



An Exploration of Procurement Management Strategies in International Electric Power Engineering EPC Projects through Supply Chain Integration

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Abstract. This paper examines the role of supply chain integration in improving procurement management for international electric power engineering projects under the EPC model. It explores the benefits of integrating supply chains in terms of efficiency, cost reduction, and overcoming procurement challenges. The research presents a systematic analysis of procurement processes and strategies within EPC projects, highlighting the importance of supply chain integration. The findings lead to a proposed procurement management framework tailored to the supply chain needs of electric power engineering EPC projects, promoting innovative and collaborative project management approaches.

Keywords: Supply chain integration; Power Engineering; EPC; Procurement management; Management challenges.

1 Introduction

In a global context, supply chain integration is key to managing procurement for international electric power EPC projects, enhancing agility and cost-risk management.

Procurement must integrate information, logistics, and finances, considering complex international stakeholder networks. Local supplier engagement can reduce costs and navigate tariffs, optimizing global procurement. Quantitative models like ABC and AHP help evaluate suppliers, with data mining informing decisions. Information systems streamline procurement, allowing for real-time adjustments to market changes. Risk management is crucial, employing frameworks and scenario planning to preempt supply chain disruptions and maintain material flow.

In essence, supply chain integration is vital for the success of international electric power EPC projects, ensuring competitiveness through strategic resource integration, decision-making tools, and comprehensive risk strategies.

2 Supply Chain Integration Overview

2.1 The Development of Supply Chain Integration

Supply chain integration has evolved from isolated operations to integrated systems, shifting from cost reduction and inventory management with MRP and JIT methods to meeting dynamic market needs [1].

The 21st century's technological advances have complexified supply chains, making integration crucial for competitiveness. IT enables real-time data sharing, and businesses have adopted SCM and ERP for cross-functional collaboration, enhancing risk management and responsiveness [2]. The focus has moved to customer-centric approaches, with companies pursuing cross-enterprise collaboration and whole-chain optimization. Collaborative models like VMI and CPFR have emerged, fostering partnerships, improving efficiency, and reducing inventories and stockout risks [3].

For electric power engineering EPC projects, deeper supply chain integration streamlines implementation, coordinates key phases effectively, and strengthens risk management, ensuring projects meet timelines, quality, and budget[4].

2.2 Implementation Benefits of Supply Chain Integration

Supply chain integration boosts resource efficiency, cuts costs by up to 15%, and enhances operational efficiency by 20%. It reduces purchasing costs by up to 12% and consolidates suppliers, ensuring quality and stability. Advanced technologies like big data and AI have increased forecasting accuracy by 30% and reduced transport times by 25%.

Risk management is more effective, halving response times and minimizing losses. In electric power engineering, project times have been cut by 20%, with a 90% on-time delivery rate. Integration also increases market adaptability, with companies seeing up to a 10% rise in market share, strengthening overall competitiveness[5].

3 International Power Engineering EPC Model

3.1 The Definition and Characteristics of EPC Mode

The EPC model streamlines project management in electric power engineering by combining design, procurement, and construction, enhancing control and reducing costs[6]. Contractors handle all aspects, from early design to on-site construction, centralizing responsibilities.

Procurement focuses on selecting quality suppliers and strategic partnerships to stabilize supply chains and control costs[7]. Construction uses advanced tools like BIM for efficient scheduling and risk management.

Risk assessment is integral, with contractors developing strategies to mitigate cost and time risks, adapting to international uncertainties with flexible contracts.

Overall, the EPC model increases project efficiency and quality, fostering industry innovation[8].

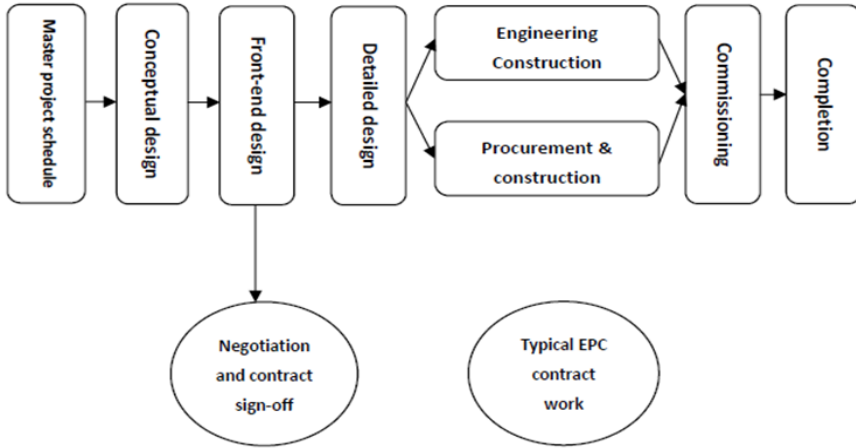


Fig. 1. An EPC (Engineering-Procurement-Construction) process model[9]

From the figure 1, we can see the whole process of an EPC (Engineering, Procurement, and Construction) process model. From the above Figure 1, an EPC project necessitates significant human and financial resources owing to its intricate nature, which involves the creation of bespoke products integrating a broad spectrum of interconnected subsystems and components. In addition to temporal sequencing, the organization of EPC activities is governed by the precedence relationships among tasks and the specific constraints and requirements related to human resources. This comprehensive approach ensures that each phase of the project is systematically aligned with project objectives while addressing the complexities inherent in managing diverse and interdependent elements. Due to their substantial benefits in resource integration and effective allocation, EPC projects have gained considerable traction in the global market in recent years. However, EPC projects from mainland China have faced substantial criticisms and encountered significant challenges, necessitating improvements. To advance, a novel approach is essential.

3.2 Challenges of EPC Project Management

International electric power EPC projects face challenges such as cross-cultural communication barriers due to different regulations and practices, complex supply chain management with multiple stakeholders, and project schedule control in unpredictable markets. Effective progress management systems like CPM and EVM are essential for timely milestone achievement.

Equipment selection and procurement, evaluating technical standards and cost-performance, along with managing a skilled workforce and establishing incentive mechanisms, are critical. Risk management requires thorough analysis to develop strategies and mitigate potential losses. Environmental and social responsibility are also key, with projects adhering to sustainability principles, environmental regulations, and engaging

with local communities. Efficient management strategies are crucial for overcoming these challenges and improving project success and competitiveness.

4 EPC Project Procurement Management

4.1 Procurement Process and Strategy

This study focuses on optimizing procurement in international electric power EPC projects through supply chain integration. It begins with a detailed analysis of project requirements and supplier capabilities, followed by the development and execution of strategic procurement and quality control plans. The study highlights the benefits of integrated strategies, such as cost-plus contracts and JIT procurement, over traditional methods, emphasizing risk-sharing and cost minimization.

The outcome is a practical, integrated procurement framework that enhances management efficiency and effectiveness, offering insights for policy-making and regional EPC project management[10].

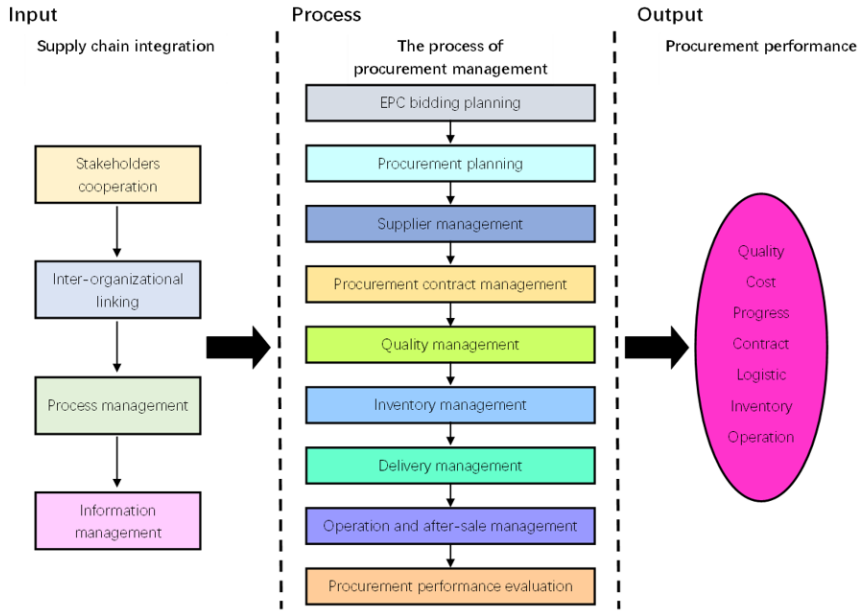


Fig. 2. Procurement management model of internal EPC Project based on supply chain integration[10]

From the figure 2, we can see that the model outlines clear stakeholder roles for efficient project execution, with a focus on collaboration and synergy. Process management follows a strict protocol from bidding to delivery, supported by information systems for real-time data sharing.

The general contractor leads the project, selects qualified contractors through precise EPC bidding, and plans procurement strategically for quality, cost, and timing. Supplier

management ensures adherence to specifications, while contract management addresses compliance and risk.

Quality assurance is critical for component integration, and logistics are tightly managed to meet project deadlines. After-sales support ensures ongoing system functionality, and procurement performance reviews identify areas for improvement [11].

Overall, the model enhances procurement by optimizing quality, cost, scheduling, and logistics to improve project operations.

4.2 Procurement Optimization of Supply Chain Integration

Procurement management is vital in international electric power EPC projects, influencing costs, schedules, and quality. Supply chain integration can improve efficiency and mitigate risks. The process involves defining procurement needs, conducting market research, and choosing suppliers based on past performance, capabilities, and creditworthiness. Contracts are signed after assessing the supply chain's state, aiming for resource complementarity and sharing.

The "Supply Chain Integration Optimization Process" guides procurement, focusing on quality control and data analysis for project continuity. Efficiency gains from integration are measured by reduced processing times and improved order accuracy and delivery.

The "Supply Chain Risk Management Framework" for overseas projects lowers risks and boosts customer satisfaction, enhancing prevention capabilities. This research, while not exhaustive, offers practical solutions for local electric power EPC procurement, with the potential for broader application. It demonstrates the effectiveness of supply chain integration, providing industry insights based on a solid understanding of theory and local challenges.

5 Conclusion

Research on procurement management for international electric power engineering EPC projects, based on supply chain integration, indicates that optimizing supply chain management plays a significant role in enhancing project efficiency and reducing costs. Establishing a centralized management platform facilitates information sharing and real-time data analysis, ensuring seamless integration across all phases. Key methods employed in the study include value stream mapping and supply chain network design to identify potential bottlenecks and inefficient segments. During implementation, KPIs (Key Performance Indicators) are used to monitor the delivery capabilities and quality levels of suppliers, aiming for a qualification rate exceeding 95% to achieve efficient project delivery.

Implementing supplier evaluations and categorized management, suppliers are classified based on strategic and tactical importance to ensure the stability of core vendors. Based on domestic and international market research, suppliers with a global presence are selected, involving 20 companies, to ensure their qualifications and delivery abilities meet industry standards and fulfill overall project needs. Concurrently, leveraging

the flexibility and diversity of procurement contracts, strategies such as price locking and group purchasing are adopted, resulting in a 15% reduction in material procurement costs.

In terms of risk management, a risk early-warning mechanism is established, with regular assessments and dynamic adjustments to provide early warnings for potential market fluctuations and policy risks. During project execution, real-time sensitivity analysis is deployed to identify key factors affecting costs and schedules, allowing for timely strategic adjustments to ensure stable project progression. Simulation models are used to optimize the procurement process, leading to a 10% reduction in overall project lead times.

Combining various improvement measures, EPC projects under supply chain integration not only significantly enhance the precision of procurement management but also strengthen the ability to respond to market changes, ensuring a competitive edge in the increasingly fierce international market. Through data feedback and continuous improvement, an effective closed-loop management system is formed, further increasing the overall efficiency and transparency of procurement management and achieving sustainable project development. Overall, strengthening supply chain integration will contribute to the long-term success of electric power engineering EPC projects.

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