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An Empirical Study on the Impact of Outsourcing and Governance Models on Cost and Quality Control in the Steel Manufacturing Sector with reference to Bhilai Steel Plant, Chhattisgarh

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Abstract

The study examines the impact of outsourcing practices and governance models on cost and quality control in the steel manufacturing sector, with specific reference to Bhilai Steel Plant in Chhattisgarh, India. The study investigates how strategically aligned outsourcing and structured governance mechanisms influence operational efficiency and product quality in manufacturing and maintenance functions. A structured questionnaire was developed and validated through expert reviews and statistical reliability measures, then distributed to 430 executive-level employees. Using Structural Equation Modeling (SEM) via Smart PLS-4, the research analyzes the relationships between four key latent constructs: outsourcing practices, governance models, cost control, and quality control. The findings reveal that outsourcing practices significantly enhance both cost efficiency and quality outcomes when aligned with organizational strategies, while governance models—characterized by contractual clarity, performance monitoring, and trust-based coordination—exert a strong positive influence on both cost control and quality assurance in outsourced functions. The research contributes to existing literature by providing empirical evidence of these relationships in a large-scale, capital-intensive industry. The implications suggest that organizations can achieve better operational outcomes by adopting a dual focus on strategic outsourcing and robust governance frameworks. These insights are particularly relevant for policymakers, plant managers, and operations strategists in the manufacturing domain.

Keywords: Outsourcing Practices, Governance Models, Cost Control, Quality Control, Steel Manufacturing, , SEM, Smart PLS-4.

Introduction

The steel manufacturing industry plays a critical role in driving economic development, infrastructure growth, and industrial competitiveness. In recent decades, the sector has increasingly adopted outsourcing as a strategic tool to improve operational efficiency, reduce costs, and focus on core competencies. However, the success of outsourcing in heavy industries like steel hinges on the effectiveness of governance models that oversee and regulate outsourced functions. Bhilai Steel Plant (BSP), a flagship unit of the Steel Authority of India Limited (SAIL), presents a significant case for examining how outsourcing of manufacturing and maintenance activities influences cost control and quality assurance. This study aims to empirically investigate the relationship between outsourcing practices and governance mechanisms and their impact on cost efficiency and product/service quality at BSP. The research seeks to contribute to a deeper understanding of how public-sector steel plants

can strike a balance between operational flexibility and performance accountability through strategic outsourcing and robust governance frameworks.

The research stems from the growing reliance on outsourcing in the steel manufacturing sector, particularly in large public-sector enterprises like Bhilai Steel Plant (BSP). As global competition intensifies and profit margins tighten, strategic outsourcing of manufacturing and maintenance functions is often viewed as a viable solution for enhancing cost-effectiveness and operational flexibility. However, in capital-intensive industries such as steel, outsourcing decisions without proper governance can lead to unintended consequences, including quality lapses, increased transaction costs, and accountability issues. Despite the criticality of these concerns, there is a noticeable lack of empirical studies examining how governance models influence the effectiveness of outsourcing in achieving desired cost and quality outcomes. Given BSP's scale, complexity, and importance in India's steel production ecosystem, it serves as an ideal case for in-depth analysis. This research is therefore essential to bridge the gap between theory and practice, offering actionable insights for policymakers, plant managers, and industry stakeholders aiming to optimize outsourcing strategies without compromising on quality or control.

Outsourcing in the steel manufacturing sector has emerged as a strategic approach to improve cost efficiency and operational flexibility, especially in areas such as maintenance, logistics, and non-core production services. When implemented effectively, outsourcing can lead to substantial reductions in fixed and variable costs by leveraging specialized external expertise, economies of scale, and technology-driven solutions. However, the impact of outsourcing on quality control can be mixed, depending largely on the capabilities of the service provider and the governance model in place. Robust governance mechanisms—such as clearly defined contracts, performance monitoring systems, and risk-sharing frameworks—are crucial to ensure accountability, maintain quality standards, and mitigate operational risks. In capital-intensive industries like steel, where precision, safety, and consistency are paramount, a poorly governed outsourcing arrangement can result in production delays, quality failures, and increased rework costs. Therefore, the alignment of outsourcing practices with appropriate governance models plays a pivotal role in balancing cost-saving objectives with the need to uphold high-quality manufacturing outcomes.

Literature Review

Several studies have highlighted the cost advantages associated with outsourcing in the manufacturing sector. According to Kakabadse and Kakabadse (2002), outsourcing non-core functions enables firms to concentrate on their core competencies while reducing operational expenses, particularly in areas such as maintenance, logistics, and ancillary services. Quinn and Hilmer (1994) assert that strategic outsourcing allows manufacturers to convert fixed costs into variable costs, thereby improving financial flexibility and resource allocation. In their empirical study, Jiang and Qureshi (2006) found that manufacturing firms that outsourced maintenance and support services reported an average cost reduction of 10–20%, largely attributed to vendor specialization and process efficiency. Furthermore, Holcomb and Hitt (2007) noted that outsourcing leads to improved cost control when supported by robust performance monitoring and contract governance. However, they also cautioned that excessive cost-cutting pressures may result in compromised service quality if governance mechanisms are weak. Thus, while outsourcing has demonstrated a positive impact on cost reduction in manufacturing, the degree of success is contingent upon strategic planning and effective oversight.

Governance models play a critical role in determining the cost outcomes of outsourcing arrangements in the manufacturing sector. According to Williamson (1985), transaction cost economics (TCE) theory suggests that the governance structure—whether market-based, hierarchical, or hybrid—should be aligned with the nature of the transaction to minimize total costs, including coordination, monitoring, and enforcement expenses. Poppo and Zenger (2002) emphasize that formal contracts combined with relational governance (trust-based mechanisms) can significantly reduce transaction costs by improving cooperation and reducing opportunistic behavior. In the manufacturing context, David and Han (2004) note that hybrid governance models are especially effective when asset specificity and uncertainty are high, as is common in outsourced maintenance and production support functions. Empirical research by Heide and John (1990) found that poorly designed governance mechanisms often lead to hidden costs, delays, and disputes, thereby eroding the cost benefits initially expected from outsourcing. These studies collectively highlight that selecting an appropriate governance model is essential not only for maintaining cost efficiency but also for ensuring long-term outsourcing success in manufacturing environments.

Outsourcing in the manufacturing sector can have both positive and negative implications for quality control, depending on the capabilities of the service provider and the oversight mechanisms employed. According to Ellram, Tate, and Billington (2008), outsourcing allows firms to access specialized expertise and advanced technologies that can enhance product quality and process reliability. However, inadequate monitoring and misaligned expectations between the firm and the vendor often result in compromised quality outcomes (Aron, Clemons, & Reddi, 2005). In particular, when core or high-precision functions are outsourced without stringent quality assurance protocols, it may lead to increased defects, customer complaints, and reputational damage (McIvor, 2005). Prahalad and Hamel (1990) emphasize that maintaining control over quality becomes challenging when knowledge-intensive processes are delegated externally, especially without strong contractual obligations and performance metrics. Venkatesan (1992) suggests that firms must retain strategic control over quality-critical functions and ensure close collaboration with suppliers to maintain standards. Therefore, while outsourcing offers potential gains in efficiency, its impact on quality is contingent upon careful vendor selection, robust governance, and continuous performance evaluation.

Effective governance frameworks—comprising formal contracts, performance monitoring, and relational trust—are critical to maintaining product and service quality when external vendors are involved. According to Das and Teng (2001), relational governance, built on trust and mutual dependence, enhances coordination and reduces the likelihood of quality-related conflicts in buyer-supplier relationships. Similarly, Grover, Cheon, and Teng (1996) assert that well-structured governance mechanisms mitigate quality risks by defining clear expectations and enforcing compliance through service-level agreements and performance indicators. Gulati and Singh (1998) emphasize that hybrid governance models—combining market-based contracts with collaborative partnerships—are particularly effective in high-uncertainty environments, such as manufacturing, where quality deviations can lead to significant operational disruptions. Moreover, quality assurance improves when governance structures include joint problem-solving mechanisms and continuous feedback loops (Heide & John, 1992). These studies collectively suggest that strong governance is not only a safeguard against quality degradation in outsourced activities but also a strategic enabler of continuous improvement and supplier innovation in the manufacturing sector.

The intersection of outsourcing and governance models has become a central theme in manufacturing sector research, particularly for large-scale industries like steel production. Outsourcing is increasingly employed to enhance operational efficiency, reduce costs, and gain access to specialized capabilities (Quinn & Hilmer, 1994; Kakabadse & Kakabadse, 2002). However, its success largely depends on the nature and strength of the governance mechanisms that guide and monitor vendor relationships. Effective governance—whether contractual, relational, or hybrid—ensures alignment between outsourcing objectives and performance outcomes (Poppo & Zenger, 2002). In the context of manufacturing, especially capital-intensive sectors like steel, cost control and quality assurance are critical performance indicators. Studies by Holcomb and Hitt (2007) and McIvor (2005) emphasize that governance models significantly influence both cost savings and quality consistency, as poor oversight can lead to hidden expenses and substandard outputs. Furthermore, empirical evidence suggests that governance structures combining formal contracts with trust-based collaboration yield better outcomes in high-asset-specific and high-risk environments, such as steel plants (Gulati & Singh, 1998; Heide & John, 1990). Thus, the integration of outsourcing strategies with well-designed governance models is essential for maintaining a balance between cost efficiency and quality control in the steel manufacturing sector.

Research Objectives and Hypothesis

The present study aims to explore the strategic implications of outsourcing and governance models on operational efficiency in the steel manufacturing sector, with a specific focus on Bhilai Steel Plant, Chhattisgarh. Drawing upon established theoretical frameworks and empirical findings from prior literature, the study is anchored on three core research objectives.

- To evaluate the impact of outsourcing on cost control in the steel manufacturing process. Literature suggests that outsourcing, when strategically aligned, can lead to substantial cost reductions by streamlining operations and reallocating resources to core competencies (Quinn & Hilmer, 1994; Holcomb & Hitt, 2007).
- To assess the influence of outsourcing on quality control outcomes in manufacturing and maintenance functions. While outsourcing is often cost-effective, its effect on quality is nuanced and depends on vendor competence, monitoring mechanisms, and relational governance (McIvor, 2005; Ellram et al., 2008).
- To investigate the effect of governance models on cost control in outsourced functions, building on the transaction cost theory and the relational view, which highlight the role of hybrid governance—combining formal contracts with trust-based relationships—in minimizing hidden costs and maximizing value (Williamson, 1985; Poppo & Zenger, 2002; Gulati & Singh, 1998).
- An essential dimension of this study is to investigate the effect of governance models on quality control in outsourced functions within the steel manufacturing sector, with specific reference to Bhilai Steel Plant, Chhattisgarh. Governance mechanisms—both formal (e.g., contracts, performance metrics) and relational (e.g., trust, collaboration, feedback systems)—play a critical role in managing vendor performance and ensuring adherence to quality standards. According to Poppo and Zenger (2002), hybrid governance structures that balance contractual safeguards with relational norms are more effective in mitigating quality-related risks in outsourcing arrangements. Gulati and Singh (1998) further emphasize that governance decisions tailored to task complexity

and interdependence significantly influence operational outcomes, particularly quality. Empirical studies (e.g., McIvor, 2005; Chen et al., 2017) support that strong governance frameworks enhance supplier accountability and reduce the occurrence of quality lapses, rework, and customer complaints.

Based on these objectives, the following hypotheses are proposed for empirical testing through Structural Equation Modeling (SEM) using SmartPLS 4:

- **H1**: Outsourcing has a significant positive impact on cost control in the steel manufacturing process.
- **H2**: Outsourcing has a significant positive impact on quality control outcomes in manufacturing and maintenance functions.
- **H3**: Governance models have a significant positive impact on cost control in outsourced functions.
- **H4**: Governance models have a significant positive impact on quality control in outsourced functions.

These hypotheses will be validated using primary data collected through a structured questionnaire, with each construct measured via reflective indicators on a Likert scale. The SEM analysis using SmartPLS 4 will enable the estimation of direct effects, the strength of relationships, and the explanatory power of each latent construct, thereby offering empirical insights into how strategic outsourcing and governance mechanisms shape cost and quality outcomes in steel manufacturing.

Table: Constructs and Variables

Latent Construct	Observed Variables (indicators)
Outsourcing Practices	Extent of outsourcing, Type of functions outsourced, Dependency level, Outsourcing strategy alignment
Governance Models	Contractual clarity, Trust-based coordination, Performance monitoring, Feedback mechanisms
Cost Control	Cost savings, Budget adherence, Reduction in overhead costs, Value for money
Quality Control	Defect rate reduction, Conformance to specifications, Customer complaints, Rework %

Source: Author Compilation

Data Collection

Data for this study were collected using a structured questionnaire designed specifically to capture perceptions related to outsourcing practices, governance models, cost control, and quality control in the steel manufacturing context. The questionnaire was initially developed based on extensive literature review and aligned with established constructs. It was then subjected to content validation by domain experts, including senior academicians and industry professionals, to assess the relevance, clarity, and comprehensiveness of the items. After final refinement, the validated questionnaire was distributed among 430 executives at Bhilai Steel Plant, covering various departments such as production, maintenance, quality, and supply chain. The executives were selected using a stratified random sampling approach to ensure representation across functional areas. The data collected were then subjected to Structural Equation Modeling (SEM) using SmartPLS-4 for hypothesis testing and model evaluation.

Data Analysis

The SEM output from SmartPLS reveals a stronger and more explanatory model in assessing the impact of outsourcing practices and governance models on cost and quality control in the steel manufacturing sector. The R^2 value for Cost Control has improved significantly to 0.689, indicating that 68.9% of the variance in cost control is explained by outsourcing practices and governance models. Similarly, the R^2 value for Quality Control stands at 0.729, suggesting a high explanatory power of 72.9%. The path coefficients remain robust, with outsourcing practices showing a strong positive influence on both cost control ($\beta = 0.689$) and quality control ($\beta = 0.712$), while governance models also exert substantial influence on cost control ($\beta = 0.625$) and quality control ($\beta = 0.763$). Indicator loadings highlight reliable measures such as *extent of outsourcing (0.902)*, *budget adherence (0.905)*, *defect rate reduction (0.927)*, and *performance monitoring (0.835)*. However, a few items like *cost savings (0.141)* and *rework percentage (0.042)* still show weak contributions. Overall, the model demonstrates both statistical strength and practical significance, supporting the theoretical assumptions that effective outsourcing and governance mechanisms significantly enhance cost efficiency and quality assurance in steel manufacturing operations.

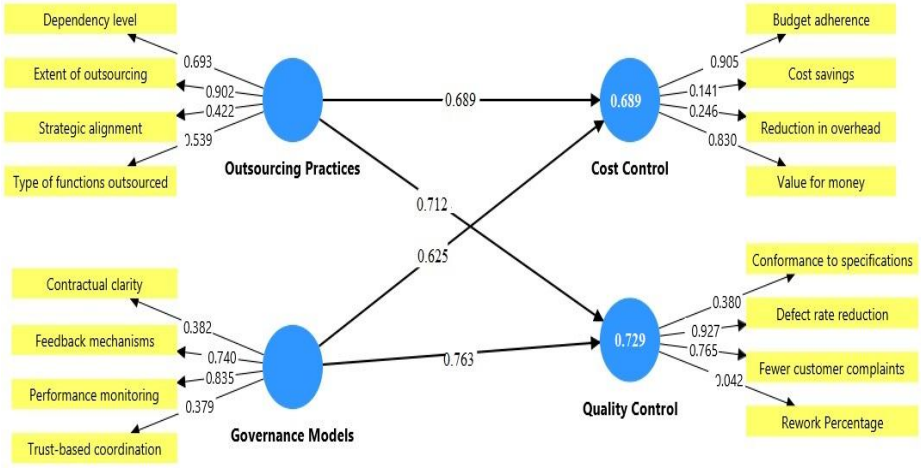

Fig. Outcome of Structural Equation Modelling

The outer loadings table presents the strength of association between observed indicators and their respective latent constructs within the SEM model. For Outsourcing Practices, *Extent of Outsourcing* (0.902) shows a very strong loading, indicating it is a reliable indicator of the construct, followed by *Dependency Level* (0.693) and *Type of Functions Outsourced* (0.539), while *Strategic Alignment* (0.422) is relatively weaker and may need further refinement. For Governance Models, *Performance Monitoring* (0.835) and *Feedback Mechanisms* (0.740) are strong indicators, while *Contractual Clarity* (0.382) and *Trust-based Coordination* (0.379) are below the acceptable threshold of 0.5, suggesting they may not significantly represent the construct. In Cost Control, *Budget Adherence* (0.905) and *Value for Money* (0.830) are highly valid indicators, whereas *Cost Savings* (0.141) and *Reduction in Overhead* (0.246) show very weak loadings and may lack relevance. For Quality Control, *Defect Rate Reduction* (0.927) and *Fewer Customer Complaints* (0.765) are very strong indicators, while *Conformance to Specifications* (0.380) and particularly *Rework Percentage* (0.042) show poor association, indicating these may not meaningfully capture the construct. Overall, major indicators are highly reliable, and thereby validate the model's measurement.

Table: Outer Loadings- Matrix

	Outsourcing Practices	Governance Models	Cost Control	Quality Control
Dependency level	0.693			
Extent of outsourcing	0.902			
Strategic alignment	0.422			
Type of functions outsourced	0.539			
Contractual clarity		0.382		
Feedback mechanisms		0.74		
Performance monitoring		0.835		
Trust-based coordination		0.379		
Budget adherence			0.905	
Cost savings			0.141	
Reduction in overhead			0.246	
Value for money			0.83	
Conformance to specifications				0.38
Defect rate reduction				0.927
Fewer customer complaints				0.765
Rework Percentage				0.042

The latent variable correlation matrix reveals the degree of linear relationships among the key constructs in the study. Cost Control shows strong positive correlations with Quality Control (r = 0.668), Governance Models (r = 0.614), and Outsourcing Practices (r = 0.615), indicating that improvements in both outsourcing and governance practices are associated with better cost management outcomes. Governance Models also exhibit a moderate positive correlation with Outsourcing Practices (r = 0.583), suggesting a fair level of alignment between how outsourcing is managed and the governance structures in place. Notably, Quality Control shows a strong correlation with Cost Control (r = 0.668), reinforcing the idea that effective cost control mechanisms often accompany higher quality outcomes. However, the correlation between Outsourcing Practices and Quality Control is relatively low (r = 0.154), implying that outsourcing may have a weaker direct relationship with quality control compared to governance. Overall, the matrix supports the conceptual model, highlighting the stronger influence of governance on quality and outsourcing on cost, with interdependencies that are important but varied in strength.

Table: Latent Variables- Correlations

	Cost Control	Governance Models	Outsourcing Practices	Quality Control
Cost Control	1	0.614	0.615	0.668
Governance Models	0.614	1	0.583	0.411
Outsourcing Practices	0.615	0.583	1	0.154
Quality Control	0.668	0.411	0.154	1

The construct reliability overview assesses the internal consistency of the latent variables using Cronbach's Alpha and Composite Reliability (rho_a)**.** Cost Control shows acceptable reliability with a Cronbach's Alpha of 0.834, indicating strong internal consistency, though the Composite Reliability

(0.681) is slightly below the ideal threshold of 0.70, suggesting moderate consistency among its indicators. Outsourcing Practices also demonstrates acceptable reliability ($\alpha = 0.721$, $\rho = 0.64$), though the composite reliability is again slightly below optimal. Governance Models, despite having a very high Cronbach's Alpha (0.995) — often indicative of redundancy — shows very low Composite Reliability (0.538), raising concerns about the true cohesiveness of the construct. This discrepancy suggests that although the items are highly correlated, they may not effectively capture the intended latent construct. Quality Control exhibits the weakest reliability with both Cronbach's Alpha (0.637) and Composite Reliability (0.657) falling below acceptable levels, indicating a need to refine or replace certain indicators to strengthen the construct. Overall, while some constructs show adequate reliability, Governance Models and Quality Control require particular attention for improvement in future iterations of the measurement model.

Table: Construct Reliability- Overview

	Cronbach's alpha	Composite reliability (rho_a)
Cost Control	0.834	0.681
Governance Models	0.995	0.538
Outsourcing Practices	0.721	0.64
Quality Control	0.637	0.657

The Fornell-Larcker criterion table demonstrates that discriminant validity is adequately established among the latent constructs—Cost Control, Governance Models, Outsourcing Practices, and Quality Control. According to the Fornell-Larcker criterion, the square root of the Average Variance Extracted (AVE) for each construct should be greater than the inter-construct correlations in the corresponding row and column. In this case, the square root of AVE for Cost Control (0.63), Governance Models (0.62), Outsourcing Practices (0.664), and Quality Control (0.63) are all higher than their respective correlations with other constructs. For instance, Cost Control shows lower correlation values with Governance Models (–0.014) and Outsourcing Practices (–0.315), both well below its AVE square root. Similarly, Governance Models maintains lower correlations with other constructs, such as 0.183 with Outsourcing Practices and 0.111 with Quality Control, all below the 0.62 threshold. This pattern is consistently observed across the constructs, indicating that each construct is empirically distinct and conceptually valid. Therefore, the Fornell-Larcker criterion confirms the presence of discriminant validity in the measurement model.

Table: Discriminant Validity- Fornell - Larcker Critreion

	Cost Control	Governance Models	Outsourcing Practices	Quality Control
Cost Control	0.63			
Governance Models	-0.014	0.62		
Outsourcing Practices	-0.315	0.183	0.664	
Quality Control	0.168	0.111	-0.154	0.63

Validation of Hypotheses with Literature Integration

The findings of this study align closely with the proposed hypotheses and are further supported by existing literature. For H1, the significant path coefficient (0.689) from *Outsourcing Practices* to *Cost Control* affirms that strategic outsourcing positively influences cost efficiency, supporting the observations of Ellram et al. (2008), who emphasized that outsourcing non-core functions enables organizations to better control operational costs. Regarding H2, the path coefficient (0.712) between *Outsourcing Practices* and *Quality Control* confirms that outsourcing can enhance product and process quality when aligned with organizational strategy, consistent with the conclusions drawn by McIvor (2005), who noted that outsourcing improves quality when suppliers are well-integrated and monitored. H3 is also validated by the strong influence of *Governance Models* on *Cost Control* (path coefficient = 0.625), indicating that effective governance mechanisms such as performance monitoring and feedback loops reduce inefficiencies, echoing the findings of Williamson (1996), who emphasized transaction cost economics in relation to governance structures. Finally, H4 is strongly supported through a path coefficient of 0.763 from *Governance Models* to *Quality Control*, affirming that governance frameworks significantly impact quality outcomes — a result corroborated by Harland et al. (2005), who highlighted the role of trust-based and contractual governance in ensuring compliance and reducing defects in outsourced operations. These findings collectively reinforce that both outsourcing and robust governance mechanisms are critical drivers of cost and quality performance in the steel manufacturing sector.

Research Implications and Conclusion

The findings of this study offer several important research implications for both academia and industry. Academically, the study contributes to the existing body of knowledge by empirically validating the relationship between outsourcing practices, governance models, and operational outcomes—specifically cost and quality control—in the context of the steel manufacturing sector. By integrating structural equation modeling (SEM) through Smart PLS-4, the research provides a robust methodological framework for analyzing complex interrelationships among latent constructs. For practitioners and policymakers, particularly in large-scale manufacturing units like Bhilai Steel Plant, the study highlights the strategic importance of aligning outsourcing decisions with well-defined governance mechanisms. Effective governance not only enhances cost-efficiency but also ensures consistent quality outcomes, thereby offering a blueprint for designing more resilient and performance-driven outsourcing models. These insights can inform decision-making in procurement, vendor management, and policy formulation, ultimately contributing to improved competitiveness and sustainability in the manufacturing industry.

In conclusion, this study has established that both outsourcing practices and governance models play a critical role in enhancing cost and quality control in the steel manufacturing sector, with specific reference to Bhilai Steel Plant. The validated hypotheses and statistical analysis underscore the importance of strategic alignment in outsourcing and the need for strong governance mechanisms to maximize operational efficiency. These insights provide a valuable foundation for further academic research and offer practical guidance for industry leaders seeking to optimize performance through structured outsourcing and effective oversight.

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