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Research on Intellectual Property Protection in the International Cooperation of the New Energy Vehicle Industry under the Background of the "Belt and Road" Initiative

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Abstract: Under the Belt and Road Initiative, China's new energy vehicle (NEV) industry faces a complex and dynamic legal and intellectual property (IP) protection environment in international cooperation. This study explores the impact of industrial policies and legal frameworks in Belt and Road countries on the IP protection of Chinese NEV companies, focusing on core technologies such as electronic control systems. Through a literature review, case studies, surveys, and expert interviews, the study identifies key IP risks faced by Chinese companies in international cooperation and outlines response strategies. It also compares IP protection laws in key Belt and Road countries, including Indonesia, Egypt, Brazil, and Italy. The findings highlight that IP protection is critical in technology transfer, market competition, and cross-border cooperation, and strengthening legal frameworks and international collaboration is essential for managing IP risks. Based on the research results, the study proposes practical and forward-looking IP protection strategies to support Chinese companies' cooperation and development in Belt and Road countries, offering theoretical and practical guidance for policymakers and industry associations.

Keywords: "Belt and Road" Initiative, New Energy Vehicles, Intellectual Property Protection

1. Introduction

The Belt and Road Initiative (BRI), a major international cooperation platform proposed by China, has accelerated globalization and regional economic ties. As China's new energy vehicle (NEV) industry expands internationally along the BRI, it promotes green technology transfer and supports global sustainability goals. However, varying legal systems and underdeveloped IP protection in some partner countries pose significant challenges, especially in technology-intensive sectors.

Chinese NEV companies face risks in areas like technology transfer, patent protection, and trade secret management. Disputes over core technologies, such as electric control systems, can harm corporate interests and global competitiveness. Effective IP protection in this complex environment is a critical challenge.

This study holds both theoretical and practical value. Theoretically, it enhances the framework for cross-border IP cooperation through comparative legal analysis. Practically, it offers strategies based on industry needs and successful cases to help mitigate IP risks and boost global competitiveness. Focusing on countries like Indonesia, Egypt, Brazil, and Italy, the research uses case studies, surveys,

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and interviews to assess key IP challenges and propose tailored strategies for enterprises and policymakers.

2. Literature review

2.1. Definition of concepts

2.1.1. Definition of intellectual property

Intellectual Property (IP) refers to the legal rights granted to individuals for the intellectual creations or innovations they generate during creative activities. It encompasses various aspects such as patent rights, copyright, trademark rights, and trade secrets, aiming to protect the interests of innovators and promote technological advancement and cultural prosperity. Patent rights protect inventions or innovative technologies, granting inventors exclusive rights to use their technologies for a certain period; copyright protects the originality of literary, artistic, and other creative works; trademark rights pertain to the exclusive use of brand names and logos; while trade secrets refer to valuable, non-public information held by businesses or individuals. The core purpose of intellectual property is to encourage innovation by granting creators control over their creations and the benefits they derive, thus fostering technological and artistic growth.

For the electric vehicle industry, intellectual property is not only a means of protecting technological innovations but also a key factor in maintaining a competitive advantage and achieving sustainable development. With the rapid growth of the electric vehicle industry, the protection of intellectual property becomes increasingly important.

2.1.2. Legal framework for intellectual property protection

The legal framework for intellectual property protection covers several areas, mainly including patent law, copyright law, trademark law, and trade secrets law. At the international level, the World Intellectual Property Organization (WIPO) and the Paris Convention provide basic principles and enforcement mechanisms for global IP protection, promoting cross-border cooperation.

Domestically, China's Patent Law protects inventions, utility models, and design patents, ensuring legal protection for technological innovations; the Copyright Law safeguards the originality of literary, artistic, and other creative works; the Trademark Law protects brand names and logos to prevent malicious imitation; and the Anti-Unfair Competition Law protects trade secrets and technological solutions.

2.1.3. The application of patents and trademarks in the new energy vehicle industry

Patents are a vital safeguard for technological innovation in the new energy vehicle (NEV) industry. Technological inventions related to batteries, motors, drive systems, and intelligent control are often protected through patents to prevent replication and imitation. By applying for and obtaining patents, companies can safeguard their innovative technologies, enhance market competitiveness, prevent unauthorized use of their technology, and provide returns on research and development investments.

Trademarks are primarily used to protect the brand image of new energy vehicles. A trademark not only represents the source of the product but is also closely tied to the brand's reputation and consumer recognition. By registering a trademark, companies can prevent others from maliciously using similar names or logos, maintain market order, and strengthen consumer trust and loyalty toward the brand.

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Thus, the application of patents and trademarks provides NEV companies with protection for innovation, market competitiveness, and brand value, contributing to the healthy development of the entire industry.

2.2. State of the art

With the Belt and Road Initiative and the rapid growth of the NEV industry, the importance of intellectual property protection in international cooperation has become increasingly prominent, giving rise to valuable perspectives and theoretical frameworks.

Chinese scholars, such as Yubi Li [1] and Changli Zhang [2], widely agree that researching intellectual property issues within the context of the Belt and Road Initiative is crucial for the following reasons. First, in the context of the Fourth Industrial Revolution, the rapid development and widespread application of technology have made it a focal point of international competition, making the protection of technological innovation and intellectual property crucial for promoting fair competition. Second, multinational companies operating in Belt and Road countries face uncertainty due to differing legal environments and policies. Systematic research on intellectual property protection can provide a clear legal framework for these companies, reducing legal risks. Finally, effective intellectual property protection not only promotes the sharing and transformation of technological achievements but also enhances the economic development of countries along the Belt and Road. Therefore, in-depth research into intellectual property protection paths is crucial for advancing Belt and Road cooperation and safeguarding the interests of businesses and nations.

Congjing Ran, Lina Ma, and Shaohui Wang [3] specifically point out that in the context of national security and development strategies in the new era, international disputes over intellectual property interests are becoming increasingly complex, with intellectual property security emerging as a new form of non-traditional security in the national security system. Jiaqi Ning [4] highlights that the stakeholders in intellectual property protection under the Belt and Road context are diverse, and that there are significant differences in intellectual property systems across the countries along the route. She also notes that there are issues such as low levels of intellectual property protection, incomplete legal governance mechanisms, and a lack of dispute resolution systems.

Researchers propose multiple strategies to enhance IP protection under Belt and Road cooperation. Handong Wu [5] advocates for a regional IP framework via multilateral agreements and innovation projects. He recommends that Chinese firms establish overseas IP bodies, engage with local systems, apply for international patents, strengthen core technology confidentiality, and implement robust IP management with regular reviews. Other scholars support a risk-based approach, urging legal and market analysis before entering BRI markets and promoting collaboration with local advisors and better supply chain oversight. Internationally, WIPO suggests IP training in BRI countries to raise professional capacity and improve the protection environment.

Research on intellectual property (IP) in the NEV industry is currently led by the practical sector. Xiang Zhang [6] highlights rising trends in IP litigation related to NEV power batteries, noting increased patent activity in Belt and Road countries and the need for systematic research on IP protection. Guo et al. [7] analyze regulatory risks and responses through a case study of Geely, while Liu, Deng, and Wang [8] explore international cooperation models involving government, industry, and enterprises. These studies show that IP risks are a major concern for Belt and Road NEV collaboration. As a global NEV leader, China faces challenges from uneven IP protection and awareness in partner countries, which constrain market expansion and innovation.

Current research shows that intellectual property protection in the NEV industry under the Belt and Road Initiative is complex and multifaceted, requiring legal, technological, and management strategies, as well as international cooperation and information sharing. However, most legal studies remain theoretical and do not fully consider the NEV sector's technological and industrial specifics.

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Industry materials often focus on data and compliance, lacking broader strategic insights. This gap highlights the need for research like this study, which aims to explore practical implementation pathways and case studies to offer detailed guidance for Chinese NEV firms in global markets.

3. Research questions

The legal systems and intellectual property (IP) protection levels among countries along the Belt and Road Initiative (BRI) vary, presenting numerous challenges for Chinese companies in terms of IP protection. The IP challenges arising from cross-border cooperation cannot be overlooked. Against this backdrop, this study aims to explore the IP protection issues in the collaboration of the new energy vehicle (NEV) industry under the Belt and Road Initiative. It will cover the background and development of the BRI, the relationship between the BRI and the NEV industry, the IP issues faced by the NEV industry, and the optimization of these issues across BRI countries. Based on extensive research materials, this study expects to apply various research methods to provide legal support and operational guidance for NEV companies' IP protection in BRI countries.

4. Research objects and methods

4.1. Research objects

During the data collection phase, the study will focus on new energy vehicle (NEV) companies, particularly those with business operations in Belt and Road Initiative (BRI) countries. The research will specifically analyze the intellectual property legal risks these companies encounter in their business operations, including the types of risks, their significance, and the ways they are addressed.

In the literature review phase, the research will focus on relevant laws and regulations, international agreements, and case studies related to IP protection in the NEV industry.

4.2. Research methods

4.2.1. Literature review method

By reviewing domestic and international literature on the "Belt and Road" initiative, the new energy vehicle industry, and intellectual property protection, this study aims to understand the current state of research and existing issues. Analyzing the existing research will provide theoretical support and a reference basis for this study.

4.2.2. Comparative research method

Compare the intellectual property protection legal systems of countries along the Belt and Road, identifying differences and commonalities to provide a basis for proposing solutions. By comparing the legal systems of different countries, the best practices in intellectual property protection can be identified, and specific measures tailored to the legal environments of different countries can be suggested.

4.2.3. Case study method

Through the analysis of real cases, this method aims to understand the intellectual property risks faced by Chinese new energy vehicle companies in Belt and Road countries and their corresponding strategies. By examining typical cases, successful experiences and lessons in intellectual property protection can be summarized, providing valuable insights and guidance for other companies.

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4.2.4. Empirical research method

Through surveys and interviews, the study aims to understand the intellectual property issues and needs encountered by enterprises in practical operations, providing firsthand data for the research. Empirical research will allow for the identification of actual problems faced by enterprises in the international market, enabling the formulation of targeted solutions.

4.3. Research ethics

In this research process, we strictly adhered to research ethics principles and underwent appropriate ethical review and approval. The personal information and privacy of all participants were rigorously protected through anonymity. The collection, storage, and processing of data complied with relevant laws, regulations, and academic ethical standards. The academic ethical guidelines primarily followed the American Psychological Association (APA) Ethics Code for Psychologists and Code of Conduct [9]. Participants were informed of the research's purpose, process, and potential risks, and their participation was voluntary, with the option to withdraw at any time without facing any negative consequences. All data analysis and results in the study will be presented in a transparent, objective, and fair manner, strictly adhering to academic integrity principles.

5. Research results and analysis

5.1. Current status of cooperation in the new energy vehicle (NEV) industry among Belt and Road countries

5.1.1. Opportunities for NEV companies in the Belt and Road Initiative

The rapid rise of China's new energy vehicle (NEV) industry offers vast opportunities for international cooperation in Belt and Road Initiative (BRI) countries. Global NEV sales surpassed 10 million units in 2022, with a penetration rate of 14%, and are projected to reach 14 million in 2023. China leads the global NEV market, contributing 3.52 million units in 2021—53% of the global share—supported by a complete industrial chain. Chinese automakers have increasingly expanded into BRI countries: BAIC established a major plant in South Africa in 2016; Geely acquired Proton in 2017; Great Wall Motors entered Thailand in 2020; and Chery set up 17 factories globally, including in Southeast Asia and Latin America.

Chinese power battery companies are also expanding globally. CATL has launched projects in Germany, the U.S., Hungary, and Indonesia, and in 2024 formed a technology partnership in Thailand. Hive Energy and over 10 other Chinese battery firms have also invested in Southeast Asia, strengthening China's NEV supply chain overseas. A recent survey shows 65% of Chinese NEV companies have ties with BRI countries—40% via trade and 25% through technology cooperation—while 35% have yet to engage, likely due to policy and market constraints. These trends reflect China's strategic shift toward globalized production and technology export in the NEV sector.

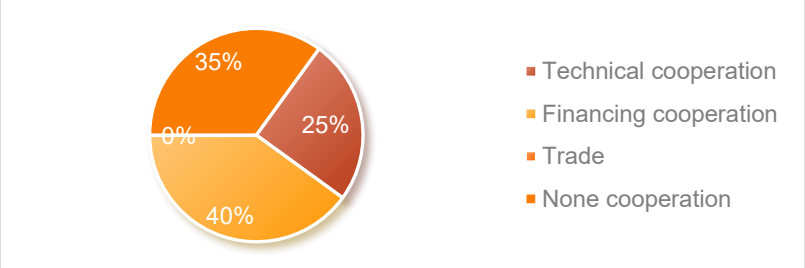


Figure 1: Business cooperation between the company and Belt and Road countries

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Overall, Chinese new energy vehicle companies have actively participated in the green development and economic transformation of Belt and Road countries through various forms such as trade, technological cooperation, and localized production. In the future, companies need to further optimize their global layout, strengthen industrial collaboration with Belt and Road countries, and promote the sustainable development of the new energy vehicle industry, providing greater support for international cooperation under the Belt and Road Initiative.

5.1.2. Intellectual property issues of new energy vehicle companies going global under the Belt and Road Initiative

As Chinese new energy vehicle (NEV) companies expand into Belt and Road Initiative (BRI) countries, intellectual property (IP) challenges have become increasingly critical. To assess the current state of IP protection, this study conducted a survey with 30 valid responses from NEV professionals across roles such as management, R&D, and market operations (see appendix). Over 90% of respondents rated IP protection as "important" or "very important" in international cooperation. Technologically, IP concerns are concentrated in three core areas: batteries (32%), motors (18%), and engines (14%) (see Figure 2). Battery technology, including management systems, material patents, and production processes, is a major focus due to its central role and dispute potential. Motor-related IP issues often involve ownership and transfer risks, complicated by cross-border legal differences. While demand for engine technology is declining, hybrid systems remain relevant in some BRI markets, keeping related IP concerns significant.

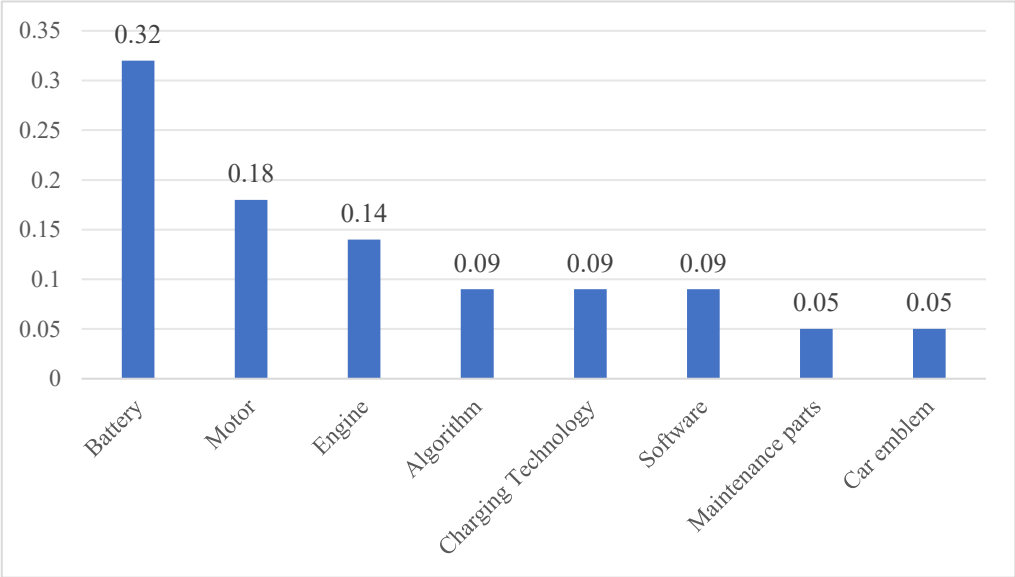


Figure 2: Distribution of intellectual property issues in the new energy vehicle industry

Survey results (Figure 3) show that the electric control system is the top priority for IP protection (average rating: 8.00), highlighting its central role and technical complexity in NEVs. To maintain global competitiveness, companies must enhance both domestic patent strategies and international cooperation to address risks from cross-border technology transfer.

Motor and engine technologies follow closely (rating: 7.96), underscoring their strategic importance in R&D and production. Given their susceptibility to infringement in international markets due to legal variations, stronger legal safeguards are essential. Battery technology, rated at 7.61, remains critical for high energy-density innovation and market adaptability. Weak patent

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strategies and potential technology leakage could harm competitiveness, making global patent protection for batteries an urgent priority.

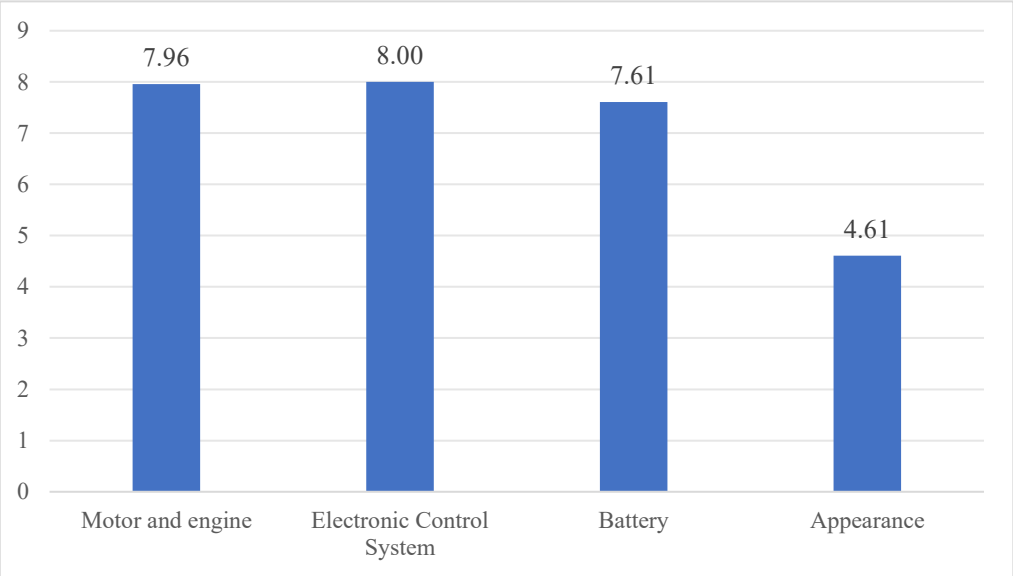


Figure 3: Importance rating of key factors in new energy vehicle intellectual property protection

Industrial design received a low average rating of 4.61, indicating it is a lower priority for IP protection, likely due to its limited technological value. However, as a key element of brand recognition, protecting industrial design remains important for maintaining brand image and avoiding reputational or market losses from infringement.

Open-ended survey responses and word cloud analysis (Figures 4 and 5) reveal key company concerns: frequent mentions of "strengthening intellectual property," "international cooperation," and "legal support" emphasize the importance of patent protection and legal backing in global markets. Terms like "dispute resolution" and "private settlement" highlight the need for effective cross-border IP conflict mechanisms. "Strengthening legislation" emerged as the top recommendation, underscoring demand for a stronger domestic legal framework. Other suggestions—such as improving IP policies, opening appeal channels, and joining international organizations—reflect the call for better global alignment and support in the IP protection environment.



Figure 4: Word cloud of key IP protection factors for NEVs

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Figure 5: Word cloud of IP protection suggestions for NEVs

Actual cases highlight the complex IP challenges Chinese NEV companies face abroad. In 2021, CATL was sued in Germany for allegedly infringing European Patent EP1939971 related to lithium battery electrodes. Though CATL filed for patent invalidation, the case exposed weaknesses in its core technology patent strategy. Similarly, in 2023, NIO lost a trademark case in Germany for using "ES6" and "ES8," which were deemed too similar to Audi's "S6" and "S8," harming its brand reputation.

These examples, along with survey data, show that Chinese NEV firms face two major IP issues in BRI markets: core technology protection and brand management. Patent infringement risks are significant in areas like batteries and motors, while trademark conflicts arise due to differing legal systems. To mitigate these risks, companies should enhance patent planning, conduct early risk assessments, and proactively register trademarks in target markets. Strengthening cross-department collaboration between legal and technical teams is also crucial for robust IP management.

5.2. Intellectual property protection status along the Belt and Road Initiative

5.2.1. Overview of the current situation

Significant regional disparities in IP protection along the Belt and Road Initiative pose varied challenges for Chinese firms. Developed markets (e.g., Europe, parts of Southeast Asia) benefit from robust legal systems—such as the unified European Patent Convention—but face complex, costly application procedures that raise market-entry barriers. Emerging economies (e.g., India, Pakistan) have improved their IP frameworks yet suffer from weak enforcement and low public awareness, leading to frequent infringements. In many Central Asian and African countries, nascent laws and enforcement gaps make technology theft and trademark violations commonplace. Addressing this uneven landscape requires stronger international cooperation to bolster IP regimes and demands that enterprises enhance compliance and risk-management practices for sustainable overseas expansion.

5.3. Characteristics of intellectual property protection in major countries and regions

Under the Belt and Road Initiative, cooperation between Chinese new energy vehicle companies and countries along the route has deepened. However, differences in intellectual property protection systems across countries present challenges for cross-border cooperation and raise higher demands for companies' technology output and market expansion. As key Belt and Road partner countries, Indonesia, Egypt, Brazil, and Italy's intellectual property protection characteristics are of significant reference value for China's global strategy.

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5.3.1. Indonesia

Indonesia's intellectual property protection system covers patents, trademarks, designs, and copyrights. On October 28, 2024, Indonesia enacted Patent Law No. 65, which amended the previous Patent Law No. 13 from 2016 [10]. The most significant change is the obligation to use registered patents in Indonesia, or they may easily become invalid or subject to compulsory licensing. This marks the possibility of delaying the use of registered patents by submitting a written request to the Indonesian Patent Office. If a registered patent is not used in Indonesia within 36 months after registration, a compulsory license can be applied for.

In the electric vehicle (EV) sector, cooperation between Chinese companies and Indonesia is deepening. For example, BYD plans to invest $1.3 billion in building an electric vehicle factory in Indonesia, producing electric buses and passenger cars. This factory is expected to begin construction by the end of 2024 and start production in January 2026, with an annual capacity of 150,000 vehicles. Additionally, SAIC-GM-Wuling is investing $1 billion to build a new automobile production base in West Java, Indonesia, including a main plant and supplier park, with an annual production capacity of 120,000 vehicles.

5.3.2. Egypt

Egypt's intellectual property protection system is based on international standards and covers areas such as patents, trademarks, copyrights, and industrial designs. As a member of the Paris Convention and the Berne Convention, Egypt has a relatively complete intellectual property legal framework. However, its enforcement and public awareness remain insufficient, which limits the practical effectiveness of these laws [11]. BYD's plan to establish an electric vehicle assembly plant in Egypt highlights the market's potential, but the weak intellectual property protection may expose companies to more risks in technology transfer. To address this challenge, businesses should clarify intellectual property ownership at the early stages of cooperation and strengthen their defense capabilities in technology transfer and brand protection through local partners. Additionally, collaborating with Egyptian universities and technical institutions can help increase technology recognition and reduce the likelihood of infringement.

5.3.3. Brazil

Brazil's intellectual property protection system aligns with international standards, but its low enforcement efficiency and lengthy judicial processes remain significant obstacles [12]. In recent years, JAC Motors has demonstrated the potential of Chinese car manufacturers in the Latin American market through collaborations with Brazilian companies to promote the production and sales of new energy vehicles. However, the complex patent environment requires companies to conduct thorough patent analysis and market research in advance. Especially in key technology areas such as power batteries and electric control systems, Chinese companies need to ensure the legality of their technological solutions while strengthening collaboration with local law firms to establish a quick-response mechanism for patent disputes.

5.3.4. Italy

Italy's well-established intellectual property protection system and efficient judicial system provide a favorable environment for the technological output of Chinese enterprises (China Intellectual Property Network, 2014). NIO's successful establishment of a design center in Turin, Italy, demonstrates how combining Italy's strengths in design and engineering can enhance product competitiveness. However, this strict protection system imposes higher compliance requirements on

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enterprises. Especially when it comes to protecting core technologies and patents for new energy vehicles, companies need to actively participate in local industry standard-setting to gain more market leverage. Additionally, strengthening cooperation with local Italian supply chains can not only optimize resource allocation but also enhance the overall efficiency of intellectual property protection.

5.4. IP protection paths for international cooperation in the NEV industry

Under the Belt and Road Initiative, the international cooperation of China's new energy vehicle industry has deepened, but the complex and ever-changing intellectual property protection environment presents new challenges for enterprises. Based on current practices and research analysis, intellectual property protection can be approached from three levels: macro, meso, and micro, forming a multidimensional protection pathway.

5.4.1. Macro level: national policies and international cooperation

The government plays a key role in intellectual property (IP) protection by strengthening legal frameworks, enhancing international cooperation, and improving dispute resolution. Strengthening IP laws, such as enforcing punitive damages, helps enterprises in global disputes. China actively engages in treaties like the Paris Convention and PCT, providing businesses with better patent procedures and legal support. Additionally, initiatives like the Intellectual Property Dispute Response Center and international arbitration courts improve cross-border IP protection and dispute resolution efficiency.

5.4.2. Meso-level: the coordinating role of industry associations

Industry associations serve as a vital bridge between enterprises and policies, playing a key role in coordinating and advancing IP protection. First, establishing risk warning mechanisms is a core responsibility. For example, the Automotive Overseas IP Infringement Early Warning Platform integrates research on foreign legal environments and infringement cases to help enterprises identify and mitigate IP risks in international cooperation. Second, information sharing enhances industry-wide IP protection. By creating case databases, legal repositories, and industry guidelines, associations provide practical support. Interviews highlight that regular seminars analyze infringement cases, equipping enterprises with effective response strategies. Additionally, industry associations play a crucial role in IP training and awareness campaigns, strengthening enterprises' ability to navigate complex global markets.

5.4.3. Micro-level: internal practices and responses of enterprises

The government plays a crucial role in intellectual property (IP) protection. Strengthening the legal framework, such as enforcing punitive damages and enhancing law enforcement, boosts enterprises' legal support in international disputes. Experts highlight that a robust national IP system improves firms' ability to navigate global conflicts.

International cooperation is key, with China actively participating in agreements like the Paris Convention and PCT, simplifying patent applications and dispute resolution. The Intellectual Property Dispute Response Center aids businesses along the Belt and Road Initiative with risk warnings and legal support. Additionally, establishing arbitration committees and international commercial courts enhances dispute resolution, reducing IP risks in cross-border collaborations.

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6. Summary and discussion

The Belt and Road Initiative (BRI) has created vast opportunities for international cooperation in the new energy vehicle (NEV) industry, especially amid the growing demand for green transportation in emerging markets. Investments in new energy infrastructure along BRI countries further provide NEV enterprises with favorable conditions for expanding into global markets. However, the complexities of cross-border collaboration also bring significant intellectual property (IP) protection challenges. Differences in the maturity and enforcement of IP laws across countries can lead to risks such as patent infringement and technology leakage. For instance, in a Southeast Asian country with an underdeveloped IP protection system, some companies have faced trade secret breaches during technology transfer processes.

To address these challenges, industry associations can play a coordinating role by establishing international IP-sharing platforms that provide patent searches and technical protection guidance. Enterprises should strengthen the standardization of contractual terms, clearly defining IP ownership in technology transfer agreements. Meanwhile, governments should enhance participation in multilateral agreements, such as the Hague Agreement, to promote a fair and transparent global IP protection framework, ensuring legal support for enterprises engaged in BRI collaborations.

7. Strategies and recommendations

A comprehensive, multi-tiered intellectual property (IP) strategy is critical for Chinese new energy vehicle (NEV) firms seeking to expand along the Belt and Road Initiative. At the national level, China should strengthen both its domestic and international IP safeguards through expanded bilateral and multilateral treaties, the empowerment of specialized IP service agencies to offer policy guidance and risk assessments, and the enhancement of arbitration and litigation mechanisms to project greater global influence. Within the NEV industry, associations ought to establish unified IP platforms that disseminate legal updates, issue risk alerts, and present illustrative case studies, while also fostering technical cooperation and the joint development of core innovations, and providing tailored legal-technical support to facilitate market entry. At the enterprise level, companies must implement end-to-end IP management—conducting thorough market due diligence, defining IP ownership explicitly in contracts, securing proprietary technologies via patents and nondisclosure agreements, and delivering employee IP-compliance training—to minimize cross-border risks. By aligning robust policy frameworks, collaborative innovation efforts, and rigorous internal controls, Chinese NEV firms can more effectively navigate heterogeneous IP environments in BRI markets, enhance their competitiveness, and contribute to sustainable global development.

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