JBLD, VOL 27, NO 2, SPECIAL ISSUE, 2026. (49- 66)
@ ARDHI UNIVERSITY, DAR ES SALAAM, TANZANIA

# Reframing Cost Information in EPC+F Road Projects in Tanzania: A Conceptual Review of Financial Risk Visibility and Infrastructure Bankability

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**ABSTRACT**

Engineering, Procurement, Construction and Financing procurement models are increasingly used in public road infrastructure delivery to accelerate implementation and mobilise private financing. Despite these intentions, many Engineering, Procurement, Construction and Financing Road projects in developing economies experience delays in achieving financial close, conservative lending conditions, and risk reversion through contract renegotiation. Existing literature largely explains these challenges through contractual, governance, and macroeconomic factors, while giving limited attention to the informational structure of project cost documentation. This paper presents a critical conceptual literature review examining how quantity-based cost information, particularly Bills of Quantities, influences financial risk visibility and infrastructure bankability in Engineering, Procurement, Construction and Financing Road projects. Using interpretive thematic synthesis across project finance, procurement, cost management, and information-oriented construction literature, the study identifies a persistent conceptual gap: although Bills of Quantities are contractually marginalised under lump-sum EPC+F arrangements, financiers continue to rely on quantity-derived cost logic during financial appraisal. The paper proposes the Bills of Quantities –Finance–Risk framework, which repositions Bills of Quantities as financial-information architectures mediating between technical scope definition and lender risk perception. The study concludes that improving the coherence, traceability, and transparency of quantity-based cost documentation may strengthen lender confidence and infrastructure bankability in developing economy contexts.

**Keywords*:*** Infrastructure finance; Financial appraisal; Cost-information systems

## INTRODUCTION

Public road infrastructure plays a foundational role in economic growth, regional integration, and social development in developing economies (Calderón and Servén, 2010; World Bank, 2020). Road networks facilitate

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trade, labour mobility, access to social services, and spatial integration of markets. Given their strategic importance, road infrastructure projects frequently constitute the largest share of public capital expenditure in low- and middle-income countries. The delivery of large-scale public road projects, however, continues to face persistent challenges related to financing constraints, cost escalation, and implementation delays. In response to increasing infrastructure demand and constrained fiscal capacity, governments have increasingly adopted integrated procurement models that combine engineering, construction, and financing responsibilities within a single contractual arrangement. Engineering, Procurement, Construction and Financing (EPC+F) procurement models are designed to mobilise private capital and technical capacity for large-scale infrastructure delivery while reducing immediate fiscal pressure on public budgets (Yescombe, 2014; Delmon, 2015; Gatti, 2018). Within EPC+F arrangements, the contractor assumes responsibility not only for design and construction but also for arranging project financing, integrating financial structuring with project execution (Yescombe and Farquharson, 2018; OECD, 2015). In principle, this integration aligns construction performance with financial accountability, improving project governance and accelerating infrastructure delivery.

In practice, many EPC+F road projects in developing economies struggle to achieve timely and affordable financial close. Project finance literature consistently identifies cost certainty, transparency of assumptions, and credible risk representation as fundamental prerequisites for bankability (Yescombe, 2014; Gatti, 2018). Where uncertainty persists regarding project scope, quantities, lifecycle obligations, or contingency adequacy, lenders adopt risk-averse positions, resulting in higher financing costs or withdrawal from projects altogether. Empirical analysis of EPC+F road projects in Tanzania reflects this broader pattern. Kalinga (2025) documents recurring financial risk instability, including uncertainty in cost definition, challenges in risk pricing, and delays in achieving financial close, suggesting that additional, under-examined structural factors may influence financial outcomes beyond macroeconomic volatility or contractual allocation mechanisms.

A critical but comparatively neglected structural factor is the informational architecture of cost documentation. Bills of Quantities (BOQs) have traditionally served as principal instruments for defining project scope, structuring quantities, and organising cost information within public construction procurement systems (RICS, 2012; RICS, 2014). Under traditional measurement-based procurement, BOQs function as contractual instruments supporting competitive tendering, interim valuation, and final account reconciliation (Cartlidge, 2013; Seeley and Winfield, 1999). Under EPC and EPC+F procurement, however, lump-sum, or performance-based pricing structures appear to reduce the contractual centrality of BOQs (Yescombe, 2014; Delmon, 2015). Despite this apparent shift, quantity-based cost information remains indispensable during project feasibility assessment, debt sizing, contingency modelling, and financial stress testing

(Gatti, 2018; World Bank, 2016; ISO, 2017). Even where BOQs are not used directly as payment instruments, financiers continue to rely on quantity-derived cost logic to interrogate scope definition, assess variability exposure, and evaluate downside risk during financial appraisal.

This tension between the contractual marginalisation of BOQs and the continued financial reliance on quantity-based cost information reveals a significant conceptual gap. The present study addresses this gap by drawing on the informational coherence perspective advanced by Mpangule (2016), who demonstrated that the productivity of cost documentation in public construction projects depends fundamentally on the degree of information integration embedded within BOQ structures. Although that doctoral research focused on total cost management performance rather than infrastructure finance, its core proposition, that documentation structure shapes decision quality, carries broader implications for finance-driven procurement environments.

The main objective of this study is to explore how the informational structure of quantity-based cost documentation influences financial risk visibility and infrastructure bankability in EPC+F road projects. The specific objectives are: (i) to clarify the link between quantity-based cost information structures and financial risk visibility in EPC+F road projects; and (ii) to propose a conceptual framework linking BOQ information logic with financial risk visibility and infrastructure bankability in EPC+F procurement environments. The study advances conceptual understanding by integrating information-centred perspectives on cost documentation (Mpangule, 2016) with insights into EPC+F financial risk challenges in road infrastructure (Kalinga, 2025).

## REVIEW METHODOLOGY

### Philosophical and Epistemological Positioning

This study is grounded in an interpretivist epistemological position, recognising that procurement systems, financial risk, and cost-information practices are institutionally embedded and context-dependent rather than objectively fixed technical phenomena. Concepts such as risk transfer, cost certainty, and bankability derive meaning from professional norms, lender expectations, procurement traditions, and public-sector governance arrangements. Within EPC+F road procurement environments, financial risk is therefore understood not solely as a measurable economic condition, but also as an outcome shaped by how project information is structured, interpreted, and communicated during financial appraisal.

Consistent with this position, the study adopts a constructivist orientation in which knowledge is generated through interpretation and synthesis of existing theories, empirical studies, professional standards, and institutional practices relevant to infrastructure procurement and finance (Crotty, 1998; Bryman, 2016). The objective of the study is explanatory and theory-oriented rather than predictive or hypothesis-testing. Accordingly, the paper does not seek to establish causal relationships or statistically generalizable findings. Instead, it aims to explore how quantity-based cost information structures may influence financial risk visibility and

infrastructure bankability within EPC+F road projects.

Methodologically, the study employs a critical conceptual literature review. Critical conceptual reviews extend beyond descriptive summarisation by interrogating dominant assumptions, identifying conceptual gaps, and synthesising fragmented bodies of knowledge to advance theoretical understanding (Grant and Booth, 2009; Torraco, 2005). This approach is appropriate for the present study because the relationship between cost-information logic and financial risk visibility spans several disciplinary domains, including project finance, infrastructure procurement, cost management, and information-oriented construction research. Although these domains have independently examined contractual risk allocation, bankability, and cost management practices, limited attention has been given to the informational role of quantity-based documentation in shaping financial risk perception during infrastructure appraisal.

A formal PRISMA-based systematic review protocol was not adopted because the purpose of the study is conceptual integration rather than empirical aggregation or meta-analysis. PRISMA approaches are generally suited to reviews synthesising comparable empirical studies or evaluating intervention outcomes (Page et al., 2021). In contrast, the present study draws upon heterogeneous forms of literature, including theoretical contributions, qualitative studies, institutional reports, and professional standards, which are not directly comparable through statistical synthesis. Methodological transparency was instead achieved through explicit articulation of the search strategy, literature selection logic, analytical structure, and interpretive synthesis process adopted in the review.

**Search Strategy and Literature Scope**

The literature informing this study was identified through structured searches of major academic databases, including Scopus, Web of Science, and Google Scholar, to ensure broad coverage across infrastructure finance, procurement studies, construction management, and cost-information research. These databases were selected because they index a wide range of peer-reviewed publications relevant to project finance, public procurement, and construction economics, and are commonly utilised in conceptual and integrative review studies (Snyder, 2019).

The search process was conducted iteratively between 2023 and 2025, allowing refinement of search terms as conceptual patterns emerged during the review. Initial searches focused on combinations of keywords related to EPC+F procurement, infrastructure finance, financial risk, and quantity-based cost documentation. Representative search terms included: “EPC+F procurement”, “engineering procurement construction finance”, “road infrastructure finance”, “financial close”, “bankability”, “project finance risk”, “Bills of Quantities”, “BOQ”, “cost certainty”, and “cost information”. These terms were combined using Boolean operators to capture literature across procurement, finance, and cost management domains.

The review focused primarily on public-sector road and civil works projects delivered under EPC, EPC+F, or related

finance-driven procurement arrangements. Road infrastructure was selected as the principal analytical context because such projects are capital-intensive, extremely sensitive to geotechnical variability, and frequently dependent on complex financing arrangements involving public and private actors (Yescombe, 2014; Gatti, 2018). In addition, road projects constitute a substantial proportion of infrastructure investment in developing economies and are particularly exposed to cost uncertainty and financial risk during project appraisal (Flyvbjerg, 2014; World Bank, 2016).

To complement peer-reviewed academic sources, the review also incorporated selected grey literature from international financial institutions, professional bodies, and infrastructure policy organisations, including the World Bank, International Finance Corporation (IFC), Organization for Economic Co-operation and Development (OECD), Royal Institution of Chartered Surveyors (RICS), and International Organization for Standardization (ISO). These sources were included to capture institutional perspectives on infrastructure finance, procurement practice, cost management standards, and lender due diligence requirements.

Literature selection followed a relevance-based screening approach consistent with conceptual review methodology (Torraco, 2005; Grant and Booth, 2009). Sources were retained where they contributed conceptually to at least one of the following analytical domains: EPC and EPC+F procurement structures and risk allocation; infrastructure finance, bankability, and financial appraisal; cost documentation and Bills of Quantities (BOQs) and information integration and cost-information systems in construction.

Priority was given to literature demonstrating theoretical relevance, interdisciplinary contribution, and conceptual significance to the study objectives. Following screening and thematic classification, approximately 45–55 sources were retained for detailed interpretive synthesis. Rather than seeking exhaustive coverage of all publications within the field, the review emphasises conceptual depth and cross-domain integration in order to clarify the relationship between cost-information logic and financial risk visibility in EPC+F road procurement contexts.

**Analytical Strategy**

The retained literature was analysed using interpretive thematic synthesis, consistent with conceptual review methodologies aimed at integrating fragmented bodies of knowledge rather than aggregating empirical findings (Torraco, 2005; Snyder, 2019). The analytical process involved iterative reading, thematic comparison, and cross-domain interpretation of literature relating to procurement systems, infrastructure finance, and cost-information practices. To enhance analytical clarity and methodological transparency, the synthesis was organised along three analytical axes. The first, the Procurement Structure Axis, examined how EPC and EPC+F procurement models define project scope, allocate responsibilities, and frame contractual risk transfer (Yescombe, 2014; Delmon, 2015). The second, the Financial Appraisal Axis, analysed how financiers evaluate cost certainty, variability, and uncertainty during infrastructure bankability assessment and lender due

diligence (Gatti, 2018; World Bank, 2016). The third, the Cost-Information Axis, investigated how BOQs and related documentation structures represent project scope, quantities, and cost drivers within construction cost management practice (RICS, 2014; Cerovšek, 2011).

Cross-axis comparison enabled identification of recurring conceptual patterns and omissions across the reviewed literature. The synthesis revealed a persistent conceptual disconnection: while procurement scholarship extensively theorizes contractual risk allocation and project finance literature explains lender risk evaluation, the informational architecture of cost documentation is rarely examined as a conditioning factor in financial risk perception. This omission provides the analytical foundation for the BOQ–Finance–Risk framework proposed in this study

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**Reliability and Analytical Boundaries**

Because this study adopts a conceptual and interpretive review methodology, analytical rigor was pursued through transparency of reasoning, systematic synthesis, and cross-domain triangulation rather than statistical validation or empirical generalisation. Reliability was enhanced by integrating literature from multiple but interconnected domains, including project finance, infrastructure procurement, cost management, and information-oriented construction research. This cross-disciplinary approach reduced dependence on a single theoretical tradition and enabled broader interpretation of the relationship between cost-information logic and financial risk visibility.

Analytical consistency was supported through iterative thematic comparison across the three analytical axes adopted in the study. Recurring concepts relating to cost certainty, risk allocation, bankability, and quantity-based documentation were compared across sources to identify areas of conceptual convergence, omission, and fragmentation. In addition, the review incorporated both peer-reviewed academic literature and institutional publications from internationally recognised organisations such as the World Bank, IFC, OECD, RICS, and ISO in order to capture both theoretical and practice-oriented perspectives relevant to infrastructure financing and procurement.

Despite these measures, the study remains subject to limitations inherent in conceptual review methodologies. The proposed BOQ–Finance–Risk framework is theoretically reasoned rather than empirically validated and should therefore be understood as an analytical lens rather than a predictive or prescriptive model. The review also focuses primarily on public-sector road and civil works projects delivered under EPC and EPC+F procurement arrangements; consequently, the applicability of the framework to other infrastructure sectors may vary depending on sector-specific procurement and financing conditions.

Furthermore, interpretive synthesis inevitably involves scholarly judgement in the selection, comparison, and integration of literature across heterogeneous domains. The study therefore does not claim exhaustive coverage of all relevant scholarship. Instead, it seeks to provide a coherent conceptual explanation of how the

informational structure of quantity-based cost documentation may influence financial risk visibility and infrastructure bankability within finance-driven road procurement contexts

## EPC+F PROCUREMENT AND FINANCIAL RISK IN ROAD PROJECTS

### EPC+F as a Finance-Conditioned Procurement Model

Engineering, Procurement, Construction and Financing (EPC+F) procurement has emerged in many developing economies as a response to increasing infrastructure demand, fiscal constraint, and pressure to accelerate project delivery. By integrating design, construction, and financing responsibilities within a single contractual arrangement, EPC+F is intended to mobilise private capital and technical capacity while reducing immediate public budget exposure. In principle, the model reallocates significant construction and financing risks to private actors through lump-sum or performance-based contractual structures (Yescombe, 2014; Delmon, 2015).

Unlike traditional public procurement systems, where financing is secured by government prior to project implementation, EPC+F embeds financing viability within the procurement structure itself. Project implementation therefore depends not only on engineering feasibility or contractual design, but also on the ability to secure debt under acceptable risk conditions. EPC+F may therefore be understood as a finance-conditioned procurement model in which infrastructure delivery is closely linked to lender confidence in project risk representation. Project finance literature emphasises that lenders evaluate projects based on the credibility and transparency of underlying cost assumptions, expected cash flows, and exposure to uncertainty (Yescombe, 2014; Gatti, 2018). Even where contractual risk appears formally transferred to contractors, financiers independently assess potential exposure to construction variability, scope uncertainty, and lifecycle obligations. Consequently, the success of EPC+F road projects depends not only on contractual risk allocation, but also on the quality and interpretability of the information presented during financial appraisal.

### Financial Risk Characteristics of Road Infrastructure

Road and civil works projects exhibit characteristics that intensify the informational demands of finance-driven procurement. Unlike vertical building projects, road infrastructure consists of linear assets extending across geographically dispersed and geotechnically variable environments. Quantities associated with earthworks, drainage systems, pavement structures, and slope stabilisation are often sensitive to changing ground conditions and provisional design assumptions made during early project stages. Infrastructure research consistently demonstrates that transport projects are particularly vulnerable to cost escalation, uncertainty, and optimism bias (Flyvbjerg, 2014; Merrow, 2011). Early-stage estimates frequently underestimate geotechnical complexity, land acquisition challenges, environmental exposure, and long-term maintenance requirements. While such uncertainties are inherent in infrastructure development, their representation within project

documentation significantly influences financial risk perception during appraisal.

From a financing perspective, uncertainty in project scope and quantities becomes more than a technical issue; it becomes a determinant of pricing and lending conditions. Debt sizing, contingency allocation, financing tenors, and interest margins are influenced by how clearly project costs, assumptions, and variability drivers are articulated. Where cost assumptions are aggregated, implicit, or insufficiently traceable, financiers may respond conservatively through increased contingencies, stricter lending conditions, or additional security requirements (World Bank, 2016; IFC, 2017). In EPC+F road projects, these dynamics become more pronounced because financing decisions must be made before construction risks are fully resolved. As a result, lenders become increasingly dependent on structured quantity-based cost information to interpret project uncertainty and assess the credibility of cost forecasts.

**Financial Close Challenges and Risk Reversion**

Although EPC+F procurement is intended to transfer significant financial and construction risks to private actors, many infrastructure projects continue to experience delays in achieving financial close. Existing literature indicates that such delays arise not only from macroeconomic instability or sponsor creditworthiness concerns, but also from uncertainty surrounding project cost representation and risk quantification (Gatti, 2018; World Bank, 2016). Where financiers perceive ambiguity in project cost assumptions or insufficient visibility of variability exposure, they often adopt more conservative lending positions. This may be reflected through higher debt service coverage requirements, increased contingency provisions, reduced debt capacity, shorter financing tenors, or enhanced security conditions. In some cases, governments are compelled to renegotiate contractual terms or provide additional guarantees in order to restore lender confidence, effectively reabsorbing risks that were initially intended for transfer to private actors (Delmon, 2015). This phenomenon of risk reversion undermines one of the central rationales of EPC+F procurement.

The challenge becomes more significant in road infrastructure projects due to long asset lifecycles and uncertainty surrounding maintenance and rehabilitation obligations. Financial models frequently rely on aggregated cost representations that may obscure variability associated with earthworks, drainage conditions, pavement performance, or future rehabilitation requirements. Consequently, lenders may perceive residual uncertainty even within projects structured under fixed-price or turnkey contractual arrangements. These observations suggest that financial close challenges in EPC+F road procurement cannot be explained solely through contract form or macroeconomic conditions. They also point toward structural issues in the way project uncertainty is represented within cost documentation used during financial appraisal.

**The Under-Examined Role of Quantity-Based Cost Information**

Although Bills of Quantities (BOQs) lose much of their contractual centrality under lump-sum EPC+F arrangements, the informational logic embedded within quantity-based cost documentation

remains structurally significant during infrastructure appraisal. Financiers do not rely solely on contractual risk allocation mechanisms; they also interrogate cost breakdowns, quantity assumptions, contingency provisions, and scope definitions in order to evaluate downside exposure and financial uncertainty. Professional cost management standards acknowledge that cost documentation performs functions extending beyond pricing and valuation, including lifecycle analysis, auditability, and risk communication (RICS, 2014; ISO, 2017). Within EPC+F procurement environments, these informational functions become increasingly important because financial viability must be demonstrated before construction begins rather than progressively reconciled through post-contract measurement.

This shift alters the role of quantity-based documentation within project delivery systems. Under traditional procurement, measurement structures primarily support tendering, interim valuation, and final account reconciliation. Under EPC+F procurement, however, quantity-based cost information also contributes to lender interpretation of scope certainty, geotechnical variability, contingency adequacy, and lifecycle exposure. The structure and coherence of cost documentation therefore influence how clearly uncertainty becomes visible during financial appraisal. Despite this continuing reliance on quantity-derived cost logic, EPC+F and project finance scholarship rarely examine the informational structure of cost documentation as a conditioning factor in financial risk perception. Cost documentation is commonly treated as a numerical input within financial models rather than as an informational architecture shaping lender interpretation of uncertainty. As a result, the relationship between quantity-based cost information and financial risk visibility remains comparatively under-theorised within finance-driven procurement research. This conceptual omission provides the basis for reframing BOQs as financial-information systems within EPC+F road procurement environments and establishes the analytical foundation for the BOQ–Finance–Risk framework proposed in the next section.

**Table 1: Conceptual Gaps in Existing EPC+F, Project Finance, and Cost Management Literature**

| Literature Domain | Dominant Focus | Limitation Identified |
|---|---|---|
| Project Finance | Debt structuring and bankability | Cost documentation treated as numerical input rather than informational structure |
| EPC/EPC+F Procurement | Contractual risk allocation | Limited attention to informational mediation of risk |
| Infrastructure Risk Studies | Cost overruns and uncertainty | Weak linkage between quantity representation and financial appraisal |
| Cost Management Research | Measurement and pricing systems | BOQs rarely examined as financial-information instruments |
| Information-Centred Construction Research | Information integration and BIM | Limited integration with infrastructure finance literature |

## CONCEPTUAL FRAMEWORK FOR BOQ INFORMATION LOGIC IN EPC+F ROAD PROJECTS

### Rationale for the BOQ–Finance–Risk Framework

The preceding analysis demonstrates that financial risk in EPC+F road projects cannot be fully understood through contractual allocation mechanisms, financing arrangements, or macroeconomic conditions alone. Although EPC+F procurement is intended to transfer significant construction and financing risks to private actors, financiers continue to interrogate project scope definition, cost assumptions, contingency adequacy, and exposure to uncertainty before committing capital. Consequently, the viability of EPC+F projects depends not only on formal contractual structures, but also on the quality and interpretability of the information used during financial appraisal. Existing EPC and project finance literature has largely conceptualised financial risk in terms of contractual allocation, sponsor capability, governance arrangements, and debt structuring (Yescombe, 2014; Delmon, 2015; Gatti, 2018). Within these perspectives, cost information is generally treated as a numerical input into financial models rather than as an informational structure shaping lender interpretation of uncertainty. As a result, limited attention has been given to how the organisation and coherence of quantity-based cost documentation may influence financial risk visibility during infrastructure appraisal.

This omission becomes particularly significant in road infrastructure projects, where geotechnical variability, spatial dispersion of quantities, and long lifecycle obligations create substantial uncertainty in project scope and cost forecasting. Under EPC+F procurement, such uncertainties must be evaluated before construction begins and before financing reaches financial close. In these circumstances, financiers rely heavily on structured cost information to assess downside exposure, interrogate assumptions, and evaluate the credibility of project estimates. Where cost documentation lacks transparency, traceability, or sufficient articulation of variability, lenders may respond conservatively through increased contingencies, stricter financing conditions, or additional security requirements.

The conceptual basis for addressing this gap draws partly from the informational coherence perspective advanced by Mpangule (2016), which demonstrated that the effectiveness of Bills of Quantities (BOQs) depends not only on measurement accuracy but also on the integration and organisation of project information within cost documentation systems. Although that work focused primarily on construction cost management and information integration, its underlying proposition has broader implications for infrastructure finance. If the structure of cost documentation influences decision-making quality during project delivery, it is plausible that it may also influence interpretation of financial risk during project appraisal. Against this background, the BOQ–Finance–Risk framework is proposed as a conceptual lens for understanding how quantity-based cost information mediates the relationship between technical scope definition and financial risk perception in EPC+F road projects. Rather than treating BOQs solely as contractual

pricing instruments, the framework repositions them as financial-information architectures through which project uncertainty becomes visible and interpretable during infrastructure financing decisions.

## Core Components of the BOQ–Finance–Risk Framework

The BOQ–Finance–Risk framework integrates three interrelated domains that together explain how financial risk visibility emerges within EPC+F road infrastructure projects. The framework conceptualises financial risk not solely as a contractual or financial condition, but as an outcome mediated by the structure and coherence of project cost information during infrastructure appraisal. The first domain is the EPC+F Procurement Context. Within EPC+F procurement environments, financing commitments are typically required before construction begins, requiring lenders to evaluate project risks using pre-construction documentation rather than observed construction performance. Unlike traditional procurement systems, where quantity adjustments and cost uncertainties may be progressively reconciled during project execution, EPC+F procurement compresses risk evaluation into the pre-financial-close stage. Consequently, the credibility and transparency of project information become central to financing viability. Although EPC+F contracts frequently employ lump-sum or performance-based pricing structures that reduce the contractual centrality of BOQs, financiers continue to rely on quantity-derived cost logic when assessing scope definition, contingency adequacy, and downside exposure.

The second domain concerns Financial Risk Visibility and Bankability Requirements. Infrastructure financiers evaluate EPC+F road projects against bankability criteria including predictability of project cost, transparency of assumptions, visibility of variability drivers, and credibility of lifecycle cost implications. Financial appraisal therefore extends beyond contractual risk allocation to include examination of how uncertainty is represented within project cost documentation. Where cost assumptions are aggregated, insufficiently traceable, or weakly linked to engineering conditions, lenders may perceive heightened uncertainty regardless of formal contractual arrangements. Such perceptions may result in conservative lending conditions, increased contingencies, reduced debt capacity, or delays in achieving financial close. The third domain relates to BOQ Information Logic, referring to the way quantity-based cost information is structured, organised, and communicated within project documentation. Within the framework, BOQ information logic functions as the mediating layer connecting technical scope definition with financial interpretation of risk. The framework emphasises informational characteristics such as disaggregation, traceability, coherence, and assumption transparency. These characteristics influence how clearly sources of uncertainty can be identified, interpreted, and evaluated during financial appraisal. In this sense, BOQs are repositioned not merely as contractual pricing instruments, but as financial-information architectures through which project scope and variability become interpretable to financiers.

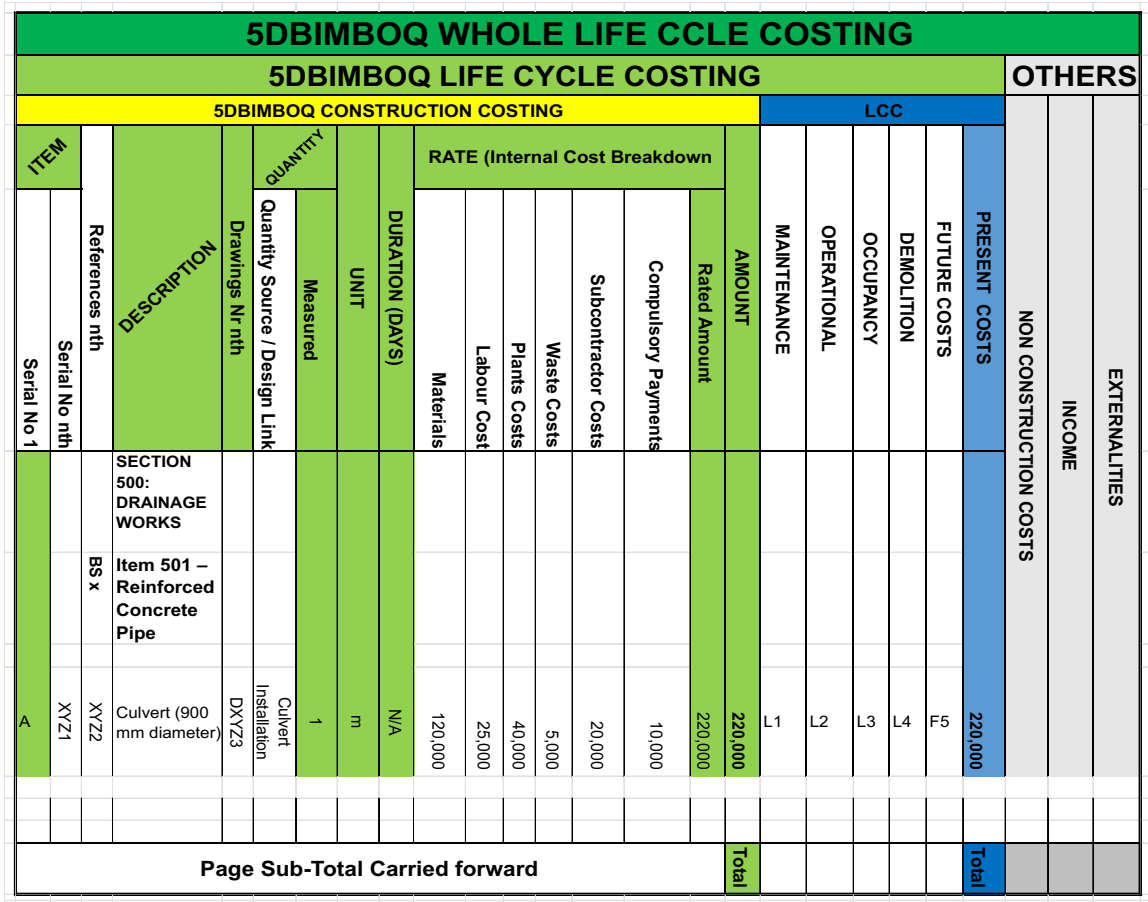



**Figure 1: Conceptual structure of the BOQ–Finance–Risk framework illustrating the mediating role of quantity-based cost information between engineering uncertainty and financial risk visibility in EPC+F road projects (Modified from Mpangule, 2016)**

The interaction between these three domains forms the conceptual basis of the framework. Procurement structures define the institutional conditions under which financing decisions occur; engineering and geotechnical conditions generate inherent project uncertainty; quantity-based cost documentation translates that uncertainty into structured information; and financial appraisal interprets that information to determine bankability. Where cost documentation lacks coherence or transparency, financial risk visibility becomes constrained even where contractual risk transfer appears formally comprehensive. The framework does not prescribe a standard BOQ format or propose replacement of existing procurement systems. Rather, it provides an analytical lens for examining how the informational structure of quantity-based documentation may influence lender confidence and financial risk interpretation within finance-driven road procurement environments, as illustrated in Figure 1.

## Illustrative Application to Road Infrastructure

The relevance of the BOQ–Finance–Risk framework becomes more apparent when considered within the specific characteristics of road infrastructure projects. Unlike many building projects, road and civil works infrastructure

involves linear assets extending across geographically dispersed and geotechnically variable environments. Quantities associated with earthworks, drainage systems, pavement layers, slope stabilisation, and rehabilitation works are often highly sensitive to ground conditions and preliminary design assumptions. These characteristics increase uncertainty in cost forecasting and intensify the informational demands placed on project documentation during financial appraisal. Under traditional measurement-based procurement, uncertainty in quantities may be progressively addressed through post-contract measurement and valuation procedures. In EPC+F procurement, however, financing decisions must be made before construction risks are fully resolved. Consequently, financiers depend on pre-construction cost information to evaluate potential variability exposure and downside financial risk. In such circumstances, the structure and coherence of BOQ information become increasingly important to lender interpretation of project certainty.

An illustrative example can be observed in earthworks documentation within road projects. Traditional BOQ structures frequently present excavation, haulage, compaction, disposal, and ground treatment as fragmented measurement items distributed across multiple sections of project documentation. While such fragmentation may support conventional pricing and valuation procedures, it can obscure the relationship between quantities, geotechnical assumptions, and potential variability during financial appraisal. Under finance-driven procurement environments, lenders may therefore struggle to interpret the extent to which project costs are sensitive to ground uncertainty or provisional assumptions. Applying the informational logic underpinning the BOQ–Finance–Risk framework, quantity-based documentation can instead be structured to enhance traceability between measured quantities, engineering assumptions, and sources of variability. For example, earthworks items may be linked more explicitly to geotechnical classifications, provisional design assumptions, and anticipated lifecycle implications. Similarly, drainage structures may be documented through integrated quantity-based elements that clarify relationships between excavation conditions, material specifications, installation assumptions, and maintenance considerations. Such informational integration does not eliminate uncertainty; rather, it improves the visibility and interpretability of uncertainty during financial appraisal.

The framework therefore suggests that the effectiveness of BOQs within EPC+F procurement should not be evaluated solely according to their contractual role in pricing or valuation. Their significance also lies in their capacity to communicate structured cost information capable of supporting financial risk interpretation. Within finance-driven road procurement environments, informational coherence may therefore become an important factor influencing lender confidence, contingency assessment, and infrastructure bankability. The framework remains intentionally conceptual and does not claim empirical validation. Its purpose is to provide an analytical basis for examining how quantity-based cost documentation may influence financial risk visibility within EPC+F road projects and to support future empirical investigation into the

relationship between informational coherence and infrastructure financing outcomes.

## DISCUSSION: THEORETICAL REPOSITIONING AND INTEGRATION

### Expanding the Conceptualisation of Financial Risk

The dominant literature on EPC+F procurement conceptualises financial risk primarily in terms of contractual allocation, sponsor creditworthiness, and macroeconomic exposure. The BOQ–Finance–Risk framework expands this understanding by introducing cost-information logic as a mediating dimension. Lenders do not evaluate engineering uncertainty directly; they assess structured representations of project scope, quantities, and costs. In this sense, financial risk perception is mediated by the informational architecture through which technical uncertainty is communicated. Contractual design alone cannot guarantee financial viability if the documentation through which project scope and cost variability are represented lacks transparency or coherence. Informational opacity may undermine lender confidence even when contractual risk allocation appears theoretically sound. This repositioning does not contradict established project finance theory; rather, it deepens it by recognising documentation structure as a determinant of perceived risk within the financial appraisal process.

### Extending the Informational Coherence Thesis

The conceptual foundation of this study builds upon the doctoral research of Mpangule (2016), which demonstrated that improvements in the informational coherence of BOQs can enhance total cost management productivity within the Tanzanian construction context. The present study extends this proposition into the domain of infrastructure finance: if informational coherence enhances cost management effectiveness during project execution, it is plausible that informational coherence also enhances financial risk visibility during project appraisal. This extension links theoretical insights from cost documentation research with empirical observations of financing instability in EPC+F road procurement (Kalinga, 2025), establishing an intellectual bridge between cost documentation theory and infrastructure finance practice.

### Resolving Disciplinary Fragmentation

The literature review revealed significant fragmentation across research domains. Project finance theory provides tools for understanding lender risk exposure, debt structuring, and financial close dynamics, but treats cost documentation as a quantitative input rather than a structuring mechanism influencing risk visibility. EPC and EPC+F scholarship emphasises contractual risk transfer while marginalising the informational role of quantity-based documentation. Road infrastructure research documents project delays, cost overruns, and financing challenges but emphasises performance outcomes rather than interrogating the informational structure of cost documentation used during project preparation. Cost management standards emphasise measurement practice and lifecycle costing without explicitly situating BOQs within finance-driven procurement contexts. The BOQ–Finance–Risk framework integrates these fragmented perspectives by

conceptualizing BOQs as informational architectures linking technical project scope and financial modelling, repositioning cost documentation as a structural component within the financial architecture of EPC+F road projects rather than as a purely contractual or accounting instrument.

**Implications for Theory, Practice, and Policy**

For infrastructure finance theory, the framework suggests that informational transparency and documentation coherence warrant development as theoretically meaningful variables within infrastructure risk models. Future scholarship may explore cost-structure sensitivity to variability as a determinant of bankability: whether cost structures that explicitly differentiate high-variability components, such as earthworks, drainage systems, or subgrade treatment, facilitate more precise financial risk evaluation. For procurement strategy, the analysis highlights a structural distinction between contractual instruments and financial-information instruments: procurement frameworks should preserve structured cost documentation as informational artefacts even when BOQs no longer govern contractual payment mechanisms. For quantity surveying and cost management professionals, reframing BOQs as financial-information architectures expands professional roles into financial risk mediation, aligning with RICS (2014) lifecycle cost management guidance. For public-sector policy, EPC+F project preparation guidelines should incorporate explicit criteria for cost-information quality rather than eliminating BOQs entirely under lump-sum procurement. Such reforms can improve lender confidence and reduce fiscal risk reversion without requiring immediate technological transformation, offering a pragmatic pathway for developing economies facing institutional and fiscal constraints.

**Limitations and Future Research**

This study is conceptual in orientation and subject to limitations inherent in theory-building and integrative review methodologies. The relationships articulated remain conceptually reasoned rather than empirically validated. The framework focuses primarily on road and civil works infrastructure delivered under EPC+F procurement; while insights may be transferable to other infrastructure sectors, sector-specific characteristics may influence applicability. The framework also abstracts informational logic from technological platforms, enabling broad applicability but not examining BIM-enabled cost systems in depth. Future research may build on this framework through empirical investigation of the relationship between cost documentation quality and financial outcomes in EPC+F projects. Comparative case studies may examine whether higher documentation transparency is associated with more stable financing outcomes. Qualitative research involving financiers, cost professionals, and public-sector officials may provide insight into how cost documentation is interpreted during financial appraisal. Indices of BOQ informational quality, based on disaggregation level, assumption disclosure, and lifecycle integration, could be correlated with observable financial outcomes including time to financial close, financing cost margins, and contingency levels. Further conceptual development may integrate the BOQ–Finance–Risk framework with

lifecycle costing, asset management, and sustainability frameworks given the long operational life of road infrastructure assets.

## CONCLUSION

This paper critically examined the role and value of Bills of Quantities within EPC+F road projects in response to persistent challenges related to financial risk and bankability in infrastructure delivery. Through critical conceptual synthesis of project finance theory, procurement scholarship, and cost management research, the study identified a significant gap: the informational role of quantity-based cost documentation remains under-theorised within finance-driven procurement environments. By reframing BOQs as financial-information architectures rather than purely contractual pricing instruments, the paper introduced documentation coherence as a mediating construct within infrastructure financial risk theory. The BOQ–Finance–Risk framework demonstrates how the structure and transparency of cost documentation influence financial risk visibility in EPC+F road projects. Procurement structure defines formal risk allocation; engineering conditions generate inherent variability; cost documentation translates that variability into structured information; and financial appraisal interprets that information to determine bankability. Strengthening BOQ information logic along this chain, through improved disaggregation, traceability, and assumption transparency, offers a non-technological pathway for enhancing infrastructure bankability that is particularly relevant for developing economies. Recognising BOQs as components of the financial architecture of infrastructure projects opens new avenues for empirical research linking documentation design, lender behaviour, and public-sector fiscal exposure.

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