models within this framework also requires attention to institutional and market readiness. Delivery models that demand high levels of collaboration, transparency, and technical competence may underperform if applied in contexts where legal frameworks, procurement systems, and professional capacity are insufficiently developed. A context-sensitive framework therefore includes an assessment of institutional maturity and market capability as part of delivery model selection (Lee, et al., 2015, Srivastava & Shainesh, 2015). Where capacity constraints are significant, hybrid or phased approaches may be appropriate, combining elements of different models or introducing integration incrementally. For example, early contractor involvement within a predominantly traditional procurement structure can enhance risk management without requiring wholesale institutional change. Similarly, pilot projects can be used to test more collaborative models and build experience before scaling (Abdulraheem, Olapipo & Amodu, 2012, Dzau, et al., 2017).

Governance and accountability mechanisms are integral to the effectiveness of the proposed framework. Clear decision rights, transparent reporting, and defined escalation pathways are necessary to manage the complex trade-offs inherent in high-risk healthcare infrastructure delivery. The framework emphasizes aligning governance structures with the chosen delivery model, ensuring that accountability for financial, technical, safety, and operational outcomes is explicit and enforceable. In developing health systems, strengthening governance may involve legal reforms, institutional restructuring, and investment in oversight capacity, but these efforts are critical to realizing the benefits of optimized delivery models (Huang, et al., 2017, Lim, et al., 2016).

Ultimately, the strategic framework for delivery model selection and optimization presented here recognizes that successful delivery of high-risk healthcare infrastructure in developing national health systems is as much a governance and capacity challenge as a technical one. By linking project risk profiles to appropriate delivery models, emphasizing early stakeholder integration, adopting performance-based contracting, and incorporating whole-life costing, the framework provides a structured approach to navigating complexity and uncertainty. Applied thoughtfully, this approach can enhance accountability, improve clinical and operational outcomes, and ensure that scarce public resources are translated into safe, functional, and sustainable healthcare infrastructure that strengthens health system resilience over the long term (Metcalf, et al., 2015, Utazi, et al., 2019).

2.8. Conclusion

Capital project delivery models play a decisive role in shaping the success or failure of high-risk healthcare infrastructure in developing national health systems. The analysis demonstrates that facilities such as tertiary hospitals, diagnostic laboratories, and infectious-disease centers embody a level of technical, clinical, regulatory, and operational complexity that cannot be effectively managed through conventional, one-size-fits-all delivery approaches. Persistent challenges of cost overruns, schedule delays, safety incidents, and functional deficiencies are not merely technical shortcomings, but reflections of misaligned delivery models, weak risk allocation, and limited institutional capacity. Understanding these dynamics is essential for improving how critical healthcare infrastructure is planned, delivered, and sustained.

Key insights from this study highlight that no single capital project delivery model is universally optimal for high-risk healthcare infrastructure. Traditional Design–Bid–Build approaches, while familiar and procedurally transparent, often struggle to manage complexity and uncertainty, particularly in environments with limited coordination and oversight capacity. More integrated models, including Design–Build, Construction Management at Risk, Public–Private Partnerships, and Integrated Project Delivery, offer stronger potential to improve cost certainty, schedule reliability, safety outcomes, and clinical functionality. However, these benefits are contingent on contextual alignment with regulatory maturity, procurement capability, workforce skills, and governance strength. Where such enabling conditions are absent, even advanced delivery models may underperform or introduce new risks.

The policy and practice implications are therefore clear. Policymakers and health system leaders must move beyond default procurement choices and adopt risk-informed, context-sensitive approaches to delivery model selection. Strengthening regulatory frameworks, improving procurement systems, and investing in institutional and human capacity are foundational requirements for improving project outcomes. Equally important is the adoption of performance-based contracting, early stakeholder and clinician engagement, and whole-life costing to ensure that healthcare infrastructure delivers sustained value beyond initial construction. Development partners and donors also have a critical role to play by supporting capacity building, promoting governance reforms, and aligning financing mechanisms with long-term health system objectives rather than short-term asset delivery.

Looking forward, strengthening governance and risk management for high-risk healthcare infrastructure requires a shift toward integrated decision-making, transparency, and accountability across the project lifecycle. Clear allocation of responsibilities, robust oversight mechanisms, and adaptive delivery strategies can enhance resilience in the face of uncertainty and political change. By aligning capital project delivery models with the unique risk profiles and institutional realities of developing national health systems, governments can improve the safety, functionality, and sustainability of critical healthcare facilities. Such an approach is essential for translating infrastructure investment into meaningful health outcomes, safeguarding public resources, and building resilient health systems capable of responding to current and future public health challenges.

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