Published by :
https://www.ijert.org/
An International Peer-Reviewed Journal

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 14, Issue 12, UCBO - 2026

A Study on Operations, Material Procurement, and Resource Utilization in Construction Site Management at Shri Krupasindhu Infra Projects

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Abstract **- Construction operations and supply chain management govern how engineering designs, materials, and specialized resources are transformed into civil infrastructure, where workflow interdependencies make projects highly susceptible to compounding delays. Grounded in lean construction theory and construction supply chain frameworks [1]–[3], this study examines site-level execution, material logistics, and resource productivity at Shri Krupasindhu Infra Projects in Igatpuri, Nashik. It addresses four objectives: understanding daily operational activities and site coordination, evaluating procurement and supply chain practices, examining inventory storage and material handling, and analyzing manpower and machinery utilization to isolate bottlenecks. Using an applied, descriptive case-study method during an on-the-job placement from 20 May to 31 August 2026, primary data were gathered through field observation of active civil fronts, workflow tracking, and structured discussions with site engineers, storekeepers, and vendors, supplemented by company schedules, client work orders, and daily progress logs. The findings show that a forward-planning window of about fifteen days and strong vendor relationships provide resilience against major supply disruptions, yet productivity is constrained by informal communication, poor material staging, and premature resource mobilization. Unprotected ground storage of structural steel and formwork plywood causes moisture damage, warping, and double handling, while the absence of formal work-front readiness checks leaves skilled labor and equipment such as excavators idle; monsoon waterlogging intensifies these disruptions. The study concludes that efficiency requires a shift from reactive, informal problem-solving to structured lean management, through readiness checklists, bin cards and daily goods receipt notes (GRN) on elevated dunnage, vendor blanket agreements with delivery tracking, and preventive equipment maintenance with visual progress reporting.**

Index Terms**—Construction operations, supply chain management, material handling, resource utilization, lean construction.**

I. INTRODUCTION

Operations and supply chain management (OSCM) forms the functional backbone of the construction and infrastructure sector, governing how designs and raw materials are translated into finished physical structures [5]. Unlike repetitive shop-floor manufacturing, civil construction is project-based, with transient sites, shifting work-front conditions, and complex task dependencies. Effective site-level operations management requires synchronized planning, allocation, and control of physical inputs, specialized equipment, and diverse labor trades. Construction supply chain management, in turn, coordinates the inbound procurement, transit, storage, and issuance of critical structural materials such as steel, cement, aggregates, and shuttering plywood [2]. Because civil works progress through rigid sequential milestones (excavation, formwork, reinforcement, and concreting), a delay or shortfall in a single input can trigger compound downtime across interconnected activities, escalating project durations and overhead costs.

Shri Krupasindhu Infra Projects, founded in 2022 in Igatpuri, Nashik, Maharashtra, executes civil engineering and infrastructure contracts that include highway drainage systems, retaining structures, gabion walls, and general building works. Managing contracts for primary clients and major developers (such as Ashoka Buildcon, Lodha Group, and Unico Infracon) demands rigorous resource coordination and adaptive logistics. Under competitive contracting conditions, profit margins depend heavily on controlling material wastage, coordinating reliable local vendor networks, maintaining forward planning cycles of approximately fifteen days, and managing multi-skilled labor groups alongside heavy earthmoving and concrete machinery.

This study, titled “A Study of Operations and Supply Chain Management in Construction Site Operations,” investigates the practical integration of OSCM principles on active civil project sites. By analyzing day-to-day work sequencing, material procurement, inventory preservation, and equipment utilization, it identifies systemic bottlenecks such as weather disruptions, input price volatility, manual inventory record-keeping, and equipment idling. Bridging theoretical supply chain concepts with the realities of contracting, the paper evaluates current practices at the firm and proposes actionable, scalable strategies that enhance material availability, minimize handling losses, and improve site-level productivity.

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II. THEORETICAL BACKGROUND

OSCM in civil engineering relies on managing interdependent process flows. Production theory models construction not merely as discrete conversions but as a continuous sequence of activities prone to variability [1]. Building on this, Vrijhoef and Koskela [2] describe construction supply chains as linking external vendors, logistics networks, on-site storage, and active work fronts. Effective coordination ensures that structural materials such as aggregates, steel, and shuttering timber arrive in step with work-front readiness, eliminating workflow delays and emergency spot purchasing.

Lean construction principles [3] prioritize constraint identification and waste minimization across key categories: transit delays, material double handling, scrap generation, and labor or equipment idling. To manage physical inputs without spatial congestion on site, inventory control operates through a rolling-horizon framework. This mirrors the advance-planning window observed at Shri Krupasindhu Infra Projects, which maintains essential material buffers while avoiding excess stock accumulation.

Robust vendor relationship management (VRM) further secures dependable lead times and stable pricing in volatile commodity markets, reinforcing the strategic sourcing models described by Chopra and Meindl [4]. Finally, contractual risk-sharing mechanisms [6] distribute liabilities between main contractors and project owners. Provisions enabling client support during material or labor shortages mitigate unforeseen disruptions and maintain milestone progress across sequential civil tasks.

III. MATERIALS AND METHODS

A. Objectives of the Study

This study evaluates site-level execution and supply-chain logistics at Shri Krupasindhu Infra Projects (Igatpuri, Nashik) around four objectives:

O1: To understand the day-to-day operational activities carried out at the construction site.

O2: To study procurement and supply-chain management of construction materials.

O3: To examine inventory, storage, and material-handling practices.

O4: To understand manpower, machinery, and resource utilization and identify the operational and supply-chain challenges affecting site productivity.

B. Research Design and Data Collection

An applied, descriptive, project-based case-study design was adopted to capture operational practices in a real-world civil contracting environment. Primary data were collected during an on-the-job training (OJT) placement from 20 May 2026 to 31 August 2026, through continuous field observation of active work fronts, sequential task execution, physical material transits, and daily resource deployment. These observations were supplemented by structured and informal technical discussions with site supervisors, project engineers, store managers, and material vendors. Secondary data came from site schedules, client work orders, daily progress reports, OJT logbooks, and established construction operations literature.

C. Operational Framework and Analytical Approach

The analysis followed a five-stage investigative flow: contextualizing the operating environment, mapping procurement logistics, evaluating storage and inventory controls, diagnosing resource bottlenecks, and formulating practical site enhancements. Field practices were assessed using lean construction principles [3], specifically constraint identification and the elimination of operational waste such as material double handling, transit waiting, and equipment idling. Critical-path activities were scrutinized across supplier delivery reliability, storage and preservation methods, and manpower-machinery coordination. Site vulnerability to external constraints, such as monsoon weather, was also documented systematically to support actionable efficiency measures.

V. DATA ANALYSIS AND DISCUSSION

Objective 1: Day-to-Day Operational Activities and Site Coordination

Table I summarizes the workflow elements and coordination mechanisms observed on site.

TABLE I OPERATIONAL WORKFLOW TAXONOMY AND COORDINATION MECHANISMS

Element	Protocol and Site Execution	Operational Impact
Work-front preparation	*Horizon:* pre-activity physical verification. *Execution:* clearing, layout checking, and structural clearance before resource staging.	Prevents premature deployment of labour and equipment to unready zones; mitigates waiting waste.
Activity sequencing	*Horizon:* sequential milestone alignment. *Execution:* excavation, shuttering, reinforcement, then concrete pouring.	Ensures continuous task handovers; prevents line blockage across dependent civil activities.
Daily work scheduling	*Horizon:* daily morning allocation meeting. *Execution:* priorities adjusted to preceding task status, weather, and site conditions.	Gives tactical flexibility to absorb site disruptions without derailing long-term milestones.
Information flow	*Horizon:* on-site verbal and register tracking. *Execution:* daily targets, drawing specifications, and task revisions passed across supervisors.	Minimizes communication gaps between project engineers, sub-contractors, and machine operators.
Resource dispatch	*Horizon:* real-time dynamic reallocation.	Balances site workload, avoids idle work fronts, and

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International Journal of Engineering Research & Technology (IJERT)
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	Execution: gangs and machinery shifted among drainage, retaining-wall, and road fronts.	ensures high asset utilization.

The analysis shows that execution capability in civil infrastructure relies on dynamic operational coordination rather than rigid, static scheduling. Because site operations progress through tightly coupled, predecessor-dependent activities, such as ground excavation preceding shuttering and reinforcement placement, any breakdown in site-readiness checks triggers compounding downtime. Formal work-front readiness checks, which verify space, drawings, and clearances before dispatch, prevent idle waiting and unproductive equipment setups. Structured daily morning scheduling reviews, in turn, let site engineers realign workforce gangs across active fronts such as retaining walls and drainage channels. This tactical flexibility absorbs weather variations, preceding-trade handovers, and emergent site constraints, preserving execution continuity.

B. Objective 2: Procurement and Supply-Chain Management of Construction Materials

Table II sets out the sourcing channels, planning windows, and supply-chain considerations by material category.

TABLE II

Material Sourcing Matrix, Lead Times, and Planning Policies

Material	Usage, Sourcing, and Planning Window	Critical Supply-Chain Consideration
Plywood	*Usage:* shuttering and formwork. *Sourcing:* established long-term vendor partnerships. *Window:* ~15-day rolling advance plan.	Long-term partnerships ensure competitive unit pricing and guaranteed stock during demand surges.
Steel and channels	*Usage:* reinforcement, drainage, and road structures. *Sourcing:* specification-based scheduled procurement. *Window:* strict advance order cycle.	High-value critical input; delivery delays halt primary structural works and client milestone certifications.
Binding wire and consumables	*Usage:* tying rebar, formwork accessories, site consumables. *Sourcing:* localized flexible purchasing. *Window:* as-needed / spot requisition.	Low capital value allows flexible requisitioning, though minor stockouts can stall rebar fixing.
Inbound logistics	*Usage:* fleet coordination from vendor yards to site. *Sourcing:* vendor-arranged direct-to-site transit. *Window:* synchronized with site storage capacity.	Vulnerable to road constraints, transit delays, and monsoon access problems in the Igatpuri region.

Procurement at the site follows a hybrid supply-chain model that pairs forward planning with relational contracting. High-impact structural materials, notably reinforcement steel and channels, demand strict advance scheduling tied to engineering specifications, because stockouts immediately arrest downstream civil activities. Formwork plywood, by contrast, is procured through established, preferred vendor relationships that give the firm price stability and priority dispatch during regional shortages [4]. Consumables and binding wire are bought through agile, localized spot purchases to minimize inventory capital lock-up. Inbound logistics nevertheless remain vulnerable to transit bottlenecks and communication gaps about schedule changes. Formalized purchase-tracking registers and standardized lead-time benchmarks are therefore essential to keep delivery slippages from interrupting critical structural activities.

C. Objective 3: Inventory Control, Storage, and Material-Handling Practices

Table III compares on-site storage practices, handling risks, and the lean mitigations proposed.

TABLE III

SITE STORAGE CONDITIONS, HANDLING RISKS, AND LEAN MITIGATIONS

Stream	Storage Practice and Handling Risk	Proposed Lean Mitigation
Plywood (formwork)	*Storage:* staged beside active work fronts; manual shifting and stacking. *Risk:* ground moisture, warping from improper stacking, edge damage.	Elevated wooden platform storage, water-resistant tarping, and standardized de-shuttering handling protocols.

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International Journal of Engineering Research & Technology (IJERT)
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Structural steel and channels	*Storage:* designated yard; manual unloading and sorting. *Risk:* monsoon corrosion; unsegregated stacks delay retrieval.	Raised timber dunnage, dimensional tagging, and staging close to rebar bending yards.
Consumables and hardware	*Storage:* enclosed temporary store; issuance by storekeeper. *Risk:* misplacement, unregistered consumption, stock-count errors.	Daily goods receipt note (GRN) and a physical bin-card issuance log.
Work-front movement	*Storage:* multi-point transit across site terrain; manual carrying and small-equipment hauling. *Risk:* double handling, fatigue, dropping, material loss.	Yard layout placing bulky materials along the access radius of heavy lifting machinery.

Spatial layout and preservation protocols directly govern operational efficiency and material cost performance. Because construction sites are transient and exposed, storing bulky materials such as formwork plywood and structural steel on unprepared bare ground exposes them to weather-induced degradation, including moisture warping, rotting, and surface oxidation in wet weather. Arbitrary offloading far from active work fronts also causes excessive double handling and transit damage, consuming laborer hours and inflating scrap rates. Organized storage yards with raised wooden dunnage, protective tarpaulins, and segregated dimension tagging substantially reduce material damage, and a yard layout that shortens transit distances to work fronts removes non-value-adding handling, protecting the contractor's material margins.

D. Objective 4: Manpower, Machinery, and Resource Utilization Challenges

Table IV lists the resource utilization bottlenecks, their root causes, and the countermeasures identified.

TABLE IV
RESOURCE UTILIZATION BOTTLENECKS, ROOT CAUSES, AND COUNTERMEASURES

Resource Area	Bottleneck and Root Cause	Lean Countermeasure and Tool
Site manpower	*Requirement:* gangs by skill trade (carpenters, rebar fixers, masons). *Bottleneck:* idle labour awaiting materials, drawings, or front clearance. *Cause:* misaligned trade handovers; delayed materials.	Last Planner-style daily trade handover plan and work-front readiness checks.
Machinery and equipment	*Requirement:* heavy plant (excavators, rollers, mixers) scheduled by activity. *Bottleneck:* unplanned idle time and breakdowns. *Cause:* preceding activity delays, poor access, reactive maintenance.	Preventive maintenance schedules, equipment logbooks, and synchronized fueling routines.
Weather and terrain	*Requirement:* outdoor earthworks and concrete pouring. *Bottleneck:* weather shutdowns and waterlogged fronts. *Cause:* monsoon showers in the Igatpuri/Western Ghats belt.	Weather-contingent scheduling, proactive drainage-ditch maintenance, and covered prefabrication yards.
Information and tracking	*Requirement:* schedule updates and milestone coordination. *Bottleneck:* communication gaps causing misallocated labor or wrong dispatches. *Cause:* informal verbal communication, no central documentation.	Visual progress whiteboards, standardized daily progress reports (DPR), and digital messaging groups.

Labor and heavy-machinery utilization is heavily constrained by workflow synchronization and environmental vulnerability.

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Excavators, soil compactors, and concrete mixers frequently idle when preceding structural clearances, material deliveries, or site access routes fail to materialize on time. Specialized gangs, such as formwork carpenters and rebar benders, lose productivity when shifted reactively between work fronts because of missing drawings or delayed material issues. In the high-rainfall Igatpuri terrain, these challenges are compounded by monsoon interruptions that waterlog excavation fronts. Mitigation requires structured daily progress tracking, preventive equipment servicing schedules, and rolling 15-day look-ahead plans that isolate bottlenecks before physical resources are mobilized.

V. FINDINGS OF THE STUDY

Construction site productivity at Shri Krupasindhu Infra Projects is fundamentally governed by the synchronization of material deliveries, work-front readiness, and trade sequencing; a deficiency in any single input triggers compounding delays across dependent civil activities. The company's forward-planning window of approximately fifteen days serves as an effective rolling buffer against material stockouts and labor shortages, but its effectiveness is constrained by informal communication and manual record-keeping.

On procurement, long-term vendor partnerships provide cost competitiveness and delivery reliability for high-volume inputs such as shuttering plywood, whereas structural steel and channels remain vulnerable to supplier lead times and regional transit disruptions. On storage and handling, staging formwork timber and rebar on unprotected ground increases deterioration, warping, and surface oxidation, and poor spatial layout leads to double handling, transit damage, and wastage.

On resource utilization, heavy plant such as excavators and concrete mixers, and skilled labor gangs, frequently idle because of misaligned trade handovers, missing technical details, and abrupt schedule adjustments. Severe monsoon rainfall and waterlogging in the Igatpuri region compound these bottlenecks. Overall, while flexible, reactive coordination keeps projects moving, standardized work-front readiness checklists, formal daily inventory registers, and structured preventive equipment maintenance are vital to eliminating avoidable waste and safeguarding project margins.

VI. CONCLUSIONS

Successful civil construction execution at Shri Krupasindhu Infra Projects depends on the seamless integration of operations management and supply chain logistics. Civil works are highly interdependent systems in which material availability, supplier reliability, equipment utilization, and labor coordination interact continuously. The current fifteen-day forward-planning horizon and relational vendor networks provide resilience against supply disruptions, but reliance on informal coordination leaves projects exposed to communication gaps, transit delays, and double-handling losses. Site productivity is further constrained by spatial storage limits, weather-induced disruptions, and avoidable machinery and labor idle time arising from premature deployment to unready work fronts.

Achieving operational excellence and sustaining margins as the firm scales into larger infrastructure projects requires moving from intuitive, reactive problem-solving toward formalized, lean management systems. Standardized work-front readiness checklists, daily inventory and bin-card tracking, preventive machinery maintenance, and visual schedule boards will enhance site visibility, eliminate non-value-adding waste, and support predictable, on-time delivery of infrastructure milestones.

VII. SUGGESTIONS FOR IMPLEMENTATION

Shri Krupasindhu Infra Projects should implement the following measures across key stakeholders:

1) *Site Engineers and Supervisors:* Introduce standardized work-front readiness checklists that verify drawing clearances, materials, and tools before labor and heavy equipment are deployed, eliminating avoidable waiting waste and trade-handover conflicts.
2) *Storekeepers and Warehouse Staff:* Replace informal tracking with daily goods receipt notes (GRN), bin cards, and designated raised dunnage platforms with protective tarpaulins, to eliminate double handling and moisture damage to steel and plywood.
3) *Procurement and Key Vendors:* Formalize long-term blanket agreements and digital dispatch tracking for critical steel and shuttering materials, securing lead-time predictability and price stability during demand spikes.
4) *Project Management and Machine Operators:* Implement preventive maintenance schedules, daily machinery logbooks, and mobile-based visual daily progress reporting (DPR) to minimize unplanned breakdowns and improve cross-functional communication.

VIII. STAKEHOLDER IMPLICATIONS

The operational insights of this study have direct implications for the primary project stakeholders:

- *Site engineers and supervisors:* Formal work-front readiness checks and structured morning task allocation eliminate trade-handover delays, prevent premature labor mobilization, and stabilize daily milestone achievement.
- *Storekeepers and inventory managers:* Moving from memory-based tracking to bin cards and raised, covered storage reduces material degradation (such as rusted rebar and warped plywood), curbs scrap, and yields accurate stock data.
- *Procurement teams and suppliers:* Structured 15-day look-ahead schedules with delivery tracking give suppliers reliable demand visibility, mitigating transit lead-time risk and emergency spot purchasing.
- *Project leadership and machine operators:* Equipment logbooks and preventive maintenance optimize plant uptime, cut idle fuel burn, and protect profitability against breakdowns and seasonal weather disruptions.

IX. FUTURE SCOPE OF THE STUDY

Future investigations can build on this case study in several directions:

- *Longitudinal and multi-site benchmarking:* Extending the research beyond a single placement to diverse terrains and larger EPC contract types would test the generalizability of the findings and reveal regional supply-chain dynamics.
- *Quantitative waste and OEE modeling:* Statistical modeling of material scrap rates (e.g., rebar cut-off percentages) and overall equipment effectiveness (OEE) of earthmoving and concreting machinery under varying weather regimes.

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International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 14, Issue 12, UCBO - 2026

- *Digital technologies and automation:* Studying cloud-based enterprise systems, building information modeling (BIM) 4D scheduling, and IoT-enabled asset and material tracking as replacements for manual site registers.
- *Green and sustainable SCM:* Analyzing the life-cycle carbon footprint of construction logistics and circular-economy practices such as formwork recycling and optimized reverse logistics.

ACKNOWLEDGMENT

The author expresses sincere gratitude to the management, site engineers, and project teams at Shri Krupasindhu Infra Projects, and to the mentors at Lear Corporation Limited, for their guidance, support, and practical insights throughout the summer internship, and to the faculty and leadership of the author's institution for the academic foundation and encouragement that made this study possible.

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