Strategies for Intellectual Property in Transformative Industries

A case study of the automotive industry on Sweden's west coast

Bachelor's thesis in Industrial Engineering and Management

SARA ARNESEN
MATHIAS BROBERG
NIMA HANSEN
DAVID NORDSTRÖM
MARCUS ODBRATT
VIKTOR TU

DEPARTMENT OF TECHNOLOGY MANAGEMENT AND ECONOMICS
DIVISION OF ENTREPRENEURSHIP AND STRATEGY

CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2021
www.chalmers.se
Bachelor's thesis TEKX04-21-03

Bachelor's thesis TEKX04-21-03

Strategies for Intellectual Property in Transformative Industries

A case study of the automotive industry on Sweden's west coast

IP-strategier i transformerande industrier

En fallstudie av fordonsindustrin på den svenska västkusten

SARA ARNESEN
MATHIAS BROBERG
NIMA HANSEN
DAVID NORDSTRÖM
MARCUS ODBRATT
VIKTOR TU

DEPARTMENT OF TECHNOLOGY MANAGEMENT AND ECONOMICS
Division of Entrepreneurship and Strategy
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2021

Strategies for Intellectual Property in Transformative Industries
A case study of the automotive industry on Sweden's west coast

SARA ARNESEN
MATHIAS BROBERG
NIMA HANSEN
DAVID NORDSTRÖM
MARCUS ODBRATT
VIKTOR TU

Bachelor's thesis TEKX04-21-03

Department of Technology Management and Economics
Chalmers University of Technology
SE-412 96 Gothenburg
Sweden
Telephone + 46 (0)31-772 1000

Gothenburg, Sweden 2021

Strategies for Intellectual Property in Transformative Industries
A case study of the automotive industry on Sweden's west coast

SARA ARNESEN
MATHIAS BROBERG
NIMA HANSEN
DAVID NORDSTRÖM
MARCUS ODBRATT
VIKTOR TU

Department of Technology Management and Economics
Chalmers University of Technology

SUMMARY

Problem
As industries' underlying technology alters, so does the needs of their IP strategy. This thesis investigates how firms in transformative industries adapt their IP strategies as the core technologies of their industry alters.

Purpose
The purpose of this thesis is to explore the usage of IP strategies in transformative industries and how rapid technological changes alter IP strategies.

Research Methodology
Academics and IP professionals have been interviewed and provided a framework for contemporary IP strategies to conceptualize the transition of industries. Through a case study of the automotive industry on the Swedish west coast, which is currently undergoing a rapid shift of electrification and automation, new challenges to IP strategy are unveiled. Interviews were held with key players of the automotive industry, and a quantitative patent analysis was performed.

Theoretical Grounding
IP strategy refers to the management of IPRs and the utilization of IP as a tool to manage technology within a firm. This thesis investigates the management of patents and other IPRs, and how they relate to business and innovation strategy. As industries become more software- and data-driven, the importance of IP increases and becomes a source of revenue through licensing and litigation, and innovation through facilitating collaboration.

Results and Implications
Research showed that firms are initiating renewal of their IP strategies but finding the transition of the IP culture cumbersome. These difficulties were observed to pose a hindrance to innovation. The innovation has not occurred in the types of IPRs used and patents remain the most important. However, they have evolved in their usage. IPRs have gained more strategic dimensions, especially patents. Changing the culture associated with IP was found to be challenging. However, companies that hired talent from outside of Sweden gave the IP department a more significant presence in the firm's management and/or spun off a part of its operation have progressed towards a more innovative IP strategy.

Keywords: Intellectual Property, Intellectual Property Rights, IP Strategy, Innovation, Technological Shifts, Automotive Industry, Patent Usage

Note: The report is written in English

SAMMANFATTNING

Problem
I samband med att industriers teknologier utvecklas, ändras även behovet av dess IP-strategier. Denna kandidatuppsats undersöker hur företag i transformerande industrier anpassar sina IP-strategier när deras kärnteknologi ändras.

Syfte
Syftet med denna tes är att utforska användandet av IP-strategier i transformerande industrier och hur snabba teknologiska skiften påverkar bolags IP-strategier

Metod
Akademiker och professionella inom IP har intervjuats och presenterat ett ramverk för rådande IP-strategier i syfte att konceptualisera transformationen i industrier. Genom en fallstudie av fordonsindustrin på den svenska västkusten, som i nuläget genomgår en radikal förändring mot elektrifiering och automatisering, uppdagas nya utmaningar för IP-strategier. Nyckelspelare inom fordonsindustrin intervjuades och en kvantitativ patentanalys genomfördes.

Teoretiskt Ramverk
IP-strategi omfattar både hanteringen av IPRs och hur IP används som ett verktyg för att förvalta teknologier inom ett företag. Denna uppsats undersöker användandet av patent och andra IPRs och hur dessa relaterar till företagets affärs- och innovations-strategier. Allt eftersom industrier blir mer data och mjukvarudrivna ökar vikten av IP och blir en inkomstkälla genom licenser och rättstvister, och en innovationskälla genom att främja samarbeten.

Resultat och Implikationer
Studien visade att företag har påbörjat förnyelsen av sina IP-strategier men svårigheter i förändringen av IP-kulturen har uppdagats. Dessa svårigheter att visar sig utgöra ett hinder för innovation av IP-strategier. Typen av IPR som används har inte förändrats, patent är fortfarande den vanligaste rättigheten. I stället har IPRs fått fler strategiska dimensioner, särskilt patent. Att ändra IP-kulturen har visat sig utmanande. Men företag som har anställt IP-kunniga från andra länder än Sverige, givit IP-funktionen större närvaro i företagsledningen och eller knoppat av delar av verksamheten har gjort stora framsteg gentemot en mer innovativ IP-strategi.

Nyckelord: Immaterialrätt, Immateriella Rättigheter, IP-strategi, Innovation, Teknikskiften, Fordonsindustri, Patentanvändande

Notera: Rapporten är skriven på engelska

Preface

> *"It's the end all, be all. There's trade secrets, there's copy rights, there's designs and there's patents. Patents are the key. If we were Disney I would say copyrights, If we were Netflix I would say copyrights. If we were Coca-Cola I would be talking about trade secrets and trademarks. But if you're a car company, it's patents, it's definitely patents."*
>
> - Raymond Millien, Chief IP Officer at Volvo Cars, April 2021

The study was conducted during the spring of 2021, as the last step of a bachelor's degree in Industrial Engineering and Management at Chalmers University of Technology. The thesis was written at the institution of Technology Management of Economics.

We are very grateful for Marcus Holgersson's contribution to the thesis, having facilitated collaboration with Laura Gisler, head of IP at Polestar, and providing invaluable insights into the field of IP and IP strategies. Additionally, we would like to acknowledge Laura Gisler, who has fueled our interest in IP and introduced us to its intricacies.

Furthermore, Charlotta Kronblad, our thesis advisor, has been instrumental in making this thesis a reality. She has been of major importance for the thesis, as she has guided us throughout the process.

Moreover, we would like to extend our utmost gratitude towards all the respondents who have taken their time to share their invaluable experiences and knowledge in the research field. Without your participation, this thesis would not be achievable.

Sara Arnesen
Mathias Broberg
Nima Hansen
David Nordström
Marcus Odbratt
Viktor Tu

Chalmers University of Technology,
14th of May 2021

Contents

List of Figures

List of Tables

Abbreviations

ARIPO - African Regional Intellectual Property Organization

CE - Combustion Engine

CEVT - China Euro Vehicle Technology (AB)

EPO - European Patent Office

EV - Electric Vehicle

FTO - Freedom to Operate

GHG - Greenhouse Gases

GM - General Motors

ICEV - Internal Combustion Engine Vehicles

IPR - Intellectual Property Right

IP - Intellectual Property

LOI - Letter of Intent

OEM - Original Equipment Manufacturer

PCT - Patent Cooperation Treaty

PRV - Patent- och registreringsverket
(Swedish Intellectual Property Office)

ROI - Return on Investment

R&D - Research and Development

SDGs - Sustainable Development Goals

SMEs - Small- and Medium-sized Enterprises

TPR - Tangible Property Rights

Telecoms - Telecommunications

VC - Venture Capital

WIPO - World Intellectual Property Organization

Nomenclature

Appropriability - Appropriability is the ability to capture returns from R&D investments.

Industrially applicable - Industrial applicable means that the idea has to be feasible. If the idea is purely theoretical, without any practical utility, it is not industrially applicable.

Innovation - An innovation is an invention that is commercially viable.

Invention - An invention is new and is created through creativity.

Minimal inventive step - Minimal inventive step means that a product must be creative and have a marked difference compared to earlier ways of conduct in the field.

Novel to the world - An invention is classified as novel if it is not part of the current knowledge in a particular field. Novelty is not something that can be proved, rather it is the absence of novelty that one is able to prove.

Patents - Patents grant the patent holder exclusive rights to an innovation. A patent is generally valid for 20 years and requires the applicant to give full disclosure of their invention.

Strategic disclosure - Strategic disclosure is a way to destroy the novelty of a certain innovation by publishing the knowledge concerned. This ensures that nobody is able to patent the innovation. However, the actor does not gain any exclusivity.

Tech - Tech refers to highly technical industries such as telecommunication and software industries.

Trade secrets - Trade secrets are a form of IPR. To be considered a trade secret, the information has to be of great value commercially, to be known only by a limited sphere of people, and the holder of the IPR must take adequate measures to keep the secret protected.

Introduction

1.1 Core Concepts of the Thesis

This section will present the core concepts of the thesis. It will begin by describing notions relating to intellectual property (IP), such as the intersection of innovation and intellectual property rights (IPRs), IP strategy, and the use of IP in transformative sectors today. Thereafter, the automotive industry on Sweden's west coast is described, as it provides the reader with the research context.

1.1.1 Intersection of Innovation and IPRs

The advancement of society is heavily dependent on our capability to contrive new ideas and creations (Saha & Bhattacharya, 2011). These new ideas and creations facilitate technological progress and innovations that are vital for achieving the sustainable development goals (SDGs) (United Nations, 2021a). If the SDGs are achieved by 2030, there is not only a potential to generate peace and prosperity on a healthy planet but also open up $12 trillion in market opportunities (United Nations Global Impact, 2021).

Inventors, artists, scientists, and businesses are investing time, money, and energy to develop innovations. However, without a proper system to protect the creator's IP, incentives for innovations will diminish (Saha & Bhattacharya, 2011). Thus, IPRs, such as patents, trademarks, design rights, trade secrets, and copyrights are significant sources for competition (Holgersson et al., 2018; Saha & Bhattacharya, 2011).

1.1.2 Background of IP Strategy

The concept of IP strategy is important for a firm's competitiveness (Holgersson et al., 2018; Krattiger et al., 2007), while the meaning of IP strategy is context-dependent (Krattiger et al., 2007). In some cases, it relates to the tactics which involve IPRs. In other cases, it is associated with the overall business strategy where IP is used as a tool to manage technology within a firm (Krattiger et al., 2007).

IP strategy is generally divided into external and internal IP strategies. The former comprises all activities that aim to exploit a firm's IPRs to its benefit (Krattiger et al., 2007). The financial return from IPRs can be accomplished through several approaches for example licensing and litigation (Ewing, 2012; Krattiger et al., 2007). These methods are needed since a firm seldom has sufficient complementary assets to fully exploit a new invention and therefore needs to use IP strategies for this purpose. Internal IP strategies cover all internal issues that relate to resources within an organization. These can range from valuation to coordination and information.

Further, IP strategy can be defined as strategic choices which involve IP or the intersection of access to complementary assets and the upsides of IPRs (Krattiger et al., 2007).

Under circumstances where innovation settings are complex, there is pressure on the firm in question to have an IP strategy that protects and in some cases also shares inventions as well as procure technology from external sources (Grimaldi et al., 2021; Holgersson et al., 2018). A firm's appropriability will also be affected both directly and indirectly by the choice of IP strategy in complex innovation settings (Holgersson et al., 2018).

1.2 IP in Transformative Industries

Transformative industries such as computers and electronics as well as transport equipment experience heavy investments in IP and research and development (R&D). The way firms are using IPRs is changing due to the transformative nature of the innovation landscape, the increased fragmentation of production value chains, and the heightened globalization of markets across industries (Organisation for Economic Co-operation and Development, 2016). These industries are continuing to become more data-driven as data have shown to be a key in gaining competitive advantages (Provost & Fawcett, 2013). Data lay the foreground for new business models as well as changing and improving core operations, and is, therefore, vital for a firm's competitiveness (McKinsey Global Institute, 2016).

The high rate of innovation, combined with an increased dependency on data has resulted in a shift in the usage of IPRs compared to other non-transformative industries (Backler et al., 2018). As transformative industries indulge in new unexplored technologies and business models, the affected IP strategies need to be aligned accordingly (Gowling WLG, 2018). Firms and industries that are expecting this wave of change have to prepare their IP strategies in order to effectively transform their business (Backler et al., 2018).

There is variation among innovation activities between different industries. Two of the most specialized industries in terms of technological fields are IT services and telecommunications (telecoms). Above 80% of these industries' associated patent portfolios are concentrated in four technological fields. Other IPRs such as trademarks have experienced a similar trend as patents (Organisation for Economic Co-operation and Development, 2016). Accordingly, there has been a surge of trademark applications in the last decade (Block et al., 2015).

1.2.1 IP in the Automotive Industry

There is currently a trend in the automotive industry to accelerate the substitution of traditional vehicles for new energy vehicles (McKerracher et al., 2020; Yang et al., 2019). This trend is not based solely upon technological changes, other factors are playing an important role in the transition as well (Gowling WLG, 2018; McKerracher et al., 2020).

There are regulations that drive the automotive market towards low-carbon options, improved fuel efficiency, and thus employ pressure on the elimination of internal combustion engine vehicles (ICEV) (Gowling WLG, 2018). Additionally, the attitude towards long-term decarbonization is taken more seriously by automakers and large fleet operators (McKerracher et al., 2020). Moreover, consumer preferences have shifted due to concerns around congestion, urban air quality, and fluctuating oil prices (Gyimesi & Viswanathan, 2011).

These underlying factors have all led to the emergence of connected and autonomous vehicles. Connected and autonomous vehicles, in particular, may require radical changes in the approach to IP, as the assets which need protection are significantly altered from the traditional automotive industry to one that is more data-driven (Gowling WLG, 2018; James, 2020). Unprecedented challenges are facing the automotive sector that demands an urgent re-evaluation of existing IP strategies (Gowling WLG, 2018; James, 2020).

Much of the current investments of the automotive industry are in areas that patents protect poorly, such as computer programs, computer-generated technology, data, and business models (Gowling WLG, 2018; Story, 2004). Hence, more emphasis might be directed to trade secrets and copyrights (Gowling WLG, 2018). Patents, trade secrets, and copyrights are the most important IPRs when regarding software (Story, 2004). According to Gowling WLG (2018), it has never been more crucial for the automotive industry players to identify and protect IP, to maintain freedom to operate (FTO), and review approaches to licensing. FTO allows a firm to conduct a special commercial business without infringing valid IPRs held by other actors within a certain domain.

In the report authored by Gowling WLG (2018), representatives of car manufacturers, telecoms firms, automotive industry suppliers, lawyers, and patent attorneys were asked several questions through a questionnaire regarding IP in the automotive industry. When asked whether IP rights will play a more crucial role in the sector, 95% of respondents answered yes. Moreover, patents were seen as the most significant IPR, with more than 65% of the respondents predicting that patent filings will increase.

1.2.2 Research Context: Automotive Industry

The automotive industry based on Sweden's west coast is one of the region's largest employers. It has shaped the entire business structure around Gothenburg and is now a key player globally in electrifying the automotive industry (Ottermark, 2020; Trouvé, 2020). It is mainly associated with Volvo Cars and Volvo Group. However, Polestar, a Swedish electric vehicle (EV) company, subsidiary to Volvo Cars, has recently drawn much attention in this region. With its rapid implementation of EV technology and innovative focus, it has begun altering the industry (Polestar, 2021).

The thesis will not only explore the IP strategies used by the actors in the automotive industry but also connect the actors' vision in achieving a climate-neutral future

with the SDGs, hence, connecting the notions of IP strategy and transformative industries with sustainability.

1.2.2.1 Volvo Cars

Volvo Cars is owned by Zhejiang Geely Holding of China since 2010 and was formerly a part of the Swedish Volvo Group until 1999 when the company was bought by Ford Motor Company (Volvo Car Corporation, 2021).

As Volvo Cars' head office, product development, and car production plant for the European market are located in Gothenburg, the company counts as a major player on Sweden's west coast (Volvo Car Corporation, 2021).

Not only does the company believe that electrification is a solution to become climate neutral. Tackling carbon emissions in the manufacturing network, operations, supply chain, and reusing along with recycling of materials are further emphasized, as the company wants to contribute to a sustainable future (Volvo Car Corporation, 2020).

1.2.2.2 Volvo Group

Volvo Group, a Gothenburg-based company, is a Swedish multinational manufacturer of trucks, buses, construction machinery, and marine- and industrial engines, founded in 1927. Their portfolio consists of many well-known brands, such as Volvo Trucks, Volvo Penta, Renault Truck, and Mack. Volvo Trucks is the largest manufacturer of heavy trucks in Europe and the second-largest in the world (Volvo Group, 2021a).

By developing and offering heavy-duty electric trucks, the company believes it can help its customers and transport buyers to achieve the SDGs. Additionally, Volvo Group aims to increase collaboration with different stakeholders, from customers and governments, to business partners and academia to facilitate the industry's transition towards more sustainable transport (Volvo Group, 2021a, 2021b, 2021c).

1.2.2.3 Polestar

Although Polestar is a start-up, it has already launched two different car models, Polestar 1 and Polestar 2. Polestar 1 is an electric hybrid whereas Polestar 2 is fully electric (Polestar, 2021). Last year in February the company unveiled Polestar Precept, a car model that represents Polestar's ambition in sustainability, technology, and innovation.

The Precept model is using recycled materials for the interior (Polestar, 2020), and it proves that concepts of circular economy can be implemented in the automotive industry. By leading the development of new technologies and innovations, Polestar strives to achieve net-zero greenhouse gas emissions.

1.3 Purpose

The purpose of this thesis is to explore the usage of IP strategies in transformative industries and how rapid technological changes alter IP strategies.

The thesis will contribute to the research on IP strategies in an increasingly technical and complex setting, the automotive industry. The automotive industry is innovating whilst adapting to customer demand for new technology. This research aims to examine whether their IP strategies are evolving simultaneously.

The choice of IP strategies as the focal point of the thesis is due to their growing importance, which has emerged as a consequence of an overall shift to technology and innovation.

1.4 Problem and Research Question

Previous research on IP strategy has paid much attention to the highly technological telecoms industry (Bekkers & West, 2006; Holgersson et al., 2018; Shurmer & Lea, 1995). As industries alter, their IP strategies must do so simultaneously, else, the business transformation is hindered (Backler et al., 2018).

IP strategy significantly impacts a firm's competitiveness (Granstrand, 1999; Holgersson et al., 2018; Krattiger et al., 2007), and transformative industries further its importance as multi-technological systems with complementary innovations often spread across actors. Thus, forcing firms' IP strategies to consider both protection and/or sharing of their own technologies (Holgersson & Wallin, 2017). Firms often fail to incorporate their IP and business strategy, especially as the latter is evolving (Lynskey, 2009).

The thesis seeks to investigate how IP strategies evolve in such industries, generating an academic contribution that can be implemented in a growing number of industries. The following research question has been formulated, to fulfill the purpose of the study:

> *Are firms, acting in a changing technological environment, innovating their IP strategies?*

The research question will be answered through a case study of the automotive industry, as it provides examples of firms in a changing technological environment. The case study is comprised of interviews with academics and IP professionals relating to IP in the automotive industry, interviews with IP professionals in the automotive industry, and a patent analysis.

As the automotive industry is undergoing a cataclysmic shift, it serves as an important case study, providing insights that can be generalized. Regulatory and societal forces pressure the automotive industry to eliminate the internal combustion engine (CE). Simultaneously, rapid shifts in connectivity and the core business model are occurring (Gowling WLG, 2018), altering both the product and its production. This

shift increases the importance of IP and demands an urgent re-evaluation of existing IP strategies (Gowling WLG, 2018; McKerracher et al., 2020).

As the automotive industry becomes progressively more software-driven, the needs in the automotive industry will transform to a more technologically focused industry, converging with previous highly technological sectors, and resulting in a fundamentally modified ecosystem (Gowling WLG, 2018; McKinsey Global Institute, 2016). This evolution requires significant changes in the IP strategy of the automotive industry (Dahl, 2020; Gowling WLG, 2018).

1.5 Limits and Scope

The thesis will be limited to examining automotive firms on Sweden's west coast. Hence, the case study will primarily investigate three firms, Volvo Cars, Volvo Group, and Polestar. As Volvo Group comprises many different brands targeting various markets globally, this thesis' focus will be solely on Volvo Trucks, as that division is Gothenburg-based.

The automotive industry encompasses both commercial vehicles and passenger cars, and the thesis will examine both. Additionally, the sustainability part of the research will regard sustainable transportation as a whole, not particularly the passenger nor the commercial side.

The thesis will not provide detailed technical descriptions of the assets which the IP is protecting, as the thesis' purpose is to examine IP strategy in transforming industries. Although IP legislation is similar throughout the world, it is still subject to national jurisdictions. The thesis will be limited to the Swedish laws of IP.

Furthermore, as most of the literature considers patents when introducing IP strategy, extensive coverage of this particular IPR is conducted. When interviewing respondents, patents were the main focus of the discussion. Therefore, the theoretical grounding covers patent strategy more in-depth, in comparison with other IPRs. The patent analysis was limited to filings to the European Patent Office, in order to assure that each filing which was counted was an unique invention.

Sustainability and Ethics

2.1 The Thesis' Connection to Sustainability

This section will describe how the thesis connects the overarching term of sustainability. It will further explore why action towards a more sustainable future is paramount and the main ways in which the automotive industry can transform to facilitate these changes. The third, and last, sub-section will focus on the actors in the automotive industry on Sweden's west coast and how they relate to a more sustainable future by regarding the SDGs.

2.1.1 Introduction to Sustainability

In 2015 world leaders agreed to 17 SDGs to achieve an improved and more sustainable future for everyone (The Global Goals, 2021). Many of these goals address the urgency of climate change by incorporating various objectives. Some of these objectives are good health and well-being, sustainable cities and communities, sustainable innovations, infrastructure, and industries (Barbier & Burgess, 2017).

The world's current reliance on fossil fuel is unsustainable and harmful to the planet. Thus there is a need to change the course of action in which energy is consumed and produced by implementing innovative technology. Climate action is crucial to counter one of the biggest threats to our survival (The Global Goals, 2021).

Countries adopted the Paris Agreement in 2015 to ensure climate action, which is the most significant global climate agreement to date (United Nations, 2021a). All countries partaking in the agreement aspire to limit global temperature rise below 2 degrees Celsius and reach global net-zero emissions. The implementation of the Paris Agreement is essential for achieving the SDGs (United Nations, 2021a). In addition, the agreement provides a roadmap for climate action that will reduce emissions and build climate resilience.

One way of reducing the reliance on fossil fuels is by reforming the transport sector by moving from traditional, gasoline-driven, vehicles towards electricity-powered vehicles (McCollum et al., 2014; McKerracher et al., 2020; Yang et al., 2019). There are many challenges in accomplishing this transformation, one being to outperform the already dominant technology on the market and continuously strive to create innovations for a sustainable society (United Nations, 2021a).

2.1.2 How the Thesis Contributes to Sustainability

In order to facilitate the creation of innovations, IPRs play an important role according to Racherla (2016) and Saha and Bhattacharya (2011), as they promote innovations by protecting business-focused inventions.

Furthermore, World Intellectual Property Organization (2004a, p.3) states that:

> *IP is needed for many reasons: First, the progress and well-being of humanity rest on its capacity to create and invent new works in the areas of technology and culture. Second, the legal protection of new creations encourages the commitment of additional resources for further innovation. Third, the promotion and protection of intellectual property spurs economic growth, creates new jobs and industries, and enhances the quality and enjoyment of life.*

Open innovation provides a framework that can be used to facilitate a sustainable transition. Incorporating multiple stakeholders and helping the diffusion of knowledge amongst them, thus enabling them to collaborate in achieving sustainability (McGahan et al., 2021). Managing IPRs is a key to enabling collaboration through open innovation (Gassmann et al., 2010; Holgersson et al., 2018). Thus, this thesis is deeply connected to the objectives of sustainability, as it studies IP strategies, promoting sustainable innovation.

The thesis will both be aiding sustainable transitions in all industries and provide automotive-specific observations. The section below will detail the challenges and opportunities facing the automotive industry in achieving the SDGs, and how they aim to contribute to a more sustainable future. The IP strategies required in this transition are evolving (Gowling WLG, 2018). This thesis will explore how the automotive industry is adapting to this change, thus, helping the industry's self-evaluation and help facilitate the change.

2.1.3 Sustainability: Automotive Firms

As the thesis employs a case study on the automotive industry on Sweden's west coast, it will provide an insight into the firms' current use of IP strategies. Additionally, the research will provide a basis for improving the IP strategies further. As IP strategies are imperative to facilitating the transition to fossil-free transportation, the thesis is closely linked to the automotive industry's ability to achieve the SDGs. Out of the 17 SDGs, the authors find that the five presented below are the most aligned with the automotive industry's transition to becoming more sustainable.

- SDG 3: Ensure healthy lives and promote well being for all at all ages
- SDG 9: Build resilient infrastructure, promote sustainable industrialization, and foster innovation
- SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable
- SDG 12: Ensure sustainable consumption and production patterns
- SDG 13: Take urgent action to combat climate change and its impact

While all the SDGs are interconnected, each chosen SDG is described in terms of the automotive industry's strive to become more sustainable. As the electrification

of vehicles is a major part of becoming more sustainable, the coverage of EVs will be substantial.

2.1.3.1 SDG 3 - Good Health and Well-Being

World Health Organization (2018b) claims that 93% of all children, under the age of 15 years, are exposed to toxic air. One driving factor in this development is the automotive industry. Thus, the reduction of pollution is crucial to ensure the well-being of all.

By transitioning from ICEVs to EVs, there is considerable potential in battling this dilemma (European Environmental Agency, 2018; Soret et al., 2014). European Environmental Agency (2018) points to EVs contribution to a reduced climate impact compared to ICEVs due to the increased proportion of renewable energy available (European Environmental Agency, 2018).

2.1.3.2 SDG 9 - Industry, Innovation and Infrastructure

The automotive industry has a key role in achieving SDG 9, particularly when it comes to fostering innovation. Some characteristics of the industry are the demand for rapid innovation and an extremely competitive environment. These conditions pressure innovation of IP strategy and structure of the R&D department. Firms turn towards unexpected collaboration to increase their innovation rate, such as the collaboration between Volvo Group and Daimler in the development of fuel cells (Volvo Group, 2020), even though they are competing on the same market.

However, actors in the automotive industry are not only focusing on the development of electric vehicles. By tackling carbon emissions in the manufacturing network, operations, supply chain, and reusing along with recycling of materials many of the actors aspire to promote sustainable industrialization as well (Polestar, 2021; Volvo Car Corporation, 2020; Volvo Group, 2020).

2.1.3.3 SDG 11 - Sustainable Cities and Communities

The automotive industry is a key player in achieving SDG 11. Currently, the industry contributes to an issue seriously harming the life in cities, noise pollution (Goines & Hagler, 2007). According to the European Environmental Agency (2018) when cars are stationary or at low speeds, the impact on noise pollution by the car is dependant on whether it is electric or uses a CE. In urban areas where cars are mostly going at slow speeds changing from ICEVs to EVs can contribute to improvements in making urbanisation a sustainable option (European Environmental Agency, 2018).

Another aspect of SDG 11 is ensuring that residents of urban areas have access to non-polluted air (United Nations, 2020), which as previously mentioned can be solved partly by the automotive industry (European Environmental Agency, 2018; Soret et al., 2014).

One of the sub-goals in SDG 11 is to improve road safety in cities (United Nations,

2021b). The technological advancements regarding road safety made in the automotive industry are therefore a direct contributor to SDG 11. Safety and driving assistant technologies, present in current production cars, already bring immense safety features and help reduce crashes (National Highway Traffic Safety Administration, 2021).

The development of automated vehicles and assisted driving can also have a positive impact on communities by offering added mobility options to people with any form of disability that inhibits their ability to drive. Some possible consequences of this development are increased opportunities for employment and independent living which is directly linked to any of the sub-goals of SDG 11 (National Highway Traffic Safety Administration, 2021). This further connects directly to the thesis' topic of IP, as IP is crucial in ensuring a safe transition to autonomous vehicles (Gowling WLG, 2018; James, 2020).

2.1.3.4 SDG 12 - Responsible Consumtion and Production

Sustainable consumption and production are connected to reducing the automotive industry's impact on the environment during a product life cycle. This goal is strongly connected to Polestar, as their aim to achieve net-zero emissions, creating a more sustainable consumption free from the emission of fossil fuels (Polestar, 2021).

One example of how the company is pushing to further innovation towards this goal is with the Polestar Precept, which uses recycled material for its interior (Polestar, 2020). By using the precept as a vision, they are not only putting pressure onto themselves to incorporate more sustainable ways of producing products but also on the automotive industry as a whole.

Volvo Group is also among the companies that are trying to develop more sustainable manufacturing (Volvo Group, 2021b). The firm believes that by prolonging product life and increasing reuse and recycling, the company can both improve environmental strain and lower its production costs. Volvo Group has set a goal to achieve net-zero value chain emissions by 2050 (Volvo Group, 2021c).

Volvo Cars also have strict goals for their production. The firm has set the goal of having climate neutral operations by 2025 (Volvo Car Corporation, 2020). The firm has already taken steps to achieve this, by making its production plant in Skövde climate neutral.

2.1.3.5 SDG 13 - Climate Action

A substantial part of total greenhouse gases (GHG) emissions comes from road transport, the road transport sector is responsible for approximately 20% of global GHG emission (Albuquerque et al., 2020). This means that a reduction in GHG emissions from road transport can have a significant impact on total GHG emissions. According to European Environmental Agency (2018) and Nanaki and Koroneos (2013), one of the most important aspects impacting the sustainable advantages gained from a transition to EVs is dependent on the share of renewable energy that

the battery runs on. Therefore, climate action in the automotive industry requires improvements in energy production, relating to SDG 12, detailed above.

The European Environmental Agency (2018) gives the example of using only coal or using only wind power to generate the electricity for EVs. When using coal and comparing the life GHG emissions between EVs and ICEVs, the EVs will have a slightly higher output of GHG. When using wind power to make the same comparison, EVs will have an almost 90% lower output of GHG compared to ICEVs (European Environmental Agency, 2018). Qiao et al. (2019) performed an analysis showing that with the current mix of electricity sources, the GHG emissions were 18 % lower for EVs compared to ICEVS.

Another problem that an adoption of EVs can contribute to solving is the urban heat island effect. This effect can contribute to higher emissions of GHG by requiring more electricity, e.g., for ventilation systems (Li et al., 2015; U.S. Environmental Protection Agency, 2008). Li et al. (2015) point out that the heat island also can contribute to heat-related illnesses and mortality. This means that this phenomenon is connected to both SDG 3, 11, and 13. According to Li et al. (2015), EVs only emit 19,8 % of the heat compared to a traditional car. Thus, a transition to EVs makes humans healthier, cities more sustainable to live in, and lessens the burden on the climate.

Another area where the automotive industry has the ability to lower GHG emissions is in making vehicles autonomous. According to Igliński and Babiak (2017), autonomous vehicles used in road transport will decrease greenhouse gas emissions by approximately between 40-60%. They attribute this to several different factors, among them lower driving speeds due to autonomous vehicles keeping speed limits, more smooth driving with fewer accelerations, and less congestion, especially in urban areas.

2.2 Ethics regarding IPRs

As Sønderholm (2010) explains, there is an ethical problem connected to IPRs. IPRs such as patents are designed to create a temporary monopoly for the holder, and therefore the holder can sell products at a higher price than in perfect competition. However, this also brings advantages, as this allows the company to recoup R&D costs and make a profit, which serves as a benefit of patents as they incentivize innovation (World Intellectual Property Organization, 2020b). An additional benefit of patents is their dispersion of information which is achieved through mandating disclosure for patent applications (Granstrand, 2018).

One ethical dilemma regarding the creation of monopolistic pricing is the market failure that arises. In turn, this leads to what Sønderholm (2010) refers to as "the exclusion problem". It refers to how some buyers that would have been able to, and would have wanted to, buy the product at a lower price, cannot or do not want to buy the product at this increased price-point. Sønderholm (2010) continues by arguing how this is more troubling in instances where the product is some form of

medication and less of a problem with products related to pure entertainment such as CDs or software.

As the thesis concerns the automotive industry, the authors conjecture that the monopolistic position is not a problem of the same magnitude as in the case of medication. A life-altering medication is likely protected with a single patent. Automotive vehicle technology depends on multiple IPRs. Thus, competitiveness in the market remains intact due to the vast amount of automotive producers that exist. Buyers, therefore, are not prevented from purchasing a vehicle. Instead, they will have to choose a different one.

Seeing this from an environmental perspective is a bit more nuanced. According to National Aeronautics and Space Administration (2021) and World Health Organization (2018a), carbon emissions produced by the burning of fossil fuels have clear negative environmental implications. If the access problem results in more people purchasing traditional vehicles, traditional vehicles will be more prevalent on the roads. The development of non-carbon tech will lower the cost of production and the price of alternative vehicles. However, IPRs might inhibit the adoption of this technology. Though, as previously argued, IPRs are more likely to incentivize the development of more sustainable technology.

Research Methodology

The following section presents and argues for the choice of research methodology to answer the research question.

The automotive industry on Sweden's west coast is the subject of the thesis' case study. Firstly, qualitative semi-structured interviews were held with 25 different individuals from academia, IP relevant business sector, and the automotive industry. The selection of respondents was initially based on purposive sampling. However, some respondents proposed additional people to interview, making the selection partially dependent on a snowball sampling. Secondly, a quantitative patent analysis was conducted on Volvo Cars and Volvo Trucks, two significant players in the automotive industry on Sweden's west coast.

The interviews were coded and analyzed by looking for themes in the transcripts. Hence, together with the theoretical grounding, conclusions could be drawn.

3.1 Methodological Approach

Denscombe (2010) advocates for the use of case studies when there is a need to understand the complex relationship between factors as they operate within a particular social setting. Moreover, Wallén (1993) mentions that case studies are beneficial as they provide in-depth knowledge and observations under actual conditions. Thus, a case study on the automotive industry will provide the academic field with profound insights and a holistic overview of the usage of IP strategies in transformative industries.

Bryman and Bell (2014) state that qualitative methods are convenient when the research questions are of exploratory characteristics. Furthermore, Wallén (1993) argues that qualitative methods are advantageous to interpret the holistic view from fragmented pieces of information. Hence, most of the research has been conducted as a qualitative study. This methodology was deemed the most adequate to answer the research question.

A qualitative interview study is suitable, as the research question intends to explore how IP strategies evolve as industries transform. Authors Paré et al. (2015) point to a qualitative interview study as a powerful tool to evaluate the current state of the research area. Additionally, Denscombe (2010) argues that interviews provide a more suitable method when the researcher needs to gain insights into people's opinions, feelings, emotions, and experiences.

As the automotive industry is highly innovative, and undergoing a radical transformation, a case study will be conducted to examine the usage of IP strategies and the previous trends in patenting. The objective of the case study is to generalize findings on other transformative industries.

Quantitative analysis provides accuracy in describing societal challenges. The methodology also proposes challenges of its own, the main problem being the belief that humans can be described numerically. Expressing a result quantitatively does not make it true (Holme & Solvang, 1997). Thus, this thesis combines both quantitative and qualitative methods, detailing the research question from different angles. Combining the two increases the robustness of the research and overcomes the methods' individual limitations (Wallén, 1993). Hence, the quantitative patent analysis will serve as a complement to the interviews and further the researchers' understanding of the case study.

The process of data collection and theoretical grounding have been conducted iteratively. The notion of iteration is described as an analysis that tends to be an evolving process in which the data collection and data analysis phases occur alongside each other (Denscombe, 2010).

3.2 Data Collection

This section describes the methods of data gathering more profoundly. Firstly, an overview of the case study will be provided. Secondly, the underlying components of the case study will be presented, starting with the interviews and ending with the patent analysis.

3.2.1 Case Study

Initially, the case study had the intention of being on Polestar's IP strategy for battery range technology. However, due to COVID-19 restricting accessibility to resources, the proposed case study was not feasible. Instead, the thesis was adapted, and a case study of the Swedish automotive industry was performed.

The case study could not be performed in the traditional sense as the authors had no access to observing the industry's internal workings, mainly due to COVID-19. Instead, in-depth interviews, with a semi-structured format, were held with actors knowledgeable in IP in the automotive industry.

Additionally, a patent analysis was conducted to obtain further details of the case and to act as a complement to the interviews.

Denscombe (2010) and Wallén (1993) point to case studies as suitable when the researcher wants to investigate an issue in-depth and provide an explanation that can cope with the complexity of actual situations.

3.2.2 Interviews

Denscombe (2010) points to interviews as a suitable method for data collection when exploring more complex and subtle phenomena. Additionally, Davidsson and Patel (2019) describe that interviews allow the respondent to answer questions more profoundly. Moreover, the interviewer can ask the respondent supplementary questions if needed.

Interviews were held with individuals from academia, relevant business sectors, and actors from the Swedish automotive industry. Respondents from academia were selected based on their knowledge within IP. The IP professionals were from business sectors such as the Swedish Intellectual Property Office, law firms, and management consulting firms.

The interviews with individuals from academia had a two-fold purpose. Firstly, to receive a greater understanding of the research area, and secondly, to provide further insights of the case study, as all academics were knowledgeable in aspects relevant to the case study. The interviews with IP professionals had the purpose to investigate the use of IP strategies in transformative industries.

The interviews with academics are compiled in Table 3.1 and IP professionals in Table 3.2.

Furthermore, respondents from leading companies in the Swedish automotive industry were interviewed to investigate if the views on IP strategies and its application were similar between the actors. The selected respondents can be viewed in Table 3.3.

All of the respondents were selected based on whether they were in the geographical proximity of the case study. As the case study regards the Swedish automotive industry, the majority of respondents were from Scandinavia. When regarding the actors in the automotive industry, essentially all respondents were from Sweden's west coast.

Table 3.1: Interviews with Academics Knowledgeable of IP

Respondent's name	University	Position	Date	Length
Marcus Holgersson	Chalmers University of Technology	Associate Professor	08-03-2021	34 min
Ove Granstrand	Chalmers University of Technology	Professor	11-03-2021	36 min
Terrence Brown	KTH Royal Institute of Technology	Associate Professor	16-03-2021	43 min
Matti Kaulio	KTH Royal Institute of Technology	Professor	21-04-2021	21 min
Ana Nordberg	Lunds University	Associate Senior Lecturer	8-03-2021	57 min
Fredrik Edman	Lunds University	Patent Advisor	11-03-2021	52 min
Roman Martin	University of Gothenburg	Associate Professor	16-03-2021	22 min
Christoph Grimpe	Copenhagen Business School	Professor	18-03-2021	31 min
Holmer Kok	Stockholm School of Economics	Assistant Professor	20-04-2021	33 min
Lars Henriksson	Stockholm School of Economics	Professor	20-04-2021	39 min
Tor Askild Aase Johannessen	Norwegian School of Economics	Associate Professor Emeritus	23-04-2021	46 min

Table 3.2: Interviews with IP-professionals

Respondent's name	Company	Position	Date	Length
Herman Phalén	PRV	Head Patent Department	11-03-2021	47 min
Peter Strömbäck	PRV	Director General	12-03-2021	24 min
Henrik Almström	Morris Law	Data protection and IP Lawyer	10-03-2021	28 min
Christina Berggren	MAQS Law Firm	Lawyer / Partner	12-03-2021	27 min
Emil Haldorson	Konsert Strategy & IP	Senior Manager	6-04-2021	28 min

Table 3.3: Interviews with People Specific to the Automotive Industry

Respondent's name	Company	Position	Date	Length
Raymond Millien	Volvo Cars	Chief IP Officer	13-04-2021	20 min
Peter Kollegger	CEVT	Patent Attorney	12-03-2021	42 min
Christoph Futter	Einride	Director of Battery Operations	17-03-2021	24 min
Erik Wintzell	Volvo Group	IP strategy partner	16-04-2021	31 min
Marcus Koggdal	Volvo Group	Global Head IP Strategy and Portfolio	27-04-2021	30 min
Susann Vahlenbreder Hecht	Volvo Group	Vice President Intellectual Property	30-04-2021	27 min
Michael Hatrick	Volvo Group	Group Director IP Strategy & Portfolio	30-04-2021	27 min
Laura Gisler	Polestar	Global Head of IP	28-04-2021	37 min
Aubré Rabe	Polestar	Patent Paralegal	03-05-2021	25 min
Anonymous	Automotive Firm	IP analyst	22-04-2021	32 min
Anonymous	Automotive Firm	Patent Attorney	Unspecified	17 min

3.2.2.1 Sampling Technique

Non-probability sampling was used to select a sample from the research population. Denscombe (2010) argues that the method is suitable when the aim is to produce an exploratory sample rather than a representative cross-section of the population. Additionally, non-probability sampling is convenient when there is inadequate information about which individuals make up the population.

Purposive sampling was the initial non-probability sampling method used. The respondents were selected based on their relevance to the issue and knowledge about the research area. Denscombe (2010) argues that purposive sampling is a sort of representative sampling as the researcher can deliberately select the sample to ensure that the full range of people gets included. It is also a method of getting the *best information* by selecting people most likely to have the experience or expertise (Denscombe, 2010).

Furthermore, some respondents proposed other interview candidates for the thesis. The methodology of generating a sample from referrals is called snowball sampling (Holme & Solvang, 1997). Hence, the sampling technique was partially based on an exponential non-discriminative snowball sampling, meaning that multiple referrals

from one respondent were used for data collection.

Respondents were primarily found through searching and filtering academic databases and company websites. Moreover, both Charlotta Kronblad, thesis advisor, and Laura Gisler, collaboration partner at Polestar, provided valuable respondents in the area of IP counsel and patent law.

3.2.2.2 Interview Design

There are different types of structures for research interviews, more or less applicable depending on the situation. As individuals' opinions are needed to answer the posed research question, a semi-structured format was considered the most relevant for the thesis' purpose.

A semi-structured interview consists of a list of issues and questions to be addressed. However, what distinguishes semi-structured interviews from structured interviews is the flexibility of the interviewer as well as the interviewees (Davidsson & Patel, 2019; Denscombe, 2010). The respondent is allowed to elaborate on topics and speak more widely compared to a structured interview, and more emphasis is on the respondent's points of interest.

Due to the respondents having various knowledge within the research field, the questions asked varied to some degree for each interview. However, the majority of the questions can be viewed in Appendix A.1, for academics, and Appendix A.2 for IP professionals. The questions outlined for actors in the automotive industry differed even further, as they sought to provide more profound insights into the practical use of IP strategies. These questions can be found in Appendix A.3.

Furthermore, the interviews were conducted with two interviewers and one respondent, as some respondents didn't allow for recording devices due to privacy concerns. Thus, two interviewers were needed, one taking notes and one conducting the interview.

3.2.2.3 Patent Analysis

While conducting interviews with professionals in the automotive industry it became apparent that patents were of utmost importance. Hence, a patent analysis was performed to provide more background for the case study and to further detail firms' use of patents. The patent analysis can be viewed as a complement to the semi-structured interviews, as the case study could not be conducted at a specific automotive firm detailing their procedures. The analysis used public data available from Espacenet's Worldwide patent search, thus, not limited to Swedish patents (Espacent, 2021b). Instead, the search was limited to the European Patent Office to ensure that filings containing the same inventions were not counted twice.

Volvo Cars and Volvo Trucks were examined, as they are the largest original equipment manufacturers (OEMs) on Sweden's west coast. Polestar, as a new entrant, has no patent history before 2016. Thus, the firm was unsuited to the purpose

of this analysis. The analysis includes the number of patents filed from the two corporations and their most significant use areas.

The analysis spans 20 years, where the quantity data starts at the beginning of 1999 and ends in 2019, which was specified in Espacent. The time span was chosen as priority patent data is not available for later time periods, as patents are published 18 months after their earliest priority date (Swedish Intellectual Property Office, 2019b). Moreover, the search keywords used in the Espacent patent database to obtain the Volvo Cars and Volvo trucks patent data, respectively, were:

- (Volvo Car Corporation)OR(Volvo Personvagnar AB)
- (Volvo Truck Corp)OR(Volvo Lastvagnar)

To analyze the usage areas of patents through time, the twenty years were divided into four equally sized intervals, wherein each interval the top 5 IPC subgroups, by filing, were collected. The IPC subgroups were decoded by Espacent's definitions. For legibility, the names of the categories were simplified and summarized, which removed precision. However, the authors deemed this simplification in line with the purpose of the thesis. To analyze the number of patent filings, data for patent filings was gathered. Both analyses were conducted in Microsoft Excel, along with the graphing.

3.3 Coding and Analysis of Data

A thematic analysis was performed on data gathered from the interviews. Maguire and Delahunt (2017) explain a thematic analysis as the process of identifying patterns or themes within qualitative data. Furthermore, the authors argue that it is a very flexible method which is a considerable advantage given the diversity of work in learning and teaching. Sutton and Zubin (2015) describe the process of analyzing qualitative data in four steps, firstly transcribing and analyzing the obtained interviews, secondly reading between the lines, thirdly coding, and lastly theming. Maguire and Delahunt (2017) present a similar approach to conduct the thematic analysis of qualitative data.

Transcriptions of the interviews were made to analyze the collected data thoroughly. Thereafter, the interviews were coded to reduce the amount of data to more meaningful parts (Maguire & Delahunt, 2017). The codes were categorized based on various themes. Thus, codes of similar characteristics were grouped. Finally, themes were established as a way of grouping codes.

Quotes highlighting the core concepts of each code are presented in the results. The quotes serve as support for the empirical results and provide context to the reader. Quotes in Swedish have been translated, as this thesis is written in English. The interviews were held in either English or Swedish, depending on the preferences of the respondent.

The template for coding and analysis can be viewed in Table 3.4 below. Moreover, the selected codes and themes can be found in Table 3.5.

Table 3.4: Template for Coding and Analysis

Theme *Code level 1*	Codes *Code level 2*	Quotes *Code level 3*
Intersection of Business and IP Strategy		
Patent Strategies		
Other means of protection		

Table 3.5: Selected Themes and Corresponding Codes

Theme	Codes
Intersection of Business and IP Strategy	Freedom to Operate
	The Business Implications of IP Strategy
	Integration of Business and IP Strategy
	IP in Open Innovation
	Business Strategy of Licensing Agreements
Patent Strategies	Patent Selection Process
	Patent Management
	Litigation for Patent Infringement
	Importance and Motives of Patents
Other means of protection	Use of Trade Secrets
	Use of Strategic Disclosure
	Non Patent IPRs

3.4 Method Discussion

This section examines the choice of research methodology and highlights the importance of quality assurance. Furthermore, it enlightens the reader with several challenges with the decision of research methodology. Lastly, it provides an ethical reflection on the choice of research methodology.

3.4.1 Quality Assurance

Yusof and Ali (2011) state that quality concerns are a central part of all steps in the research process, from the inception of a research question and data collection to the analysis and the presentation of research findings. Davidsson and Patel (2019) accentuate similar quality concerns.

Denscombe (2010) presents four bases to judge the trustworthiness of research. These are validity, reliability, generalizability, and objectivity.

However, the credibility of qualitative research is inadequately evaluated when using these metrics (Lincoln & Guba, 1985). Thus, a different framework for trustworthiness in qualitative studies was introduced by Lincoln and Guba (1985). The framework is based on the following four criteria: credibility, transferability, dependability, and confirmability. These evaluation criteria are equivalent to the evaluation criteria used for quantitative research, reliability, and validity (Holme & Solvang, 1997; Nowell et al., 2017).

Hence, the quality assurance will use credibility, transferability, dependability, and confirmability when regarding the qualitative methodology. However, for the quantitative research, validity and reliability will be considered, as they are the most important metrics to regard (Holme & Solvang, 1997; Nowell et al., 2017).

3.4.2 Quality Assurance for Qualitative Research

Nowell et al. (2017) describe credibility as the "fit" between respondents' views and the researcher's representation of them. Thus, the data obtained from the interviews must be reflecting the respondents' intention.

Transferability refers to the generalizability of inquiry (Nowell et al., 2017). The study should have the potential to be transferred and applied in a different context, which will only be feasible if there are thick descriptions so others can judge transferability.

To achieve dependability, researchers can ensure the research process is logical, traceable, and documented (Denscombe, 2010; Nowell et al., 2017).

Confirmability is established when credibility, transferability, and dependability are achieved. Furthermore, confirmability is concerned with the researcher's interpretations and findings, as these need to be derived directly from the data. Consequently, the researcher needs to demonstrate how conclusions and interpretations were reached (Nowell et al., 2017). The researcher can use contrasting data sources

to ensure that the data collected is "on the right lines", by using triangulation and thus create credibility (Denscombe, 2010). To ensure that the information gathered offers credibility, the authors chose to compare all of the interviews with one another, aligned with the method of triangulation.

Detailed information about the research needs to be provided if the reader is to consider the transferability of the findings. Hence, the research methodology section provides a detailed description of how the sampling, interview design, case study, coding, and analysis were performed. This will enable others to judge its transferability correctly.

To establish dependability, notes have been taken continuously throughout the research. Additionally, several copies of the thesis are independently stored, to prevent loss of data. Moreover, there are logs detailing all changes made to the thesis. Hence, there is traceability as there is a trail for where decision-making has taken place.

Denscombe (2010) states that no research is ever free from the influence of those who conduct it, some degree of subjectivity is inevitable. However, to reach good practice, the interviews have been conducted and coded in a collaborative approach between the authors. This will prevent bias and subjectivity to some degree, as the results do not reflect one's view or opinions, rather a diverse collection.

3.4.3 Quality Assurance for Quantitative Research

To ensure the quality of the quantitative study, the authors regard validity and reliability, which aligns with the literature (Denscombe, 2010; Holme & Solvang, 1997; Nowell et al., 2017). Holme and Solvang (1997) describe the most important aspect of quality assurance for quantitative research being the data on which the study is based. For this thesis' research a public governmental body is used as a data source, enabling others to verify the findings. This is encouraged in the literature (Denscombe, 2010; Holme & Solvang, 1997).

The qualitative analysis was the main research methodology of the thesis, and the quantitative only served as a complement in the case study. Thus, quality assurance was of increased importance for the qualitative analysis.

3.4.4 A Practical Approach of Quality Assurance

To ensure confirmability and credibility of the research, each respondent receives the thesis four days before submission, allowing them to confirm the findings and establish academic integrity. Respondents are also granted the opportunity to remain anonymous.

This procedure resulted in a large amount of valuable feedback. The patent analysis could be substantially improved, as it was deemed misleading by some respondents.

3.4.5 Challenges when regarding Research Methodology

Unfortunately, due to COVID-19, there have been some issues regarding the choice of research methodology. The current situation has made collaboration with external parties more difficult than anticipated. Initially, the thesis was proposed as a case study on Polestar with the purpose to focus more narrowly on IP and innovation strategies in battery technology. However, as communication has been hindered due to the current situation, the proposed thesis was no longer feasible.

Thus, the entire thesis and its purpose needed to be rewritten seven weeks after the start date. There were multiple attempts to efficiently adapt the thesis to answer a relevant research question, which was very time-consuming.

However, despite these changes, several interviews were booked with academics, IP professionals, and actors in the automotive industry. As multiple interviews were conducted before the finalization of the research question, some complexity arose in deciding how to use the findings most efficiently. Fortunately, the structure of the interviews allowed for the findings to apply to the changes in the research question.

3.4.6 Ethical Reflection

A code of conduct should be taken into account, to avoid ethical dilemmas. Blomkvist and Hallin (2015) give a summary of such a code of conduct. All research should be conducted in a way such that respondents are informed of the purpose of the research project, to follow this code. Secondly, they all must agree to have their answers be a part of the study, and confidential information must be respected and only used for the purpose agreed upon.

Davidsson and Patel (2019) also stress the importance of this matter, arguing that all respondents should know how their contribution to research will be used. Moreover, Davidsson and Patel (2019) present four general ethical rules, formulated by the Swedish Research Council. Firstly, the researcher should inform all concerned with the purpose of the research. Secondly, the respondents in the study have the right to decide to what degree they want to participate. Thirdly, it is of utmost importance to respect confidentiality when managing personal data, which has close connection to publicity and secrecy. Lastly, personal data should only be used for research purposes to avoid ethical dilemmas. Furthermore, Wallén (1993) mentions that all respondents should be allowed to terminate their participation in the research at any time. Thus, there are several guidelines and rules to adhere to in researching ethically.

All of these guidelines have been followed to conduct the research. All of the respondents have been informed about the purpose of the research twice. Once when receiving an inquiry to participate in the interview, and once more when being interviewed. Additionally, the respondents' wishes for the degree of participation have been respected. Furthermore, the authors asked for permission, from each individual, to use personal data, such as their names and position. Other personal data, not required for research purposes, have been kept confidential.

All respondents have been disengaged from the citations which are presented in the conclusion. The decision was made to ensure that no individual can be connected to a specific quote. Thus, the privacy of individuals will be secured, and more profound interviews could be held. This is in line with the third rule from the Swedish Research Council (Davidsson & Patel, 2019).

Regarding the recording of interviews, each respondent was asked for permission before or at the beginning of the interview. The recording is for transcription purposes only, which the respondents were informed of.

The Swedish Research Council (2017) highlights the importance of transparency and clear communication when researching with external parties. Thus, company representatives have been informed about the progress of the research, which aligns with good research practice (Swedish Research Council, 2017). Moreover, each respondent will have the opportunity to read through the thesis before its submission.

Theoretical Grounding

This section will provide an overview of the core concepts related to the thesis. Firstly, the chapter deepens the definition of IP, IPRs, patents, copyrights, trademarks, trade secrets, and design rights. Thereafter, strategies relating to these IPRs are emphasized. Notions such as structures of licensing agreements, challenges of managing IP in collaborative agreements, and patent motives will be covered in this section.

4.1 IP and IPRs

The World Intellectual Property Organization (2020c) refers to the term IP as creations of the mind, covering works of art to inventions, computer programs to trademarks, and other commercial signs. Bernitz (2011) describes the notion of IP as a result of intellectual achievements, such as inventions, trademarks, or design. To allow the creators or owners of IP to benefit from their work or investment, IPRs are integral (World Intellectual Property Organization, 2020c). IPRs are a legal right covering IP and provides the exclusive right of using one's creation for a certain period (World Trade Organization, 2021). Thus, IPRs are tools for businesses to protect their assets (Granstrand, 2018). There are various kinds of IPRs, such as copyrights, patents, trademarks, and design rights (World Intellectual Property Organization, 2020c).

4.1.1 Patents

The World Intellectual Property Organization (2004b) describes patents as exclusives rights granted for inventions, which are products or processes that provide, in general, a new way of doing something, or offer a new technical solution to a problem (World Intellectual Property Organization, 2004b).

Technical information about the invention must be disclosed to the public in an application to receive a patent (World Intellectual Property Organization, 2004b). Additionally, the Swedish Intellectual Property Office (2020a) explains that patents are an exclusive right to use an invention, meaning that no one else may manufacture, sell or import it without the patent owner's permission. The World Intellectual Property Organization (2004b) specifies that the exclusive right allows the patent owner to prevent anyone from commercially exploiting the invention without permission. However, patents are a legal right and do not directly entitle the holder to exclusively sell or even manufacture the invention (Granstrand, 2018). It is a negative right in the sense that the patent holder has the right to exclude others, but it will not automatically do so.

4.1.1.1 Conditions for Patenting

An invention must be industrially applicable, novel to the world, adhere to a minimal inventive step, meaning it cannot be too simple nor obvious, and be of a technical nature to be eligible for a patent (Granstrand, 2018; Swedish Intellectual Property Office, 2020a; World Intellectual Property Organization, 2004b).

However, one should be observant that there are exceptions in the Swedish patent law to what can be patented, despite the three criteria for patenting above being fulfilled (Swedish Intellectual Property Office, 2020a).

4.1.1.2 Benefits of Patents

Granstrand (2018) and Holgersson (2012) argue that patenting brings several benefits. For one, a patent can prevent competitors from introducing inventions that are alike, resulting in a competitive advantage (Granstrand, 2018). Moreover, Holgersson (2012) explains that blocking competitors from using technology may increase their cost and time for imitation and thus increase their willingness to pay for a license or stay away from the market.

Secondly, patenting also deters competitors from patenting the technology themselves, hence, being a defensive aim. Granstrand (1999, p. 214) describes this as to *"block the competitors from blocking oneself, and thereby ensure 'design freedom'"*. Furthermore, Holgersson (2012) explains that there is an offensive aim, which relates to both proprietary strategies in which the patent holder tries to obtain an exclusive position in a technological field, and leveraging strategies in which the patent holder tries to get other direct or indirect benefits from a patent. For instance, through licensing to generate revenues or through cross-licensing to access other resources.

There is also a financial factor in patenting, by creating an economic asset that could be used for financial strategy purposes. This is often referred to as the monopoly elements of patents (Granstrand, 2018). The patent system is designed to generate only one winner, "the winner gets all", which provides an incentive to constantly compete for new patents and contribute to the development of society. Furthermore, the World Intellectual Property Organization (2020c) states that patents allow firms and inventors to maximize profits from their inventions during the patent protection period. Thus, creating incentives for a firm to continue being innovative, which in turn benefits the general public and consumers (World Intellectual Property Organization, 2020c).

4.1.1.3 Limitations of Patents

Patents also involve some limitations, or disadvantages, besides being a negative right.

Firstly, patents protect for a limited period, generally 20 years (World Intellectual Property Organization, 2004b). After this, the invention can be used commercially by anyone.

Secondly, patents are territorial rights, which means that they are only applicable in the country or region they have been filed and granted, following the law of that country or region (World Intellectual Property Organization, 2004b). However, there are regional patent offices, such as the European Patent Office (EPO) and the African Regional Intellectual Property Organization (ARIPO), that accept and grant regional patent applications.

Thirdly, there are direct and indirect costs of patenting (Granstrand, 2018; Holgersson, 2013). The direct cost depends on numerous factors such as the country or region the patent will be filed in, the invention's complexity, etc (Granstrand, 2018; World Intellectual Property Organization, 2004b). Additionally, there are costs for protecting one's patent in the case of infringement. These costs may hinder smaller and medium-sized firms from actually making infringement accusations (Holgersson, 2013).

Lastly, patent protection requires information disclosure through patent publications, leading to a form of information leakage (Duguet & Kabla, 2011), which allows for competitors to legally invent around patents (Harabi, 1995; Holgersson, 2013). Relating to this, (Harabi, 1995) describes information disclosure as one of the most consequential limitations to the effectiveness of patents.

4.1.2 Design Rights

A design right is an IPR connected to the visual appearance of an industrial product (Swedish Intellectual Property Office, 2019b; World Intellectual Property Organization, 2020c). The right prohibits copying and imitation of the design's appearance and shape. However, it does not protect the product's functionality or the underlying idea (Swedish Intellectual Property Office, 2019b). Registration is required to attain the IPR. The design must be new and show a degree of originality, meaning that it must be sufficiently differentiated from previous designs, for a registration to be granted (Swedish Intellectual Property Office, 2019b; World Intellectual Property Organization, 2020c).

In Sweden, the design right is valid for five years. However, the IPR can be prolonged to a maximum of 25 years (Swedish Intellectual Property Office, 2019b). The design right is territorial, meaning that designers or firms may need to deal with multiple national systems to get extensive protection (World Intellectual Property Organization, 2020c). The right can also be transferred and licensed (World Intellectual Property Organization, 2020c).

In the space of the automotive industry, design rights can be a helpful tool to protect the vehicle design from infringement (Foundation Law, 2021). This includes visible aspects of the car, such as the overall design and also spare parts for example the grill or the bumpers (Meyer-Dulheuer Legal Patentanwälte, 2016).

4.1.3 Copyrights

A copyright is granted, without registration, to the creator of an artistic or literary work. For a copyright to be admissible, the work has to be sufficiently original. Examples of copyrights are software, pictures, paintings, plays, and music (World Intellectual Property Organization, 2020c). In Sweden, copyright is valid for 70 years after the creator's death. Upon decease, the copyright is transferred to an heir or according to the will. A copyright may be traded or licensed provided there is a contractual agreement (Swedish Intellectual Property Office, 2020b). The use cases of copyrights in the automotive industry are, for instance, to protect the software system of the vehicle (Warner Norcross+Judd LPP, 2015).

4.1.4 Trademarks

A trademark is an IPR that gives the holder an exclusive right. It consists of a recognizable design, sign, or expression which is unique for a particular firm's products or services. It could be a combination of words, the shape of packaging goods, or symbols used in association with the firm (World Intellectual Property Organization, 2020c). In Sweden, a trademark lasts for ten years and can then be renewed indefinitely (Swedish Intellectual Property Office, 2020b). Trademarks in the automotive industry can, similarly to design rights, protect the design of the vehicle against infringement. Moreover, trademarks can protect the brand of the OEM (Foundation Law, 2021).

4.1.5 Trade Secrets

According to the World Intellectual Property Organization (2020b) trade secrets are IPRs on confidential information related to a company. Trade secrets may be sold or licensed but are non-registrable. A trade secret must fulfill the following criteria:

- Only be known to a limited group of people
- Be commercially desirable due to its secrecy
- A reasonable amount of effort has been taken by the rightful owner to protect its secrecy, such as confidentiality agreements

Holgersson and Wallin (2017) point to secrecy as a substitute to patenting to appropriate returns from innovation. A patent filing requires the company to disclose proprietary information to the public in exchange for a temporary and limited monopoly (Holgersson & Wallin, 2017). Meanwhile, secrecy provides a monopolistic advantage as long as it remains a secret, which might require significant efforts (Hannah, 2005). However, there is a risk that the secrecy strategy leads to someone else patenting the invention. In that way, trade secrets do not mitigate FTO risks, and commercial opportunities run the risk of being inhibited (Holgersson & Wallin, 2017).

Additionally, some intellectual assets are not eligible for a patent but can act as

valuable trade secrets, such as a recipe. The Uniform Trade Secret Act, which is a nationwide law in the US, prohibits intrusion on trade secrets through improper means. The law further protects non-disclosure agreements being broken (Schilling & Shankar, 2019). Thus, trade secrets are an alternative to patents, for protecting information about a proprietary product or process (World Intellectual Property Organization, 2020c).

4.2 Strategic IP Management

Strategic IP management refers to formulating and executing strategies related to IP, including issues such as how to acquire and create IP, how to govern IP, and how to exploit and extract value from (commercialize) IP (Holgersson, 2012).

4.2.1 Freedom to Operate

The definition of FTO is being able to conduct R&D and to commercialize an innovation without risking intrusion on tangible property rights (TPR) or IPRs of other firms (Holgersson & Wallin, 2017; Kowalski, 2007; World Intellectual Property Organization, 2004a). To ascertain that FTO exists, an FTO analysis can be conducted by the company itself or a third party. An FTO analysis is performed by rigorous analysis of the technology in its smallest integral components and then looking at existing IP-/TP rights for these (Kowalski, 2007).

One reason for conducting such an analysis is to ensure the ability to use the purchased technology in the case of a patent procurement, since the value of a patent is the opportunity to exercise the right (Morgan Lewis, 2008). Kowalski (2007) highlights how FTO can be viewed as a tool to systematically manage, and thereby reduce, the risk of infringement liability. Additionally, Kowalski (2007) emphasizes that FTO should strictly be regarded as an estimate of infringement liability at an arbitrary time frame for a given jurisdiction.

If the analysis reveals that one or more patents limit a company's FTO, there are several options for the firm to proceed (Sandal & Kumar, 2011; World Intellectual Property Organization, 2005). Firstly, the firm may consider purchasing the patent or licensing it (Sandal & Kumar, 2011; World Intellectual Property Organization, 2005).

Secondly, if the firm has a valuable patent portfolio it can use cross-licensing to obtain the license that provides the firm with FTO (World Intellectual Property Organization, 2005). Thirdly, the firm can choose to "invent around", meaning an alternative product or process is created or changed to avoid infringing on the patent(s) owned by others (Sandal & Kumar, 2011; World Intellectual Property Organization, 2005).

Lastly, patent pools could be used, meaning two or more firms practicing relating technologies put their patents in a pool to establish a clearinghouse for patent rights (World Intellectual Property Organization, 2005).

4.2.2 Strategic Disclosure

According to Peters et al. (2013, p. 122), strategic disclosure is;

> *"The act of creating novelty-destroying prior art in order to prevent or impede another agent from being able to obtain IP protection on the same or a similar invention or artistic or literary creation".*

As patentability requires novelty of the invention, firms can act strategically to limit competitors' possibilities to obtain a patent by defensive publishing, in other words using strategic disclosure (Holgersson, 2012; Peters et al., 2013).

By employing the strategy of defensive publishing, the firm's FTO will be protected (Holgersson & Wallin, 2017). FTO can therefore be achieved by using strategic disclosure as well as by patenting, even though they are substitute strategies (Holgersson & Wallin, 2017). By publishing, the actor refrains from future patentability (Granstrand, 2018).

Lichtman et al. (2000) explain that there are several incentives for strategic disclosure. One incentive may arise for trailing firms in a given patent race, as disclosing information will preempt the rival's chances for a patent. Additionally, Lichtman et al. (2000) show that a firm leading a patent race, similarly, has an incentive to disclose in order to reduce its rival's expected payoff. Hence, reducing the rival's willingness to continue participating in the race.

However, Holgersson and Wallin (2017) point to important differences between patenting and publishing. One difference is that patenting requires more time, more money, and a higher inventive step than publishing. These factors might hinder firms from patenting, especially small- and medium-sized enterprises (SMEs), as high direct and indirect costs of patenting were one reason many SMEs refrained from patenting (Holgersson, 2013). Moreover, it creates incentives for publishing, especially for firms lagging behind the most innovative firms, to stop the innovators from patenting (Lichtman et al., 2000; Parchomovsky, 2000). Thus, publishing is an inexpensive way to secure FTO. However, the drawback is that the exclusivity to the innovation and its pecuniary and non-pecuniary benefits will cease to exist when publishing (Holgersson & Wallin, 2017).

4.2.3 Patenting Motives

The primary motive for society to have a patent system is to improve the provision of innovations by giving inventors a transferable right during a limited period to protect their inventions from imitation (Holgersson & Granstrand, 2017). Therefore, allowing them to capture or appropriate adequate returns from their inventions and enable disclosure (Holgersson & Granstrand, 2017). However, firms do no longer patent only to prevent imitation (Cohen et al., 2002; Holgersson, 2013). There are several other motives to patent, for instance, to obtain bargaining power in negotiations or to improve corporate image. In addition, Holgersson and Granstrand (2017) and Holgersson and Wallin (2017) emphasize FTO as an important motive behind patenting.

Blind et al. (2006) underline a strategic motive for patenting, which is to block competitors. This differs from the more traditional patent motive, to protect inventions from imitation. Furthermore, Blind et al. (2006) point to negotiations with other enterprises and preventing infringement lawsuits by third parties as the two most significant strategic motives for patenting, a similar viewpoint as Cohen et al. (2002) and Holgersson (2013).

By dividing motives to patent into the following subgroups: protection, bargaining, improving corporate image, attracting external financing, and internal motives, Holgersson and Granstrand (2017) identify protection as the most dominant motive behind patenting. Second to protection is improving corporate image, followed by internal- and bargaining motives, such as cross-licensing and R&D collaborations.

Holgersson and Granstrand (2017) find that external financing appears to be the least vital group regarding motives for patenting. However, the importance might be different for SMEs, where Holgersson (2013) shows that patents are used to attract Venture Capital, and sometimes even being prerequisites for investments.

Moreover, Farre-Mensa et al. (2020) state that enhancing the firm's value is a common motive for patenting, and especially for smaller firms that might have a higher probability of fundraising if in possession of several patents.

4.2.4 Patent Management

Researchers often divide patent strategies into offensive and defensive (Grzegorczyk, 2020). An offensive aim of patenting is to block competitors from using a proprietary technology (Holgersson, 2012). Thus, blocking them from gaining entry to one's business sector too. Defensive patenting, on the other hand, aims at blocking competitors from blocking oneself (Granstrand, 1999). Although there is some kind of IP management in companies, it rarely has a strategic dimension (Fisher & Oberholzer-Gee, 2013). Therefore, the following section aims to explore the strategic dimensions of patent management.

By looking at patent management strategies from the perspective of the firm, a higher practical value can be obtained according to Grzegorczyk (2020). Furthermore, additional literature point to the following possibilities for a patent holder: The use of market power (direct commercialization), sale, licensing and cross-licensing, patent-pooling, cooperation, disclosure of the patent rights, and their donation, abandoning them, as well as using a patent for mutual hold up (Fisher & Oberholzer-Gee, 2013; Grzegorczyk, 2020).

Additionally, Holgersson and Wallin (2017) highlight that patent management is often occupied with optimizing the utilization of patenting as a source of competitive advantage. Furthermore, patent management links to a firm's strategic and financial consequences of its patent portfolio and financial profitability (Ernst et al., 2016). Ernst et al. (2016) explain that there are two aspects of patent management, namely patent information management, and patent protection management, which both relate to a firm's ability to capture value from its patent portfolio.

Holgersson and Wallin (2017) suggest a patent management trichotomy where firms make strategic decisions between patenting, publishing, and secrecy. These are viewed as substitute choices associated with distinct advantages. Furthermore, they can be understood in terms of whether they generate appropriation advantages, and/or increases the firm's FTO (Holgersson & Wallin, 2017).

Additionally, Holgersson and Wallin (2017) and Jell (2011) explain that patent management and patenting motives can be driven by technology motives, but highlight that patenting motives can be linked to the inherent patent management structure of a firm. The firms which regard patent management as an above-average important concept experience increased bargaining power and decreased transparency of their patent portfolio, as a consequence (Jell, 2011).

When the objective is to capture the value of an invention, trade secrets and patents are often preferred over strategic disclosure. Additionally, Holgersson and Wallin (2017) mention that when the complexity of technology increases, the objective of capturing value is better achieved through using patents instead of trade secrets.

In deciding whether to patent, publish or keep as a secret there are numerous factors to consider. Firstly, the innovation type impacts the effectiveness of various methods. According to Jorda (2008), product innovations are more suited for patent protection (relative to secrecy) than process innovations.

Secondly, the strategy is dependent on the firm's size. There is evidence that smaller firms find it cumbersome to protect their inventions with patents (Holgersson, 2012). Therefore, this factor may affect the strategic choices made by a firm.

Thirdly, the choice of strategy is also dependent on the industry in which the firm operates. Moreover, Holgersson and Wallin (2017) point to the market structure as a significant factor to consider, as it impacts the effectiveness and efficiency of various types of strategies.

4.2.5 Patent Strategies

Patent strategies are influenced by a firm's patenting motives which in turn is influenced by its patent management practices (Ernst et al., 2016). A firm's monetization of its patent portfolio may occur in many different ways, not necessarily from producing and selling the invention themselves. Patents can provide a limitation for the options available to competitors, earn revenues from licensing deals or earn revenues through aggressive patent lawsuits (Granstrand, 2018; Schilling & Shankar, 2019).

Patent filing strategies may involve the utilization of both pendency and publication of patent applications to achieve prolonged patent application processes. The purpose of this is twofold: to allow firms to more thoroughly evaluate the value of a patent due to increased time, and to reduce patent portfolio transparency to competitors (Ernst et al., 2016). Delaying patents is another patent filing strategy and can be achieved by choosing different filing routes (Van Zeebroeck & Van

Pottelsberghe de la Potterie, 2011). It is possible to apply at a national patent office, the EPO, or the Patent Cooperation Treaty (PCT) (Swedish Intellectual Property Office, 2019a, 2021; Van Zeebroeck & Van Pottelsberghe de la Potterie, 2011), depending on what filing speed that is sought after (Van Zeebroeck & Van Pottelsberghe de la Potterie, 2011).

Another patent strategy used by firms is filing patents to expand their patent portfolio. There are two main reasons for this, firstly, to deter competitors from suing, and secondly, to gain bargaining power (Ernst et al., 2016). A patent strategy can also relate to the drafting style of a patent application. The three fundamental dimensions a patent application consists of are the number of claims, patent constructionism, and the dependence on divisional filings. These tactics aim to provide the firm which files the patent with extra-legal strength, to create smoke screens in the technical field in which the patent is filed, and to evade disclosure requirements (Van Zeebroeck & Van Pottelsberghe de la Potterie, 2011).

In highly technological industries, patents become ambiguous as there arises a dense web of overlapping patents known as "patent thickets". These can be used to monetize patent infringement. An example is the formation of tech consortia and patent portfolios gained through acquisitions, used to litigate competitors (Schilling & Shankar, 2019). Ernst et al. (2016) explain that another use-case of patent thickets is to prevent competitors from entering and advancing in a particular field.

4.2.6 Litigation for Patent Infringement

Both litigation tactics and strategies are important aspects to take into consideration when regarding patent infringement. Litigation tactics concern issues such as which country to focus on when litigating against infringers, meanwhile litigation strategies concern strategic choices in litigation cases. An example of this could be if a firm is to grant licenses to infringers (Krattiger et al., 2007).

The thought process behind granting licenses to infringers instead of resisting is to avoid taking the litigation to court (Aoki & Hu, 1999; Krattiger et al., 2007). Further, Aoki and Hu (1999) explain that licensing can be a method for firms to avoid litigation costs. In the case where the threat of litigation is evident, the litigation costs will directly affect the licensing fee (Aoki & Hu, 1999).

Krattiger et al. (2007) highlight that decisions whether to grant licenses in general should not be based on an aspiration to avoid litigation regarding patent infringement. This particular strategy of converting infringers into licensees is notably effective regarding overseas IPRs infringements. However, there exists a danger with this strategy, since infringers might deliberately infringe in the hope of acquiring a license with favorable terms (Krattiger et al., 2007).

In terms of the effects of litigation, McCracken (2003) concludes that litigation in addition to economic damage can harm a firm's reputation, which in many cases can be more harmful in the long run. Nevertheless, a firm's litigation strategy should not be based on infringers, but the firm itself. Furthermore, if the goal of the firm

is to maximize the usage of their innovation, licensing and exploitation are to be preferred over litigation. (Krattiger et al., 2007).

Authors Lanjouw and Schankerman (2001) suggest that there are patterns in the cases where firms choose litigation as a course of action. The first pattern is that it is more common for firms to pursue action in court if the infringement is linked to patents that have a clear technological trajectory or are the source of a cumulative chain of the invention. Having control over the first invention directly results in control over subsequent inventions which have the potential to generate income by exploiting or licensing them (Lanjouw & Schankerman, 2001).

The second pattern concerns reputational building, which Lanjouw and Schankerman (2001) explain is linked to the decision of whether to litigate or not. The reputational building plays a vital role since firms want to convey the image that they are willing to protect their IPRs (Lanjouw & Schankerman, 2001; McCracken, 2003). This is especially apparent seeing that firms are more likely to go to court if the infringing party operates in a related field of technology (Lanjouw & Schankerman, 2001).

4.2.7 Open Innovation

One particular type of innovation strategy that is emphasized in this report is open innovation. The term was coined originally coined by H. W. Chesbrough (2003) and refers to the idea that companies benefit from bringing in ideas from outside the organization's boundaries, and sharing their own.

H. Chesbrough and Bogers (2014, p. 10) described it in their paper as:

> *"Open innovation refers to a distributed innovation model that involves purposely managed inflows and outflows of knowledge across organizational boundaries, for pecuniary and non-pecuniary reasons, in line with the organization's business model"*

Due to the open innovation era, the value of cooperation between firms in terms of innovation has risen in importance. Simultaneously, the focus has shifted away from internal R&D activities. However, there are disadvantages with excessive openness such as loss of core competencies and control which in the long-term might harm a firm's innovation prosperity. Other frequently mentioned drawbacks of open innovation are higher coordination costs and higher complexity in innovation settings (Enkel et al., 2009).

IP acts as an essential key to open innovation, especially regarding patent trades in open innovation collaborations. Inability to correctly evaluate patents results in issues surrounding these trades since it becomes increasingly difficult for the collaborating firms to assess the value of the collaboration (Gassmann et al., 2010). Holgersson et al. (2018) conclude that previous research has found patents to be perceived as more important in open innovation settings than in closed.

4.2.7.1 Open Innovation in the Automotive Industry

Several factors force companies, especially in the automotive industry, to search for external sources of knowledge (Lazzarotti et al., 2013). Globalization, technological fusion, and technological intensity are the most prevalent amongst these factors.

The dominant motive behind collaboration was stated by Lazzarotti et al. (2013) to be enlargement of the company's competence base, stimulation of creativity and capability of generating ideas, reduction and sharing of risks related to innovation activities, and costs of the innovation process. These findings are also highlighted by Dahl (2020, p.46), who underlines that:

> *"one of the main objectives of IP management, in open innovation, is to assemble the parties' resources and allocate the project results among the involved parties"*

Furthermore, Dahl (2020) emphasizes the expansion of IP management in the era of open innovation. IP management has evolved into a tool that governs the utilization of technology and allocation of research results from collaboration projects.

4.2.8 Licensing Agreements

Licensing is when the holder of an IPR (the licensor) transfers, a part or the entire right, to another legal entity (Granstrand, 2018). The licensor is compensated, whereas the new owner, the licensee, now obtains the right of the IPR. Granstrand (2018) differentiates between licensing-out, a strategic decision made by the seller, and, licensing-in, a strategic decision made by the buyer.

The ability to license and trade is a central notion of patents, as patent rights are granted to the holder of the patent, thus enabling trade and licensing (World Intellectual Property Organization, 2004b).

Reasons for licensing-in could be to ensure FTO or save costs (Granstrand, 2018). The reasons for licensing-out could be to obtain revenues or to enable diffusion of a proprietary standard (Granstrand, 2018; Krattiger et al., 2007). Licensing can also be used as a tool to reach prior inaccessible markets and technical fields. Compared to other means of interaction between firms such as joint ventures, sales, and purchase-through-licensing, licensing is more approachable in the case where the firm has limited resources (Krattiger et al., 2007). Moreover, licensing might be valuable in the context of coopetition since it has the potential to negate risks associated with exposing IP to other firms (Holgersson, 2018).

What, who, and to whom a license can be issued, is depicted in Figure 5.6. Licenses can be a bundle of different IPRs and know-how.

Table 4.1 contains a summary of the main types of license agreements (Granstrand, 2018).

Figure 4.1: Illustration of Licensing Agreements

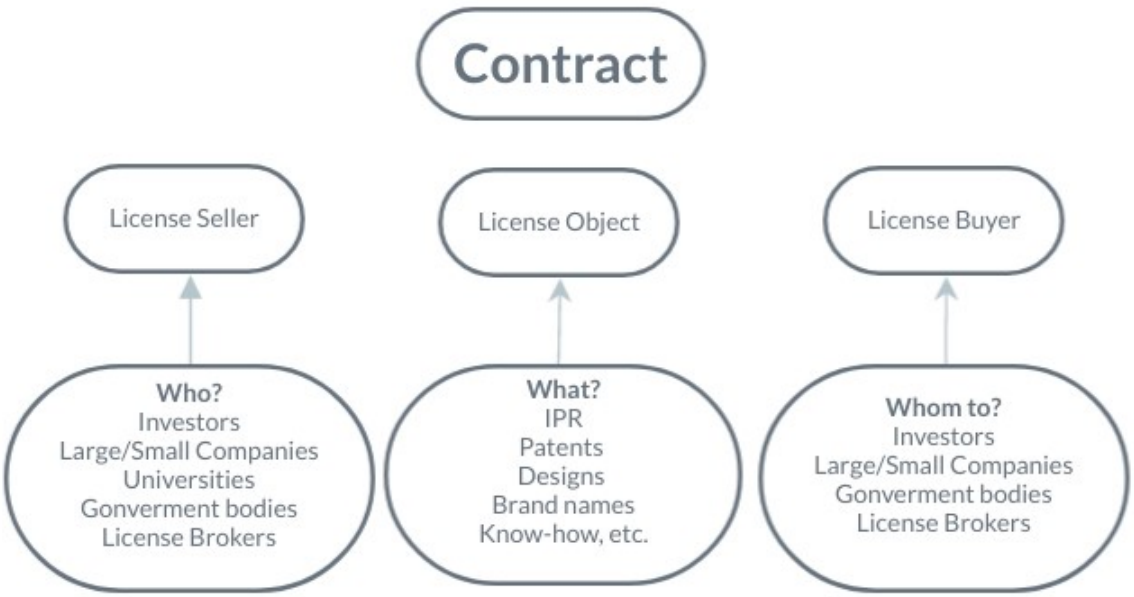


Table 4.1: Summary of the Main Types of Licensing Agreements

License Type	Summary
Exclusive License	Only permits one user
Sole License	An exclusive license that also permits the licensor to use the license
Simple License	Non-exclusive
Sub-license	The licensee is permitted to further sell the license
Grant-back License	The licensee is obliged to offer the licensor a license on all improvements made by the licensee
Cross-license	Licenses are exchanged between license buyer(s) and license seller(s)
Package License	Various IPRs bundled together in a license, for example, a portfolio of patents

The decision of whether to license or not is influenced by two opposite forces. The "revenue effect" and the "profit dissipation effect". The benefits accrued from royalty revenues (revenue effect) have to be weighed against the price reduction that the increased competition from the licensee creates (profit dissipation effect). There are many potential steps to mitigate the effect of the latter, such as imposing territories or quantity restrictions. Hence, licensing is more attractive if the licensee

operates in a different market, or if the licensor's market share is small (Granstrand, 2003).

4.3 IP Strategies in the Automotive Industry

The automotive industry faces emerging technologies that are expected to revolutionize the industry (Gusikhin et al., 2007). Autonomous vehicles, global warming, and uncertainties regarding taxation both in the EU and other regions have resulted in the need of re-evaluating current IP strategies (Gowling WLG, 2018). As the technology in the automotive industry continues to evolve, IP rights will become more important for OEMs (James, 2020). This development in technology is driven by autonomous vehicles as well as communication between vehicles (Gowling WLG, 2018; James, 2020).

Patents will remain important in the industry, but other IPRs may also rise in importance (Gowling WLG, 2018). A trend in patent filing in the automotive industry can be seen. The overall patent activity within the industry has risen dramatically (DeSantis et al., 2015), with Asian companies filing over half of the patents filed at the EPO in this area from 2011 to 2016 (European Patent Office, 2017). Moreover, increased patent infringement litigation can be observed, driven in particular by non-practicing entities (DeSantis et al., 2015).

4.3.1 Historical Overview of IP strategies

Historically, the automotive industry has not witnessed many disputes over IPRs (DeSantis et al., 2015; James, 2020). Two characteristic features of the arena have been that licensing disputes have been solved amicably between parties and that some technology such as technology concerning safety was licensed for minuscule amounts. Another defining trait is the supply chain handling IP licensing instead of the OEMs themselves (Gowling WLG, 2018).

4.3.2 Future Challenges

First and foremost the industry can be subject to changes in business models, related to the emergence of autonomous vehicles alongside car-sharing and ride-hailing services. Which will require car manufacturers to adapt their IP strategy to accommodate this trend shift (James, 2020). Following the potential shift toward car-sharing and ride-hailing services, it is possible trademarks and brand recognition will be impacted (Gowling WLG, 2018).

Further challenges include increased demand to manage licensing agreements as smart features increase in importance, protecting data related to the connectivity features of the vehicle, high-tech entrants asserting patents, and managing software and data protection related to autonomous vehicles (Aiello et al., 2020).

4.4 Analysis of Patent Information

Patent information is a growing public dataset that historically has been underutilized. There are many sources of patent information, such as auxiliary documents, proprietary information, licensing information, and patent documents, where the latter is most easily accessible and abundant (World Intellectual Property Organization, 1999). Patent information can be used to assess competitors' technological profiles, technological trends, opportunities for cross-licensing, valuation, etc (Granstrand, 2018).

Patent analysis can be conducted quantitatively or qualitatively. Examples of quantitative patent analysis are quantity-based-, time-based-, and ranking analysis. Qualitatively the analysis is conducted by understanding the content of patents and relating different patents. Patent mapping includes qualitative and quantitative patent analyses (Worldwide Intellectual Property Society, 2016).

Table 4.2: Summary of Information Needed for Patent Analysis

Analysis Application	Useful Patent Information
Competitor's Technology Analysis	Patent class code, year of application, patent positions, R&D direction
Technological Trends	Patent counts over time, patent citation data to assess importance
International Market Analysis	Patent country code and coverage of patent families of competitors
Valuation of Technology	Patent volume, patent shares, patent citations, patent renewal fees

4.4.1 IPC Groups

IPC stands for international patent classification and is a tool for classifying and searching patent applications. Technology fields have been divided into eight sections (A-H). Each section has subdivisions, in total there are approximately 75,000 subdivisions, each described by a letter and numbers (World Intellectual Property Organization, 2020a).

The IPC enables the searcher to locate the right technology in many types of patent-related searches or to overview the field of patents filed in a certain technological field, representing IPC symbols (World Intellectual Property Organization, 2020a).

The IPC hierarchy gives greater and greater detail as more symbols are added for further specification (Espacent, 2021a). Table 4.3 illustrates an example of this hierarchy, based on Espacent (2021a).

Table 4.3: Example of IPC Classification Levels

Level	Symbol	Description
Section	A	Human necessities
Class	A21	Baking; edible doughs
Subclass	A21C	Machines or equipment for processing doughs
Group	A21C1	Mixing or kneading machine for the preparation of dough
Subgroup	A21C1/06	With horizontally-mounted mixing or kneading tools

4.4.2 Patent Maps

Patent maps are a method of patent visualization in a particular technology space. It helps identify relationships, zones of infringement and get an overview of the patent characteristics. Patent maps are usually 2- or 3-dimensional diagrams, graphs, tables, or matrices. Common dimensions for these include time, patent class, product, application, and sub-application, by combining these dimensions illustrative figures can be created (Granstrand, 2018).

Patent maps can be useful for planning, research, and technology management. There are software tools to assist in patent mapping, such as PM-manager (Worldwide Intellectual Property Society, 2016).

Results

The following section discloses the research's results, collected from the qualitative interviews performed with academics, IP professionals, and automotive-specific IP respondents. The findings will have a clear distinction between what was proposed by actors in the automotive industry and what was gathered from interviews with academia and IP professionals. Moreover, the section includes the results from a patent analysis performed in support of the case study.

5.1 Interviews

This segment of the results has been divided into four sections, corresponding to the emerging themes to evaluate the research questions. Each section consists of the empirical findings linked to the theme and will be further divided into codes.

An illustration of the themes and codes related to how IP strategies adapt in transformative industries can be found in Table 3.5.

5.1.1 Intersection of Business and IP Strategy

Table 5.1: Results. Intersection of Business and IP Strategy

Codes	Quotes Academia and IP Professionals	Quotes Automotive Industry
Freedom to Operate	*"A good IP strategy would be a strategy that allows you and guarantees you freedom to operate."*	*"The central point that we want to reach with our IP strategy is to protect the freedom of operation."*
	"Two important points with an IP strategy are to create freedom to operate and to create an advantage in value capturing."	*"Generally, to achieve FTO in a patent-heavy area, you need a patent portfolio yourself."*
The Business Implications of IP Strategy	*"IP strategy is much more than what should and should not be patented. It's about how we should use the entirety of our knowledge base, that is the patent portfolio and everything else. What is the best business model"*	*"The IP strategy facilitates the rest of the company's operations. However, more of our revenue is now directly associated with IP, which drives further internal recognition of its importance."*
	"You can have the best strategy in the world, but if your engineering team does not deliver you will never succeed. But the bad strategy will result in you not protecting what needs protecting, which can seriously damage your business."	*"When you're looking for investors, or you're working with venture capital (VC), I think IP plays a huge role there and figuring out what your IP management story is."*
Integration of Business and IP Strategy	*"If you discuss this with IP-strategy consultants they are not very good at this, on average, [...] a reason for this is that they don't have entries high enough in tech leadership within companies. Frankly, they don't reach the strategic level in the big companies."*	*"You could see Volvo (Cars) was way behind. So we changed the inventor reward system for everyone filing patent applications, the inventors. We showed them that Volvo is not going to survive and be the pride of Gothenburg any more if we don't start innovating and capturing that innovation with our IP."*
IP in Open Innovation	*"[IP in Open Innovations, fostering or hindering] If the boundary conditions are set, and everything is defined in a legally binding contract I don't see that as hindering at all."*	*"I think that as much as you want to say open innovate, open innovate, open innovate, unless there is some IP expertise that comes in and lays that structure, there's always going to be an inequity of power."*
	"Open innovation does not mean innovation without IPRs, most companies that collaborate have a solid IP strategy."	*"I think structure and transparency are the biggest keys for open innovation. That being said, I think it's the path forward. I think that it is the future; open innovation across industries."*
Business Strategy of Licensing Agreements	*"If you think that you are a company that has a competitive advantage in a certain area, you don't necessarily want to license out your patents, because that might also lead to new competitors."*	*"There's sort of a gentleman's agreement in the automotive industry, you won't see BMW suing Daimler, you won't see Volvo suing Ford, you won't see General Motors (GM) suing anybody [...], let's just make cars and each get patents and we'll fend off the competitors but the big folks aren't going to sue each other. But that won't last long. As the economy goes down, as fewer cars get sold, there will be some financial pressure to start exerting those patents. So there, I think you will be seeing more lawsuits and some more cross-licensing."*
	"Instead of licensing out and in to gain permission to use a product, many firms choose collaborative contracts, especially in highly technological projects. You might exchange rights with each other through a deal."	*"If we come up with a good solution, we don't go calling Scania asking if they want to license it. It gives us more value being exclusive, forcing others to come up with their own solutions."*

5.1.1.1 Importance of Freedom to Operate

Academics and IP-professionals' views on freedom to operate

Many respondents define FTO as the most critical aspect of an IP strategy. One respondent describes FTO as the following.

> *"Freedom to operate is having the freedom to conduct your own business, and that is equally important as being able to protect your business. So the first step is ensuring you can have that"*

Furthermore, two other respondents point to FTO as critical when deciding whether to pursue R&D activities in a specific area. Without knowledge about other parties' IPRs, R&D activities can be obstructed and lead to considerable sunk costs.

Respondents differ in their views on how to achieve FTO. Some explain that mass-patenting creates a web for which firms can operate unhindered. Others highlight collaborations as central parts of achieving FTO, as reliable licensing deals ensure mobility.

Respondents repeatedly highlighted how the size of a company is a determining factor in what tactics can be employed to ascertain FTO. Smaller companies can leverage open source projects, strategic publishing, or partnerships, whilst larger firms have the liberty to employ patent webs or leverage their position in a consortium.

How the automotive industry pursues freedom to operate

FTO is viewed as a central point when establishing an IP Strategy in the Automotive Industry. However, actors in the industry express difficulties in navigating the IP landscape which is formed by the need for electrification and connectivity. Previously unknown competitors emerge, along with new technical areas. Many respondents feel that this environment has made it cumbersome to achieve FTO.

To pursue FTO, patents are viewed as the most common mean. One respondent mentions that the automotive industry is traditional, meaning that the dominant motive behind patenting is to attain FTO by inhibiting others from patenting one's invention.

Moreover, players in the automotive industry point to FTO as something to seek after, not to achieve. Additionally, one respondent mentions that ones IPRs may not be crucial in the pursuance of FTO.

The respondents propose two main solutions to achieve FTO in the automotive industry. Firstly, to actively patent within the new necessary technological fields.

> *"There are new technological fields, frankly, we know quite little about the new players, that's quite a challenge. To have freedom of operation it's important to patent within the new field."*

Secondly, as firms enter new fields, where IPRs are owned by companies outside of the automotive industry, FTO is hindered. To ensure that the firm can still operate within the space they choose to license in required technologies. Many of these are

standard-essential patents on technologies such as Bluetooth and internet connectivity. For these, one respondent explains that licensing is the only solution.

> *"We pay, solving it is paying."*

5.1.1.2 Business Implications of IP Strategy

Academics and IP-professionals' views on business implications of IP strategy

Some of the respondents distinguish between small and large firms when regarding business implications of IP strategy. Larger firms do often have a well-established business model and strategy. Thus, the outcome of their IP strategy is more or less predetermined and aligns with their core business. For smaller firms, an important purpose of the IP strategy is attracting capital. For instance, the utilization of patents may convey that something novel and good has been created for the firm's stakeholders. Hence the objective of IP strategies for smaller firms might not be a portfolio to protect oneself. Instead, the implications facilitate various business opportunities. Amongst these opportunities lies collaboration, where IPRs are central for establishing a great partnership.

Additionally, another respondent points to a better bargaining position in negotiations for the party which has ownership of relevant patents. The respondent mentions that complex collaboration often implicates licensing of patents. Thus, the ownership of patents plays an essential role in collaboration. When acquiring technological companies, the control of patents will increase the acquisition target's valuation. Conversely, when divesting, a solid patent portfolio plays a critical role in increasing the valuation of the business unit.

Furthermore, there is consensus amongst respondents that an inadequate IP strategy might damage the firm, as inventions may not be properly protected.

How IP strategy in the automotive industry affects the business

Multiple respondents provide insights into the growing value of IP strategy in the automotive industry. Some of the critical aspects which have increased the significance of IP strategy in the automotive industry are securing external funding, managing spin-offs, and strategic acquisitions through internal investment vehicles.

As automotive companies are looking to grow and expand into new technologies, external funding is increasingly important. Respondents point to IP strategy as a critical selling point for investors. They are anticipating similar outcomes to the telecoms industry and placing increasing value on a strong IP portfolio.

Acquisitions in the automotive industry will become progressively more driven by IP strategy. It is essential to acquire firms whose IP portfolio is valuable and procuring firms whose IP strategy can be integrated with the acquiring company.

> *"The IP culture has to be aligned, or at least, speaking the same language as the players that they're investing in for seamless or effective integration."*

As new competencies are required, traditional automotive firms can not manage the transition of their entire organization. Instead, they may spin off parts of their firm. In doing so, the new company is dependent on whether a new IP strategy can emerge, one which was unfeasible to implement at the old firm.

> *If the automotive industry really is moving on a similar trajectory as the tech industry, we'll see a lot of small companies being acquired by some of these traditional companies. And spin-offs will be more frequent, as some of these bigger companies realize that they have areas that they want to run a little faster to keep up with the market. I think IP strategy is at the core of both those activities, that, again, are traditionally not that relevant to the automotive space.*

Many automotive firms have already taken steps to acquire startups through internal VC funds. Some respondents highlight the importance of Volvo tech fund and its ability to establish an IP portfolio that sustains changes.

> *R&D at large companies is not good at doing R&D, R&D is, in most companies, about taking the XC90 and creating the XC100. But true moonshots, 4-5 years ahead, startups are better at that. But that's why we have the technology arena and the startup fund. To bring those rabbit hole ideas into Volvo Cars.*

5.1.1.3 Integration of Business and IP Strategy

Academics and IP professionals' views on how well-established firms integrate business and IP strategy

A consensus among respondents is that the integration between business and IP strategy has improved. Some attribute this to the increasing complexity in highly technological industries, which requires a more sophisticated and integrated IP department. Others point to legislative trends which have heightened the value and complexity of IP.

Although it has improved, it has *"improved from a pretty bad initial state"*, as one respondent describes it. Many say that the integration requires further development. A common sentiment amongst respondents is that companies that manage this integration rapidly succeed. It is described as one of the driving factors behind expeditiously growing tech giants.

One respondent gives an insight into how the IP budget still commonly interferes with this integration.

> *It's still commonly occurring. IP departments are assigned a certain budget, and then proceed to attain as many patents as is possible within that budget. Then there's no focus on the business strategy, just to have as large of a portfolio as possible.*

Respondents highlight the differences in industries and sophistication of IP strategy in relation to business strategy. Where industries that now have matured with a high technological focus have a good grasp of this integration, as IP has been crucial

to their success, whilst previously stagnant industries are now seeing rapid changes and fail to adapt.

The automotive industry's integration of business and IP strategy

Most respondents associated with the automotive industry agree that the industry requires further integration with the IP strategy. It is an effort in which many respondents highlight rapid improvements within.

> *"We are on a journey towards understanding and using IP in a more sophisticated manner, which is the case for almost all industries, especially in Sweden."*

A recurring theme is the characterization of the automotive industry as previously not seeing much change in the integration of IP and business strategy. An aggressive procurement of international IP professionals, outside of the automotive industry, has rapidly propelled the focus of IP strategy.

The majority of companies interviewed describes a restructuring within the company, where the IP department has received additional resources and power within the corporate culture. Previously, IP departments were small and inconsequential. However, the high-profile staff acquisitions combined with new titles have changed the culture of IP within the automotive industry.

Many companies choose to look outside of Sweden, and sometimes even outside of Europe, for talent to facilitate the change of IP culture to a more business-oriented one. As one respondent puts it *"hiring the right people is the key to changing the IP culture"*. The IP culture, which they seek to emulate, is largely based in America.

> *"We have to start doing IP as the Americans do it. There are lots of messed-up things with America, but no one is going to say that we don't do IP law right."*

A leading player in the Swedish automotive industry uses a long-term IP plan, which is closely developed together with the firm's management team, to ensure this integration. It details areas that are of high strategic significance and is altered once a year. The plan helps with prioritization. It also facilitates both internal and external communication, where for the latter, only part of the plan is shared.

> *"Our strategic work has become more closely linked to top management in the company. We are seen and require top executives to sign off on our decisions. We want to affect the strategic work and have come to do so more."*

This strategic integration was emphasized more by top IP management, whilst many conducting the IP operations in the organization had not yet seen a similar extent of this development. Speaking to patent attorneys and IP analysts revealed that many believed the firm lacked strategic usage and knowledge of IP.

Some respondents highlight how IP strategy has evolved to take on a longer time horizon. Technology areas that the firm decides to move towards are dictated by

where a valuable patent portfolio is located.

> *We look towards what is important in the long term, and which areas are strategically important for us to patent within. It can drive the development towards those areas. That's a shift I have witnessed in the last few years.*

5.1.1.4 IP in Open Innovation

Academics and IP professionals' views on the role of IP in open innovation

A consensus achieved from the interviews is that IPRs, most importantly patents, are necessary to facilitate open innovation agreements. Respondents emphasize the uses of IPRs in open innovation agreements, detailing some essential considerations. All of the main ones relate to structuring contracts to enable the disassembly of IP.

A common way the respondents describe these agreements is that they are similar to divorce settlements. Explaining that if you have a prenuptial, you have an easier time dissolving the agreement. Detailing what is prior knowledge is crucial to successfully distribute IPRs post contract.

Multiple respondents highlight how the emergence of open innovation agreements has shifted the focus of IP departments, resulting in a more integrated IP strategy and heightened the influence of the department.

How open innovation is used in connection to IP in the automotive industry

A majority of the respondents describe open innovation as crucial for the development of the automotive industry. However, many were reluctant to share their IP with others.

Automotive firms which are part of a large group focus their collaborative efforts within this setting, simplifying the IP aspects. However, this behavior is likely to change in the future, as outside competencies are required.

There is a consensus that IPRs are required to facilitate open innovation and that it is an essential tool to manage the power dynamic amongst the collaborators. The central issue is to provide the "right party with the right IP". Some respondents claim that shared IP is often not beneficial. Instead, both parties can leave the collaboration satisfied by using a letter of intent (LOI) and innovative contractual solutions. One such contractual solution was to grant the IP to one party but ensure that the other is receiving a license.

> *One structure that we've worked with that allows for much more open innovation and collaborations is where you state in the contract that if it falls in your technology area, you keep it and we get a license back. In that case, there could be a revenue model with royalty included, where you pay us if you start monetizing it.*

5.1.1.5 Business Strategy of Licensing Agreements

Academics and IP professionals' views on how licensing agreements affects the business strategy

Licensing is detailed as a central notion to the appropriability of IP, but the common licensing contracts are undergoing an evolution.

A frequent notion from the respondents is how a rise in the complexity of an industry fosters more collaboration, sometimes replacing traditional ways of structuring licensing agreements. Highly technological sectors are seeing more cross-licensing, or technology exchanges, where both parties have technologies interesting to the other.

One respondent explains that licenses have grown to include a greater portion of "know-how", caused by increased complexity. Licensing agreements can comprise consultants who are on long contracts helping implement and integrate the technology in the licensee company. Moreover, the respondent points to data being of growing importance in licensing agreements, exemplifying training data as an essential add-on to licenses. License agreements are said to require more than a simple patent license.

> *"If you only have a simple licensing agreement looking at patents, then I think you're in trouble."*

The significance of acquiring IP through buying companies with desirable portfolios has, according to some respondents, been lessened by more sophisticated licensing agreements. These agreements can be structured in manners such that they promote and enable a common standard or platform.

A greater portion of the industries are now understanding that IP's value comes from transactions, favoring licensing agreements, claims one respondent.

How the automotive industry utilizes licensing agreements as a business strategy

The interviews portrait the automotive industry as one where money is made through selling products, and protecting those products is the main objective of IP.

> *"If we come up with a good solution, we don't go calling Scania asking if they want to license it. It gives us more value being exclusive, forcing others to come up with their own solutions."*

However, many respondents feel that this is changing, and needs changing. New competitors emerge and as the technology shifts from the core competencies of the OEMs to different ones, more collaboration and licensing are necessary.

> *"We have top-level support for wanting to sell cars like a tech company. In order to do that, I think licensing agreements are one of the huge differentiators between the industries."*

In this regard, some respondents see the automotive industry moving towards how tech firms use licensing agreements. Patent brokers, a phenomenon not yet fully

established in the automotive industry, are standard in tech, something soon to be in the automotive industry as well, one respondent explains. The shift towards using licensing agreements as a more integral part of the business strategy is an important change in a more sophisticated IP strategy, one more closely resembling tech.

5.1.2 Patent Strategies

Table 5.2: Results. Patent Strategies

Codes	Quotes Academia and IP Professionals	Quotes Automotive Industry
Patent Selection Process	*"The bigger picture is that firms often find it difficult to say that their patents are valuable because they patent almost everything they can. So, if you go to a big firm, they file around 50-60 patents per day. A tiny fraction of those are valuable, but because it is not that expensive for them to patent almost everything, they do so. When you look at the whole picture, you might say you know your average patent is not that valuable."*	*"You give it a score from 0 to 10 of how well it fits this specific field and then if it reaches a certain threshold, it counts as relevant and then you file for it. If it does not, well usually, if you're tight on resources, you put it in the drawer."*
	"Firms have gone from mass patent protection to only patenting what is worth protecting."	*"The patents you create are focused on the different types of needs you have in relation to the product you are going to put on the market."*
Patent Management	*"In cases where it is difficult to control boundaries around what kind of invention you're trying to protect it can be more difficult to get value from the patent and it might be easier to circumvent it [. . .] they invent around patents or they just don't bother with it because everything is moving so fast anyway that whatever you patent now will become outdated in a little bit [...]."*	*"We use patent mapping to try to keep track of areas that we feel are strategically important, in order to make better decisions, and to train our R&D organization. To try to increase the value created by R&D."*
	"In the telecommunications industry, you must have a certain patent portfolio to, for example, develop in a network [...]. Then what happens is that they trade (patents) among each other[...]. Then they say if you get my hundred (patents), I get your hundred (patents), so basically it is used as an entry barrier."	*"I think many companies aspire to be able to use IP more proactively. Proactively in as for example by selling and licensing patents."*
Litigation for Patent Infringement	*"In some industries the propensity to litigate increased, but it is risky. If someone infringes on your patent, a patent which you license to ten different companies, you will be reluctant to initiate litigation."*	*"The litigation is going to be driven by what happens when nine out of those ten startups fail, and the wall-street money and the Stockholm money starts buying these patents and asserting them against the OEMs."*
	"You see these cases where it is always about to unlatch infringement of intellectual property rights by one party and then the other party says yes but you have also infringed my patent portfolio here [. . .] they can agree to engage in a cross-licensing deal so they would mutually license each other's technology in order to avoid a situation where you would infringe on the other technology."	*"The best way to make money off of patents has always been to litigate. That's not my strategy, that's just the market. People have to get over this "we don't sue" thing."*
Importance and Motives of Patents	*"It's ridiculous that people think that patents are the end all be all and that if they just get a patent everything will go well."*	*"I think that patents are more important than ever [. . . .] now you start seeing patents being used much more to facilitate transactions."*
	"A lot of patents are very valuable. There are extremely important patents. There are definitely a few among them that are very valuable. But a lot of them also are not, which is what you see."	*"It's the end all, be all. There's trade secrets, there's copyrights, there's designs and there's patents. Patents are the key. If we were Disney I would say copyrights, If we were Netflix I would say copyrights. If we were Coca-Cola I would be talking about trade secrets and trademarks. But if you're a car company, it's patents, it's definitely patents."*

5.1.2.1 Patent Selection Process

Academics and IP professionals' views on how patents are selected for filing

Respondents have frequently explained the process of patent selection as one which arises due to limited resources. Respondents have observed a trend where patenting is more thoughtful and with clear intent. Mass patenting is not only expensive due to filing costs, cleaning up a patent portfolio can also be a demanding task, one respondent reveals. However, some academics clarify that mass patenting in related fields to one's specific technology can be effective in creating patent-fences, which can act as an additional layer of protection. Another respondent points out that the costs related to patenting often are minuscule in relation to revenue, especially for larger companies. This has resulted in vast amounts of patent filings.

Patent selection depends on multiple factors according to respondents. Firstly, the industry in which the firm operates is imperative to how patents ought to be selected. When one product requires one patent, a streamlined selection process is enabled. In complex product industries where multiple patents are required for a product, there is a greater propensity to create patent webs. This impairs competitors' FTO and incentivizes lucrative licensing deals complicating the process, one respondent notes. If the majority of competitors in an industry are mass patenting, it forces the remaining firms to adopt a similar strategy, to avoid getting into an inferior position or losing bargaining power.

Secondly, the speed of the market influences the patent selection process. Respondents highlight that in some markets speed may be of great importance, whilst others are more reliant on precision and scope of the patent filing.

Thirdly, the patent selection process is dependent upon the resources and position of the firm in question. Additional resources provide the ability to file more patents, enabling strategies such as patent webs. The firm's leverage in the competitive landscape plays a crucial role in its ability to threaten litigation and enforcing patents. Which in turn can influence the patent filing process and the propensity for collaboration, one respondent discloses. Smaller firms with less financial strength have to be more selective when patenting since the investment is lost if the patent filing is rejected.

How the automotive industry selects patents to file

The patent selection process in the automotive industry is highlighted as one where patents are categorized by their strategic importance and thereafter evaluated from a business perspective. Respondents point to this process evolving lately, where previously patent selection did not contain a strategic dimension.

Another respondent explains that one can think either broadly or narrowly about what to patent and that the broader view often is sought after in firms. The broader view involves financial factors such as the probability to sell the patent or opportunities for the patent to be licensed out.

Patent selection is about evaluating the benefits of a patent to its total lifetime costs.

One respondent characterizes the patent selection process as a return on investment (ROI) calculation. Other strategies regarding what to patent are ranking innovations on a 0 to 10 scale of how well it fits the specific field, where everything above a certain limit is to be patented.

5.1.2.2 Patent Management

Academics and IP professionals' views on how patents are managed and utilized

Respondents describe various ways in which companies utilize patents. Some firms use patents as a mechanism to create entry barriers by exchanging patents with other actors in the industry. Thus, blocking competitors with no lucrative patents. This is especially common in industries where some standard-essential patents are impossible to operate without. Additionally, respondents highlight that patents can be used as a strategic block to interfere with competitors. Furthermore, it is possible to prevent inventing around by patenting in adjacent technological fields.

Another application area of patents or is in negotiations in various legal cases where the purpose is either collecting damage fees from competitors or engaging in favorable cross-licensing deals.

However, in fast-moving industries, or where it is possible to invent around, the value of a patent is considerably lower. Respondents express that some actors refrain from patenting in such industries, as the patents may be rendered irrelevant in a short period.

How the automotive industry manages and utilizes patents

The predominant use of patents is to protect the core technology from infringement, according to respondents. Additionally, patents can be used to capture value from innovations created by the R&D department by using patent mapping. Patent maps are becoming increasingly significant as they provide valuable information about competitors and inform engineers of vital developments.

Moreover, patent maps are used to inspire engineers of emerging technologies and guiding them towards unpatented areas. Thus, increasing the likelihood of the creation of valuable patents. However, one respondent explains that it is not sought after to disclose excessive information to engineers of the patent landscape. It may increase the cost of damages when inevitable infringement occurs.

As explained by one respondent, patents can serve the purpose of facilitating the strategic focus of a firm by thinking long-term and patenting in the technological areas in which the firm wants to operate in going forward.

A common consensus is that firms strive towards proactive patent usage, which includes selling and licensing patents as well as actively seeking and pursuing litigation activities. In other words, patents can be used to generate direct revenues for the firm.

5.1.2.3 Litigation for Patent Infringement

Academics and IP professionals' views on the strategic implications of litigation

Most of the respondents describe litigation as an expensive and risky endeavor, favoring large corporations. One respondent explains a risk associated with litigation. When proceeding with litigation for patent infringement, you do not only risk losing the case. If you already have licensing deals associated with the patent, the litigation case may cause all licensing revenues to be lost. Companies generating revenue from licensing will sometimes refrain from litigation due to this risk. Furthermore, the patent may become invalid when scrutinized during the litigation case.

However, some respondents note that one is also at risk by neglecting litigation. If one does not enforce patent rights, one risks losing the ability to protect oneself from future patent infringement. Another respondent furthers the complexity by emphasizing the competitive dynamics arising from these actions. The propensity to litigate will be noted by competitors, and one risks losing credibility of enforcing future patents.

Litigation between large corporations can often result in situations where both parties have infringed on each other. In such cases, engaging in cross-licensing with the opposite party may be a viable solution.

How the automotive industry views the strategic implications of litigation

A majority of the respondents describe the automotive industry as one where the focus long has been on delivering products, not filing patent lawsuits.

Patent lawsuits frequently occur but are engaged in non-practicing entities or patent trolls. Large OEMs are rarely pursuing patent litigation against each other. One respondent describes it as a gentleman's agreement, which the same respondent expects to be short-lived.

However, some respondents believe that there will be an increase in litigation, stemming from two reasons.

Firstly, new competitors, gaining relevance and procuring large patent portfolios, have no interest in upholding the aforementioned gentleman's agreement. One of the emerging players is startups, which may find lucrative uses for their patent portfolios in litigation. One respondent draws parallels to how the telecoms industry has seen some players leverage their portfolios.

Secondly, slim margins require OEMs to find additional revenue streams as the economy declines, patent litigation can in that manner be a rewarding endeavor.

Furthermore, one respondent expresses that litigation is the best way to profit from patents. By enforcing litigation, infringers will pay for the usage, thus, the patent maintains its value. However, many respondents are still reluctant to the change and do not feel increased litigation would be beneficial for the industry.

> *"I don't see us wanting to move towards more litigation. Though, we want to have strong patents to defend ourselves. However, not pursuing litigation ourselves."*

5.1.2.4 Importance and Motives of Patents

Academics and IP professionals' views on the importance and motives of patents

The importance of patents yielded polarizing answers from the respondents. Some hailing patents as becoming increasingly valuable compared to other IPRs, whilst others criticize the structures of patent protection and are pessimistic towards their future significance.

Academics responded more pessimistically towards the future of patents than practitioners. Multiple academics question their usefulness and describe them as obsolete. Others instead point to their societal benefits and praise the transactions enabled by them. Several respondents from academia provide concerns for patent enforcement for smaller companies, pointing to the unhealthy power dynamic created.

Many practitioners note their increasing value as technological dependence intensifies. One respondent explains that the uses of patents are evolving along with their relevance. The new uses highlighted are more transaction and collaboration-based. Patents enable large-scale collaborations and licensing, which, according to some respondents, is of increasing value. This is connected to the stated motives of patenting, which include protection, FTO, enabling licensing agreements, bargaining power, facilitating collaborations, obtaining external funding, and receiving validation from investors and other stakeholders.

The significance of patents is dependent on the type of industry, as patents in discrete product industries tend to be of greater usefulness than in complex product industries, one respondent says.

The importance and motives of patents in the automotive industry

The automotive industry is aligned in its view of patents as the most important IPR. Motives to patent depend on the size of the firm and are changing as the industry changes. As much of the inventions in the automotive industry are technical, patents provide the best protection, which often is described as sufficient functionality.

> *"Patents do give you protection, or the right to exclude, if one is to be formal, in a much broader sense than contractual IPRs and pseudo-IPRs, which involve some type of IP and a contract."*

The motives to patent are evolving in the industry. Many respondents still describe protection as the most predominant motive, representing a self-declared traditionalist's view of patents, one still largely present in the industry. However, some respondents emphasize the enabling of transactions, collaborations, and licensing agreements as prevalent motives.

Seldom is the patenting motive aggressive. OEMs do generally not engage in such patenting motives as to hinder or litigate competitors.

5.1.3 Other Means of Protection

Table 5.3: Results. Other Means of Protection

Codes	Quotes Academia and IP Professionals	Quotes Automotive Industry
Use of Trade Secrets	*"It [to combine patents and trade secrets] also holds for software protection. You keep much of the source code secret and patent parts of the architecture."*	*"Any cloud-based algorithm where you're processing data to get information. That is protectable by trade secrets that you would not patent."*
	"Can you patent it? Is the idea new and has an inventive step? Then you patent it and leaves trade secrets for your specific implementation."	*"But trade secrets have not become less important in a transactional framework. Rather, the need to handle them and distinguish what ought to be shared has."*
Use of Strategic Disclosure	*"Patents are expensive and are hard to use as a defense. It's an enormous investment you need to prepare for. Publication can be an alternative to this."*	*"We haven't made great use out of that [Strategic disclosure]. That's one of those things where you talk about it, that's sort of in-between. Do we keep it a trade secret or do we file for a patent? No, let's use strategic disclosure. Not a lot of things fall in between. Most of the time you just go for one or the other."*
	"A hole very easily emerges in such a protection web when you publish. Then it's possible to fall through. Patents are also a form of publication."	*"Our software department is super active in the open-source community and we publish a lot of software products contributing to the scene [...] once it's open-source it's not at risk to anyone else gaining IP coverage on it."*
Non-patent IPRs	*"Another thing that I think is quite interesting is that a lot of things are protected simply by the fact that if you want to replicate our product you need to talk to 50 of our employees."*	*"Trademarks are more important in the passenger car industry than in trucking. There are more passenger cars that are similar, trucking is more differentiated. Here we can focus more on the technical solutions."*
	"The more you move towards some sort of open innovation idea or types of modern business models, the more you should think about IP strategy. You may need to protect other things and use other types of rights."	*"I do not think that design right is the most important part, but it's an important part. It's equally important as patents. We have different tools in the toolbox, I would say."*

5.1.3.1 Use of Trade Secrets

Academics and IP professionals' views on the importance of trade secrets

There is a disparity between the respondents regarding the relevance of trade secrets. One of the respondents points to trade secrets as a weak tool for protection, as such secrets must be combined with non-disclosure agreements to be effective. Conversely, another respondent highlights trade secrets as critical, especially before

the establishment of formal rights. In a sense, patents are always preceded by trade secrets, as patenting is simply a conversion of an informal right to a formal right that is registered.

Another academic suggests that the legislation in the US has reduced patents' possibilities of court proceedings. Hence, greater emphasis has been directed towards trade secrets. Additionally, the same respondent highlighted production technology, process technology, and source code of software as areas where trade secrets are most prevalent.

Furthermore, one respondent claims that trade secrets are used to win time-to-market, and another one sees trade secrets as more common than patents as the technological landscape develops at a rapid pace. The majority of IP professionals highlight trade secrets as critical, especially for data, as the database protection under EU law is cumbersome to obtain.

However, there is a consensus between the respondents when touching upon the negative aspects of trade secrets. There is no mechanism to protect oneself or blocking the competitor if inventions are infringed upon when using trade secrets. Additionally, if another party patents the secret, there are no legal means to protect one's FTO.

The positive aspects are preventing the disclosure of information and the appropriability aspects, which are harder to obtain when using strategic disclosure. However, indirect appropriability, such as setting standards or facilitating collaboration will be more difficult to implement with trade secrets than patents.

The implementation of trade secrets in the automotive industry

Many of the respondents in the automotive industry point to trade secrets when regarding software of various kinds. Especially, predictive software and cloud-based data tend to be protected by trade secrets rather than patents.

Majority of the respondents claim that trade secrets are not as common as patents for protecting inventions. However, many of the interviewees use trade secrets as a part of their IP strategy. As trade secrets are confidential, most of the respondents were hesitant to share further details.

One of the dominant motives for trade secrets is confidentiality, as both patents and publishing disclose information. Thus, trade secrets are used to inhibit others from exploiting one's technology and at the same time maintaining the technical details as a secret.

One of the respondents mentions that one strategy is to patent the invention and preserve the details of implementation as a trade secret. Additionally, trade secrets were viewed as more common when regarding inventions in processes compared with product inventions.

Lastly, one of the respondents comments that firms in the automotive industry often have a defensive patent strategy. Meaning the main reason behind patents is to ensure FTO and hinder others. Hence, trade secrets are a great substitute as

they fulfill these criteria. Therefore, the two can be interchanged depending on the purpose of protecting IP.

5.1.3.2 Use of Strategic Disclosure

Academics and IP professionals' views on the importance of strategic disclosure

The majority of the respondents point to publishing as a strategic alternative to patenting, as both ensure FTO to some degree.

However, many of the respondents highlight the limitations of strategic disclosure. One respondent stresses the risks that come with publishing. When publishing, and thus unveiling information, competitors will have the opportunity to reverse engineer the disclosed invention.

As strategic disclosure does not give the publisher any legal rights, patenting, which could be viewed as a more expensive form of publication, provides greater protection. Additionally, one of the respondents mentions that strategic disclosure might be increasingly common due to information being more approachable nowadays. The way prior art is handled has changed, as information is easily retrievable in a more highly technological society.

> *It has become increasingly popular to use strategic disclosure as a tool for creating FTO, and that is fundamentally true. It's probably just that it's easy to magnify that possibility. There is a very easy hole in such a safety net when you publish, and then you can fall through this.*

The benefit of strategic disclosure is a cheap way of obtaining FTO. The use of publishing might become more common for smaller firms, as they, in most cases, do not have the resources to apply for a patent nor defend it. The downside is losing competitive advantages, as the barriers to entry are torn down when information is revealed.

Many academics point to the use of patents and strategic disclosure in combination with one another. A product may consist of many technologies, such as a core technology and complementary technologies. Hence, it might cost-effective to patent the technology and strategically disclose the complementary technologies to ensuring FTO.

> *"You could choose to patent only your core technology and then publish the other complementary inventions. However, you will always need the protection of the core technology to succeed in doing something."*

Furthermore, many of the IP professionals explain that strategic disclosure can be done discreetly. Thus, minimizing the revelation of information, however, still securing prior art. There are various ways, for instance, by using date stamps or disclosing information to collaboration partners. However, most importantly, whether to use strategic disclosure is an option that should be reviewed on a case-by-case basis.

How actors in the automotive industry use strategic disclosure

Strategic disclosure is not a strategy that is commonly used in the automotive industry. However, when practiced, it is used subtly and for smaller projects. The exception is for open source projects, which are more frequently occurring. Yet, these projects' main objective is not strategic disclosure. The contribution to the prior art is a pleasant by-product.

> *We haven't made great use out of that. That is one of those things where you talk about it, that is sort of in-between. Do we keep it a trade secret or do we file for a patent? No, let's use strategic disclosure. Not a lot of things fall in between. Most of the time you just go for one or the other.*

Respondents explain that they do not publish inventions in journals, rather they try to conceal them in conversations with suppliers, or preserve dated documents that are brought forward in the case of a competitor filing for a patent.

> *"If someone later tries to patent something similar, we have already spoken about it with our supplier. It is enough showing some type of document, picture, or mail conversation to ruin the novelty requirement."*

The complexity associated with inventions in the industry gives advantages to disclosure, as it is not necessary to disclose the exact details of the solution. Contrary to patent filings, it protects as others can not reverse engineer, one respondent explains.

5.1.3.3 Non-patent IPRs

Academics and IP professionals' views on non-patent IPRs

One respondent from academia provides insight into how the passenger car industry is becoming more dependant on trademarks, as the technical aspects of different car brands are converging. Thus, various trademarks, such as the company name but also the products' name have risen in relevance to differentiate from rivals. Additionally, another academic explains that design rights play an essential role in the automotive industry, as spare parts are a great source of income on the aftermarket. Hence, design rights can be used to prevent other actors from obtaining market shares in lucrative businesses. The same respondent, stresses the importance of trademarks too, quoting:

> *If H&M and Balenciaga produce a jacket, which one would you prefer? Technically speaking, the product from H&M might even be of better quality. However, you will still pay a premium for the other brand. Trademarks are no technical dimension.*

Furthermore, another academic stresses the value of trademarks when dealing with generic products, as a tool for differentiating oneself.

Many of the respondents claim that companies, in some cases, lack understanding of what IPRs are and when to use what protection. Moreover, the combination of IPRs is prone to create stronger protections. By combining trademarks, patents,

copyrights, and design rights one can not only protect, but also differentiate from other competitors' products.

> *"The more different instruments you can use, the better."*

Other academics highlight the malfunctioning of IPRs, explaining that business actors can obtain rights that are not relevant to their business, only to interfere with competitors.

How the automotive industry uses non-patent IPRs

Numerous respondents highlight the significance of trademarks, although, to varying degrees. Respondents active in the passenger car industry, emphasize that trademarks are highly significant. One respondent points to trademarks, and thus branding, as crucial when initiating new collaborations with distributors.

In the trucking industry, trademarks are seen as less crucial. One respondent explains that exclusive transport solutions signify the trucking industry, whereas the passenger car industry might undergo an increasing product convergence. Hence, the respondent argues that trademarks might be more vital in the passenger car industry.

Many respondents emphasize design protection as crucial for an IPR toolbox, although many point to patent as the most important IPR.

The respondents mention various application areas for design rights. One of the respondents explains that design right is used for the exterior to differentiate from competitors. Another respondent emphasizes the use of design rights to create a mechanism of protection on the aftermarket. As the aftermarket is a vital source of revenue, design rights of spare parts must be protected to prevent infringement and hence lost market shares.

The respondents did not speak about copyrights to a great extent. Additionally, few of the questions were targeted at that specific IPR.

5.2 Patent Analysis

Below are the results from a patent analysis conducted on the largest players in the automotive industry on Sweden's west coast. The findings display the number of patent filings along with the key areas in which the patent filings occurred.

5.2.1 Patent Quantity

Below are graphs displaying the number of patent filings by Volvo Cars and Trucks per year between 1999 and 2019. The results are only for patent filings to the EPO and are dated by the priority date.

The graphs illustrate how both Volvo Cars and Volvo Trucks have increased their quantity of patent filings over the 20 years examined. The percentage increase

between 1999 and 2019 was 642% for Volvo Trucks and 260% for Volvo Cars. This translates to an annual compounded increase of 10% and 5% respectively.

Figure 5.1: Quantity of Patent Filings by Volvo Cars

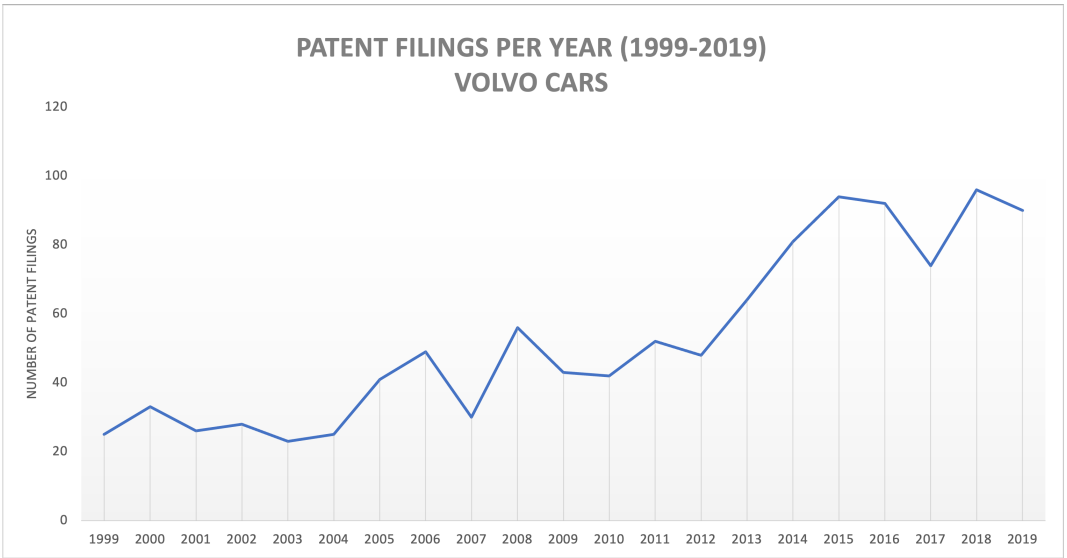
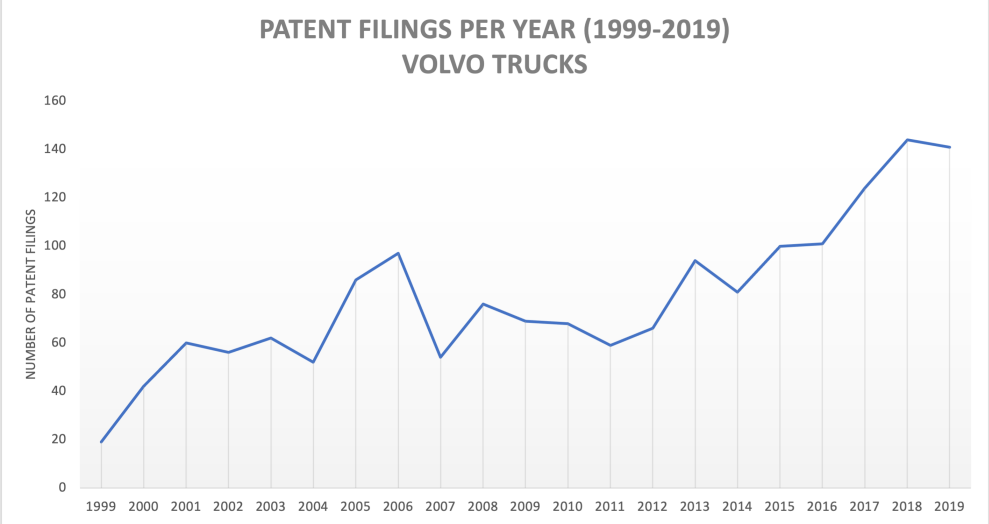


Figure 5.2: Quantity of Patent Filings by Volvo Trucks



5.2.2 Patent Groups

Below are graphs summarizing the firms' largest categories of patent filings. The groups are assembled from the five biggest IPC subgroups every five years between the period of 2000-2020. If only four subgroups are displayed, two of the largest relate to the same technology. For a detailed list of each IPC subgroup see Table B.1 and Table B.2 of the appendix.

Figure 5.3: Major Patent Groups Volvo Cars (2000-2010)

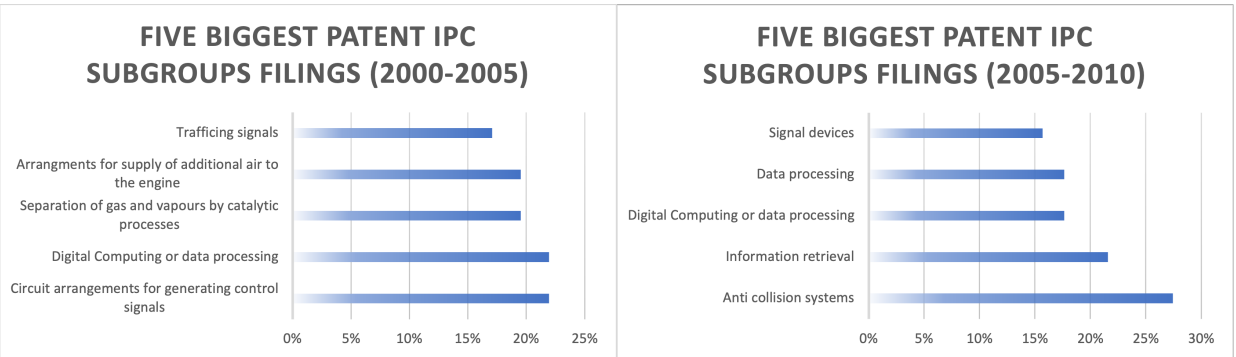
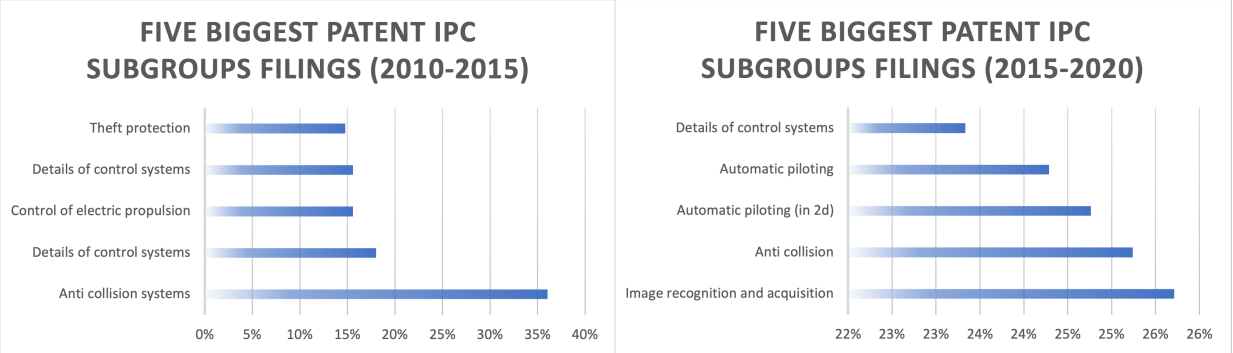


Figure 5.4: Major Patent Groups Volvo Cars (2010-2020)



The results display a major shift from patenting technical aspects of the vehicle, such as traffic signals, signal devices, and catalytic processes, towards software-driven patents such as automatic piloting and image recognition and acquisition.

Figure 5.5: Major Patent Groups Volvo Trucks (2000-2010)

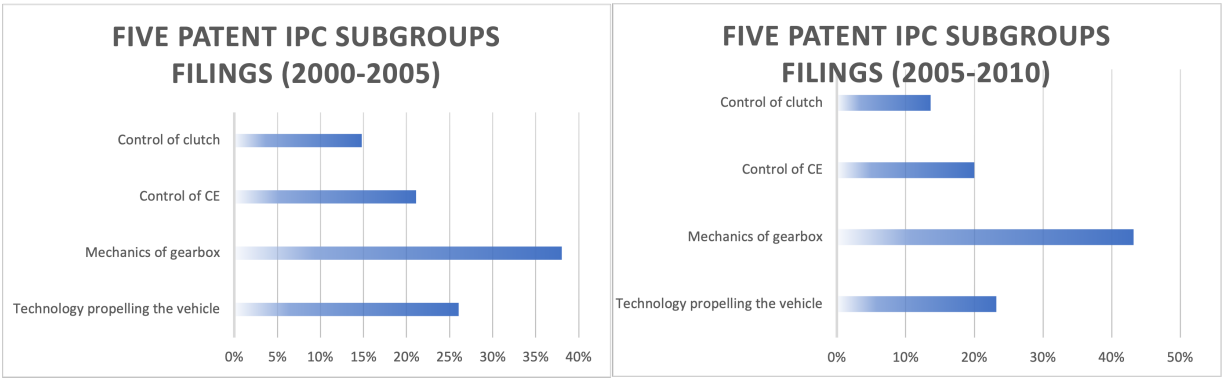
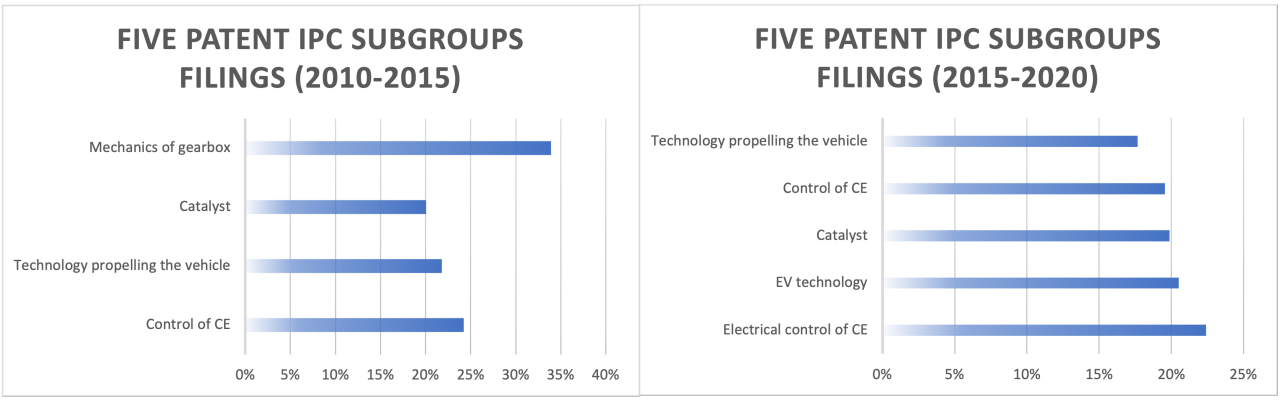


Figure 5.6: Major Patent Groups Volvo Trucks (2010-2020)



The results from the patent analysis on Volvo Trucks, indicate a shift from patenting in areas such as mechanics of gearbox and control of clutch moving towards areas such as EV technology and electrical control of CE.

Discussion

This chapter aims to answer the thesis' research question.

> *Are firms, acting in a changing technological environment, innovating their IP strategies?*

In doing so, this chapter discusses the study's findings in relation to previous literature, and highlights the authors' own insights.

6.1 Relation between Business and IP Strategy

6.1.1 Freedom to Operate

The results indicate increased patenting, both from industry incumbents, as shown by the patent analysis, and from new entrants, which is indicated from the interviews. The authors theorize that this new patenting climate increases the risk of having complications with FTO.

A harder-to-navigate patent climate could motivate firms to trade, license, or cross-license patents, as it mitigates risks related to FTO (Sandal & Kumar, 2011; World Intellectual Property Organization, 2005).

6.1.2 Stratification of Views on IP Strategy within Firms

The results point towards business strategy being more closely incorporated in the attitudes of top IP management, whilst those executing the IP strategy do not share the same extent of strategic outlook.

This finding is aligned with previous management literature, studying the division of corporate strategy within firms (Kaplan & Norton, 2001, 2005), which indicates that only top management is privy to corporate strategy. However, the finding is not emphasized within IP literature.

6.1.3 Negligence of Collaborations and Licensing Agreements

The results indicate a fear of loss of IP through collaboration and licensing agreements with competitors. This concern is highlighted both in the literature (H. Chesbrough & Bogers, 2014; Grimaldi et al., 2021; Holgersson & Granstrand, 2017) and in the interviews with academics as outdated and harmful for innovation within an industry. The findings related to the reluctance to enter licensing agreements are aligned with previous research on the automotive industry (Gowling WLG, 2018).

The same division, as present through many of the topics touched on by this discussion can be seen here. Where some adamantly advocate for the necessity of increased collaboration and licensing, whilst others portrait those acts as non-suitable for the industry, as it is more profitable keeping innovations in-house. Each issue imposes the same division, one side representing a traditionalist's view of the automotive industry, and the other representing one aiming for the industry's IP management to more closely resemble tech.

Smaller firms and spin-offs are incorporating the sharing of IP as a part of their business strategy, facilitating collaborations and licensing agreements. Where the large players are hesitant to share their IP with competitors, small players embrace this as their competitive advantage.

6.1.4 Attracting Capital

Similar to previous literature (Farre-Mensa et al., 2020; Holgersson, 2013), the results indicate a strong connection between IP strategy and the ability to attract investments.

This is further emphasized by smaller actors, such as Polestar, which managed to secure additional funding during the period of research. The company partly attributes the funding to a strong IP strategy and being able to convey its IP vision. This result, being of further importance to smaller actors, is also in line with previous research (Farre-Mensa et al., 2020; Holgersson, 2013). The authors speculate that securing funding will become increasingly important, even for large actors, as the industry transforms. Thus, IP strategy is likely to increase in importance, bolstering investor confidence.

6.2 Patent Strategies

6.2.1 Changing Motives of Patenting

The industry displays a clear divergence in the motives for patenting, where traditional industry players, domestic to the industry, regard the main patenting motive as protecting the core product. Staff acquired outside of the industry are advocating for a more transactions-centered view, as are consultants and outside counsel, non-native to the industry.

There is an ongoing struggle to convey patents as means of transactions, collaboration, litigation, and trade. However, the results indicate that not all are convinced by the New York lawyers preaching how IP ought to be used.

Previous literature points to defense as the predominant motive of patenting (Holgersson & Granstrand, 2017). However, a more sophisticated view of IP, not only regarding patents as a sword or a shield, brings advantages (Palfrey, 2011). The automotive industry has not yet arrived at a place of unity in terms of the conceptualization of patents.

6.2.2 Changing Areas of Patent Filings

The patent analysis, in unity with the interviews, indicates an increased patent activity. Where the main areas of patenting have altered from concerning the ICE to EVs and autonomous driving.

Increased patenting activity in technical fields is in agreement with previous research (Gowling WLG, 2018; Holgersson, 2012), which indicates a trend of increased patent filings. This trend is further supported by automotive-specific literature (DeSantis et al., 2015; European Patent Office, 2017). In accordance with Gowling WLG (2018), the areas of patenting have evolved towards ones with greater emphasis on connectivity, autonomous driving, and electrification. This further indicates that the automotive industry has not evolved its IPRs of choice. Patents are found to be the most important today, and previous literature suggests the same for the history of the industry (Ambastha, 2009; Gowling WLG, 2018). Instead, the industry has evolved its use of patents. Filing more software-related patents as opposed to previously focusing on technical aspects of the vehicle. This is in line with previous literature indicating the transition towards electrification and automation (Gowling WLG, 2018).

6.2.3 Litigation for Patent Infringement

Historically, litigation rarely occurs between OEMs (Decker & Beene, 2017). The results indicate more battles and a shift from only defending lawsuits to filing them against competitors. These findings align with previous literature, which shows increased patent litigation in the automotive industry both from industry incumbents and new entrants leveraging their IP portfolio (Aiello et al., 2020; DeSantis et al., 2015; James, 2020; Shah, 2017). However, the research found this development not to be welcomed by the entire industry where many still believe that each firm ought to focus on their own product, not diverting their attention towards handling IP claims.

Regardless of the traditional OEMs' views, litigation is forced upon the automotive industry by new entrants. It is possible that the OEMs are wary of this, and thus are placing a greater emphasis on having a strong patent portfolio, explaining the results indicating an increase in patent filings. The authors theorize that, as the industry converges with tech from an IP perspective, the result will be an increase in IP litigation. As is shown by previous research to be the case in information technology industries (Chakrabarti, 1991; Liang, 2010; Raghu et al., 2007).

6.3 Other Means of Protection

6.3.1 Trade Secrets

The results point to a great diversity of opinions when regarding trade secrets. However, the dominant motive for using trade secrets is to evade disclosure of information, which is aligned with previous literature (Holgersson & Wallin, 2017;

Schilling & Shankar, 2019). Negative aspects that are also mentioned in the results, such as no legal means to protect oneself upon infringement or no FTO as competitors could patent the secret, is coherent with previous literature (Holgersson & Wallin, 2017).

Although many of the respondents from the automotive industry indicate that trade secrets are not as common as patents, there is an implication to more emphasis being directed towards the IPR, especially when regarding software. A previous study by Gowling WLG (2018) has suggested this shift as well. However, as trade secrets are confidential, unsurprisingly, most of the respondents were reluctant to elaborate further on the topic.

The authors can only speculate on whether trade secrets will have a more significant role when innovating IP strategies. However, as the transition from a traditional automotive industry to a more data-driven one requires various software (Gowling WLG, 2018), it would not be surprising to find that trade secrets will be more prevalent in the changed approach to IP.

6.3.2 Strategic Disclosure

The actors in the automotive industry use strategic disclosure modestly. In their implementation, they indeed diverge from the literature. Instead of openly publishing and contributing with knowledge to competitors (Holgersson & Wallin, 2017), the actors have refined the establishment of prior art by using subtle methods. Consequently, actors can reap the benefits of strategic disclosure without being exposed to its disadvantages, such as publication.

Actors in the automotive industry have innovated strategic disclosure by declaring details in contracts with suppliers and only revealing contribution to prior art once a competitor files for a patent. In this way, they can ensure FTO and avoid the expenses that come with patenting (Holgersson & Wallin, 2017). However, foremost actors can conceal their findings and appropriate on their invention until competition threatens their position.

The authors believe that this procedure might jeopardize the patent system, as the purpose is to disclose technological innovations in order to diffuse knowledge and foster society's technological progress (Granstrand, 2018; Holgersson, 2012; World Intellectual Property Organization, 2020b). If this trend were to spread to different industries and gain increased usage, it could harm the foundations on which the patent system is predicated.

6.3.3 Non-Patent IPRs

The results indicate that trademarks are becoming more significant in the passenger car industry as opposed to trucking. Even more so for smaller firms not possessing a strong patent portfolio. Moreover, the results reveal that design rights are an important IPR to protect the aftermarket of spare parts.

There is an urgency of acting upon climate change (The Global Goals, 2021; United

Nations, 2021a), and previous research indicates that battling this through a circular economy results in a greater need for spare parts (Morlet et al., 2016). The authors thus speculate that the aftermarket of spare parts for the industry might increase in importance moving forward. All of the automotive companies, Polestar (2021), Volvo Car Corporation (2021), and Volvo Group (2021c), highlight the importance of reusing and recycling, to foster a more sustainable future. Hence, the authors imply that design rights will continue to be of importance, and may even speculate that there will be an increase.

Design rights were barely touched upon when talking to academia and IP professionals. Additionally, the coverage of design rights in the literature of IP strategies were scarce. Merely actors in the automotive industry mentioned design rights as an IPR of importance. Thus, the authors find a divergence between IP strategies in theory and practice.

When regarding copyrights, there is an expectation by respondents outside the automotive industry that copyrights will increase in importance to protect software. Software protection was described to grow in importance as the industry becomes increasingly data-driven (Gowling WLG, 2018; Provost & Fawcett, 2013). These indications were further supported by the literature (Gowling WLG, 2018; Provost & Fawcett, 2013). However, the results indicate that actors in the automotive industry instead use either patents or trade secrets to protect software.

6.4 Keys when Innovating IP Strategy

The results show that the main obstacle in innovating IP strategy is the IP culture. The automotive industry has a culture of product focus, where protection of the core product is seen as the fundamental function of the IP strategy. However, licensing agreements, litigation, and collaboration are inhibited by this IP culture.

6.4.1 Hiring Talent with new Perspectives

The automotive industry has attempted to solve the cultural problem by profile talent acquisitions from outside the industry. These acquisitions have significantly altered the importance of IP within the firms and have successfully innovated their IP strategy.

Many players within the automotive industry have implemented this strategy. The IP functions of these firms are not comprised of business insiders, instead, many are from industries that have put a greater emphasis on IP strategy traditionally. This strategy has been implemented top-down, as it is the top executives that are hired from outside the industry.

In hiring talent with new perspectives, the industry has opted for American talent in many cases, which is coupled with the results indicating a large influence of American IP culture, even on the domestic staff. American IP strategy is modeled as an example, in specific, in connection to the tech industry.

Some have chosen to hire international outside counsel, which is well versed in IP strategic issues. The rise in digital meetings may have simplified the process of using counsel based outside of Scandinavia, which the results indicate.

6.4.2 Giving IP Internal Resources

The automotive industry has experienced restructuring in terms of the IP function, from working behind the scenes to becoming an outward-facing influential function.

IP has become more closely linked to top management, establishing a new paradigm where the IP function is part of the firm's strategic team. The industry has begun implementing measures such as long-term strategic plans, which dictate both the firm's strategy and its IP strategy.

6.4.3 Spin Off

A prominent strategy is divesting a business unit and then developing it outside of the larger firm. This has allowed the smaller units to build their IP strategy from scratch, allowing the culture to be aligned with the industry's long-term goals of electrification and automation.

Polestar has attempted this strategy, leading to a culture where they attempt to "sell cars like a tech company". This has had major implications for the construction of the IP strategy, where they view IP as a resource to facilitate collaborative agreements, leverage negotiations, and ultimately generate revenue through licensing and trading their portfolio.

Doing so, they have implemented the strategies mentioned above, as international staff has been hired such as outside counsel based in the U.S and U.K. Additionally, giving the IP department greater internal agency.

6.4.4 Acquisitions of Startups

The ability to scout valuable acquisitions is rising in the industry, as all large players have some sort of VC arm. The results find that this tactic's potential has not been fully realized. No startups have managed to acquire IP portfolios that challenge the OEMs. However, the authors believe that it is only a matter of time.

Startups will likely disrupt the ecosystem, as the industry converges with tech. OEMs have to be cognizant of the fact that their IP will be contested by these players, or else they will risk not enjoying the fruit of their labor. The results indicate that the efforts in acquiring these start-ups have largely been technology-driven, not emphasized from an IP perspective.

Some firms do not appear to be concerned about how the IP landscape might be altered by smaller players. The authors believe that there is a great risk that these new entrants, not inhibited by any traditional IP culture, pursuing aggressive liti-

gation in areas in which the OEMs are poorly protected will threaten the position of traditional industry players.

6.5 Unexpected Findings

This section presents results that do not directly address the research question, thus, findings are not anticipated for the report. Yet, they provide an important basis of discussion, guiding further research.

6.5.1 Disparity Regarding the Importance of Patents

In accordance with previous literature (Ambastha, 2009; Gowling WLG, 2018) patents are the most important IPR in the automotive industry, and one growing in importance as the industry evolves. However, academics proved more hesitant about the usefulness of patents. They highlight the flaws of their protection and are keener on finding alternatives.

A reason for this could be that the companies that have been interviewed have mostly been large corporations, which, in accordance with the literature (Holgersson, 2013; Schilling & Shankar, 2019), view patents more favorably. However, this is unlikely to be the case, as even the smaller firms interviewed highlighted the usefulness of patents.

It is likely that the practitioners play within the rules which they are given, and innovate within this framework, whilst, academics view the rules as malleable. Yet, many academics speak strongly of alternatives to patents, trade secrets in particular. Indicating that this does not present the full story.

Lastly, as the automotive industry is one comprised of many purely technical solutions, patents are likely to be of inflated importance (Organisation for Economic Co-operation and Development, 2004), compared to the average industry. The authors theorize that academics are using the average industry as their presupposition, thus causing a disparity as the thesis samples interviews from more technical industries than the average.

6.5.2 Divergence in Views on Patent Usage

The use of patents also received diverging opinions from practitioners and academics. Academics highlight a lacking strategic component to the use of patents, whilst industry practitioners convey knowledge in multiple strategic areas in which patents can be used.

Both groups, in line with the literature (Granstrand, 2018; Schilling & Shankar, 2019), describe America and Japan as pioneers in this manner. However, academics seem not aware of the strides that industry is taking towards emulating the patent usage of the aforementioned nations.

Perhaps academics see only the results of the industry's efforts to innovate their

patent usage once it permeates their strategy. The results indicate an ongoing struggle and intent for their patent usage to resemble American or Japanese firms, though it's not there yet. It could be theorized that the intent which the results indicate soon will bear fruit, and only then will those outside the industry be aware of the industry's improvements.

6.6 Discussion of Sustainability and Ethics

6.6.1 Sustainability

Five of the SDGs were identified as the most applicable within the context of the automotive industry. The solution to these goals involves sustainable transportation, which is only achievable if the automotive industry evolves. This thesis has brought forward both the challenges and opportunities, from an IP perspective, in achieving this evolution.

The ability to protect and leverage IP facilitates innovation (Saha & Bhattacharya, 2011), thus, connecting directly to SDG 9, and indirectly to them all, as innovation is required for sustainable transportation. Furthermore, the adaptation of IP strategies will be essential for the safe and efficient introduction of autonomous and EVs (James, 2020), hence this thesis plays an important role in assisting the industry's transition to sustainable transportation.

The patent analysis indicates that passenger car manufacturers patent more within autonomous driving while truck manufacturers are more active within electrification. The authors theorize that this result could be explained by the passenger car industry having advanced further in its conversion to sustainable transportation. As the passenger car industry is found to be a larger pollutant (U.S. Environmental Protection Agency, 2020), this result carries positive implications for sustainability, implying that the most critical sector has indeed come the farthest. However, the sample size is only one truck manufacturer and one passenger car manufacturer, making the findings hard to generalize.

The results display an important role of IPRs for a circular economy, through protecting the aftermarket. In order to achieve sustainability, it is paramount to abolish the "make and break" paradigm (The Global Goals, 2021). By supplying spare parts, an economy that gives the incentive to reuse can be established, providing the means for reverse logistics (Morlet et al., 2016). Without the protection of design rights, inhibiting counterfeit spare part distribution, customers would risk obtaining sub-par spare parts, repelling them from a circular economy. Thus, the authors conclude that IPRs are essential in achieving sustainability.

Lastly, the results indicate a reluctance to enter open innovation agreements, hindered by the fear of losing IP. This is an important finding relating to sustainability, as open innovation agreements are essential in promoting sustainable innovation (McGahan et al., 2021). The authors conclude that additional efforts aiding the industry's collaborative efforts are beneficial for sustainability.

6.6.2 Ethics

The results display how strategic disclosure could be used to inhibit patentability, without diffusing the technical knowledge. The authors believe this to propose an ethical issue, as the societal motivation for patents is predicated on a diffusion of knowledge (Granstrand, 2018; World Intellectual Property Organization, 2020b), which is suppressed by such procedures.

As the industry's shift towards sustainable transportation requires continual innovation, the caution in sharing IP could be regarded as an ethical issue. The ethical dilemma arises as the automotive industry's innovation would further benefit if it embraces an innovative IP strategy, thus this thesis could help to facilitate innovation, solving the ethical dilemma.

Conclusions

Based on the conducted analysis the thesis reaches multiple conclusions, presented below. Moreover, an indication of its academic contribution and the report's implications for further research are provided. Lastly, practical advice for how any industry undergoing a technological shift can improve its adaptation of IP strategies is presented.

7.1 Conclusions

The conducted research concludes that firms acting in transformative industries face multiple barriers in innovating their IP strategy. However, they make great efforts in overcoming those. The main obstacle identified in innovating IP strategies was the firm's internal IP culture.

When innovating IP strategies, technological companies do not alter their IPRs of preference. Patents are still perceived as the most important IPR, but the industry's use of patents has changed. Patents have augmented strategic implications, facilitating trade and collaboration.

Patent landscape analyses are performed to direct the efforts of the R&D department, long-term plans for the IP portfolio incorporates business management, and patents are selected through a lens of their strategic importance. However, the traditional perception of IP as only a protective function lives on, inhibiting collaboration and licensing agreements, thus, inhibiting innovation.

Patent filings within the industry are found to be rapidly growing, indicating increased importance. Moreover, the areas in which these patent filings occur have evolved to favoring connectivity and electrification.

Measures identified to changing the IP culture include high profile acquisitions of non-native IP talent, creating greater internal agency for the IP function, spinning off part of the business in order to build the IP strategy from scratch, and strategic acquisitions of companies with a strong IP portfolio and culture.

The report identifies a division within companies, where some view IP through a traditional lens, favoring protection over collaboration, meanwhile others push the industry towards how tech uses IP, advocating licensing and collaboration.

An unexpected conclusion of the thesis is that academics and practitioners differ in their views on specific IPRs. Patents are viewed as less favorable by academics than practitioners, while design rights display the reverse. Moreover, the literature and respondents in academia theorize that copyrights would rise in importance to protect software. Instead, the industry chose patents to protect software and trade secrets to protect data, neglecting copyrights.

7.2 Academic Contribution

This thesis contributes to IP research in three distinct ways. Firstly, the importance of IP culture in innovating IP strategy is highlighted. Previous literature (Dahl, 2020; Holgersson, 2012; Holgersson & Granstrand, 2017; Holgersson et al., 2018) has implied this finding. But has instead focused on technical aspects, shying away associated social and cultural challenges.

Secondly, essential measures in the creation of said IP culture have been identified. This thesis presents novel and practical solutions, not found in previous literature. Previous research has identified the problems, which this thesis attempts to solve, (Granstrand, 1999; Holgersson & Granstrand, 2017; Schilling & Shankar, 2019), but has not presented practical solutions.

Thirdly, the thesis provides a nuanced view of how academics and practitioners differ in their opinion on the usefulness of IPRs and their management. In particular, patents, design rights, and copyrights. Previously, this finding was absent from IP literature. However, research displays similar findings in a more general sense, differentiating academics and practitioners' overall philosophy (Baron et al., 2011; Bartunek & Rynes, 2014).

7.3 Future Research

During the research, it becomes apparent that there is a desire for IP to be more easily traded. Yet, there is little knowledge on how to price it or how to arrange trades. Further research is required in pricing IP and how markets for IP function. Moreover, it is revealed that patent selection is performed based on qualitative aspects. However, there appears to be a desire for firms to streamline this process using ROI calculations. Additional research is necessary for the firms to establish frameworks for how to select patents more rigorously.

The research also highlights a great diversity and curiosity in how the IP department is structured to facilitate innovation. There is large ingenuity in terms of workshops, communicative software, incentives for inventors, use of outside counsel, and budget allocation. However, there seems to be a lacking consensus as to how the IP department best facilitates innovation, in need of additional research.

The study finds differing views on IPRs from academics and practitioners. As this was not an intended research question of the thesis, additional research evaluating this would be of interest. Moreover, research mapping the reasons for divergence and where it originates would prove interesting.

Lastly, the research reveals how a majority of the patent mapping and patent landscape analysis is conducted by firms, not academics. Firms might be reluctant to share their findings. Additional academic research on how the patent usage of the automotive industry has changed, through a quantitative perspective, would be welcomed.

7.4 Practical Implications

Based on the conducted research and its conclusions the following advice has been distilled, aimed at any firm, in a transformative industry, looking to innovate its IP strategies. The advice is firstly presented as points and then summarized in a flow chart, where the flow chart aims at helping firms address the first point: How to build the IP culture.

The first point being.

- *Companies should begin by building the internal IP culture.*

To do so, companies have some strategies at their disposal. These are the ways which the report finds to be the most efficient. How to implement these are summarized in Figure 7.1.

1. Hire talent outside your industry.
2. Give the IP function greater internal agency.
3. Establish closer collaborations with top management through long-term strategic plans, detailing the IP portfolio's goals.
4. Use strategic acquisitions to build the IP portfolio and align the targets' IP strategy with yours.

What are the characteristics of an innovative IP strategy? Below are some factors which this report finds to be associated with an innovative IP strategy. Firstly, patents are considered in a strategic context.

- *Consider the strategic uses of patents.*

Below is a list of how to use patents in a more strategic context.

1. Use strategic acquisitions to build the IP portfolio and align the targets' IP strategy with yours.
2. Use patent maps to guide long-term business strategy.
3. Assess the strategic value of a patent before filing, avoid mass filing.

Secondly, innovative IP strategies incorporate stakeholders outside of the firm's boundaries.

- *The goal of IP is not only protection but facilitating collaboration and generating revenue.*

IP strategies that do so incorporate some of the following aspects.

1. Strive towards generating revenue through license agreements.
2. License and collaborate with competitors.
3. Regard IP as an asset that can be traded.

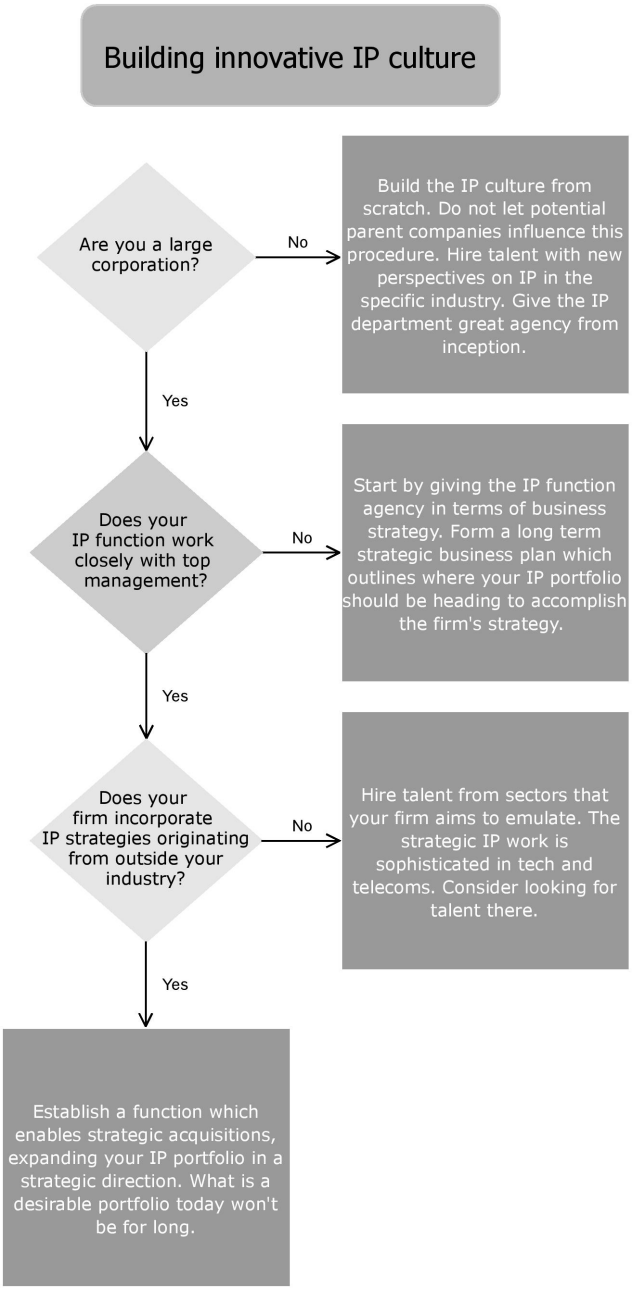
Thirdly, innovative IP strategies combine multiple IPRs and IP strategies.

- *IPRs are combined and multiple parts of the IP toolbox are used.*

When combining IPRs and IP strategies a company should consider.

1. The use of subtle strategic disclosure, disclosing details in supplier agreements.
2. Trade secrets as a mean, only for non-transaction oriented IP.
3. Naming technical solutions, thus, extending the possible use of trademarks.

Figure 7.1: Building an Innovative IP Culture



Bibliography

Aiello, M. A., Camarena, F., Cardona, Englund, R. N., & et.al. (2020). *Top Legal Issues Facing the Automotive Industry in 2020*. Retrieved May 2, 2021, from https://www.jdsupra.com/legalnews/top-legal-issues-facing-the-automotive-16975/

Albuquerque, F. D., Maraqa, M. A., Chowdhury, R., Mauga, T., & Alzard, M. (2020). Greenhouse gas emissions associated with road transport projects: Current status, benchmarking, and assessment tools [Recent Advances and Emerging Issues in Transport Research – An Editorial Note for the Selected Proceedings of WCTR 2019 Mumbai]. *Transportation Research Procedia*, *48*, 2018–2030. https://doi.org/10.1016/j.trpro.2020.08.261

Ambastha, L. (2009). *Role of Intellectual Property in Auto Industry*. Patentwire. https://www.patentwire.co.in/wp-content/uploads/2019/05/Role-of-IP_Auto-Industry.pdf

Aoki, R., & Hu, J.-L. (1999). Licensing vs. litigation: The effect of the legal system on incentives to innovate. *Journal of Economics & Management Strategy*, *8*(1), 133–160. https://doi.org/10.1111/j.1430-9134.1999.00133.x

Backler, W., Heikkilä, T., & Kennedy, D. (2018). *The New IP Strategy: Make Love, Not War*. Retrieved May 8, 2021, from https://www.bcg.com/publications/2018/new-ip-strategy-make-love-not-war

Barbier, E., & Burgess, J. (2017). The Sustainable Development Goals and the systems approach to sustainability. *Economics: The Open-Access, Open-Assessment E-Journal*, *11*, 1–22. https://doi.org/10.5018/economics-ejournal.ja.2017-28

Baron, S., Richardson, B., Earles, D., & Khogeer, Y. (2011). Marketing academics and practitioners: Towards togetherness. *Westburn Publishers Ltd*, *10*(3), 291–304. https://doi.org/10.1362/147539211X602522

Bartunek, J. M., & Rynes, S. L. (2014). Academics and practitioners are alike and unlike: The paradoxes of academic–practitioner relationships. *Journal of Management*, *40*(5), 1181–1201. https://doi.org/10.1177/0149206314529160

Bekkers, R., & West, J. (2006). The effect of strategic patenting on cumulative innovation in UMTS standardization. *DIME Working Paper 9; DIME Workshop on Rules, norms and standards, London, March 4th, 2006.*, 17–39.

Bernitz, U. (2011). *Immaterialrätt och otillbörlig konkurrens: Upphovsrätt, patent, mönster, varumärken, namn, firma, otillbörlig konkurrens*. Retrieved May 10, 2021, from https://www.ne.se/uppslagsverk/encyklopedi/l%C3%A5ng/immaterialr%C3%A4tt

Blind, K., Edler, J., Frietsch, R., & Schmoch, U. (2006). Motives to patent: Empirical evidence from germany. *Research Policy*, *35*(5), 655–672. https://doi.org/10.1016/j.respol.2006.03.002

Block, J. H., Fisch, C. O., Hahn, A., & Sandner, P. G. (2015). Why do SMEs file trademarks? Insights from firms in innovative industries. *Research Policy*, *44*(10), 1915–1930. https://doi.org/10.1016/j.respol.2015.06.007

Blomkvist, P., & Hallin, A. (2015). *Metod för teknologer*. Studentlitteratur.

Bryman, A., & Bell, E. (2014). *Företagsekonomiska forskningsmetoder*. Liber.

Chakrabarti, A. K. (1991). Competition in high technology: Analysis of patents for Canada, France, USA, Japan, UK and West Germany. *IEEE Transactions on Engineering Management*, *38(1)*, 78–84. https://doi.org/10.1109/17.65763

Chesbrough, H., & Bogers, M. (2014). Explicating open innovation: Clarifying an emerging paradigm for understanding innovation. *New Frontiers in Open Innovation*, 3–28.

Chesbrough, H. W. (2003). *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Harvard Business Press.

Cohen, W. M., Goto, A., Nagata, A., Nelson, R. R., & Walsh, J. P. (2002). R&D spillovers, patents and the incentives to innovate in Japan and the United States. *Research Policy*, *31*(8), 1349–1367. https://doi.org/10.1016/S0048-7333(02)00068-9

Dahl, E. (2020). *The changing role of IP. A case study of open innovation in automotive* (Master's thesis). Chalmers University of Technology. https://odr.chalmers.se/handle/20.500.12380/301293

Davidsson, B., & Patel, R. (2019). *Forskningsmetodikens grunder*. Studentlitteratur.

Decker, S., & Beene, R. (2017). *Carmakers want Silicon Valley's tech without its patent wars*. Retrieved May 2, 2021, from https://www.autonews.com/article/20171207/MOBILITY/171209827/carmakers-want-silicon-valley-s-tech-without-its-patent-wars

Denscombe, M. (2010). *The good research guide for small-scale research projects*. McGraw-Hill Education.

DeSantis, M., Oberholtzer, S., & Shereda, R. (2015). *Patent Related Trends in the Automotive Industry*. Brinks Gilson & Lione. https://www.brinksgilson.com/webfiles/AutoArticle.pdf

Duguet, E., & Kabla, I. (2011). Appropriation Strategy and the Motivations to Use the Patent System: An Econometric Analysis at the Firm Level in French Manufacturing. *Annales d'Economie et de Statistique*, *49 50*, 289–327. https://doi.org/10.1007/978-1-4757-3194-1_11

Enkel, E., Gassmann, O., & Chesbrough, H. (2009). Open R&D and Open Innovation: Exploring the Phenomenon. *R&D Management*, *39*(4), 311–316. https://doi.org/10.1111/j.1467-9310.2009.00570.x

Ernst, H., Conley, J., & Omland, N. (2016). How to create commercial value from patents: The role of patent management. *R&D Management*, *46*(S2), 677–690. https://doi.org/10.1111/radm.12210

Espacent. (2021a). *International Patent Classification (IPC) system*. Retrieved May 6, 2021, from https://pt.espacenet.com/help?locale=pt_PT&method=handleHelpTopic&topic=ipc

Espacent. (2021b). *Patent search*. Retrieved May 6, 2021, from https://worldwide.espacenet.com/patent/

European Environmental Agency. (2018). Electrical vehicles from life cycle and circular economy perspectives. *TERM 2018: Transport and Environment Reporting Mechanism (TERM) report*, 80. https://doi.org/10.2800/77428

European Patent Office. (2017). *New patent study confirms growth in Fourth Industrial Revolution technologies*. Retrieved April 8, 2021, from https://www.epo.org/news-events/news/2017/20171211.html

Ewing, T. (2012). Indirect Exploitation of Intellectual Property Rights By Corporations and Investors: IP Privateering & Modern Letters of Marque & Reprisal. *Hastings Sci. & Tech. LJ*, *4*, 1.

Farre-Mensa, J., Hegde, D., & Ljungqvist, A. (2020). What Is a Patent Worth Evidence from the U.S. Patent "Lottery". *The Journal of Finance*, *75*(2), 639–682. https://doi.org//10.1111/jofi.12867

Fisher, W. W., & Oberholzer-Gee, F. (2013). Strategic Management of Intellectual Property: An Integrated Approach. *California Management Review*, *55*(4), 157–183. https://doi.org/10.1525/cmr.2013.55.4.157

Foundation Law. (2021). *Protecting Car Designs*. Retrieved May 12, 2021, from https://www.foundationlaw.com/car_design_patents/

Gassmann, O., Enkel, E., & Chesbrough, H. (2010). The Future of Open Innovation. *R&D Management*, *40*(3), 213–221. https://doi.org/10.1111/j.1467-9310.2010.00605.x

Goines, L., & Hagler, L. (2007). Noise pollution: A modern plague. *The Southern Medical Journal*, *100*(3), 287–294.

Gowling WLG. (2018). *IP and the Automotive Sector*. Managing Intellectual Property. https://tinyurl.com/27jm8xcc

Granstrand, O. (1999). *The Economics and Management of Intellectual Property – Towards Intellectual Capitalism*. Edward Elgar.

Granstrand, O. (2003). *Economics, Law and Intellectual Property*. Springer Science & Business Media Dordrecht. https://doi.org/10.1007/978-1-4757-3750-9

Granstrand, O. (2018). *Industrial Innovation Economics and Intellectual Property*. Svenska kulturkompaniet.

Grimaldi, M., Greco, M., & Cricelli, L. (2021). A framework of intellectual property protection strategies and open innovation. *Journal of Business Research*, *123*, 156–164. https://doi.org/10.1016/j.jbusres.2020.09.043

Grzegorczyk, T. (2020). Managing intellectual property: Strategies for patent holders. *The Journal of High Technology Management Research*, *31*(1), 100374. https://doi.org/10.1016/j.hitech.2020.100374

Gusikhin, O., Rychtyckyj, N., & Filev, D. (2007). Intelligent systems in the automotive industry: Applications and trends. *Knowledge and Information Systems*, *12(2)*, 147–168. https://doi.org/10.1007/s10115-006-0063-1

Gyimesi, K., & Viswanathan, R. (2011). *The shift to electric vehicles*. IBM Global Business Services. https://www.ibm.com/downloads/cas/R6AZDA8E

Hannah, D. R. (2005). Should I Keep a Secret? The Effects of Trade Secret Protection Procedures on Employees' Obligations to Protect Trade Secrets. *Organization Science*, *16*(1), 71–84.

Harabi, N. (1995). Appropriability of Technical Innovations: An Empirical Analysis. *Research Policy*, *24*(6), 981–992. https://doi.org/10.1016/0048-7333(94)00812-4

Holgersson, M. (2012). *Innovation and Intellectual Property: Strategic IP management and Economics of Technology* (Doctoral dissertation). Chalmers University of Technology. https://doi.org/10.13140/2.1.2258.0000

Holgersson, M. (2013). Patent Management in Entrepreneurial SMEs: A Literature Review and an Empirical Study of Innovation Appropriation, Patent Propensity, and Motives. *R&D Management*, *43*. https://doi.org/10.1111/j.1467-9310.2012.00700.x

Holgersson, M. (2018). Technology-based coopetition and intellectual property management. In A.-S. Fernandez, F. Chiambaretto P.and Le Roy, & W. Czakon (Eds.), *The routledge companion to coopetition strategies* (pp. 329–338). Routledge. https://doi.org/10.4324/9781315185644-29

Holgersson, M., & Granstrand, O. (2017). Patenting motives, technology strategies, and open innovation. *Management Decision*, *55*(6), 1265–1284. https://doi.org/10.1108/MD-04-2016-0233

Holgersson, M., Granstrand, O., & Bogers, M. (2018). The evolution of intellectual property strategy in innovation ecosystems: Uncovering complementary and substitute appropriability regimes. *Long Range Planning*, *51*(2), 303–319. https://doi.org/10.1016/j.lrp.2017.08.007

Holgersson, M., & Wallin, M. (2017). The patent management trichotomy: Patenting, publishing, and secrecy. *Management Decision*, *55*(6), 1087–1099. https://doi.org/10.1108/MD-03-2016-0172

Holme, I. M., & Solvang, B. K. (1997). *Forskningsmetodik: Om kvalitativa och kvantitativa metoder*. Studentlitteratur.

Igliński, H., & Babiak, M. (2017). Analysis of the Potential of Autonomous Vehicles in Reducing the Emissions of Greenhouse Gases in Road Transport. *Procedia Engineering*, *192*, 353–358. https://doi.org/10.1016/j.proeng.2017.06.061

James, L. (2020). *A New Way to Manage IP Rights in the Automotive Sector is Needed*. Retrieved May 2, 2021, from https://www.allaboutcircuits.com/news/a-new-way-to-manage-ip-rights-in-the-automotive-sector-is-needed/

Jell, F. (2011). *Patent filing strategies and patent management: An empirical study*. Springer Science & Business Media. https://doi.org/10.1007/978-3-8349-7118-0

Jorda, K. F. (2008). Patent and Trade Secret Complementariness: An Unsuspected Synergy. *Washburn Law Journal*, *48*, 1–32.

Kaplan, R. S., & Norton, D. P. (2001). *The strategy-focused organization: How balanced scorecard companies thrive in the new business environment*. Harvard Business School Press.

Kaplan, R. S., & Norton, D. P. (2005). *The Office of Strategy Management*. Retrieved May 12, 2021, from https://hbr.org/2005/10/the-office-of-strategy-management

Kowalski, S. (2007). Freedom to Operate: The Preparations. In A. Krattiger, R. T. Mahoney, L. Nelsen, J. A. Thomson, A. B. Bennett, K. Satyanarayana, G. D. Graff, C. Fernandez, & S. Kowalski (Eds.), *Intellectual property management in health and agricultural innovation: a handbook of best practices* (pp. 1329–1343). MIHR: Oxford, U.K; PIPRA: Davis, California, U.S.A.

Krattiger, A., Mahoney, R. T., Nelsen, L., Thomson, J. A., Bennett, A. B., Satyanarayana, K., Graff, G. D., Fernandez, C., & Kowalski, S. (2007). *Intellectual Property Management in Health and Agricultural Innovation: A Handbook of Best Practices* (Vol. 1). MIHR: Oxford, U.K; PIPRA: Davis, California, U.S.A.

Lanjouw, J. O., & Schankerman, M. (2001). Characteristics of Patent Litigation: A Window on Competition. *The RAND Journal of Economics*, *23*, 129–151.

Lazzarotti, V., Manzini, R., Pellegrini, L., & Pizzurno, E. (2013). Open Innovation in the automotive industry: Why and How? Evidence from a multiple case study. *International Journal of Technology Intelligence and Planning*, *9*, 37–56. https://doi.org/10.1504/IJTIP.2013.052620

Li, C., Cao1, Y., Zhang1, M., Wang, J., Liu, J., Shi, H., & Geng, Y. (2015). Hidden Benefits of Electric Vehicles for Addressing Climate Change. *Scientific Reports*, *5*(9213). https://doi.org/https://doi.org/10.1038/srep09213

Liang, M. (2010). The Aftermath of TS Tech: The End of Forum Shopping in Patent Litigation and Implications for Non-Practicing Entities. *Texas Intellectual Property Law Journal*, *19*. https://doi.org//10.1038/srep09213

Lichtman, D., Baker, S., & Kraus, K. (2000). Strategic Disclosure in the Patent System. *Vanderbilt Law Review*, *53*(6). https://scholarship.law.vanderbilt.edu/vlr/vol53/iss6/35/

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage Publications.

Lynskey, M. (2009). Aligning strategy and intellectual property to maximise business value: A proposal for new technology-based firms. *International Journal of Intellectual Property Management*, *3*, 301–325. https://doi.org/10.1504/IJIPM.2009.026909

Maguire, M., & Delahunt, B. (2017). Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars. *The All Ireland Journal of Teaching and Learning in Higher Education*, *9*(3), 1–14. http://ojs.aishe.org/index.php/aishe-j/article/view/335

McCollum, D., Krey, V., Kolp, P., Nagai, Y., & Riahi, K. (2014). Transport electrification: A key element for energy system transformation and climate stabilization. *Climatic Change*, *123*, 651–644. https://doi.org/10.1007/s10584-013-0969-z

McCracken, S. A. (2003). Auditors' strategies to protect their litigation reputation: A research note. *Auditing: A Journal of Practice & Theory*, *22*(1), 165–179. https://doi.org/10.2308/aud.2003.22.1.165

McGahan, A. M., Bogers, M. L. A. M., Chesbrough, H., & Holgersson, M. (2021). Tackling Societal Challenges with Open Innovation. *California Management Review*, *63*(2), 49–61. https://doi.org/10.1177/0008125620973713

McKerracher, C., Izadi-Najafabadi, A., O'Donovan, A., Albanese, N., Soulopolous, N., Doherty, D., Boers, M., & Fisher, R. (2020). *Electric Vehicle Outlook 2020*. Bloomberg. https://about.bnef.com/electric-vehicle-outlook/

McKinsey Global Institute. (2016). *The age of analytics: Competing in a data-driven world*. Retrieved May 8, 2021, from https://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/the-age-of-analytics-competing-in-a-data-driven-world

Meyer-Dulheuer Legal Patentanwälte. (2016). *In detail: Design Protection in the EU for Auto Spare Parts - Part 1*. Retrieved May 12, 2021, from https://legal-patent.com/design-law-en/design-protection-in-the-eu-auto-spare-parts-1/

Morgan Lewis. (2008). *Emerging life sciences companies*. https://tinyurl.com/742jx9t9

Morlet, A., Pollard, S., & Appel, F. (2016). *WASTE NOT, WANT NOT*. Ellen MacArthur Foundation. https://www.ellenmacarthurfoundation.org/assets/downloads/ce100/Reverse-Logistics.pdf

Nanaki, E. A., & Koroneos, C. J. (2013). Comparative economic and environmental analysis of conventional, hybrid and electric vehicles the case study of Greece. *Journal of Cleaner Production*, *53*, 261–266. https://doi.org/10.1016/j.jclepro.2013.04.010

National Aeronautics and Space Administration. (2021). *Overview: Weather, global warming and climate change*. Retrieved April 7, 2021, from https://climate.nasa.gov/resources/global-warming-vs-climate-change/

National Highway Traffic Safety Administration. (2021). *Automated vehicles for safety*. Retrieved May 9, 2021, from https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic Analysis. *International Journal of Qualitative Methods*, *16*(1). https://doi.org/10.1177/1609406917733847

Organisation for Economic Co-operation and Development. (2004). *Patents and Innovation: Trends and Policy Challenges*. Retrieved May 8, 2021, from https://www.oecd.org/science/inno/24508541.pdf

Organisation for Economic Co-operation and Development. (2016). *World Corporate Top R&D Investors: Shaping the future of technologies and of AI*. Retrieved May 8, 2021, from https://www.oecd.org/sti/world-corporate-top-rd-investors-shaping-future-of-technology-and-of-ai.pdf

Ottermark, M. (2020). *Västsvensk Konjukturindikator December 2020*. Retrieved May 6, 2021, from https://www.vastsvenskahandelskammaren.se/artiklar/vastsvensk-konjunkturindikator-december-2020/

Palfrey, J. (2011). *Intellectual property strategy*. MIT-press.

Parchomovsky, G. (2000). Publish or perish. *Faculty Scholarship at Penn Law*.

Paré, G., Trudel, M.-C., Jaana, M., & Kitsiou, S. (2015). Synthesizing information systems knowledge: A typology of literature reviews. *Information & Management*, *52*(2), 183–199. https://doi.org/10.1016/j.im.2014.08.008

Peters, T., Thiel, J., & Tucci, C. L. (2013). Protecting Growth Options in Dynamic Markets: The Role of Strategic Disclosure in Integrated Intellectual Property Strategies. *California Management Review*, *55*(4), 121–142. https://doi.org/10.1525/cmr.2013.55.4.121

Polestar. (2020). *Polestar precept*. Retrieved February 2, 2021, from https://www.polestar.com/se/precept/

Polestar. (2021). *A design-focused electric performance car brand, harnessing refined performance and cutting-edge technology*. Retrieved February 2, 2021, from https://about.polestar.com/

Provost, F., & Fawcett, T. (2013). Data Science and its Relationship to Big Data and Data-Driven Decision Making. *Big data*, *1*(1), 51–59. https://doi.org/10.1089/big.2013.1508

Qiao, Q., Zhao, F., Liu, Z., He, X., & Hao, H. (2019). Life cycle greenhouse gas emissions of Electric Vehicles in China: Combining the vehicle cycle and fuel. *Energy*, *177*, 222–233. https://doi.org/10.1016/j.energy.2019.04.080

Racherla, U. S. (2016). Do IPRs Promote Innovation? In K.-C. Liu & U. S. Racherla (Eds.), *Innovation and IPRs in China and India: Myths, Realities and Opportunities* (pp. 25–52). Springer Singapore. https://doi.org/10.1007/978-981-10-0406-3_2

Raghu, T. S., Woo, W., Mohan, S. B., & Rao, H. R. (2007). Market reaction to patent infringement litigations in the information technology industry. *Information Systems Frontiers*, *10*. https://doi.org/10.1007/s10796-007-9036-5

Saha, C. N., & Bhattacharya, S. (2011). Intellectual property rights: An overview and implications in pharmaceutical industry. *Journal of advanced pharmaceutical technology & research*, *2*(2), 88–93. https://doi.org/10.4103/2231-4040.82952

Sandal, N., & Kumar, A. (2011). Role of Freedom to Operate in Business with Proprietary Products. *Journal of Intellectual Property Rights*, *16*, 204–209.

Schilling, M., & Shankar, R. (2019). *Strategic Management of Technological Innovation*. McGraw-Hill Education.

Shah, A. (2017). *Upward trend in patent litigation relating to automobiles*. Retrieved April 7, 2021, from https://www.financierworldwide.com/upward-trend-in-patent-litigation-relating-to-automobiles#.YJe0QRMzbs0

Shurmer, M., & Lea, G. (1995). Telecommunications Standardization and Intellectual Property Rights: A fundamental dilemma. *StandardView*, *3*, 50–59. https://doi.org/10.1145/208164.208166

Sønderholm, J. (2010). Ethical Issues Surrounding Intellectual Property Rights. *Philosophy Compass*, *5*, 1107–1115. https://doi.org/10.1111/j.1747-9991.2010.00358.x

Soret, A., Guevara, M., & Baldasano, J. (2014). The potential impacts of electric vehicles on air quality in the urban areas of Barcelona and Madrid (Spain). *Atmospheric Environment*, *99*, 51–63. https://doi.org/10.1016/j.atmosenv.2014.09.048

Story, A. (2004). Intellectual Property and Computer Software. *Intellectual Property Rights and Sustainable Development*, *10*, 53.

Sutton, J., & Zubin, A. (2015). Qualitative Research: Data Collection, Analysis, and Management. *The Canadian journal of hospital pharmacy*, *68*(3), 226–231. https://doi.org/10.4212/cjhp.v68i3.1456

Swedish Intellectual Property Office. (2019a). *Internationell ansökan, PCT*. Retrieved April 20, 2021, from https://www.prv.se/sv/patent/ansoka-om-patent/internationellt-skydd/internationell-ansokan-pct/

Swedish Intellectual Property Office. (2019b). *Mönsterskydd*. Retrieved April 19, 2021, from https://www.prv.se/sv/kunskap-och-stod/vanliga-ord-och-begrepp/monsterskydd/

Swedish Intellectual Property Office. (2020a). *Patent*. Retrieved April 19, 2021, from https://www.prv.se/sv/patent/

Swedish Intellectual Property Office. (2020b). *Varumärke*. Retrieved February 28, 2021, from https://www.prv.se/sv/varumarke/

Swedish Intellectual Property Office. (2021). *Europeisk patentansökan*. Retrieved April 21, 2021, from https://www.prv.se/sv/patent/ansoka-om-patent/internationellt-skydd/europeisk-patentansokan/

Swedish Research Council. (2017). *God forskningssed*. https://www.vr.se/download/18.2412c5311624176023d25b05/1555332112063/God-forskningssed_VR_2017.pdf

The Global Goals. (2021). *The global goals*. Retrieved February 2, 2021, from https://www.globalgoals.org/

Trouvé, J. (2020). *Fordonsindustrin kan sätta sveriges hjul i rullning*. Retrieved May 6, 2021, from https://www.vastsvenskahandelskammaren.se/artiklar/fordonsindustrin-kan-satta-sveriges-hjul-i-rullning/

United Nations. (2020). *Sustainable cities: Why they matter*. Retrieved May 9, 2021, from https://www.un.org/sustainabledevelopment/wp-content/uploads/2019/07/11_Why-It-Matters-2020.pdf

United Nations. (2021a). *Climate action*. Retrieved March 7, 2021, from https://www.un.org/sustainabledevelopment/climate-action/

United Nations. (2021b). *Goal 11: Make cities inclusive, safe, resilient and sustainable*. Retrieved May 9, 2021, from https://tinyurl.com/yddu3xhm

United Nations Global Impact. (2021). *Breakthrough Innovation for the SDGs*. Retrieved April 6, 2021, from https://www.unglobalcompact.org/take-action/action-platforms/breakthrough-innovation

U.S. Environmental Protection Agency. (2008). *Reducing urban heat islands: Compendium of strategies*. Retrieved May 8, 2021, from https://www.epa.gov/sites/production/files/2017-05/documents/reducing_urban_heat_islands_ch_1.pdf

U.S. Environmental Protection Agency. (2020). *Green vehicle guide*. Retrieved May 6, 2021, from https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions

Van Zeebroeck, N., & Van Pottelsberghe de la Potterie, B. (2011). Filing Strategies and Patent Value. *Economics of innovation and new technology*, *20*(6), 539–561. https://doi.org/10.1080/10438591003668646

Volvo Car Corporation. (2020). *Caring for the environment, caring for our employees*. Retrieved May 8, 2021, from https://group.volvocars.com/sustainability/company-impact

Volvo Car Corporation. (2021). *This is volvo*. Retrieved April 22, 2021, from https://www.media.volvocars.com/global/en-gb/corporate/this-is-volvo

Volvo Group. (2020). *The Volvo Group and Daimler Truck AG to lead the development of sustainable transportation by forming joint venture for large-scale production of fuel cells*. Retrieved April 25, 2021, from https://www.volvogroup.com/en/news-and-media/news/2020/apr/news-3640568.html

Volvo Group. (2021a). *Års- och hållbarhetsredovisning 2020*. https://www.volvogroup.com/se/news-and-media/events/2021/feb/annual-and-sustainability-report-2020.html

Volvo Group. (2021b). *Circularity*. Retrieved April 25, 2021, from https://www.volvogroup.com/en/sustainability/environmental-resources-efficiency/circularity.html

Volvo Group. (2021c). *Climate strategy*. Retrieved May 2, 2021, from https://www.volvogroup.com/en/sustainability/climate-goals-strategy.html

Wallén, G. (1993). *Vetenskapsteori och forskningsmetodik*. Studentlitteratur AB.

Warner Norcross+Judd LPP. (2015). *Will Software Copyright Protection Control the Future Development of Vehicles?* Retrieved May 12, 2021, from https://www.wnj.com/Publications/Will-Software-Copyright-Protection-Control-the-Fut

World Health Organization. (2018a). *Climate change and health*. Retrieved April 7, 2021, from https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health

World Health Organization. (2018b). *More than 90% of the world's children breathe toxic air every day*. Retrieved May 7, 2021, from https://www.who.int/news/item/29-10-2018-more-than-90-of-the-worlds-children-breathe-toxic-air-every-day

World Intellectual Property Organization. (1999). WIPO Regional Training Course on Intellectual Property for Developing Countries of Asia and the Pacific.

World Intellectual Property Organization. (2004a). Freedom to operate. *WIPO Magazine*, *5*.

World Intellectual Property Organization. (2004b). *Wipo intellectual property handbook*. WIPO. https://www.wipo.int/edocs/pubdocs/en/wipo_pub_489.pdf

World Intellectual Property Organization. (2005). IP and Business: Launching a New Product: freedom to operate. *WIPO Magazine*, *5*.

World Intellectual Property Organization. (2020a). *International Patent Classification (IPC)*. wipo.int/publications/en/details.jsp?id=4509

World Intellectual Property Organization. (2020b). *Trade secrets*. Retrieved February 28, 2021, from https://www.wipo.int/tradesecrets/en/

World Intellectual Property Organization. (2020c). *What is intellectual property*. https://www.wipo.int/publications/en/details.jsp?id=4528

World Trade Organization. (2021). *What are intellectual property rights?* Retrieved April 19, 2021, from https://www.wto.org/english/tratop_e/trips_e/intel1_e.htm

Worldwide Intellectual Property Society. (2016). *Patent Map (PM)*. https://www.wipo.int/edocs/mdocs/sme/en/wipo_ip_bis_ge_03/wipo_ip_bis_ge_03_16-annex1.pdf

Yang, D.-x., Qiu, L.-s., Yan, J.-j., Chen, Z.-y., & Jiang, M. (2019). The government regulation and market behavior of the new energy automotive industry. *Journal of Cleaner Production*, *210*, 1281–1288. https://doi.org/10.1016/j.jclepro.2018.11.124

Yusof, H., & Ali, A. M. (2011). Quality in Qualitative Studies: The Case of Validity, Reliability and Generalizability. *Issues in Social and Environmental Accounting*, *5*(3), 25–64.

Interview Questions

A.1 Questions to Academics

1) How do you view the integration between innovation and IP, how integrated are they today, as well as historically, and will/should this integration be furthered?

2) Are there any ways to build an IP strategy to facilitate innovation in a firm? What kinds of strategies are possible to employ to make sure that IP gets captured and arises within your organization?

3) How important is it for a somewhat R&D-dependent firm to have a good IP strategy? Is it becoming less important or more important in the future?

4) How do you select what patents are worth filing?

5) What are the advantages of integrating IP strategy with the firm's overall strategy?

6) How do you structure a firm to protect its intellectual property rights? Does the size of the firm affect this?

7) Do firms often fail to recognize intellectual property as an asset class?

8) How common are open innovation collaborations today? What challenges and opportunities do these pose to the IP strategy?

9) How can firms structure an agreement in regards to the IP disassembly process to make it as smooth as possible?

10) What is your view from a macro perspective on patents? How do you think they work? Do you think the importance of patents will increase or decrease in the future?

11) Should the strategy be to file as many patents as possible? Or have a more measured, strategic approach?

12) How do you view strategic disclosure as an IP strategy?

13) How do you view trade secrets? Have they increased or decreased in importance? How will the use cases evolve going forward?

A.2 Questions to IP professionals

1) What do you think about the way patent usage has developed? Are there other underlying factors for patenting today than before? How will this change in the future?

2) How do companies decide their patent strategy? Does it depend on the industry, the size of the company, or what maturity phase the company is in?

3) Should firms file patents for everything or be more restrictive? Does it depend on the company's industry and size?

4) How good are companies at patenting today? In what regard can they improve?

5) What are your thoughts on the patent system? How do you think the patent system will develop in the future?

6) In what situation should trade secrets be used instead of patents?

7) What is your view on the integration between the IP department and the innovation department? Is more integration required and how can it be improved? What factors affect it?

8) Tell us about your IP strategies. Are there any deciding factors when you establish an IP strategy for your company?

9) How important do you think it is to have a good IP strategy?

10) Should the entire company have knowledge of the IP strategy?

11) Do you think that the IP strategy in the automotive industry will change as the industry's core technology changes? What strategy do you think will benefit automotive companies?

12) What is your view on trade secrets? What role do you think they will play in the future?

13) What is your view on strategic publishing?

14) What is your view on collaborations such as open innovations? What are the difficulties and benefits and how do you solve these?

A.3 Questions to the Automotive Industry

1) How important are patents in the automotive industry and how are they used?

2) What do you see as the challenges and opportunities with a more data-driven automotive industry? How are IP issues handled?

3) How common are open innovation collaborations in the automotive industry and what challenges do those place on the IP strategy?

4) How are licensing agreements structured? Is it common with some sort of consortium or do you share patents within the group, or is cross-licensing frequently occurring? How common are licensing agreements between OEMs?

5) How do you deal with infringement on your IPRs and how does the automotive industry view litigation?

6) Do you ever work with strategic disclosure and what is your opinion of that?

7) How do you view trade secrets? Is it something that has increased or decreased in importance and usage? How does the automotive industry use trade secrets?

8) How has the use of IP changed with new challenges in terms of electrification and connectivity? Has it taken new strategic dimensions?

Patent Analysis

B.1 Detailed IPC Subgroups

For Volvo Cars the following IPC subgroups were found to contain the largest quantity of filings, they are ordered from largest to smallest in Table B.1 below.

Table B.1: Detailed IPC Subgroups Volvo Cars

Years	2000-2005	2005-2010	2010-2015	2015-2020
Largest	F02D41/02	G08G1/16	G08G1/16	G06K9/00
	G06F17/60	G06F17/30	B60W50/14	G08G1/16
	B01D53/94	G06F19/00	B60W30/08	G05D1/02
	F01N3/00	G06F7/00	B60W50/00	G05D1/00
Smallest	B60Q1/00	B60Q1/00	B60R21/00	B60W50/00

For Volvo Trucks the following IPC subgroups were found to contain the largest quantity of filings, they are ordered from largest to smallest in Table B.2 below.

Table B.2: Detailed IPC Subgroups Volvo Trucks

Years	2000-2005	2005-2010	2010-2015	2015-2020
Largest	B60W30/18	B60W30/18	B60W10/06	F02D41/00
	B60W10/10	B60W10/10	B60W30/18	B60L11/18
	B60W10/06	F16H61/02	F01N3/20	F01N3/20
	B60W10/02	B60W10/06	F16H61/02	B60W10/06
Smallest	F16H61/02	B60W10/02	B60W10/10	B60W30/18

DEPARTMENT OF TECHNOLOGY MANAGEMENT AND ECONOMICS
DIVISION OF ENTREPRENEURSHIP AND STRATEGY
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2021
www.chalmers.se

CHALMERS