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RESEARCH ARTICLE

TECHNOLOGY-ENABLED LOCAL CONTENT OPTIMIZATION IN CONSTRUCTION PROCUREMENT IN SUPPORT OF SAUDI VISION 2030

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1. Critical Integrative Review and Conceptual Model.

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Abstract

Local content objectives are increasingly embedded in Saudi construction procurement, yet the translation of procurement expenditure into demonstrable domestic economic value remains difficult. A contractor's local registration does not establish the origin of its materials, the location of value-adding activity, or the durability of its employment and capability effects. This critical integrative review examines how interoperable procurement systems, building information modelling, supplier analytics and verifiable transaction records can improve the design, implementation and assessment of local-content decisions in construction projects. Thirty DOI-identifiable publications issued between 2020 and 2025 are synthesised across policy design, construction procurement, supplier evaluation and digital governance. The analysis distinguishes eligibility constraints from multi-objective optimisation and develops a six-stage architecture linking demand definition, supplier verification, tender evaluation, contract execution, expenditure attribution and performance learning. Three analytical tables and three original figures explain the architecture and illustrate a fully hypothetical SAR 100 million procurement portfolio. The worked example demonstrates why nominal domestic purchasing and verified domestic value added can diverge, and why a higher local-content percentage cannot by itself establish better project value. The review argues that digitalisation creates an auditable decision infrastructure rather than a guarantee of localisation outcomes. Benefits depend on clear attribution rules, competitively capable domestic suppliers, trustworthy records, contractual accountability and proportionate assurance costs. The resulting framework offers testable propositions and an implementation agenda for procurement authorities, developers and major contractors supporting Saudi Vision 2030.

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Introduction:-

Saudi Arabia's investment-led economic transformation has turned construction procurement into an important instrument of industrial development. Buildings, transport systems, infrastructure networks and destination

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Address:- Critical Integrative Review and Conceptual Model.

developments require extensive purchases of concrete, steel, equipment, engineering services, specialist labour and advanced systems. Each procurement decision can potentially stimulate domestic manufacturing, professional capability, employment and knowledge transfer. Nevertheless, the developmental effect is not identical to the monetary value of contracts awarded within the Kingdom. Imported equipment may pass through a locally incorporated distributor, while a smaller domestic fabricator may undertake substantial engineering and manufacturing activity without possessing the commercial scale to win a major package. An analytically credible procurement policy must therefore distinguish location of contracting from location of value creation.

Local-content optimisation is often framed as choosing the highest proportion of domestic expenditure. That formulation is incomplete. Owners have obligations to procure compliant products, maintain competition where possible, satisfy technical specifications and deliver within the time and risk limits of an agreed project business case. Suppliers differ in capacity, quality assurance, cash-flow resilience, design readiness and ability to evidence domestic value. A local option that cannot produce certified goods on schedule may threaten programme performance; an imported option may offer short-term certainty but weaken the economic development objective. The optimisation problem is consequently multi-dimensional and intertemporal rather than a single percentage maximisation (Mahmoudi et al., 2022; Donyavi et al., 2024).

The Saudi regulatory context gives this distinction practical urgency. The country's procurement approach employs mechanisms including mandatory national-product lists, local-content preferences and commitments against which contractors may be evaluated. The precise applicability of any instrument depends on the contracting authority, tender and current rules, and should not be assumed universal. Comparative legal analysis describes how these mechanisms attempt to convert public purchasing power into domestic productive demand, while sector evidence points to difficulties with supplier readiness and implementation (Kola and Sołdyński, 2025; Abuhussain, 2025). An important research question follows: can digital procurement systems make such requirements both more effective and more defensible without simply automating an inadequate measurement convention?

Digital innovation has materially expanded the information available to construction buyers. Interoperable tendering environments can publish requirements and compare bids; building information modelling (BIM) can associate quantities with work packages; enterprise systems can link purchase orders to receipts and payments; analytics can monitor concentration, capacity and delivery performance. Emerging approaches to traceability can preserve change histories and origin claims. Yet software capability and policy achievement must be kept conceptually separate. The review by Yevu et al. (2021) maps the considerable promise of construction supply-chain digitalisation, whereas later research exposes persistent adoption barriers, problems of data governance and limited sector-wide interoperability (Singh et al., 2023; Masoom et al., 2025).

An additional problem is the fragmentation of research itself. Saudi studies often address legal preference mechanisms, supplier selection, construction technology or sustainable supply chains individually. Technology evaluations may prioritise transaction efficiency without examining whether local economic participation actually rises. Policy discussions may foreground expenditure shares without testing delivery risk. Supplier evaluation studies commonly treat localisation as one criterion among several but rarely connect scoring to verified domestic value added across subcontracting tiers. This review brings those literatures into one causal account and proposes a decision architecture linking procurement inputs to auditable outcomes rather than conflating digital adoption with success.

The study's aim is to develop an evidence-informed framework for using digital technologies to optimise verifiable local economic contribution in major construction procurement while preserving project value and compliance. Four objectives guide the analysis: to clarify competing definitions and indicators of local content; to evaluate digital mechanisms for supplier discovery, screening and expenditure verification; to specify a transparent multi-objective decision process balancing domestic contribution with price, time, quality and risk; and to identify governance conditions and future tests required before the proposed system can be claimed effective.

Review design and analytical procedure:-

Review orientation and scope:-

A critical integrative review is appropriate because the subject spans policy, construction management, information systems, supply-chain strategy and public value. The available studies use different units of analysis, including contractors, projects, suppliers, retail partnerships and industrial networks. Their outcome measures are similarly heterogeneous: cost, transparency, readiness, local procurement, sustainability, resilience and adoption intention.

Pooling effect sizes would therefore imply a comparability that the evidence does not establish. Instead, the review asks what mechanisms are plausibly supported, under which conditions, and where evidence remains insufficient. Its contribution is conceptual synthesis rather than a statistically generalisable effect estimate.

The core scholarly set comprises thirty DOI-identifiable publications with publication or first-online dates between January 2020 and December 2025. Works were identified through topic-led examination of the supplied reference papers, targeted searches of scholarly publisher and institutional records, and backward identification of closely related research. Terms included 'local content', 'Saudi procurement', 'construction supply chain', 'supplier localisation', 'e-procurement', 'BIM procurement', 'digital traceability', 'supplier evaluation' and related combinations. Full bibliographic searches conducted directly inside subscription Scopus or Web of Science accounts were not available for this review. Consequently, no claim is made to exhaustive database retrieval, a reproducible census of all relevant studies or a formal study-screening flow. The thirty-item bibliography should be read as a purposively assembled analytical corpus.

Eligibility required a verifiable DOI record, a publication date in the specified period, and substantive relevance to at least one of four constructs: local-content policy and productive capacity; construction purchasing and supplier capability; digital procurement and evidential assurance; or multi-criteria governance and sustainable supply chains. Priority was given to studies focused on Saudi Arabia or construction. Broader international or sectoral studies were included only where they clarified an identifiable mechanism potentially transferable to construction. The 2026 example papers supplied for style and conceptual orientation were deliberately excluded from the cited research window.

Coding, appraisal and synthesis:-

Each publication was examined for its research question, setting, method, data characteristics, proposed mechanism, outcome type and limitations. Thematic coding grouped claims into five analytical clusters: compliance architecture; supplier access and capability; interoperable information; verification and accountability; and value-sensitive procurement choice. Studies could contribute to several clusters, but the manuscript does not manufacture quantitative counts of themes from an unobserved database export. The source-to-argument mapping instead emphasises where evidence converges, where it conflicts and where the paper's recommendations remain propositions. For example, procurement automation research supports the possibility of improved transparency, but cannot alone verify that a project has generated incremental Saudi manufacturing value.

Quality appraisal followed a fit-for-purpose logic. Empirical Saudi construction studies have stronger direct contextual relevance but may be limited by sample size or self-reporting. Prototype demonstrations establish technical feasibility more readily than routine commercial effectiveness. Legal analyses clarify applicable instruments yet do not estimate causal economic effects. Studies from retailing, solar energy or other jurisdictions are treated as analogical, not as evidence of measured Saudi construction outcomes. This distinction is particularly important because academic work frequently reports successful demonstrations under controlled conditions rather than interoperable deployment across live multi-tier construction contracts (Celik et al., 2023; Yoon et al., 2024).

Analytical boundaries and numerical demonstration:-

The proposed framework is a normative design developed from the literature, not an empirically calibrated optimisation engine. No interviews, proprietary tender files, contractor cost ledgers or original Saudi project observations were collected for this article. The numerical tables below contain either precisely attributed values from published work or transparent synthetic values selected to expose decision trade-offs. The illustrative portfolio uses a SAR 100 million budget and a small supplier-choice example, with explicit definitions and arithmetic, so that it can be replicated without being mistaken for an evaluated giga-project. The synthetic values are neither national benchmarks nor regulatory thresholds.

Table 1. Selected published quantitative anchors informing the review (not a pooled sample).

Publication	Evidence context	Sample / units	Published quantitative anchor	Interpretation
Abuhussain (2025)	Saudi construction survey	82 respondents	85% policy awareness; 15% of firms >50% local materials	Direct context; self-report
Taha et al. (2025)	Saudi heavy construction	85 respondents	19 barriers; economic model $R^2 = 0.432$	Direct context; non-causal SEM
Addy et al. (2022)	Construction e-procurement, Ghana	205 respondents	Adoption influenced by performance expectations and social factors	Transferable adoption mechanism
Yevu et al. (2022)	Digital procurement strategies	121 datasets	14 strategies grouped into five categories	Cross-context process evidence
Kim and Kim (2024)	Construction blockchain procurement	54 reviewed studies	Mapped technology applications across procurement processes	Technical review, not local value
Waqar et al. (2024)	Construction supply chains	136 professionals	Reported five traceability / smart-contract constructs	Non-Saudi sector evidence

The six studies have different questions, populations and methods. Values are reproduced only as reported in those papers; they are not aggregated into a common effect size.

Local content as a construction procurement problem:-

From domestic purchasing to domestic value creation:-

The term 'local content' has several operational meanings. It may denote the share of direct procurement expenditure placed with domestic vendors, the proportion of eligible products originating within the country, domestic employment, national ownership, use of indigenous technology, or a broader accounting measure of value added within national borders. These measures are related but not interchangeable. In particular, a purchase order issued to a domestic intermediary can contain substantial imported value. Conversely, locally undertaken design engineering, testing and fabrication can create domestic value within a supply chain that also includes foreign equipment. Comparative procurement research shows why the intended policy effect must be specified before the metric is selected (Kola and Söldyński, 2025).

For analytical purposes, this review distinguishes gross domestic procurement (payments to Saudi-based counterparties), verified domestic value (the supported portion attributable to recognised domestic activity), and developmental additionality (domestic activity plausibly generated beyond what would have occurred without the relevant procurement intervention). A project might increase the first measure through contract routing without raising the second; an already-established factory may contribute to verified value but offer little immediately demonstrable additionality. While additionality is conceptually important, it is difficult to establish without counterfactual evidence. This paper therefore recommends verification of economic contribution before any stronger causal claim about employment, knowledge or diversification is made.

The distinction also warns against double counting. A main contractor can report a local subcontract, while the subcontractor may report the same underlying materials purchase. A software tool that aggregates both as independent contributions will exaggerate localisation even if every invoice is authentic. A robust data model must preserve expenditure lineage across tiers, reconcile contract amounts with underlying invoices and specify whether measures are reported on a gross purchasing basis or on a value-added basis. Decisions about wages, profit, imported intermediate goods and subcontract services belong to the governing accounting methodology, not to a vendor-selected scoring convention. Digital records can facilitate calculation but cannot decide the policy definition (Alyafie, 2025; Alquraish, 2025).

Demand structure and supplier capacity:-

Construction differs from repeated retail purchasing because every major project combines unique design interfaces with a temporary delivery coalition. High-value items are often specified months before procurement, while qualified firms may be constrained by overlapping orders from multiple projects. A supplier's nominal eligibility is therefore insufficient evidence of availability. Procurement optimisation requires knowing whether a factory can meet the specified grade, obtain required testing, deliver within the installation window and sustain the associated working-capital demands. Work on Saudi contractor prequalification underscores the importance of technical, commercial and managerial capabilities rather than relying on price alone (Alshamrani et al., 2023).

Supplier localisation may also require redesign of procurement packages. A very large, bundled engineering-procurement-construction package can exclude otherwise competent domestic firms that lack the financing or guarantees needed to bid for the whole contract. Conversely, splitting every package into small lots can multiply interfaces, warranties and transaction costs. Package design thus determines market access before any scoring algorithm runs. Evidence from micro, small and medium-sized construction enterprises highlights the complex interaction of material ordering, information reliability and cash flow (Donyavi et al., 2024). The procurement system must assess supplier capability at the level of technically separable works, not merely count domestic bidders after tender publication.

One implication is that supplier development cannot be reduced to preferential award. Manufacturers may need forecast visibility, recognised certification, stable specifications, process upgrading and transparent feedback to invest confidently. Larger construction programmes can act as demand anchors, but accelerated localisation can also create capacity bottlenecks when several projects simultaneously require the same product. Research on Saudi solar industrial capability demonstrates the relevance of distinguishing policy targets from available in-country productive capacity (Alghamdi et al., 2025). Although solar systems differ from general building materials, the mismatch between ambition and sector readiness is instructive.

Institutional incentives and procurement fairness:-

Policy preferences can be efficient where they correct coordination failures or build capabilities with credible future demand. They can also impose short-term price premiums or shield low-performing suppliers if unaccompanied by verification and competition safeguards. The objective should not be to suppress cost information but to compare bids against an explicit combined project and development value. Saudi procurement mechanisms must be applied according to current legal requirements and tender conditions, rather than replaced with academic weights. The choice architecture developed below is therefore a decision-support layer: mandatory eligibility filters operate first, and discretionary optimisation occurs only among compliant alternatives (Kola and Sołdyński, 2025).

What technologies contribute—and what they do not:-**Interoperable procurement and building information:-**

Electronic procurement platforms can standardise requests for quotation, approvals, clarifications, bid comparison and the communication of award conditions. Their value for localisation is greatest when each record connects a project-specific material requirement with a registered supplier, an authorised origin claim and subsequent delivery evidence. Research on electronic procurement implementation finds that technology education, organisational integration and incentives interact: installation alone is insufficient (Yevu et al., 2022). Adoption studies similarly identify performance expectations and social conditions as factors influencing uptake (Addy et al., 2022). Procurement platforms therefore need operational governance alongside software functionality.

BIM can supply the demand-side reference for this process. A design object or bill-of-quantities item can be associated with technical specifications, required date, approved product category and package identifier. Procurement data can then be evaluated against the design rather than stored as disconnected vendor records. Kalantari et al. (2024) demonstrate the feasibility of BIM-linked procurement planning, while Celik et al. (2023) investigate how structured project information and distributed records can improve collaboration and traceability. Neither result guarantees that the supplier behind a digital object creates the claimed domestic value; independently validated origin and activity records remain necessary.

Interoperability is especially significant for projects where owners, consultants, contractors and suppliers each use different enterprise software. If an approved substitution in the design environment fails to update a purchase order, invoices may describe goods that no longer correspond to the specified item. Conversely, a delivery may be correctly received but linked to the wrong work package in an expenditure report. Common identifiers, governed

data dictionaries, event timestamps and clear master-data ownership make the chain of evidence more reliable. Digital procurement becomes analytically useful when updates are reconciled rather than merely replicated across dashboards (Yevu et al., 2021; Masoom et al., 2025).

Supplier intelligence, screening and optimization:-

Data-driven supplier selection can combine qualification evidence, verified production capacity, commercial terms, lead-time uncertainty and domestic contribution. Mahmoudi et al. (2022) explicitly examine construction suppliers under localisation, agility and digitalisation criteria, indicating that the factors should be evaluated jointly rather than as isolated labels. Wu et al. (2023) demonstrate the broader potential of product-category-specific selection criteria and machine learning. A defensible Saudi application would nevertheless require that each factor is interpretable to bidders, materially relevant to the package and checked for discriminatory errors.

A useful distinction is between descriptive analytics and prescriptive optimisation. A dashboard can describe the percentage of tenders offered to domestic suppliers; it cannot establish whether an alternative award pattern would have delivered more domestic value at an acceptable total cost. Prescriptive methods must define the objective function, mandatory constraints and treatment of uncertainty. Sensible constraints may include engineering certification, minimum production capacity, completion dates, concentration ceilings and approved contract terms. Where public procurement regulations prescribe an award rule, the optimiser should not override it. For negotiable private-sector procurement, decision models can expose the incremental cost of moving from one feasible local-content portfolio to another.

Analytics are vulnerable to poor inputs. A supplier-reported local-manufacturing share may lack auditable supporting records; capacity may be overstated; historic lead-time data may exclude failed orders. An apparently precise score is then a transformation of uncertainty into misleading certainty. A stronger approach records each figure's source, date, assurance grade and eligibility period. It also provides an escalation route for contested classifications and retains human accountability for exceptions. Studies of technology barriers in Saudi construction and other sustainable supply chains repeatedly highlight gaps in skills, data maturity and leadership support (Alfalah et al., 2024; Taha et al., 2025).

Transaction assurance, origin and contract execution:-

Distributed ledgers and smart-contract prototypes can make transaction changes easier to trace, particularly where parties disagree about bid timing, approvals or payment conditions (Ahmadisheykhsarmast and Sönmez, 2020). Demonstrations by Yoon and Pishdad-Bozorgi (2022) and Yoon et al. (2024) explore trust-oriented subcontractor selection and integrated automated procurement. Kim and Kim (2024) identify opportunities and remaining organisational limitations in construction procurement applications. These technologies should be understood as alternatives or complements to conventional controlled databases, not as compulsory infrastructure for a successful localisation programme (Waqar et al., 2024).

An immutable record is not equivalent to truthful source information. If a supplier initially uploads a false certificate of domestic origin, a ledger may preserve that false assertion with excellent technical integrity. Verification consequently requires controls outside the software: issuing-authority checks, inspections where appropriate, document reconciliation, periodic sampling and procedures for correcting historic classifications. Similarly, automated contract execution must recognise exceptions for design changes, safety events, disputed measurements and regulatory updates. Research on construction contract administration and regional adoption warns that organisational legitimacy and appropriate allocation of decision rights are central to deployment (Mohamed et al., 2024; Singh et al., 2023).

Technology-enabled traceability may nevertheless reduce the cost of maintaining a usable audit trail. A selected order can be linked to its original eligibility assessment, invoice, goods receipt, fabrication record, certificate and payment. When a project reports local content, the computation can be traced backwards to permitted categories and supporting evidence. Work on blockchain-based environmental, social and governance information demonstrates how transparent data structures may support accountability for construction activity (Gong et al., 2024). The same design logic could assist local-content audits, but claims about measurable fraud reduction or economy-wide industrial growth would require separate evidence.

Organisational readiness, adoption cost and market inclusion:-

Digital transformation introduces new administrative work before it removes old work. Suppliers must learn portals, manage product codes, upload evidence and respond to system-generated exceptions; project teams must resolve

inconsistent quantities and train users to interpret data. The burden is proportionally heavier for small firms with limited specialist staff. Alyafie (2025) identifies data-sharing costs and trust challenges in Saudi buyer–supplier relationships, while Alquraish (2025) relates digital maturity to sustainability and resilience in industrial supply chains. Although both studies provide transferable insight, their sectoral contexts should not be conflated with direct Saudi construction evidence.

A staged adoption strategy is therefore more defensible than a single mandatory technology stack. At basic maturity, the programme might prioritise a supplier registry, standardised product classifications and a controlled evidence repository. At intermediate maturity, it can link tender, purchase-order and invoice data. Predictive analysis and automated discrepancy detection become useful only once data completeness and ownership are demonstrably adequate. An expanding audit workload or the systematic exclusion of capable small firms would represent a failure of the localisation objective even if electronic transaction rates increased (Zouari et al., 2021; Taha et al., 2025).

A proposed technology-enabled local-content decision architecture:-

Logic and sequence:-

Figure 1 summarises the argument: construction demand and localisation rules define the feasible decision space; digital tools improve supplier visibility and evidence quality; commercial and developmental criteria shape compliant award decisions; and contract data determine the verified outcome. The model does not assume that technology exerts a direct, constant effect on local content. Instead, it specifies observable mediating processes such as competition, supplier capability, evidence completeness and corrective feedback. The architecture is designed to preserve accountability for both procurement performance and public economic objectives.

FROM PROCUREMENT RULES TO VERIFIED DEVELOPMENT VALUE



Figure 1. Proposed mediation pathway between procurement choices, evidence quality and attributable local economic value (author-developed).

Six stages constitute the proposed architecture. In the first stage, teams establish a governed requirements baseline: project design, bill of quantities, package boundaries, required dates, applicable local-content rules and definitions of allowable domestic contribution. The second stage creates a supplier intelligence layer with verified capabilities, certifications, domestic activities, capacity and performance history. The third stage screens bids for mandatory compliance, then compares feasible alternatives using explicit measures of delivered value, cost and risk. The fourth records decisions, award commitments and responsible persons. The fifth reconciles delivery and expenditure records against auditable value attribution. The sixth uses exceptions and post-award performance to improve future package design and supplier development.

SIX-STAGE PROCUREMENT CONTROL ARCHITECTURE



Figure 2. Six-stage integrated local-content decision architecture with governance at every stage (author-developed).

The stages are linked rather than autonomous. A change to a product specification may alter eligible domestic manufacturing options and require requalification; a factory capacity shortage may lead to a justified split award or revised delivery sequence; a disputed local-value figure may trigger evidence collection instead of changing the project's commercial ledger. The system should log these events so that the final percentage can be interpreted in relation to design change, supplier availability and actual value generated. Research on digital construction information integration and materials procurement supports this need for cross-functional consistency (Celik et al., 2023; Kalantari et al., 2024).

Decision variables and accountability:-

A procurement model can be formulated around a set of compliant supplier-package choices. Let $x(i,j)$ represent the share of package i awarded to supplier j , and let $v(i,j)$ denote the independently supportable domestic value attributed to that choice under the applicable accounting rules. Define C as total expected ownership and delivery cost; R as an explicit index of supply risk; and L as verified domestic contribution. A conceptual objective is to improve L while controlling C and R , subject to technical, regulatory, capacity and schedule restrictions. The precise weights should not be fixed by this review: they are project and policy decisions requiring authorised governance.

The first decision gate is binary, not compensatory. Bids failing a mandatory requirement do not become acceptable because they promise an exceptionally high local-content score. Among compliant bids, a buyer may use constrained optimisation or an interpretable multi-criteria comparison. If a weighted score is used, factors should be normalised transparently and sensitivity-tested; adding a domestic-activity percentage to a differently scaled quality score without justification would create an arbitrary ranking. Procurement managers must also examine the price and risk trade-offs, not only the final score, and preserve written reasons for departures from the model (Wu et al., 2023; Kola and Sołdyński, 2025).

Attribution, indicators and assurance:-

Verified domestic contribution is represented in the illustrative model by the sum of eligible expenditure multiplied by its supported domestic share, after removing duplication. It is an explanatory simplification, not a substitute for the prescribed Saudi accounting template. A practical system should distinguish material origin, domestic transformation, engineering and labour contribution, and the provenance of reported figures. Its main advantage is evidential discipline: reported performance can be linked to invoice-level records and audited against the same definitions used when bids were compared.

The reporting dashboard should include more than a single local-content percentage. Useful indicators comprise domestic-value-attribution rate, proportion of eligible spend supported by adequate evidence, qualified local bidders per package, supplier-on-time delivery, non-conformance rate, concentration of awards and unresolved audit exceptions. These measures reveal different failure mechanisms. A high local-content result with a low evidence-completeness rate is not equivalent to a high result supported by verified receipts and manufacturing records. The preferred measurement set therefore combines developmental, delivery and data-quality dimensions (Abuhussain, 2025; Gong et al., 2024).

Evidence-informed implementation roadmap:-

Implementation should begin with a limited group of product categories for which demand can be specified precisely and supporting records are attainable. An initial pilot can focus on routinely purchased construction inputs and a small number of willing suppliers. Before software integration, procurement teams should agree common material codes, traceability requirements, who may certify origin, how missing documents are handled and when awards may be revised. Expanding to more technically complex equipment should follow a demonstrated reduction in discrepancy rates, not a ceremonial platform launch. Saudi construction research illustrates that training, coordination and technical readiness are material conditions rather than optional enhancements (Al Azmi et al., 2022; Alfalah et al., 2024).

Analytical illustration: localisation, cost and reliability:-

Synthetic supplier-choice example:-

To test the internal coherence of the proposed decision logic, Table 2 sets out four entirely hypothetical bids for one construction work package. All four are assumed to pass the minimum engineering and regulatory eligibility screen; otherwise a direct ranking would be inappropriate. Each bid is assigned an illustrative price, expected delivery lead time, estimated supported domestic share and independent evidence completeness. The example separates 'domestic supplier' status from supported local value: a locally registered distributor may have less in-country contribution than a smaller domestic producer performing fabrication, engineering and testing.

Table 2. Illustrative technically eligible supplier alternatives for one construction package.

Supplier	Bid (SAR m)	Lead (weeks)	Supported local share	Evidence complete
A	9.0	9	18%	95%
B	9.7	10	46%	92%
C	10.6	15	68%	80%
D	10.0	11	55%	96%

Entirely synthetic inputs; evidence completeness is the proportion of required documents independently supported, not a substitute for local-value verification. These inputs should not be mistaken for a market survey or for typical Saudi rates. Suppose Supplier A submits the lowest price but supports only 18% domestic attribution; Supplier B offers a higher share with an intermediate price; Supplier C provides the strongest domestic content but carries a longer lead time; and Supplier D offers a balanced alternative. The buyer cannot rationally choose solely on domestic share, because delivery constraints and evidence quality determine whether the promised outcome is realisable. Nor should the lowest price automatically prevail if the governing procurement mechanism attaches lawful value to local content. The point is to expose the trade-off with recorded assumptions.

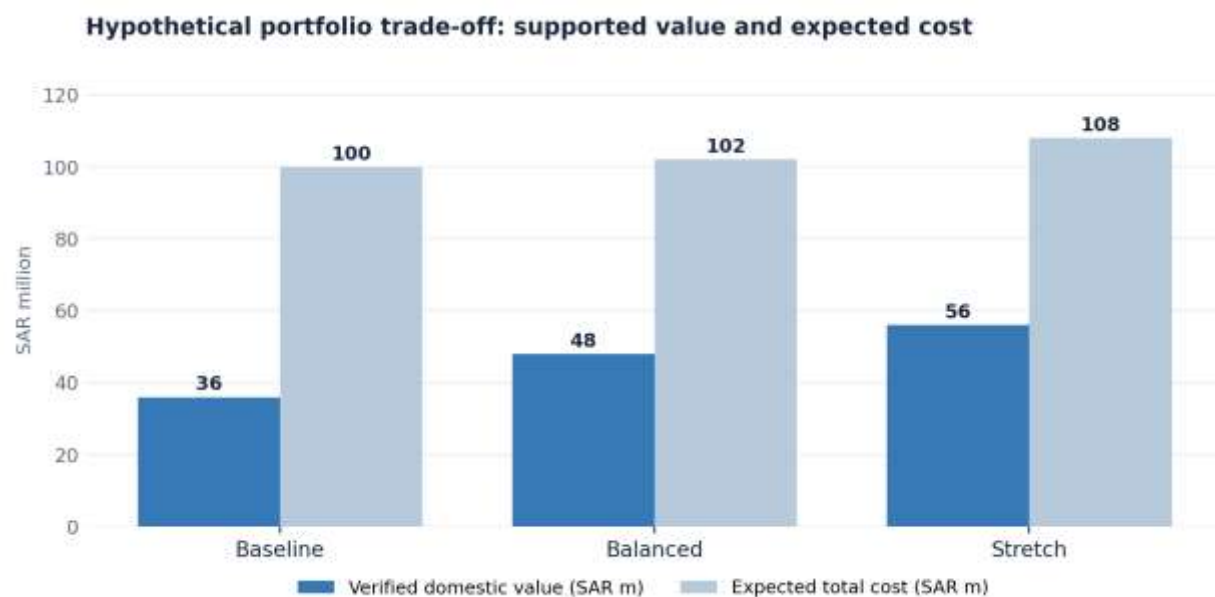
Portfolio-level scenarios and calculations:-

Table 3 scales the reasoning to a hypothetical SAR 100 million construction procurement budget. The baseline assumes SAR 36 million of verified domestic contribution, or 36% of the budget, with total expected cost of SAR 100 million. A feasible optimisation scenario raises supported domestic value to SAR 48 million while increasing expected procurement cost to SAR 102 million, resulting in an incremental SAR 2 million cost and SAR 12 million additional supported domestic value. A more aggressive target yields SAR 56 million of domestic value at an expected cost of SAR 108 million and higher delivery exposure. These are illustrative alternatives, not predictions or observed policy impacts.

Table 3. Transparent sensitivity illustration for a hypothetical SAR 100 million procurement programme.

Scenario	Expected cost (SAR m)	Verified domestic (SAR m)	Share of SAR 100m base	Share of actual cost
Baseline	100	36	36.0%	36.0%
Balanced	102	48	48.0%	47.1%
Stretch	108	56	56.0%	51.9%

All values are scenario assumptions, not collected data. Shares of actual cost = supported domestic value / scenario cost; incremental cost is SAR 2m then SAR 6m between successive options. The baseline-to-optimised scenario implies SAR 6 of extra supported domestic contribution per incremental SAR 1 of expected cost, but that is a mechanical ratio generated by the assumed input data, not a social benefit-cost estimate. It ignores substitution effects, economic multipliers, tax flows, enduring employment and the counterfactual availability of supplier capacity. The more aggressive move from SAR 48 million to SAR 56 million produces only SAR 1.33 of additional domestic attribution per extra SAR 1 of expected procurement cost. This demonstrates diminishing incremental gains within the fabricated scenario and motivates an explicit decision about acceptable delivery risk and the value of long-term capacity formation.

**Figure 3. Expected procurement cost and supported domestic value for three fully hypothetical scenarios; not observed data.**

The local-content share also depends on its denominator. If realised cost rises above the baseline while attributed domestic value remains unchanged, the percentage falls even without a reduction in domestic economic activity. For comparative clarity, Table 3 states both the original budget denominator and actual scenario cost. A policy-compliance report should use the currently prescribed method, whereas an analytical project dashboard may display multiple denominators to avoid misleading interpretations. Procurement authorities and commercial teams should explain any difference clearly, particularly where the final cost includes contingency expenditure or remeasured scope (Kola and Sołdyński, 2025; Alghamdi et al., 2025).

Interpretation and decision sensitivity:-

The synthetic results illustrate three propositions. First, local-content gains are not free and should be evaluated against performance rather than assumed to follow from a digital tender. Second, the economic quality of localisation matters: increasing a superficial transaction share can yield less developmental value than investing in the manufacturing, training and engineering activities of qualified suppliers. Third, audit quality is endogenous to the decision. A bid with a high self-reported domestic percentage but deficient evidence should not receive the same confidence as a smaller, verifiable contribution. These conditions imply that portfolio optimisation is a problem of credible information and supplier development as much as price comparison.

Discussion and theoretical implications:-

The integrated framework modifies the usual story about construction digitalisation. Software does not create domestic industrial capacity by itself; it makes specified activities discoverable, eligible suppliers comparable and subsequent performance more readily verifiable. The causal chain includes complementary investments in productive facilities, skills, standards and commercial trust. This is consistent with evidence that digital technologies can improve information integration while remaining constrained by technical and organisational barriers in Saudi heavy construction (Taha et al., 2025). It also accords with broader supply-chain research connecting digital maturity with resilience while cautioning against equating adoption with an invariant result across contexts (Zouari et al., 2021).

From an institutional perspective, the proposed system makes policy intent measurable at procurement interfaces. Tender requirements communicate the preferences and obligations governing market access; supplier onboarding determines who can participate; award models translate objectives into decisions; and contract records establish what was actually delivered. Misalignment at any point can produce apparent compliance without material economic change. A digital system should make these contradictions visible rather than hide them behind a single score. In this sense, the technology's most defensible contribution is not maximum automation but more accountable discretionary judgement (Kola and Słodyński, 2025; Kim and Kim, 2024).

From a dynamic-capability perspective, supplier development is the mechanism that converts repeated project demand into future competitive supply. Forecast visibility can help firms invest in machinery or certification; transparent performance feedback can support improvement; better procurement data can permit informed reallocation of packages. However, long-term capability formation needs more evidence than order placement. For instance, a supplier might win a domestic-content-weighted tender yet remain dependent on imported inputs and foreign engineering. The developmental question is whether the firm's domestic productive contribution grows and persists after the tender incentive disappears. Future research should therefore measure capability trajectories rather than only one-off local-spend outcomes (Alghamdi et al., 2025; Alquraish, 2025).

There is also a competition-policy tension. Preference instruments can help new entrants overcome accumulated disadvantages, but poorly designed digital ranking systems may intensify concentration around firms with the largest compliance departments and cleanest historical data. An apparently neutral requirement for elaborate digital evidence may be difficult for the very suppliers that localisation seeks to support. Proportionate documentation, transparent appeals, common data standards and technical assistance are needed to reconcile auditability with access. Evidence from materials procurement among smaller contractors reinforces the importance of cash-flow conditions and transaction burden (Donyavi et al., 2024; Addy et al., 2022).

The paper also distinguishes the traceability promise of distributed records from economic measurement validity. Blockchain can help establish when a document was submitted and whether later edits occurred; it cannot independently determine where fabrication took place or whether the domestic value was additional. Field verification and credible certification remain indispensable. The relevant literature contains convincing technical demonstrations of tender security, subcontractor transparency and material traceability, but these do not amount to measured localisation benefits under Saudi procurement programmes (Ahmadisheykhsarmast et al., 2023; Elghaish et al., 2023; Gong et al., 2024). The architecture accordingly allows different technology choices as long as data provenance and decision rights are controlled.

Transferability requires caution. Evidence on data sharing in Saudi retailing explains inter-organisational trust and technology costs, but retailer inventory dynamics differ from unique project procurement (Alyafie, 2025). Research on solar localisation helps distinguish nominal thresholds and industrial readiness, yet product certification and import structures differ across equipment categories (Alghamdi et al., 2025). Evidence from external construction markets provides technological feasibility and supplier-assessment methods, not estimates of local benefits in Saudi Arabia (Yevu et al., 2021; Masoom et al., 2025). Rather than smoothing over these differences, the proposed model identifies the context-sensitive parameters that must be established during each application.

Implications for policy and practice:-

For procurement authorities and major owners, the central recommendation is to align local-content definitions with the records contractors can realistically provide. A documented taxonomy of eligible expenditure, product origin, supplier activity and assurance standards would reduce inconsistent reporting between tenders. Governance should specify which rules are non-negotiable and which objectives can be balanced. An accountable owner of the metric

must approve data dictionaries, changes to eligibility logic and corrections to reported figures. Authorities may also use aggregated, suitably protected demand forecasts to help domestic firms identify commercially credible investment opportunities (Abuhussain, 2025; Kola and Söldyński, 2025).

For developers and project delivery teams, localisation should begin during design and packaging rather than at the final bid evaluation. Early engagement can reveal which specifications are unnecessarily exclusionary, which domestic products can meet performance standards and where split awards would introduce excessive interface risk. BIM-linked quantity planning can improve timing and consistency, while structured supplier screening can identify qualification gaps before tender release. Post-award monitoring should reconcile commitments with receipts and approved economic-attribution evidence; claims that cannot be validated should be reported as unresolved, not silently counted (Kalantari et al., 2024; Yevu et al., 2022).

Finally, procurement performance assessment should use a balanced dashboard. Domestic value attributed, realised price, programme reliability, supplier competition, quality outcomes and evidence completeness each capture a different facet of value. A higher domestic share accompanied by severe delay or unsupported attribution cannot be judged superior without explicit, authorised trade-off rules. Nor does reduced procurement administration cost prove incremental Saudi economic growth. Transparent reporting on these distinctions is necessary if digital transformation and local-content policy are to reinforce one another rather than obscure their respective contributions (Taha et al., 2025; Jiang and Gao, 2025).

Limitations and future research agenda:-

The principal limitation is the available evidence base. This integrative review uses a focused thirty-publication corpus rather than an exhaustive search of subscription bibliographic databases; therefore, omitted relevant studies are possible. Several cited investigations examine contexts outside Saudi construction. The proposed architecture is conceptual and the numerical demonstration synthetic. It is not an algorithm tested against contractor procurement files, and no causal estimates of employment, cost savings or industrial diversification are claimed. The model also cannot substitute for the detailed accounting and tender mechanisms applicable to an individual Saudi project at the time of procurement.

A rigorous next study could combine multi-project transaction data with interviews from owners, domestic manufacturers and subcontractors. It should compare verified domestic value with self-reported local purchasing, record audit exception rates and measure lead-time, quality and cost impacts at the work-package level. A prospective pilot could introduce standardised supplier records on selected packages while matching comparison packages on material category and risk. Researchers should predefine outcome indicators, account for concurrent changes in market demand and evaluate whether improved scores reflect real domestic production or reclassification of expenditure.

Future analytical work should incorporate demand uncertainty, supplier learning curves and the possibility that capacity investments have multi-project benefits. Methods such as robust optimisation and scenario analysis could investigate how the preferred supplier portfolio changes when deliveries or verified local-value shares differ from bid estimates. Longer-term evaluation should address skills transfer, sustained production capability, manufacturing investment and unintended market concentration. Such research would move beyond the software-adoption question to a stronger test of whether digitally governed procurement supports domestic industrial development at acceptable project cost and risk (Alquraish, 2025; Al Azmi et al., 2022).

Conclusion:-

Technology-enabled local-content optimisation in construction is best understood as an evidence-and-decision problem embedded within an industrial development policy. Saudi Vision 2030 creates a compelling reason to link procurement demand with domestic manufacturing, services and employment, but neither domestic registration nor digitised expenditure alone establishes the extent of local value created. An effective procurement architecture must screen mandatory requirements, assess supplier readiness, disclose trade-offs, attribute domestic contribution consistently and learn from delivery evidence.

The review develops an integrated six-stage model that connects project demand to supplier intelligence, compliant bid evaluation, contract commitments, verified economic attribution and subsequent capability improvement. Its hypothetical numerical illustration shows that additional supported domestic contribution may come with varying price and delivery implications, and that confidence in the supporting evidence is integral to decision quality. The central conclusion is conditional: digital tools can improve transparency and discipline in construction localisation

when rules, organisational capabilities and independent assurance support them. Establishing whether they actually increase domestic value added while protecting project performance remains a task for carefully designed empirical studies.

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