

The Implementation of GBT30512 Standard and Its Implications for the Sustainable Development Strategy of Automotive Enterprises

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Abstract: Under the background of the dual-carbon goal and the accelerated evolution of global green supply chain, mandatory technical standards are increasingly becoming the key institutional tools to guide the strategic transformation of manufacturing industry. Focusing on "GBT30512-2014 Requirements for Prohibited Substances in Automobile", this paper systematically analyzes how this standard goes beyond the scope of technical compliance and deeply participates in the shaping process of sustainable development strategy of automobile enterprises from the perspective of institutional theory and strategic management. The study first deconstructs the logic and technical connotation of standard preventive governance, and then reveals its role in reconstructing the traditional strategic dimension, pointing out that environmental compliance, resource recycling, technical foresight and institutional synergy have become the core pillars of the new strategic framework. Further analysis shows that the standard guides enterprises to adjust their strategic objectives and reshape their internal governance structure through the mechanisms of objectification, power and responsibility reconfiguration and process embedding. This paper points out that the full release of standard efficiency depends on the multi-dimensional policy coordination with carbon management, green finance and international rules, and calls for promoting its evolution to an intelligent and life-cycle oriented institutional form.

Keywords: GBT30512 standard; Sustainable development strategy; Institutional logic; Reconstruction of strategic dimension; Policy coordination.

1. Introduction

With the increasing pressure of global climate control and the tightening of resource constraints, the automobile industry, as a typical manufacturing sector with high energy consumption and high emissions, is facing unprecedented transformation challenges [1]. In this context, the national standardization system has gradually become an important institutional tool to guide the green and low-carbon evolution of industries [2]. GBT30512-2014 Requirements for Prohibited Substances in Automobile issued in 2014 (hereinafter referred to as GBT30512) is the first mandatory standard for the control of harmful substances in vehicle materials in China. It not only sets the upper threshold of six kinds of restricted substances such as lead, mercury, cadmium and hexavalent chromium, but also embeds the basic framework of environmental compliance from the perspective of product life cycle [3]. Although the standard focuses on material substitution and supply chain management and control at the technical level, its institutional logic essentially constitutes a structural guide to the strategic direction of automobile enterprises. That is, from the traditional cost-efficiency orientation to the sustainable development paradigm that takes into account ecological responsibility and long-term resilience [4].

Existing research mostly regards GBT30512 as a compliance technical specification, focusing on testing methods, performance of alternative materials or difficulties in supply chain implementation, but paying little attention to its deep impact on the strategic level as an institutional signal [5]. In fact, the implementation of standards is not an isolated technical event, but a key node embedded in the context of multiple policies such as "double carbon" goal, circular

economy legislation and ESG disclosure strengthening [6]. When enterprises are forced to reconstruct the logic of material selection, adjust the supplier access mechanism, and even reset the R&D process, their strategic cognitive framework also shifts. This shift is not only reflected in the adaptive adjustment at the operational level, but also likely to trigger a re-examination of the definition of core competitiveness, value chain positioning and even corporate mission [7]. Especially at the moment when electrification and intelligence accelerate penetration, material safety and environmental friendliness have changed from marginal attributes to the core components of product value proposition, and standards have thus become an institutional bridge connecting technical compliance and strategic upgrading.

At present, the discussion on the interaction mechanism between standards and strategies in theoretical circles is still weak. Mainstream strategic management literature tends to regard external regulation as a constraint rather than an endogenous variable. However, environmental policy research often ignores the heterogeneity and initiative of corporate strategic response. This separation leads to a lack of systematic interpretation of the strategic significance of technical standards such as GBT30512. This paper attempts to bridge this gap, and from the perspective of the intersection of institutional theory and strategic evolution, analyzes how standards affect the formulation logic and implementation path of sustainable development strategy of automobile enterprises by setting technical boundaries, reshaping the legitimacy foundation and reconstructing the expectations of stakeholders.

2. The System Logic and Technical Connotation of GBT30512 Standard

The institutional logic of GBT30512 standard is rooted in the concept of preventive environmental governance, and its core is not pollution control after the event, but to set a technical threshold through the prohibition of front-end materials and internalize ecological risks at the source of product design [8]. This institutional arrangement has established a unified technical bottom line, and also constructed a responsibility allocation framework based on material traceability, which has prompted vehicle enterprises to change from passive testing to active management and control.

In terms of technical connotation, GBT30512 focuses on the threshold control of six kinds of harmful substances. The technical difficulty lies not in the detection itself, but in how to realize material substitution and process compatibility on the premise of ensuring functional performance. Although the standard does not specify the specific alternative path, it implies the technical requirements for material database construction, green supplier certification and life cycle data management. The standard takes "exemption clause" as a dynamic adjustment mechanism, allowing specific application scenarios not to implement the restriction requirements temporarily under limited conditions, which not only reserves the technical feasibility space, but also reserves the institutional interface for subsequent standard iterations.

3. Reconstruction of Strategic Dimension of Sustainable Development of Automobile Industry

The traditional automobile industry strategy has long focused on cost control, scale expansion and technical performance, and environmental factors are often regarded as compliance costs or external constraints. However, driven by the goal of "double carbon" and the pressure of global green supply chain, sustainable development has risen from a marginal issue to a core strategic dimension, forcing enterprises to systematically reconstruct their strategic framework. This reconstruction is not a simple superposition of environmental protection indicators, but a fundamental adjustment of the logic of value creation, the mechanism of resource allocation and the definition of competition barriers [9]. Product definition has turned to the ternary structure of "function-cost-environmental impact", and material selection, recyclability and carbon footprint have become key inputs. Supply chain management emphasizes resilience and responsibility, and environmental compliance becomes the entry threshold for suppliers. Corporate legitimacy depends on the accountability of supervision, investment and consumption, and ESG performance directly affects financing cost and brand premium.

The expansion of this strategic dimension is embodied in four interrelated sub-dimensions: environmental compliance, resource recycling, technical foresight and institutional synergy. Each dimension not only sets a new objective function, but also reshapes the allocation of rights and responsibilities within the enterprise and the cross-departmental cooperation model. Different dimensions correspond to different strategic focus, organizational response mechanism and performance measurement methods,

which together constitute the operational framework of sustainable development strategy. Among them, environmental compliance emphasizes the active internalization of mandatory standards and goes beyond the minimum requirements to build a preventive management system. The recycling of resources focuses on the closed-loop utilization and remanufacturing potential of materials, and promotes the evolution of product architecture in the direction of modularization and easy disassembly. Technology foresight is reflected in the early layout of low environmental load materials and green processes, forming a technical reserve advantage. Institutional synergy requires enterprises to actively participate in standard setting, policy pilot and industry initiatives, and turn external institutional pressure into strategic opportunities. These four dimensions are not nonlinear progressive, but a dynamically coupled whole, and the lag of any one dimension may restrict the overall strategic efficiency.

4. Guiding Mechanism of Standard Implementation to Strategic Objectives and Governance Structure

The implementation of GBT30512 standard not only changed the technical path of automobile enterprises, but also reshaped their strategic goal setting and internal governance structure through institutional pressure. This guiding mechanism does not rely on direct instructions, but urges enterprises to internalize environmental compliance as a strategic priority by setting a unified technical bottom line, reconstructing legal boundaries and activating stakeholder supervision. At the target level, standards force enterprises to shift from meeting the minimum limit to building a forward-looking material management system, and then promote the transformation of sustainable development goals from fuzzy vision to operational and assessable specific indicators. The key to this goal transformation is that the standard provides not only the technical threshold, but also a quantifiable and auditable governance anchor point, which makes the original abstract green manufacturing concept institutionalized.

In terms of governance structure, the implementation of GBT30512 gave birth to the institutionalization of cross-functional coordination mechanism. Traditionally, material compliance affairs are mostly dealt with temporarily by quality or procurement departments, lacking strategic height; The mandatory nature of standards requires enterprises to establish a joint governance structure covering R&D, procurement, production, legal affairs and ESG management. Typical performance is to set up a full-time material compliance committee, or to embed a banned substance verification module in the product life cycle management system (PLM) to realize data communication from the design end to the recycling end. This structural adjustment has improved compliance efficiency and changed the allocation of decision-making power-environmental factors have thus entered the high-level strategic agenda, rather than being treated as technical issues at the operational level. Standards also strengthen the vertical integration ability of supply chain governance. By writing the requirements of GBT30512 into the terms of the supplier contract, and supporting the material declaration template and the third-party verification mechanism, the vehicle enterprise has built an accountability system with data traceability as the core. This system forces

suppliers to upgrade their internal governance simultaneously, forming a system diffusion effect.

Table 1. Guidance Pathways of GBT30512 for Strategic Governance in Automotive Enterprises

Guidance Dimension	Mechanism of Action	Typical Organizational Response	Strategic Output Performance
Target Concretization	Transform compliance requirements into quantifiable KPIs	Develop a roadmap for material substitution and set annual exemption reduction targets	Incorporate sustainability goals into executive performance evaluations
Reallocation of Rights and Responsibilities	Reconstruct cross-departmental responsibility boundaries	Establish a Material Compliance Officer and grant environmental veto power to the R&D department	Include environmental issues in the core checklist for product project approval reviews
Process Integration	Embed verification nodes into the main development process	Integrate an automatic banned substances comparison module into the PLM system	Reduce the number of compliance reviews during the new vehicle model development cycle by 40%

The specific action path of the above guidance mechanism can be summarized into three levels: objectification, power and responsibility reconfiguration and process embedding. As shown in Table 1, standards act on strategic objectives and organizational structure through different mechanisms, forming a system-strategy coupling loop. The true strategic value of the standard lies not in its technical content itself, but in whether it can stimulate the adaptive evolution of corporate governance structure, so as to identify and build new competitive advantages in institutional constraints.

5. Policy Coordination and Future Evolution Path

If the institutional effectiveness of GBT30512 standard is to be fully released, it should not be run in isolation at the level of technical compliance, but should be embedded in a wider policy coordination network. At present, China has formed a multi-level policy framework in the fields of green manufacturing, peak carbon dioxide emissions Action, circular economy legislation and ESG information disclosure, but there are still some problems among the policy tools, such

as misplaced goals, fragmented implementation and incompatible incentives. The key to the future evolution is to promote the deep coupling between GBT30512 and related systems, and to build a "standard-regulation-market mechanism" trinity collaborative governance ecology.

The deepening path of policy coordination should focus on three directions. The first is the vertical integration within the standard system, that is, aligning GBT30512 with the technical policy of automobile product recycling and the evaluation standard of green design products in terms of technical indicators and implementation rhythm to avoid repeated requirements or logical conflicts. The second is the horizontal linkage of cross-disciplinary policies, such as bringing material compliance data into the carbon emission accounting boundary, or giving high-standard material management weight points in green financial evaluation. Third, the international rules should be adapted, and the mutual recognition mechanism of China standards should be promoted under the framework of RCEP and "Belt and Road" green supply chain initiative, so as to reduce the system conversion cost of export enterprises.

Table 2. Policy Synergy Dimensions for the Future Evolution of GBT30512

Synergy Level	Institutional Interface	Technical Support	Strategic Value
Basic Level	Align with the indicators of the "General Rules for the Evaluation of Green Factories"	Standardized interfaces for material databases	Reduce enterprise compliance costs for multiple standards and enhance implementation efficiency
Extended Level	Include in the appendix of carbon footprint accounting methodologies	Integrate LCA models for material environmental loads	Strengthen preferential financial interest subsidies for green products and government procurement priorities
International Level	Align with the ISO 22628 international standard for vehicle recycling	Blockchain-based cross-border material declaration verification platform	Support export vehicle models to quickly pass EU ELV certification

As shown in Table 2, different levels of collaboration correspond to different institutional interfaces, technical support and strategic values, which together constitute the system picture of standard upgrading. The future evolution of GBT30512 should not be limited to updating the list of restricted substances, but should be transformed into intelligent standards-that is, technologies such as digital identification, material passports and blockchain traceability should be integrated to realize the transition from static threshold control to dynamic risk warning.

6. Conclusion

This paper systematically sorts out the system logic and strategic influence of GBT30512 standard, and reveals the deep mechanism of mandatory technical standards in the

sustainable transformation of automobile industry. It is found that the standard does not only exist as a technical specification for material control, but reconstructs the cognitive framework of enterprises on value creation, risk management and competitive barriers by setting a unified environmental compliance boundary. At the strategic level, it urges enterprises to transform sustainable development from marginal responsibility to core strategic dimension, and promotes the systematic adjustment of product definition, supply chain governance and organizational structure. The cross-departmental collaborative mechanism and data-driven governance model inspired by the implementation of standards have laid an organizational foundation for enterprises to deal with more complex environmental regulations in the future. However, the institutional potential of standards has not been fully released. At present, the policy

system is still fragmented, and the policy tools such as material ban, carbon accounting and circular economy lack effective connection, which leads to multiple compliance pressures for enterprises, but it is difficult to form a strategic synergy.

In the future, efforts should be made to build a policy collaboration network with the whole product life cycle as the core, and to promote the deep integration of GBT30512 with green finance, carbon market and international standard system. At the same time, the standard itself needs to evolve to intelligence, and with the help of digital technologies such as material passports and blockchain traceability, the transition from static threshold control to dynamic risk warning can be realized. This path is not only suitable for the automobile industry, but also provides a theoretical reference for the sustainable transformation of other high environmental load manufacturing industries.

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