



Original Research Article

Risk Management Frameworks for Regional Development Projects: Lessons from Saudi Vision 2030 Giga-Project Environments

Shibu Pulapadi^{1*} 

¹Independent Researcher

*Corresponding Author

Shibu Pulapadi

Independent Researcher

Article History

Received: 26.06.2026

Accepted: 18.08.2026

Published: 20.08.2026

Abstract: Saudi Arabia's Vision 2030 has repositioned regional development as a national transformation instrument, with giga-projects acting simultaneously as infrastructure programs, investment platforms, tourism destinations and social reform laboratories. Their scale creates value, but it also concentrates strategic, financial, environmental, social, procurement and interface risks that cannot be managed through linear construction controls alone. This review develops an integrated risk management framework for regional development projects in Saudi Vision 2030 giga-project environments. Drawing on literature from 2020 to 2025, policy reports and project-governance standards, the paper synthesizes lessons from megaproject governance, construction risk, resilient safety management, sustainable infrastructure and portfolio delivery. The methodology follows an integrative review design using keyword-based database screening, thematic coding and framework synthesis. The analysis identifies six recurring risk clusters: strategic alignment and scope volatility; finance, inflation and market exposure; procurement and supply-chain fragility; design-interface and systems integration; environmental, social and heritage legitimacy; and workforce, safety and capability maturity. The proposed framework links these clusters to four governance layers: national portfolio steering, project owner capability, collaborative delivery ecosystems and digital risk intelligence. The paper argues that giga-project risk management should shift from compliance registers toward adaptive assurance, scenario-based decision gates, transparent stakeholder engagement and continuous learning. Its contribution is a context-specific model that aligns risk practices with Saudi Vision 2030's regional development objectives while preserving accountability, sustainability and public value.

Keywords: Risk Management, Regional Development, Saudi Vision 2030, Giga-Projects, Megaproject Governance, Construction Risk, Sustainable Infrastructure.

Copyright © 2026 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC 4.0) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

1 INTRODUCTION

Regional development projects are no longer understood only as physical construction packages. In the Saudi Vision 2030 context, they are instruments for reshaping economic geography, attracting investment, localizing supply chains, expanding tourism and raising quality of life. The Public Investment Fund identifies giga-projects such

as NEOM, Red Sea Global, Qiddiya, ROSHN and Diriyah as transformative platforms for diversification and national competitiveness (PIF, 2025). Vision 2030's annual reporting similarly presents delivery, private-sector participation and quality-of-life outcomes as interdependent transformation targets rather than separate construction outputs (Vision 2030, 2025a). This

Citation: Pulapadi, S. (2026). Risk Management Frameworks for Regional Development Projects: Lessons from Saudi Vision 2030 Giga-Project Environments; *Glob Acad J Econ Buss*, 8(4), 1026-1035. <https://doi.org/10.36348/gajeb.2026.v08i04.045>

policy setting makes risk management strategically important because failure, delay or reputational damage can affect not only project cost and schedule, but also investor confidence, regional employment, environmental credibility and social legitimacy.

The scale of Saudi giga-projects magnifies classic megaproject problems. Research on poor megaproject performance links overruns and delivery failure to optimism bias, weak front-end definition, fragmented governance, unbalanced procurement, insufficient stakeholder management and immature risk practices (Denicol *et al.*, 2020). Organisational studies further show that megaprojects operate through temporary, multi-level systems in which the client, delivery authority, consultants, contractors, regulators, communities and investors must coordinate across changing boundaries (Denicol *et al.*, 2021; Zani *et al.*, 2024a). These characteristics are visible in regional development environments where transport, utilities, hospitality, housing, cultural assets, digital infrastructure and ecological restoration are delivered as interdependent programs. A single design change can ripple through permitting, logistics, financing and community expectations, while a single supply-chain disruption can affect several packages at once.

Saudi Arabia's project environment adds further complexity. Rapid construction growth under Vision 2030 has been associated with time and cost overrun risks in government-funded building projects, including design changes, weak planning, delayed approvals, contractor capability constraints and material market volatility (Alshihri *et al.*, 2022). Studies of Saudi contractors emphasize the interaction of internal hazards, external hazards and statutory regulations in shaping risk management effectiveness (Rehman *et al.*, 2024). At the same time, climate stress, extreme heat, water scarcity, biodiversity protection, heritage conservation and social inclusion are becoming central to the licence to operate in major destinations (IPCC, 2023; WEF, 2025). Risk management for regional development therefore has to protect the delivery triangle of time, cost and quality while also safeguarding sustainability, resilience and public value.

The aim of this review is to develop a context-sensitive risk management framework for regional development projects operating within Saudi Vision 2030 giga-project environments. The specific objectives are: first, to synthesize recent literature on megaproject and construction risk management; second, to identify risk categories most relevant to Saudi regional development projects; third, to compare conventional and adaptive risk management frameworks; and fourth, to propose

governance practices that improve risk anticipation, ownership, mitigation and learning across the project life cycle. The contribution lies in connecting international megaproject theory with the institutional, sustainability and delivery characteristics of Saudi giga-projects.

The review is also motivated by a practical gap. Saudi giga-projects are often described through their ambition, investment value or design vision, while the managerial question of how risk governance should operate across the whole regional ecosystem receives less structured attention. Existing Saudi studies tend to examine building projects or contractor perceptions, whereas giga-project environments require attention to program portfolios, public value, infrastructure interdependence and place-based legitimacy. A review paper can therefore support decision-makers by translating dispersed evidence into a usable framework for ministries, development companies, project management offices, investors and delivery partners.

2 LITERATURE REVIEW

Megaproject risk management has moved from a narrow project-control discipline toward a broader governance and value-protection function. The PMBOK Guide frames risk as uncertainty that can affect project objectives and encourages tailoring, stakeholder engagement and systems thinking rather than rigid process compliance (PMI, 2021). However, megaproject scholarship suggests that standard risk registers are often insufficient when uncertainty is political, social, technological and institutional. Brunet (2021) argues that governance frameworks create accountability, efficiency and legitimacy, but they also need equilibrium between control and flexibility. For giga-projects, this means that risk practices must be embedded in decision rights, funding gates, escalation routes and assurance routines, not treated as a documentation exercise.

Recent frameworks also differ in their dominant logic. Standards-based approaches emphasize processes, roles, risk appetite and response planning; governance approaches emphasize accountability, decision rights and escalation; resilience approaches emphasize weak signals, redundancy and recovery; and sustainability approaches emphasize environmental, social and intergenerational consequences. No single logic is sufficient for regional development. A giga-project can be on schedule yet lose value if its operating model is unviable, its destination brand is damaged, or its regional communities do not see benefits. Conversely, an adaptive decision to rephase work may appear negative in a schedule report but positive for long-term feasibility. This is why risk evaluation

should include both delivery indicators and outcome indicators.

A second stream concerns organisational architecture. Denicol *et al.*, (2021) describe megaprojects as project system organisations that evolve from intra-organisational structures to inter-organisational ecosystems and wider system-level arrangements. This is especially relevant to Saudi regional development, where the owner may coordinate master planning, utilities, mobility, tourism, real estate, environmental mitigation and local economic development across multiple delivery partners. Zani *et al.*, (2024a) show that organisation design in megaprojects involves dynamic capabilities, boundary design and coordination mechanisms. Zani *et al.*, (2024b) further identify client roles as meta-organizer, gatekeeper, interface manager and mediator, indicating that the project owner must actively orchestrate risk across organisational boundaries. Without this capability, risks become displaced between contracts rather than resolved at system level.

A third stream addresses Saudi construction risk. Alshihri *et al.*, (2022) identify risk factors leading to time and cost overruns in Saudi building projects, reinforcing the importance of realistic planning, competent contractors and clear change control. Rashid *et al.*, (2022) found that internal risk factors directly affect Saudi construction project failure, while COVID-19 and natural conditions mediated internal and external risk relationships. Rehman *et al.*, (2024) add that leadership, team competence, communication, technological change, political conditions, cultural factors and governmental by-laws are connected to risk management outcomes. These studies suggest that Saudi giga-projects require a hybrid model combining project controls with regulatory scanning, workforce development, contractor maturity assessment and contingency planning.

A fourth stream relates to sustainability and resilience. The Red Sea and other destination projects position environmental stewardship, regenerative tourism and community value as part of their development identity (Vision 2030, 2025c). Resilient governance research in construction safety indicates that megaprojects need prevention, response and adaptation capacities rather than merely incident statistics (Liu *et al.*, 2024). Climate risk reports also indicate that infrastructure systems face rising exposure to heat, water stress, extreme weather and cascading supply-chain disruption (IPCC, 2023; WEF, 2025). In this setting, environmental and social risks cannot be separated from delivery risk. Ecological damage, heritage disputes or weak local engagement

may cause reputational loss, regulatory intervention, redesign and investor concern.

A fifth stream concerns collaborative and financial risk allocation. Shi *et al.*, (2024) show that collaborative mechanisms and insurance participation can influence decision-making and risk-sharing in megaprojects. PIF's capital-market reporting demonstrates that long-term financing, green finance and portfolio-level liquidity are significant elements of national investment strategy (PIF, 2024, 2025). Yet global inflation, interest rates, energy revenue uncertainty and changing investor expectations can alter feasibility assumptions during lengthy delivery periods. Recent public audit lessons from major projects stress that governance should challenge optimism, define scope clearly, track whole-life costs and maintain independent assurance (NAO, 2025). For Saudi regional development projects, this implies that risk management must integrate finance, procurement, sustainability and delivery controls into a portfolio view.

Risk response strategies in regional development also require a broader vocabulary than avoid, transfer, mitigate or accept. Some risks need sequencing, where uncertain packages are delayed until prerequisites mature. Some require modularity, where infrastructure is designed so later demand changes do not force complete redesign. Others require relational contracting, because the party best able to reduce uncertainty may not be the party carrying the contractual consequence. Portfolio owners also need option-based thinking: preserve alternative routes, suppliers, phasing plans or design capacities until evidence improves. This is especially relevant where visitor demand, regulatory expectations, technology choices and climate adaptation requirements continue to evolve during implementation. Therefore, the best framework is not the one with the longest risk register, but the one that keeps strategic choices open while progressively reducing uncertainty. This view is consistent with responsible innovation, which asks project leaders to anticipate impacts, include affected actors, reflect on assumptions and respond to changing evidence (Lin *et al.*, 2025). In regional development, these principles convert stakeholder engagement from a communication task into a risk sensing mechanism. Residents, suppliers, regulators and operators may notice weak signals before central teams do. Their feedback can reveal gaps in access, culture, safety, affordability, employment or environmental protection that technical dashboards miss. Structured participation therefore improves both legitimacy and risk intelligence. For Saudi project companies, this means that community engagement, environmental monitoring and commercial control should report into the same governance rhythm, so

early concerns are not lost between departments or treated as public relations issues after strategic choices are already locked at project board level.

3 METHODOLOGY

This paper uses an integrative review methodology suitable for topics where evidence spans academic research, professional standards, public reports and policy documents. The approach follows three linked stages: search and selection, thematic coding and framework synthesis. Integrative review is appropriate because risk management in Saudi giga-projects is not confined to a single empirical literature; it draws from megaproject governance, construction management, public infrastructure policy, sustainability, finance and regional planning. The review was designed to produce a conceptual framework rather than a statistical meta-analysis.

Search terms combined four keyword groups: risk management frameworks, megaproject governance, Saudi Vision 2030 or giga-projects, and regional development or construction. Publications were limited to 2020-2025 to reflect current delivery conditions, post-pandemic supply-chain lessons, recent project-governance research and contemporary sustainability expectations. Priority was given to peer-reviewed journal articles indexed in established publishers, official Saudi Vision 2030 and PIF documents, and recognized professional or public-sector sources such as PMI, OECD, WEF and national audit bodies. Sources were excluded when they were older than 2020, focused only on small projects, lacked relevance to infrastructure or regional development, or offered unsupported commentary without methodological transparency.

Thematic coding was conducted in two rounds. First, evidence was coded according to risk source: strategic, financial, regulatory, procurement, technical, environmental, social, safety, workforce

and governance. Second, sources were coded according to management response: avoidance, mitigation, transfer, sharing, acceptance, escalation, assurance, monitoring or learning. This double coding allowed the review to connect the nature of risks with practical governance mechanisms. The synthesis then compared risk clusters against the life cycle of giga-projects: vision and feasibility, master planning, procurement, design integration, construction, commissioning, operations and legacy realization. The resulting framework was evaluated against three criteria: relevance to Saudi Vision 2030 objectives, applicability to regional development projects and alignment with recent megaproject scholarship.

To strengthen interpretive reliability, sources were assessed for recency, relevance, authority and transferability. Peer-reviewed articles were prioritized for theoretical claims about megaproject governance and risk factors; official Saudi documents were used for Vision 2030 context, project scope and portfolio priorities; and professional standards were used for terminology and managerial processes. Evidence was then triangulated rather than ranked by citation count alone. For example, a risk factor was considered significant when it appeared across academic studies and was also logically connected to Saudi delivery conditions, such as contractor capability, regulatory change, environmental sensitivity or market exposure.

The review has limitations. It does not claim to measure actual risk probability within any specific Saudi project, and it does not use confidential project data. Instead, it draws transferable lessons from recent literature and public evidence. The strength of the approach is its ability to combine multiple evidence types into a practical framework that can guide future empirical studies, risk audits and governance design for regional development programs.

Table 1: Integrative review protocol used for source screening and framework synthesis

Review element	Operational decision	Rationale	Quality control
Time frame	2020-2025 sources only	Captures post-pandemic delivery, sustainability and Saudi Vision 2030 acceleration conditions	Older sources excluded except for background standards, which were not used as in-text citations
Evidence types	Peer-reviewed articles, official Saudi reports, professional standards and public audit sources	Risk governance spans scholarship, policy and practice	Priority to indexed journals, official documents and recognized institutional publications
Search logic	Risk frameworks + megaproject governance + Saudi Vision 2030 + regional development/construction	Captures both global megaproject lessons and Saudi delivery context	Duplicate or commentary-only sources removed

Review element	Operational decision	Rationale	Quality control
Synthesis method	Thematic coding by risk source and management response	Allows risk categories to be linked with practical controls	Clusters compared against life-cycle stages and governance layers

4 RESULTS AND DISCUSSION

The synthesis identifies six risk clusters that repeatedly shape regional development outcomes. The first is strategic alignment and scope volatility. Giga-projects are politically visible and often designed to deliver several objectives at once: economic diversification, tourism growth, housing, jobs, cultural identity, innovation and environmental restoration. This multi-objective nature creates ambiguity if priorities are not translated into measurable decision criteria. Denicol *et al.*, (2020) show that poor performance is often rooted in weak decision-making behavior and inadequate front-end governance. Flyvbjerg (2023) similarly emphasizes that large projects improve when planners define purpose clearly, learn from comparable reference classes and reduce late-stage surprises. In Saudi regional development, scope volatility may emerge when market demand, event deadlines, technology ambitions or investor expectations change faster than delivery baselines.

The second cluster is finance, inflation and market exposure. Giga-projects rely on long-term capital allocation, supplier capacity, private-sector confidence and stable market assumptions. PIF reports that its portfolio supports Saudi transformation while maintaining liquidity and sustainable returns (PIF, 2025). However, regional development projects are exposed to material price escalation, interest-rate movements, contractor insolvency, global logistics disruption and changes in tourism or real estate demand. Traditional project risk tools often treat these as external events, but a portfolio owner should treat them as scenario variables. Financial risk management should therefore include sensitivity analysis, stage-gated investment release, realistic contingency, cost-plan benchmarking, whole-life costing and early warning dashboards.

The third cluster is procurement and supply-chain fragility. Regional development projects require specialized packages such as tunneling, utilities, renewable energy systems, marine works, hotels, public realm, digital platforms and transport integration. The shortage of experienced contractors or skilled labor can increase cost, delay approvals and reduce quality. Saudi construction studies link delays and overruns to contractor capability, planning quality and material procurement constraints (Alshihri *et al.*, 2022; Mosly, 2025). PIF's private-sector engagement initiatives demonstrate the

importance of local partnerships and supply-chain development (PIF, 2024). Risk frameworks should therefore move beyond lowest-price procurement toward capability-based selection, collaborative delivery models, supplier resilience mapping, localization plans and dispute avoidance mechanisms.

The fourth cluster is design-interface and systems integration risk. Giga-projects are not single assets; they are interconnected systems of mobility, power, water, digital infrastructure, accommodation, environmental buffers and public services. Design interfaces become critical because a delay in one utility corridor, transport node or permitting package can affect multiple districts. Denicol *et al.*, (2021) and Zani *et al.*, (2024a) show that megaproject organisation design must address inter-organisational boundaries and coordination roles. In practice, this requires integrated master schedules, digital design coordination, interface registers, model-based systems engineering, configuration control and strong change governance. Risk owners should be assigned not only by contract package, but also by cross-system interface.

The fifth cluster is environmental, social and heritage legitimacy. Vision 2030 destinations compete on global reputation, which makes sustainability performance a strategic risk. NEOM, Red Sea Global, Qiddiya and Diriyah each combine infrastructure development with place branding, ecological value, tourism, entertainment or heritage identity (Vision 2030, 2024, 2025b, 2025c). If communities perceive exclusion, heritage is mishandled or biodiversity impacts are underestimated, delivery progress can be undermined by redesign, opposition, regulatory scrutiny or reputational harm. Contemporary megaproject responsible innovation argues for anticipation, inclusion, reflexivity and responsiveness across the life cycle (Lin *et al.*, 2025). This implies that social and environmental risks should be monitored through engagement quality, benefit distribution, heritage safeguards, biodiversity indicators and transparent grievance mechanisms.

The sixth cluster is workforce, safety and capability maturity. Saudi regional development projects require a large, diverse workforce operating under demanding climate, schedule and productivity conditions. Safety risk is not only an operational matter; it is linked to procurement pressure,

subcontractor maturity, heat stress, accommodation quality, language diversity and supervision ratios. Resilient safety governance emphasizes prevention, response and adaptation, which suits complex megaproject environments where hazards evolve as construction intensity changes (Liu *et al.*, 2024). Capability maturity also affects risk culture. A project may have sophisticated procedures but weak field adoption if leaders do not communicate priorities, escalate weak signals or learn from near misses.

Across these clusters, one lesson is clear: risk management must be integrated vertically and horizontally. Vertical integration links national strategy, portfolio steering, project boards, delivery teams and site operations. Horizontal integration links finance, planning, procurement, design, environmental management, stakeholder relations, safety and operations readiness. Conventional approaches often separate these functions, creating blind spots. For example, a design acceleration decision may appear beneficial for schedule but create later safety, procurement and environmental risks. A mature framework should make such trade-offs visible at decision gates.

The review also indicates that early warning indicators should be customized to the project phase. During feasibility, useful indicators include unresolved land issues, insufficient reference-class benchmarking, unrealistic demand projections and weak alignment between scope and funding. During procurement and design, indicators include repeated design freezes being missed, late utility information, contested risk allocation, a high number of provisional sums and long-lead items without confirmed suppliers. During construction, indicators include productivity variance, unresolved requests for information, claims growth, subcontractor churn, heat-related stoppages, near-miss trends and environmental non-conformance. During commissioning and operations, indicators include incomplete asset data, training gaps, service-readiness delays and weak handover governance.

Risk ownership is another recurring weakness. In large programs, risks may be recorded but not genuinely owned, especially when they sit between agencies, design teams, regulators and contractors. Effective ownership requires an accountable decision-maker, an agreed response budget, a deadline for action and a path for escalation. Shared risks should be mapped through interface boards rather than duplicated in separate registers. Where uncertainty is too broad for one team, such as regional labor availability or destination demand,

ownership should sit at portfolio level. This distinction between package risk, interface risk and portfolio risk is essential for Saudi giga-project environments.

A second lesson is the need for adaptive assurance. Assurance should not be a late audit that merely records non-compliance. It should challenge assumptions before commitments become irreversible. NAO (2025) emphasizes governance and decision-making lessons for major public projects, including clarity of scope and accountability. In the Saudi context, adaptive assurance could include independent reviews at feasibility, master-plan freeze, procurement strategy, major change requests, commissioning and transition to operations. Each review should test whether the business case remains valid, whether risk allocation is realistic, whether stakeholder commitments are being honoured and whether contingency remains adequate.

A third lesson concerns digital risk intelligence. Regional development projects generate large data streams: schedules, cost reports, BIM models, procurement records, inspection results, incident data, environmental monitoring, permits, stakeholder cases and weather information. When integrated, these data can identify weak signals earlier than periodic reports. Digital twins, dashboards and predictive analytics can support scenario testing, but technology is not a substitute for governance. Data must be standardized, owned, audited and connected to decisions. Otherwise dashboards become visual reporting tools without authority. The risk framework therefore requires digital tools linked to escalation thresholds, accountable owners and lessons-learned routines.

A fourth lesson is that risk should be treated as a public-value issue. Regional development projects affect surrounding communities, labor markets, public infrastructure, ecosystems and national reputation. OECD infrastructure governance principles emphasize transparent decision-making, value-for-money, stakeholder engagement and whole-life performance (OECD, 2020, 2023). Applying this logic to giga-projects means measuring not only delivery metrics, but also regional employment, local supplier participation, safety performance, accessibility, environmental restoration, operational readiness and long-term fiscal implications. These indicators help prevent a narrow focus on asset completion at the expense of regional development outcomes.

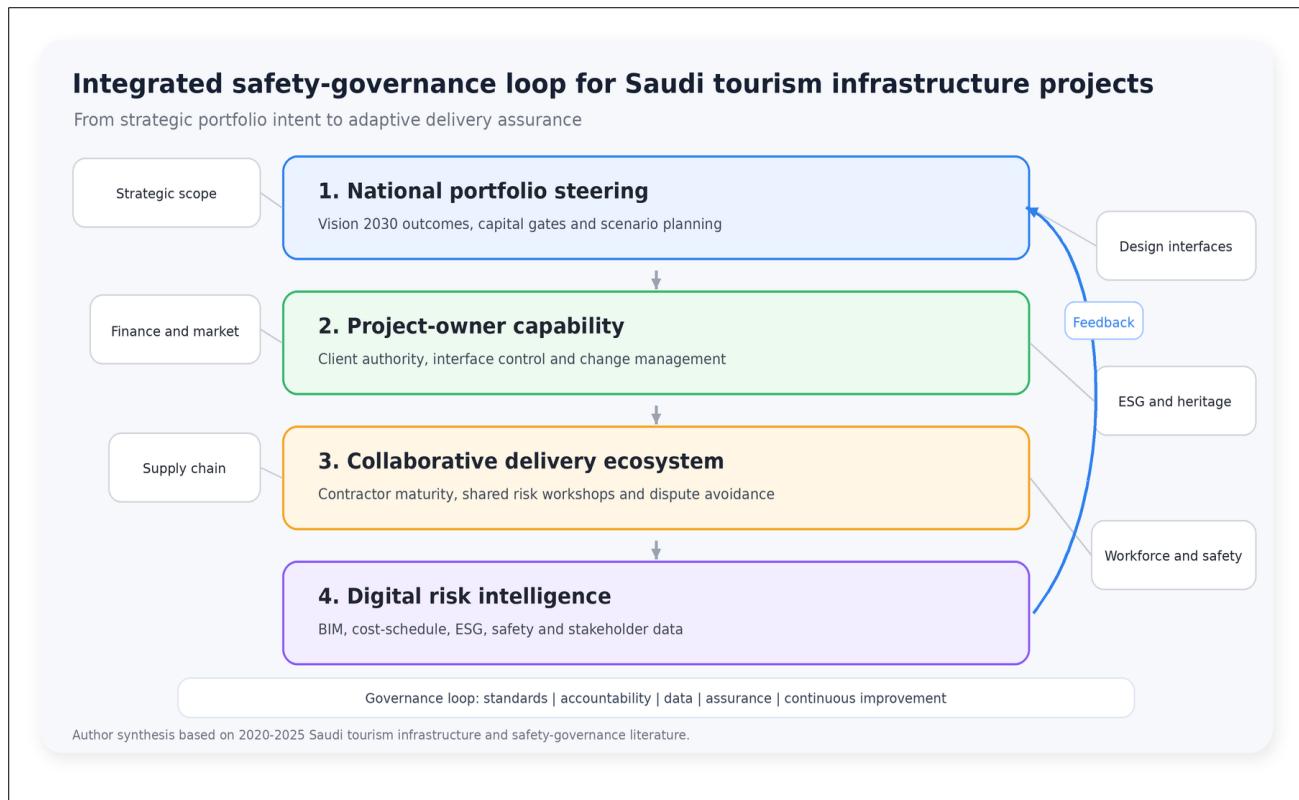


Figure 1: Integrated risk governance loop for Saudi Vision 2030 giga-project environments

The figure synthesizes the review findings into a four-layer governance loop linking portfolio steering, project owner capability, collaborative delivery and digital risk intelligence.

5 Proposed Framework for Saudi Giga-Project Risk Management

The proposed framework has four layers. The first layer is national portfolio steering. At this level, sponsors align project objectives with Vision 2030 outcomes, allocate capital, approve major gates and manage inter-project dependencies. Key practices include portfolio risk heat maps, scenario planning for macroeconomic and climate variables, shared lessons across giga-projects and independent challenge of optimistic assumptions. This layer ensures that regional development projects remain connected to national priorities rather than drifting into isolated prestige assets.

The second layer is project owner capability. The project owner should act as an intelligent client able to define requirements, orchestrate stakeholders, manage interfaces and challenge contractors. This role reflects megaproject governance literature that presents the client as meta-organizer and interface manager (Zani *et al.*, 2024b). Required capabilities include commercial strategy, technical assurance, risk analytics, sustainability governance, community engagement and change control. Owner teams must be strong

enough to integrate consultants and contractors without becoming dependent on fragmented external advice.

The third layer is collaborative delivery ecosystem. Because no single organization controls all risks, the framework encourages shared risk workshops, alliancing principles where suitable, early contractor involvement, transparent change protocols and dispute avoidance boards. Risk allocation should follow control and capability: risks should not be transferred to parties unable to manage them. For example, contractors can manage site productivity, but owners may be better positioned to manage land, permitting, stakeholder and strategic scope risks. Collaborative governance reduces adversarial behavior and improves early warning.

The fourth layer is digital risk intelligence and learning. This layer converts data into decisions by connecting risk registers with schedule, cost, BIM, procurement, safety, environment and stakeholder systems. Dashboards should show leading indicators such as design maturity, late approvals, procurement lead times, interface clashes, heat stress exposure, incident trends and grievance response times. Lessons learned should be captured after each phase and transferred across projects. This supports a continuous improvement cycle: anticipate, assess, allocate, act, assure and adapt.

Applied to a tourism or heritage destination, the framework would begin with a regional risk baseline covering ecology, heritage, land, utilities, access, market demand and community expectations. It would then translate the baseline into procurement criteria, interface maps and assurance checkpoints. During construction, the focus would shift to contractor coordination, environmental controls, safety and stakeholder communication. During opening, attention would move to operations readiness, visitor management, revenue assumptions and maintenance capability. In this way, risk management follows the destination life cycle rather than stopping at practical completion.

Implementation should proceed through a maturity pathway. At the basic level, projects maintain consistent risk registers, owners and response plans. At the managed level, risk data are

linked to cost, schedule, procurement and change control. At the integrated level, project boards use leading indicators, portfolio heat maps and independent assurance to make decisions. At the adaptive level, lessons are transferred across giga-projects, scenarios are refreshed, and communities and regulators are treated as partners in risk intelligence. This pathway allows development companies to improve without waiting for a perfect system.

Together, these layers form a practical risk management model for Saudi regional development. The framework does not replace established project standards; it tailors them to giga-project realities. Its central principle is that risk is dynamic, systemic and value-related. The strongest projects will be those that combine disciplined control with flexibility, local responsiveness and transparent assurance.

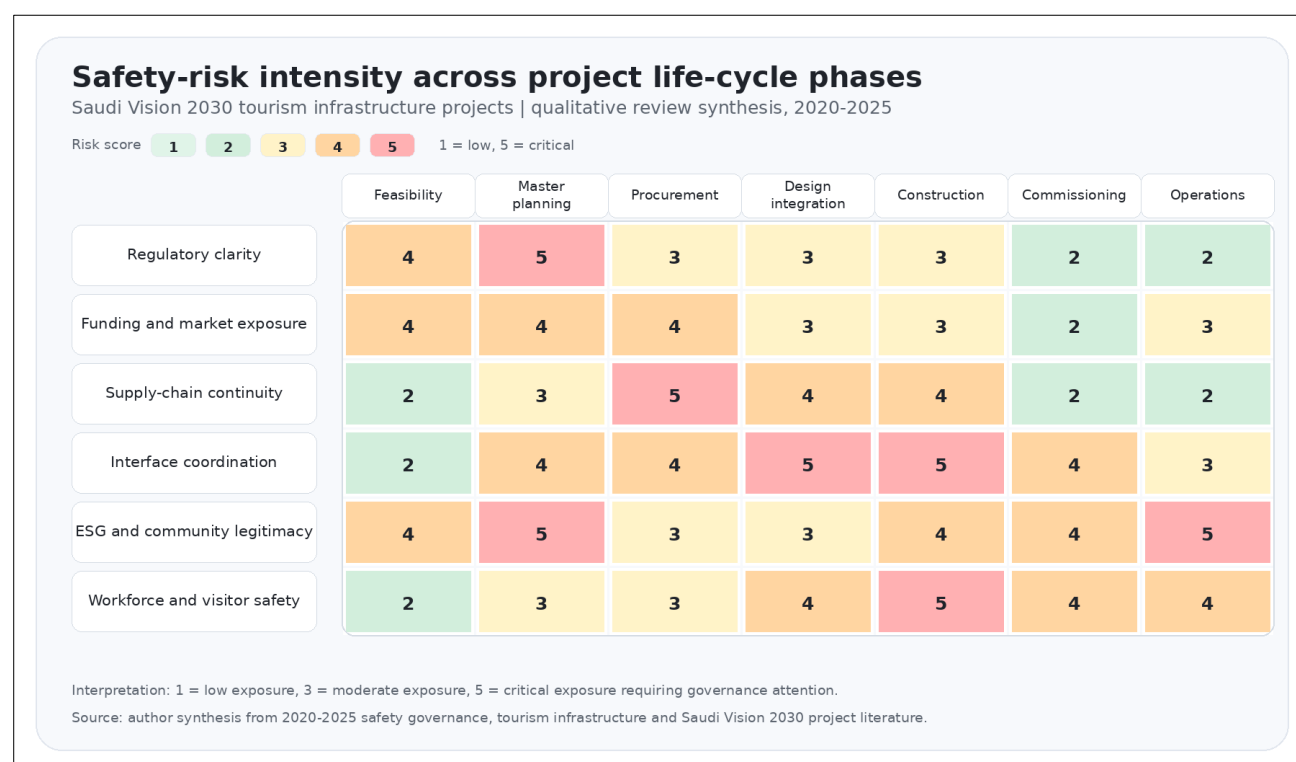


Figure 2: Dynamic risk intensity across the regional development life cycle

The heat map illustrates how risk emphasis changes from feasibility to operations, supporting adaptive assurance rather than static risk registration.

Table 2: Risk cluster, governance response and early warning indicators for Saudi regional development projects

Risk cluster	Giga-project relevance	Core governance response	Early warning indicator
Strategic scope volatility	Multiple economic, tourism, housing and quality-of-life objectives compete for priority	Vision-to-benefit mapping, reference-class forecasting and independent challenge at decision gates	Repeated change requests, weak benefit definition or shifting demand assumptions
Finance and market exposure	Long delivery periods magnify inflation, interest-rate, tourism demand and investor risks	Scenario planning, phased capital release, whole-life costing and contingency governance	Cost-plan drift, low private participation or declining forecast returns

Risk cluster	Giga-project relevance	Core governance response	Early warning indicator
Procurement and supply chain	Specialist packages depend on contractor capability, long-lead items and local supply development	Capability-based procurement, supplier resilience maps and collaborative contracting	Late supplier nomination, subcontractor churn or unresolved provisional sums
Design-interface integration	Utilities, mobility, hospitality, digital and public-realm systems are interdependent	Interface registers, BIM coordination, configuration control and owner-level systems integration	Clash growth, missed design freezes or unresolved requests for information
ESG, heritage and community legitimacy	Regional destinations rely on ecological credibility, heritage value and social acceptance	Transparent engagement, biodiversity controls, heritage safeguards and grievance response	Community complaints, non-conformances or delayed permits
Workforce, safety and capability maturity	Large multicultural workforces operate under climate, productivity and schedule pressure	Resilient safety governance, heat-stress controls, competency plans and near-miss learning	Incident trends, supervision gaps, fatigue signals or training deficits

6 Policy and Managerial Implications

For policymakers, the review suggests that giga-project oversight should focus on portfolio coherence, independent assurance and whole-life public value. Regulations and reporting systems should make environmental, social, safety and financial risk visible in comparable formats across projects. For project owners, the priority is to build intelligent-client capability rather than outsource risk thinking. Strong owner teams can challenge assumptions, integrate interfaces and maintain alignment with Vision 2030 outcomes. For contractors and consultants, the implication is that technical delivery must be supported by transparent reporting, collaboration and proactive escalation. For communities, the framework supports early engagement, clear benefit pathways and accessible grievance mechanisms.

For research, the proposed framework creates a basis for empirical testing. Future studies can survey Saudi giga-project professionals, compare risk maturity across project types, map early warning indicators or examine how digital dashboards affect decision-making. Comparative case studies between tourism, entertainment, housing and heritage projects would also help refine risk categories and governance mechanisms.

For journal contribution, the paper positions Saudi giga-projects as a distinctive setting for advancing megaproject risk theory. They combine sovereign investment, place-making, infrastructure systems, sustainability claims and accelerated delivery in one portfolio. This combination challenges researchers to move beyond isolated project cases and examine regional development as a system of interacting risks, benefits and governance choices.

7 Limitations

This review is conceptual and relies on public sources and recent literature. It does not disclose confidential risk data from any Saudi giga-project and should not be interpreted as an audit of individual developments. The 2020-2025 limit improves currency but excludes some classic megaproject literature. Nevertheless, the review captures the most relevant recent debates for a fast-changing delivery environment and provides a framework suitable for further validation.

8 CONCLUSION

Saudi Vision 2030 giga-projects represent a distinctive regional development environment in which infrastructure delivery, economic diversification, tourism, sustainability and national reputation are deeply connected. The review shows that risks are systemic rather than isolated: strategic scope changes interact with finance, procurement, design interfaces, environmental legitimacy, workforce capability and safety. Conventional risk registers remain useful, but they are not sufficient for projects of this scale and ambition. A stronger approach requires portfolio steering, capable project ownership, collaborative delivery ecosystems and digital risk intelligence. The proposed framework translates recent literature into a practical model for anticipating, allocating, mitigating and learning from risk across the life cycle. Its value lies in aligning risk management with public value, sustainability and the long-term success of Saudi regional development. The central lesson is that risk control should not slow transformation; it should make transformation more credible, investable and resilient. By treating uncertainty as a governance responsibility, Saudi giga-projects can convert complexity into managed opportunity and strengthen their contribution to Vision 2030.

REFERENCES

- Al-Otaibi, A., Alghamdi, S., & Alharbi, M. (2025). Barriers to sustainable building project performance in developing construction markets. *Sustainability*, 17(8), 3539.
- Alqershy, M. T., Zhang, L., & Wang, T. (2025). Exploring governance mechanisms in megaprojects: A mixed-methods systematic review. *Engineering Management Journal*.
- Alrashid, R. (2025). Risk, change and complexity: The triple threat to mega-project control in Saudi Arabia and beyond. *PM World Journal*, XIV(10).
- Alshihri, S., Al-Gahtani, K., & Almohsen, A. (2022). Risk factors that lead to time and cost overruns of building projects in Saudi Arabia. *Buildings*, 12(7), 902.
- Brunet, M. (2021). Making sense of a governance framework for megaprojects: The challenge of finding equilibrium. *International Journal of Project Management*, 39(4), 406-416.
- Cottafava, D., Corazza, L., & Sillig, C. (2025). Megaprojects from the lens of business and management studies: A systematic literature review. *Project Leadership and Society*.
- Denicol, J., Davies, A., & Krystallis, I. (2020). What are the causes and cures of poor megaproject performance? A systematic literature review and research agenda. *Project Management Journal*, 51(3), 328-345.
- Denicol, J., Davies, A., & Pryke, S. (2021). The organisational architecture of megaprojects. *International Journal of Project Management*, 39(4), 339-350.
- Farid, P., Andersen, B., & Laedre, O. (2025). Mega construction projects: Governance challenges for the project owner. *Procedia Computer Science*.
- Flyvbjerg, B. (2023). How big things get done: The surprising factors that determine the fate of every project. *Currency*.
- Intergovernmental Panel on Climate Change. (2023). *Climate Change 2023: Synthesis Report*. IPCC.
- Lin, H., Zhao, X., & Chen, Z. (2025). Megaproject responsible innovation: Concept, framework and governance strategy. *Frontiers of Engineering Management*.
- Liu, K., Li, X., & Wang, Y. (2024). Study on construction safety management in megaprojects based on a resilient governance perspective. *Safety Science*.
- Mosly, I. (2025). Multivariate analysis of factors influencing construction project performance in Saudi Arabia. *Buildings*, 15(5), 687.
- National Audit Office. (2025). *Governance and decision-making on mega-projects: Lessons learned*. NAO.
- Organisation for Economic Co-operation and Development. (2020). *Recommendation of the Council on the Governance of Infrastructure*. OECD.
- Organisation for Economic Co-operation and Development. (2023). *G20/OECD Principles of Corporate Governance 2023*. OECD Publishing.
- Public Investment Fund. (2024). *Allocation and Impact Report 2024*. PIF.
- Public Investment Fund. (2025). *Annual Report 2024*. PIF.
- Public Investment Fund. (2025). *Giga-projects: PIF's transformative national development portfolio*. PIF.
- Project Management Institute. (2021). *A guide to the Project Management Body of Knowledge (PMBOK Guide) (7th ed.)*. PMI.
- Project Management Institute. (2025). *Megaprojects: Challenges, opportunities and the role of the project profession*. PMI Thought Leadership.
- Rashid, Y., Maqbool, R., Mansoor, S., Altuwaim, A. A., & Saiba, M. R. (2022). *Construction projects in Saudi Arabia: Risk analysis*. Eighth International SEEDS Conference, Bristol, United Kingdom.
- Rehman, M. A., Ishak, M. S. B., & Adeleke, A. Q. (2024). The moderating effects of statutory laws and regulations of risk factors and management in the Kingdom of Saudi Arabia construction industries. *Business, Management and Economics Engineering*.
- Shi, Q., Li, H., & Zhang, Y. (2024). Research on collaborative risk management mechanism of mega projects with the participation of insurance institutions. *Systems*, 12(7), 240.
- Vision 2030. (2024). *Qiddiya: A Vision 2030 quality-of-life giga-project*. Saudi Vision 2030.
- Vision 2030. (2025a). *Vision 2030 Annual Report 2024*. Saudi Vision 2030.
- Vision 2030. (2025b). *NEOM: Transforming the Red Sea coast of northwest Saudi Arabia*. Saudi Vision 2030.
- Vision 2030. (2025c). *Red Sea Global: Regenerative tourism and regional development*. Saudi Vision 2030.
- World Economic Forum. (2025). *The Global Risks Report 2025*. WEF.