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Intellectual Property Strategy Required for Startups to Join a New Business Ecosystem: A Case Study of Tesla

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Abstract

This paper provides a case study of Tesla's Intellectual Property (IP) strategy to clarify the effective IP strategy required for startups to join a new business ecosystem. It is not realistic for startups to file many patent applications comprehensively in each technology area because they lack sufficient funds and human resources to file patent applications. As a result of a case study of Tesla's IP strategy, it was found that it would be effective to file patent applications for the interface to avoid contractual problems due to overlapping business areas with the transaction entity and to spread the core technology.

Keywords: IP Strategy, Open-Source Patent, Business Ecosystem, Startup, Interface

1 Introduction

Expectations for electric vehicles (EVs) are increasing due to global warming. In approximately 2020, many countries announced plans to ban the sale of internal combustion engine vehicles in the future, such as gasoline and diesel vehicles, and shift to zero-emission vehicles. EV sales are now accelerating in the world's major automotive markets, especially in China, Europe, and the United States [1][2]. Until now, traditional automobile manufacturers focused on gasoline and diesel vehicles have built a long-term competitive advantage by strengthening the coordination of technologies such as engine control. However, they have been exposed to changes such as modularization and international division of labor due to the shift to EV [3]. At the same time, the coordination of technologies, which was a source of competitive advantage, will no longer work, and the cost of joining for startups that have no experience in manufacturing automobiles has decreased [4]. In the future, the power balance in the global automobile industry will be significantly changed.

In this context, Tesla, which had no previous experience in manufacturing automobiles, joined the EV industry and keeps releasing new EV models with great impact one after another. In particular, the Roadster was launched in 2008 as the first mass-produced EV. It is equipped with batteries, which is one of the core parts, and is not manufactured by Tesla but outsourced [5], and the body, such as the chassis, is also manufactured in collaboration with Lotus [6]. It can be positioned as the EV created with production changes such as modularization and an international division of labor.

In 2012, Tesla employed a car designer with a proven track record in Mazda North America to strengthen the design, and released Model S, a luxury sedan, Model X, a crossover SUV in 2015, Model 3, a compact sedan in 2017, and Model Y, a crossover SUV in 2020 [7][8]. From July to

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September 2022, Tesla's consolidated net profits surpassed that of Toyota, with a net profit per vehicle of 1.32 million yen, which is eight times that of Toyota [9]. Tesla is now the leading innovation company in the EV industry.

Around the same time, Tesla also impacted the Intellectual Property (IP) strategy. In June 2014, Tesla pledged that all Tesla's patents would be released as open-source (In this study, we call such patents as "open-source patents".) [10]. This pledge caused various discussions. For example, negative evaluations were that it was nothing more than a "PR move" and that no competitors would use Tesla's technology because the definition of "good faith" as a condition for using an open-source patent is ambiguous. However, as an effective evaluation, it led Toyota to license approximately 5,700 fuel cell technology patents free of charge until 2020, meaning Tesla's announcement also affected the IP strategies of traditional automobile manufacturers [11].

On the other hand, Tesla's breakthrough in the EV industry is not guaranteed to continue. Chinese company BYD is already chasing Tesla in the EV sales race [12][13], and even Toyota, which has adopted an all-directional strategy that is not limited to EVs plans to sell 1.5 million EVs annually by 2026 [14]. Tesla will soon be exposed to competition from traditional automobile manufacturers.

Regarding Tesla's IP strategy, the patent strategy may be one of the means as a startup to endure tough competition from traditional automakers and maintain its competitive advantage. Tesla pledged that all its patents would be released as open-source patents. However, it is stated on Tesla's website that "Tesla Patents" means all patents owned now or in the future by Tesla (other than a patent owned jointly with a third party or any patent that Tesla later acquires that comes with an encumbrance that prevents it from being subject to this Pledge) [15]. This means that not all Tesla's patents are open-source patents. In addition, it must not be ignored that the filing of the patent applications continues even after the open-source pledge. In fact, according to the list of open-source patents published on Tesla's website [16], approximately 280 US patents were not released as open-source patents, and only a few were owned with third parties as of October 31, 2022. In other words, despite Tesla's open-source patent pledge, Tesla also owns patents except for open-source patents to maintain its competitive advantage.

In addition, while traditional automobile manufacturers have much experience in filing many patent applications and have already filed many patent applications in the field of EVs, Tesla keeps filing a relatively small number of patent applications [17]. It is considered difficult for Tesla to keep the funds of filing many patent applications because Tesla is still in the growth stage. Therefore, Tesla may target in a specific technology field and file a minimal number of patent applications. Furthermore, the EV industry has progressed in modularization and the international division of labor, which did not appear in the previous stage of the automotive industry [3]. In particular, a new business ecosystem is being formed that includes an unspecified number of transaction entities, including existing automobile-related companies and battery-related electric and chemical companies from different industries. In the new business ecosystem, there is a possibility that Tesla has designed an "open area" where one of the core parts such as batteries are not developed by Tesla but outsourced [5][6], and a "closed area" where minimal patents protect core areas for building a competitive advantage for Tesla's business. Furthermore, Tesla might attempt to redesign an "open area" by releasing many of Tesla's patents as open-source patents and a "closed area" that are not released as open-source patents.

Furthermore, along with the design of a "closed area" based on patents, the design of an "open

area" through international standardization is also a subject of discussion. Some EV charging technologies have already been standardized. Currently, there exist CHAdeMO (mainly in Japan), Combo (mainly in Europe and North America), GB/T (China), and NACS (North American Charging Standard, which standardizes Tesla's charging connector and charging port) [18]. Tesla also provides adapters that enable charging of Tesla's EVs from each standardized charging station [19][20]. MPEG LA, a patent pool management company, publishes a list of standard essential patents (SEPs) related to standardized charging technology and licensors of these patents [21][22]. The licensors are GE Hybrid Technologies, LLC, Mitsubishi Heavy Industries, Ltd., Robert Bosch GmbH, Siemens AG, and Sun Patent Trust. What kind of IP strategy does Tesla, which is still in the growth stage, apply in the presence of SEPs owned by large electronics companies?

Tesla's IP strategies may represent the approach needed for startups to join a new business ecosystem such as the EV industry. Therefore, this study aims to analyze the IP strategies required for startups to join a new business ecosystem that includes an unspecified number of transaction entities, from different industries, as modularization and international division of labor progress.

This paper is organized as follows. Chapter 2 reviews the research on EV and battery manufacturer's patent strategies and patent application statistics for batteries and so on. Chapter 3 presents the research method. Chapter 4 analyzes Tesla's IP strategy. Chapter 5 summarizes IP strategies required for startups to join a new business ecosystem. Finally, Chapter 6 provides a conclusion.

2 Literature Review

Chena et al. show the architecture of Tesla's EVs, consisting of battery pack, electric motor, power electronics, charging infrastructure, body, and chassis, and analyze how these components have changed in terms of modular and integral, outsourcing and in-house production in the evolution from Roadster to Model S [3]. However, regarding the patent strategy it is only explained that all patents were released as open-source patents, and the relationship with these architectures is unclear. Also, as mentioned above, it is not realized that not all Tesla's patents are open- sources patents. This study clarifies the relationship between these architectural elements and patents, and between open-source patents and other types of patents.

Lang et al. point out that one area that plays an important role in EV modularization is the battery pack, which acts as an interface between the patented platform and the module [23]. However, in terms of the patent strategy, Lang et al. only mention that the platform has been patented but does not explain which kind of patents related to the platform exists.

Park et al. describe a collaboration between EV companies and battery manufacturers [17]. Comparing the number of battery and charging patents among EV companies, Toyota has more than Volkswagen and Tesla, but Tesla has the highest number of EV sales, among battery manufacturers Panasonic and LG Chem are outstanding, but the Chinese company CATL has the largest number of sales, which means that technical superiority through patents does not necessarily lead to business success. Furthermore, while Toyota is strengthening patent filing for all-solid-state batteries, which are attracting attention as next-generation batteries, CATL is focusing on LiFePO4, which are inexpensive batteries that are easy to mass produce. It is hypothesized that Tesla maintains its competitive advantage by providing cheap CATL batteries to Tesla. This is

considered a competitive advantage brought to Tesla by positioning batteries as an open area in the modularization and international division of labor of EVs and by outsourcing batteries at low cost. However, the relationship between competitive advantage as a result of outsourcing and Tesla's patents is not explained. Furthermore, Park et al. focus on the number of batteries and charging patents, but these patents are not further classified; thus, the kind of IP strategy designed with a small number of patents has not been analyzed.

According to battery patent statistics from 2000 to 2018 compiled by the EPO and IEA [24], Japan and South Korea are leading the battery technology competition, and seven of the top 10 patent applicants are Japanese companies. Panasonic and SONY, the top 10 companies, have been long-term leaders in this field, but others have increased their patent applications for lithium-ion batteries for EVs. In recent years, LG Electronics, Toyota, Nissan, and Bosch have rapidly increased patent applications for automotive batteries. Furthermore, since 2011, battery pack patents for automobiles have continued to increase because battery packs have different structures depending on their uses, and battery research has shifted from basic research to commercialization activities. These patent statistics indicate quantitative trends in patent applications and show the macro trends of some large companies. However, it is difficult to clarify the patent trend of a company with a small number of patents such as Tesla using such patent statistics. This study not only conducts a quantitative evaluation, but also examines the technology fields with a small number of patent applications to analyze the quality of patent strategies.

Furthermore, regarding open-source patents, there is prior research on outbound open innovation aimed at creating and acquiring value through the diffusion of technology to the outside. For example, Enkel et al. point out that to make a profit by multiplying technology, ideas are brought to the market, the IP is sold, and the ideas are transferred to the external environment [25]. However, it is also pointed out that anyone who implements Tesla's open-source patents automatically gives Tesla the right to implement their patents. Furthermore, because Tesla has already acquired major patents for EVs, when major automakers enter the EV market in the future, they will need to license Tesla's patents [26]. Therefore, this study analyzes whether Tesla's open-source patents have promoted outbound open innovation and whether Tesla's patents have given an impact on competitors.

3 Research Methods

3.1 Target of Analysis

Since many of Tesla's open-source patents have been filed in the United States, this study focuses on US patents and design patents. In addition, because the filing dates of Tesla's open-source patents are between 2006 and 2015, Tesla's open-source patents and other patents filed from 2006 to 2015 were analyzed.

3.2 Classification/Extraction of Relationship

In this study, we read the scope of rights of all Tesla's patents and design patents and gave a more detailed classification than that of previous studies. This classification makes it possible to analyze the outsourcing area (open area), the in-house development area (closed area), the interface between open and closed areas, and the SEPs regarding EV charging technology provided by MPEG LA website [22].

If there is a citing/cited relationship between multiple patents/design patents, it can be considered that those patents/design patents include at least a partial technology/design relationship. Therefore, in this study, when patents/design patents cite certain patents/design patents, we considered that these patents/design patents have a relationship of improved patents/design patents over certain patents/design patents. Then, using the relationship we organized the relationship between the open-source patents/design patents and other patents/design patents.

3.3 Extraction of Relationship of Other Companies

In order to confirm whether Tesla's open-source patents promoted innovation such as improved inventions by other companies, we compared the number of citations of Tesla's open-source patents with those of Tesla's other patents. In addition, the EV industry is built as a new business ecosystem that includes an unspecified number of transaction entities, existing automobile-related companies, and battery-related electric and chemical companies from different industries. Therefore, to confirm whether the business areas of Tesla and other companies in the EV industry overlap or not, we analyzed the citation relationship between Tesla's patents and the patents of other companies.

4 Analysis of Tesla's IP Strategy

4.1 Scope of Patents/Design Patents

Table 1 shows the results of the classification based on the scope of patents/design patents. Due to space limitations, only the results of breaking down the battery and charging technology are presented here. In recent years, patents for battery packs have increased more than for battery cells [24]. In Tesla's case, the maximum number of 52 open-source patents for the structure of the battery pack were confirmed; in contrast, there were no patents for the battery itself. The reason is explained below.

Tesla had been outsourcing batteries since its founding [5], but in June 2014, in collaboration with Panasonic, Tesla started to build the Gigafactory to manufacture batteries and other products in-house [27], which means Tesla shifted production from outsourcing to in-house. However, even though it now engages in-house production, Panasonic and Tesla have separate floors in the Gigafactory, and the battery cells manufactured by Panasonic are then handed over to Tesla [27]. Therefore, it is considered that Tesla is still outsourcing technology to transaction entities within the EV industry business ecosystem, rather than engaging in self-sufficient development. In 2018, more than 6,000 battery technology patent applications were filed in major countries [24]. In general, when a significant number of patent applications are filed in a technology field, it is difficult to avoid implementation of many patents owned by competitors; thus, it may be necessary to enter into cross-licensing agreements. As a result, companies may be forced to license their own high-value technologies to competitors in exchange for competitors' technologies. It is assumed that this same situation can be occurred with EV battery technology, but Tesla, which is still in the growth stage, has little motivation to actively develop battery technology and file many patent applications of battery technology. Tesla may have decided that it is better to outsource batteries to a company that owns battery technology, entering into a partnership with Panasonic, which ranks among the top 10 companies in the world in battery technology patents from 2000

to 2018. Tesla may have adopted a strategy of entrusting Panasonic with strengthening its patent portfolio and cross-licensing agreements related to battery technology.

Table 1: Relationship between 3 Patterns of Open & Closed Strategy and Tesla's Patents

Classification		Registered Patents			Registered Design Patents		
		Open-Source Patents: 237		Non Open-Source Patents: 47	Open-Source Design Patents: 11		Non Open-Source Design Patents: 8
		Pattern 1: Full Open-Type	Pattern 2: from Open-Type to Close-Type	Pattern 3: Full Close-Type	Pattern 1 Full Open-Type	Pattern 2 from Open-Type to Close-Type	Pattern 3 Full Close-Type
Battery	Characterized by the Battery Control (ex.Thermal Control)	13	21	1			
	Characterized by the Structure of the Battery Pack	23	29	2			
	Characterized by the Battery Control (Others)	6	2				
	Combined Use of the Metal-Air Battery		7				
	Combined Use of the Engine	3					
	Method of Replacing the Battery Pack			2			
	Refining Method of NMP Used in Battery Manufacturing Process			1			
Charging	Control/System (Rapid Charging)	2	2	1			
	Control/System (Charging of the Metal-Air Battery)		5				
	Control/System (Optimizing the Charging Environment)	3	5				
	Control/System (Selection of Charging Method)	8	7				
	Control/System (Prevention of Battery Deterioration)	2	4	2			
	Control/System (Power Distribution for Multiple Charging Ports)	2					
	Control/System (Using AC Power)	1	1				
	Control/System (Others)	2		1			
	Connector	4			2		
	The Door of Charging Port	5					
	Adapter			1			
	Charging Stand (Public)				2		
	Charging Stand (Private)						1

Why, then, did Tesla focus on patenting battery packs? In a sense, it is only natural that patents for battery packs for EVs will increase in order to install batteries in EVs. However, if the battery is a completely outsourced area, as in Tesla's situation, there may be another reason to focus on patenting the battery pack. Within the business ecosystem of the EV industry, not all transaction entities are necessarily separated. Boundaries between entities, that is, different business areas of companies, can overlap. In fact, as shown in Table 2, nine out of Tesla's 52 patents related to the structure of battery pack cited the patents of Panasonic, a known battery manufacturer, and six patents were cited by Panasonic. It was confirmed that other battery manufacturers also have a similar citation/cited relationship. In other words, Tesla's business areas and battery manufacturers overlap in the field of the battery pack. As various battery manufacturers can be candidates for negotiations regarding outsourcing batteries, there is a risk that some battery manufacturers will require Tesla to buy not only batteries but also other technologies including battery packs. In other words, there is a possibility that various interventions will occur in the company's business domain, resulting in an increase in transaction costs. To avoid this risk, it is effective to obtain a large number of patents for battery packs to form barriers not to be entered into the Tesla's business domain and to create favorable conditions for advancing contracts.

Table 2: The Number of Citations of Tesla's Patents

Characterized by the Structure of the Battery Pack: 52	
Citation of Panasonic: 9	Cited by Panasonic: 6
Citation of CATL: 0	Cited by CATL: 4
Citation of LG: 2	Cited by LG: 9
Citation of Samsung: 9	Cited by Samsung: 18
Characterized by the Battery Control (ex.Thermal Control) : 34	
Citation of Panasonic: 7	Cited by Panasonic: 3
Citation of CATL: 0	Cited by CATL: 4
Citation of LG: 0	Cited by LG: 5
Citation of Samsung: 2	Cited by Samsung: 15
Charging Connector: 4	
Citation of Mitsubishi Motors: 1	Cited by GM: 1
Citation of Ford, GM, Volkswagen, BMW, AUDI, Hyundai, Toyota, Nissan: 0	Cited by Ford, Volkswagen, BMW, AUDI, Hyundai, Toyota, Nissan, Mitsubishi Motors: 0

Additionally, as shown in Table 2, 34 patents related to battery thermal control were identified. The battery temperature affects charging efficiency and battery life, thus, it affects the quality of EVs. Seven of 34 patents cited Panasonic's patents and three were cited by Panasonic; other battery manufacturers had similar relationships. In other words, similar to battery pack, business areas may overlap. These citation relationships show that to obtain efficient patents, interfaces should not only be captured as structural interfaces such as battery pack, but should also be captured as control interfaces such as battery thermal control, which may overlap with other companies' business domains.

However, in contrast to the battery pack, only four patents and two design patents were confirmed for the charging connector, which is the interface between the battery and the charging station (see Table 1). As mentioned above, EV charging has been standardized in each region, but the shape of the charging connector varies from region to region. Thus, as shown in Table 2, the four patents have no citation relationship with major battery manufacturers, and only one of Tesla's patents cited a patent of a traditional automaker, Mitsubishi Motors and one of Tesla's patents was cited by GM. This is probably because the charging connector is not positioned as an interface with an outsourcing area like a battery pack.

4.2 Relationship Between Open-Source Patents and Other Patents

(1) Pattern of Open and Closed Strategy

Figure 1 shows the transition in the number of open-source patents/design patents and other patents/design patents. As a whole, patents/design patents with old filing dates were released as open-source patents, but there are a certain number of patents with old filing dates that have not

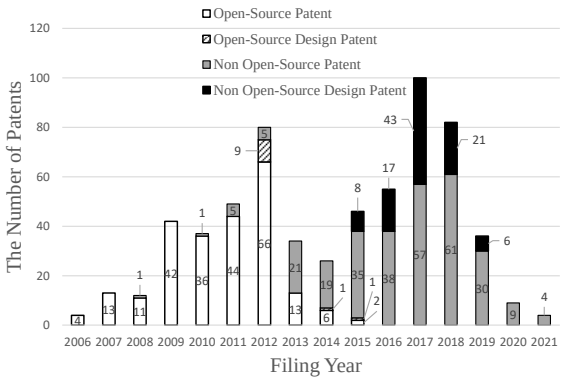

Figure 1: The Number of Tesla's Patents

been released as open-source patents. As described in **3.2**, we analyzed the relationship between these patents/design patents using the citation relationships and found the following three patterns.

Pattern 1: Open-source patent/design patent, and improved open-source patent/design patent is also open-source patent (full open-type). It is expected that Tesla's technology/design will be widely used in the market, and eventually becoming the de facto standard by encouraging other companies to implement and improve Tesla's technology/design.

Pattern 2: Open-source patent/design patent, but improved open-source patent/design patent is not open-source patent (from open-type to closed-type). It is expected that Tesla's basic or older technology/design will be widely used in the market, eventually becoming the de facto standard by encouraging other companies to implement and improve Tesla's basic or older technology/design. In addition, it is expected that Tesla maintains its competitive advantage with the latest technology/design, while encouraging other companies to improve Tesla's technology/design to the extent that they do not infringe on Tesla's improved patents/design patents.

Pattern 3: Non-open-source patent/design patent, and improved non-open-source patent/design patent is also non-open-source patent (full closed-type). It is possible to allow other companies to implement the Tesla's technology/design or enable Tesla to enforce the patents/design patents to other companies depending on the circumstances.

(2) Response of Other Companies

Table 3: The Average Number of Citations of Tesla's Patents

Filing Year	Open-Source Patents		Non Open-Source Patents	
	The Number of Patents	The Average of the Citation	The Number of Patents	The Average of the Citation
2006	4	38.8		
2007	13	140.0		
2008	11	27.1	1	8.0
2009	42	33.6		
2010	36	30.3	1	5.0
2011	44	26.3	5	31.0
2012	66	17.4	5	12.4
2013	13	10.0	21	13.3
2014	6	19.0	19	9.7
2015	2	6.0	35	8.1

Table 3 shows the average number of citations for open-source patents and other patents. No significant difference was found between them. It is unclear whether other companies implemented these open-source patents or not, and it is considered that the improvement of open-source patents by other companies was not promoted. Therefore, outbound open innovation may not have been encouraged.

4.3 Relationship Between the Scope of Patents and Three Patterns of Open/Closed Strategies

Table 1 presents the relationship between the scope of patents and the three open/closed strategy patterns. Due to space limitations, only the results of breaking down the battery and charging technology are presented here. The 121 patents (51%) of the 237 open-source patents belong to Pattern 2, of which 83 patents (35%) are related to batteries and charging. In addition, there are 90 patents (38%) that follow Pattern 1 that coexisted with Pattern 2, and 24 patents (10%) of only Pattern 1.

Here, focusing on the "charging connector", which is the interface between the battery and the charging station, not only the patent, but also the design patents belong to only Pattern 1. Therefore, the charging connector is thoroughly open area. In addition, the charging adapter that allows the chargers to connect with different connector shapes that are standardized in each region belong to only Pattern 3. Therefore, the charging adapter is thoroughly closed area.

4.4 Relationship between Tesla's Patents and International Standardization

(1) Relationship between Tesla's Patents and SEPs Managed by MPEG LA for Charging Technology

The SEPs related to EV charging include 35 US patents [22]. The citation relationship between these SEPs and Tesla's US charging patents were analyzed. Only one of Bosch's SEPs was cited by one of Tesla's open-source patents, which may indicate that the technical relationship between the SEPs and Tesla's patents is weak. As shown in Table 1, Tesla's open-source patents related to EV charging are classified into rapid charging, selection of charging method, and so on. On the other hand, 35 SEPs are related to the authentication method and billing method at the time of charging and so on.

So, what explains the weak technical relevance? While standardized areas are cooperative areas, Tesla may not have aimed for SEPs for EV charging technology, but instead aimed to build a competitive advantage by improving the charging technology performance independently, such as rapid charging technology. This is related to Tesla's patents on charging, including Pattern 2 and 3 that can be enforced on competitors depending on the situation. In addition, most of the licensors of EV charging SEPs are large companies with long patent application experience. Tesla may have avoided engaging in patent filing competition with large companies, as it did in the case of the battery.

(2) Relationship between Tesla's Charging Technology and Charging Connector

For Tesla to build a competitive advantage in EV charging technology, it is necessary to not only improve Tesla's charging technology, but also to increase Tesla's own charging stations. First, however, some type of strategy is required to spread Tesla's EV charging technology because the shape of the charging connector differs for each international standard.

Regarding this point, as shown in **4.3**, Tesla has patents/design patent for the charging connector, which is the interface between the battery and the charging station, as in Pattern 1. It is considered that Tesla encouraged other companies to join Tesla's charging station business. Furthermore, in 2022 Tesla released the technical specifications and Computer Aided Design files of the charging connector [20].

However, the charging adapter that enables charging even with charging connectors of different standards belongs to Pattern 3. Regarding the charging connector and adapter, in 2021, Elon Musk said on Twitter, "We're making our Supercharger network open to other EVs later this year" [28]. A senior White House official appears to have urged automakers, including Tesla, to open their charging systems to other EVs; however, while Tesla's charging system is capable of rapid charging, the charging systems of other automakers are slow charging [29]. Therefore, in the near future, Tesla's rapid charging technology can be a differentiating factor. However, even if the charging system is opened to other EVs, the charging connector must be the same or a charging adapter must be used. Therefore, Tesla may have opened the charging connector to standardize Tesla's charging technology as a de facto standard. In addition, as long as other companies also have charging stations, the charging adapter may become a source of revenue for Tesla; therefore, the charging adapter patent may be kept closed as Pattern 3.

5 IP Strategy Required for Startups to Join a New Business Ecosystem

As explained in Chapter 4, while there are already many patents related to battery technology, Tesla, which is still in its growth stage, has little motivation to actively research and develop batteries and file many patent applications, Tesla may have decided that it is preferable to outsource battery technology to a major battery manufacturer which has many patents of battery technologies. In addition, transaction costs may increase when outsourcing batteries because various battery manufacturers can be candidates for negotiations. Tesla may have filed many patent applications for the interface to form barriers not to be entered into the Tesla's business domain and to create favorable conditions for advancing contracts.

Additionally, while some EV charging technologies are being standardized, Tesla may not have aimed for SEPs for EV charging technology, but, instead, sought to file patent applications for improving the performance of charging technology, for example, rapid charging technology to build a competitive advantage. Furthermore, Tesla may have aimed to spread its high-performance charging technology by open-source patents for the charging connector, which is the interface between the battery and the charging station.

It is not realistic for startups to file many patent applications comprehensively in each technology area because they lack sufficient funds and human resources to file patent applications. As mentioned above, the strategy of filing patent applications focusing on the interface combined with an open-source patent strategy can be very effective.

However, it was also suggested that the open-source patent strategy may not necessarily be working. This study does not conclude that the open-source strategy is ineffective. The definition of "good faith," a condition of using the open-source patent is ambiguate [11]; that is, anyone who implements Tesla's open-source patents automatically gives Tesla the right to implement

their patents [26], which means that the conditions of implementation of open-source patents may hinder their promotion.

6 Conclusion

This study clarified the IP strategy required for startups to join a new business ecosystem. It is not realistic for startups to file many patents comprehensively in each technology area because they lack sufficient funds and human resources to file patent applications. A case study of Tesla's IP strategy has shown that it would be effective to file patent applications for the interface to avoid contractual problems due to overlapping business areas with the transaction entity and to spread the core technology; however, careful consideration is required to execute an open-source patent strategy.

This study focused on patents/design patents up to the filing date of 2015. However, the patents after 2016 included new technology, for example, neural networks, and as shown in Figure 1, the number of design patents is increasing. Therefore, it is necessary to analyze Tesla's IP strategy, including its recent strategy.

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