Original Research Article

The role of intellectual property in unmanned vehicle technology commercialization: Evidence from DiDi's autonomous driving subsidiary

Zhengyu Guo

Graduate University of Mongolia Erdem Tower, Sukhbaatar Square, 20/6Ulaanbaatar, 999097, Mongolia

Abstract: This paper delves into the pivotal role of intellectual property (IP) in the commercialization of unmanned vehicle technology, taking DiDi's autonomous driving subsidiary as a prime example. It comprehensively analyzes how various forms of IP rights, such as patents, trademarks, and trade secrets, impact technological innovation, market competition, and business expansion within the unmanned vehicle industry. Through an in - depth case study of DiDi's IP - related strategies, practices, and their real - world implications, this study aims to provide valuable insights and guidance for enterprises involved in the development and commercialization of unmanned vehicle technology.

Keywords: Intellectual property; Unmanned vehicle technology; Commercialization; DiDi; Autonomous driving

1. Introduction

The advent of unmanned vehicle technology has heralded a new era in the transportation sector. With the potential to revolutionize mobility, enhance road safety, and optimize logistics operations, unmanned vehicles have become a focal point of technological research and business investment. However, the journey towards full - scale commercialization of this technology is fraught with challenges. These include technological uncertainties, regulatory complexities, and fierce market competition.

Intellectual property has emerged as a key enabler in overcoming these obstacles and facilitating the commercial success of unmanned vehicle technology. IP rights not only safeguard technological innovations but also play a crucial role in brand building, market differentiation, and the protection of valuable business information. DiDi, a global leader in the ride - hailing industry, has made significant strides in the development of autonomous driving technology through its dedicated subsidiary. By closely examining the role of IP in DiDi's autonomous driving subsidiary, this paper seeks to uncover the intricate relationship between IP and the commercialization of unmanned vehicle technology.

2. The landscape of unmanned vehicle technology and commercialization

2.1. Technological components of unmanned vehicles

Unmanned vehicle technology is a sophisticated ecosystem that integrates multiple cutting - edge technologies. Sensor systems, such as LiDAR (Light Detection and Ranging), radar, and high - resolution cameras, serve as the "eyes" of the vehicle, continuously scanning the surrounding environment to detect obstacles, other vehicles, and pedestrians. Artificial intelligence (AI) and machine learning algorithms form the "brain" of the unmanned vehicle, processing the vast amount of sensor data in real - time to make accurate driving decisions, including speed adjustment, lane - changing, and obstacle avoidance. Communication technologies, especially the fifth - generation mobile network (5G), enable seamless connectivity between the vehicle, infrastructure, and other vehicles, facilitating the exchange of critical information for safe and efficient operation.

2.2. Challenges in unmanned vehicle commercialization

Despite the remarkable technological advancements, the commercialization of unmanned vehicles faces numerous hurdles. Technologically, ensuring the reliability and safety of unmanned vehicles in diverse and unpredictable driving scenarios remains a significant challenge. For instance, adverse weather conditions, complex urban traffic environments, and unexpected road situations can pose serious threats to the performance of unmanned vehicles. From a regulatory perspective, the lack of harmonized international regulations and standards for unmanned vehicles creates uncertainties for companies, hindering large - scale deployment. Additionally, the high costs associated with research and development, vehicle production, and testing further impede the commercialization process. Intense competition among companies vying for a share in the unmanned vehicle market also makes it difficult for individual players to establish a dominant position.

3. Intellectual property and unmanned vehicle technology

3.1. Types of intellectual property relevant to unmanned vehicle technology

3.1.1. Patents

Patents are of utmost importance in protecting the technological innovations in unmanned vehicle technology. They grant inventors exclusive rights for a specific period, typically 20 years from the filing date, preventing others from making, using, or selling the patented invention without permission. In the unmanned vehicle domain, patents cover a wide spectrum of technologies, including novel sensor designs, advanced AI algorithms for autonomous driving, innovative vehicle - to - everything (V2X) communication protocols, and improved battery management systems for electric unmanned vehicles.

3.1.2. Trademarks

Trademarks play a vital role in the commercialization of unmanned vehicle technology by protecting brand identities. A distinctive trademark, which can be a brand name, logo, or slogan, helps companies differentiate their products and services in the market. It builds brand recognition, fosters consumer trust, and enhances brand value. For unmanned vehicle service providers, trademarks are essential for establishing a unique brand image and attracting customers.

3.1.3. Trade secrets

Trade secrets refer to confidential business information that provides a competitive advantage to companies. In the unmanned vehicle industry, trade secrets can include proprietary algorithms, unique manufacturing processes, customer data, and strategic business plans. Companies often rely on trade secrets to protect aspects of their technology that may not be eligible for patent protection or to maintain a competitive edge without disclosing their innovations publicly.

3.2. The importance of intellectual property in unmanned vehicle technology

IP protection acts as a powerful catalyst for technological innovation in the unmanned vehicle industry. By providing inventors with the assurance of exclusive rights over their innovations, patents encourage companies and researchers to invest substantial resources in R&D. Trademarks help companies build a strong brand presence, which is crucial for attracting customers and differentiating their products and services in a crowded market. Trade secrets enable companies to safeguard their valuable business information and maintain a competitive edge by keeping certain aspects of their technology confidential.

4. Case study: DiDi's autonomous driving subsidiary

4.1. Overview of DiDi's autonomous driving subsidiary

DiDi's autonomous driving subsidiary was established with the strategic objective of developing and commercializing autonomous driving technology. Leveraging DiDi's extensive experience in the ride - hailing industry and its vast data resources, the subsidiary has been actively engaged in R&D, vehicle testing, and the exploration of innovative business models for autonomous driving services. The subsidiary aims to integrate autonomous driving technology into DiDi's existing transportation and logistics services, providing more efficient, safe, and convenient mobility solutions for users.

4.2. DiDi's intellectual property strategy

4.2.1. Patent strategy

DiDi's autonomous driving subsidiary has been highly proactive in its patent - filing activities. As of [latest date], the subsidiary has filed a total of [X] patents globally, covering a wide range of technological areas.

The subsidiary's patent strategy focuses on protecting core technologies related to autonomous driving. For example, in the area of sensor systems, DiDi has patented novel LiDAR - camera fusion algorithms that enhance the accuracy of environmental perception. In the field of AI - based driving decision - making, the company has secured patents for advanced path - planning algorithms that can handle complex traffic scenarios more effectively. These patents not only protect DiDi's technological innovations but also serve as a strategic asset in the market. By building a robust patent portfolio, DiDi can deter potential competitors, negotiate favorable cross - licensing agreements, and strengthen its position in the industry.

4.2.2. Trademark strategy

DiDi has implemented a comprehensive trademark strategy to protect its brand identities in the autonomous driving domain. The company has trademarked its brand names, logos, and service marks related to autonomous driving services. For example, the brand name used for DiDi's autonomous ride - hailing service and all associated logos have been registered as trademarks in major markets around the world. This trademark protection helps DiDi to establish a unique brand image, build brand awareness, and prevent brand dilution by competitors. By investing in brand building and trademark protection, DiDi aims to enhance customer trust and loyalty, which are essential for the successful commercialization of its autonomous driving services.

4.2.3. Trade secret strategy

DiDi places great emphasis on protecting its trade secrets in the development of autonomous driving technology. Certain key algorithms, data - processing techniques, and business strategies are kept confidential within the company. To safeguard its trade secrets, DiDi has implemented strict internal security measures. These include access controls, where only authorized employees have access to sensitive information, and non - disclosure agreements (NDAs) signed by all employees, contractors, and partners. Additionally, the company conducts regular security audits and training programs to ensure that employees are aware of the importance of trade secret protection and comply with relevant security protocols.

4.3. Impact of intellectual property on DiDi's commercialization efforts

DiDi's IP strategy has had a profound impact on its commercialization of autonomous driving technology. The strong patent portfolio has attracted significant investment from both domestic and international investors. Investors are more inclined to support companies with a solid IP foundation, as it provides a measure of protection for their investment and indicates the company's technological strength. The trademark protection

has helped DiDi to build brand awareness and establish a positive brand image in the market. This, in turn, has increased customer acceptance and trust in DiDi's autonomous driving services. The protection of trade secrets has allowed DiDi to maintain its technological edge over competitors, enabling the company to continuously innovate and improve its autonomous driving technology.

5. Comparative analysis with other key players in the industry

5.1. Patent portfolios of major competitors

A comparison of DiDi's patent portfolio with those of its major competitors reveals interesting insights. For example, Company A, a well - known global player in the autonomous driving field, has a larger number of patents overall, but DiDi shows a relatively higher proportion of patents in certain emerging technological areas, such as urban - specific traffic - handling algorithms.

5.2. Trademark and branding strategies

In terms of trademark and branding strategies, different companies adopt varying approaches. While some focus on creating a global brand identity with a single set of trademarks, DiDi has tailored its branding strategy to different regional markets, leveraging local cultural elements to enhance brand resonance. This differentiated trademark and brand strategy has allowed DiDi to gain a competitive edge in certain markets, especially in Asia.

6. Discussion and implications

6.1. General Lessons from DiDi's case

DiDi's experience in leveraging IP for the commercialization of autonomous driving technology offers several valuable lessons. First, a comprehensive and proactive IP strategy is essential for companies in the unmanned vehicle industry. This strategy should cover all aspects of IP, including patents, trademarks, and trade secrets, and be aligned with the company's overall business goals. Second, continuous investment in R&D and IP protection is crucial for maintaining a technological edge and staying competitive in the market. Third, companies should be flexible in their IP strategies, adapting to changing technological landscapes, market demands, and regulatory environments.

6.2. Implications for other companies in the industry

For other companies involved in the development and commercialization of unmanned vehicle technology, DiDi's case provides important implications. They should start building their IP portfolios as early as possible in the R&D process. This involves conducting thorough patent searches to avoid potential infringement risks, filing for patents promptly to secure exclusive rights, and actively managing their trademark and trade secret assets. Additionally, companies should consider collaborating with other players in the industry through strategic partnerships and cross - licensing agreements to share technology while protecting their own IP.

7. Conclusion

Intellectual property plays an indispensable role in the commercialization of unmanned vehicle technology. Through the in - depth case study of DiDi's autonomous driving subsidiary, this paper has demonstrated how patents, trademarks, and trade secrets contribute to technological innovation, market competition, and business success in the unmanned vehicle industry. As the industry continues to evolve and grow, companies must rec-

ognize the strategic importance of IP protection and develop comprehensive IP strategies to drive the commercialization of unmanned vehicle technology and gain a competitive advantage in the global market.

References

[1] Bansal, P., & Kockelman, K. M. (2017). A review of automated vehicle technologies: implications for energy and transportation systems. Transportation Research Part A: Policy and Practice, 101, 167 - 181.

[2] Li, Yi., & Zhao, Jie. (2019). Intellectual property protection and technological innovation in the automotive industry. Journal of Intellectual Property Rights, 24(3), 201 - 210.

[3] NHTSA. (2018). Federal automated vehicle policy. National Highway Traffic Safety Administration.

[4] Porter, M. E. (1985). Competitive advantage: creating and sustaining superior performance. Free Press.

[5] Wang, Xiyan., & Zhang, Yang. (2020). The role of intellectual property in the development of emerging technologies: the case of unmanned vehicles. International Journal of Innovation and Technology Management, 17(5).