UNIVERSITY OF TURKU

ABSTRACT

Abstract

This thesis discusses various elements of value co-creation through APIs in the context of Multi-sided platforms. A design science research methodology is applied to answer the main research question of how APIs contribute to value co-creation in a Multi-sided platform environment. During the research, a model is developed that shows the impact of offering APIs to complementors, competitors and individual developers. This model is applied in the context of the E-Mobility industry. The target company, a Multi-sided platform provider that connects EV drivers with charging stations, serves as a real-world context for this thesis. During the application of the model, several artifacts are created, and the theoretical model is refined through direct feedback from business and IT professionals in the E-Mobility field.

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VALUE CO-CREATION THROUGH APIS IN MULTI-SIDED PLATFORMS

A design science research in the E-Mobility industry

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Abbreviations

API	Application Programming Interface
BEV	Battery Electric Vehicle
CDR	Charge Detail Record
CPO	Charge Point Operator
CRM	Customer Relationship Management
DS	Design Science
DSO	Distribution System Operator
eMI3	eMobility ICT Interoperability Innovation Group
E-Mobility	Electric-Mobility
EMP	Electro Mobility Provider
EV	Electric Vehicle
IP	Intellectual Property
KPI	Key Performance Indicator
MSP	Multi-Sided Platform
OCHP	Open Clearing House Protocol
OCPI	Open Charge Point Interface
OCPP	Open Charge Point Protocol
OICP	Open Intercharge Protocol
PHEV	Plug-in Hybrid Electric Vehicle
PSD2	Second Payment Service Directive
RFID	Radio-Frequency Identification
SDK	Software Development Kid
SLA	Service Level Agreement

1   INTRODUCTION

This thesis is motivated by a practical problem that the researcher faced while working for a Multi-Sided Platform (MSP) in the Electric-Mobility (E-Mobility) industry. The purpose of the research is to design and validate a model that contributes to the understanding of value co-creation through APIs in the industry context and can be applied to companies in different industrial areas but with the MSP business model.

E-Mobility has been booming over the past 7 years. Battery electric vehicles (BEVs) adoption between 2012 and 2018 has nearly doubled each year, with 110.000 cars on the roads worldwide in 2012, totaling to approximately 3,3 Million BEVs at the end of 2018 (IEA 2019, p. 210). A crucial factor that facilitates the wide-spread adoption of Electric Vehicles (EVs) - besides BEV attributes like price, range and availability - is the public charging infrastructure, that enables long-distance travel with BEVs and reduces the so-called range anxiety for EV-Drivers. However, the relative amount of public charging poles being constructed has decreased in momentum compared to previous years. Totaling to a number of 539.000 chargers at the end of 2018, which is "only" a plus of 24 % compared to the previous relative growth of 30 % in 2017 and 80 % in 2016 (IEA 2019, 38-40).

There is a wide range of businesses like energy utilities, car manufacturers, electric installation companies and native EV charging network providers that invest in building up the public charging networks. The target company of this study supports companies that invest in public charging infrastructure. It helps charge point operators (CPOs) by providing a platform that offers tools to manage public charging infrastructure. Furthermore, it offers various white-label applications that help E-Mobility providers (EMPs) to offer charging services to end-customers, the EV-drivers.

Previous studies of Korpelainen (2017) and Säde (2019) have examined the business model of the company and concluded it to be that of an MSP provider. Thus, principles of platform economics will be used to determine how value can be co-created by the multiple sides in the platform ecosystem. Furthermore, a review of strategic measures like envelopment and recommendations on how to avoid pitfalls like the chicken and egg problem (Caillaud and Jullien 2003; Evans 2009) will be incorporated to form a model that describes how value is co-created through APIs in an MSP environment.

The second domain that is discussed in this thesis are the principles and strategies in the API economy. Most importantly the positive and negative effects of allowing third-party developers to create additional applications and integrations that generate value for one or multiple sides of MSP actors.

1.1   Research question

This thesis relies on the research done in the disciplines of platform economics and API economics. The research goal is to gain an understanding through literature research what factors – in general - influence value co-creation of MSPs and the ecosystem and how an API offering of an MSP provider – in particular – can facilitate, enable or block value co-creation. Therefore, the main research question that should be answered through this thesis is:

MainRQ: How value is co-created through APIs in a Multi-sided platform environment?

The research question has practical relevance for the case company, as there are different views in the company on how open or closed interfaces should be. It will contribute to the existing body of knowledge by building on top of existing platform economy and API economy research. Therefore, the findings from applying the model in the industry context of an E-Mobility platform provider will contribute to the existing body of knowledge in the named disciplines.

1.2   Scope of study

To keep the research manageable in the context of a master thesis, the scope of the thesis lies on examining value co-creation potential from the supplier of the API point of view. In the case of this research, it will be mainly the MSP provider perspective that is considered. As MSPs however live, grow and perish with their ecosystem, the viewpoint of the API consumers also plays a vital role in this research. Having the MSP provider as main focus point is not only justifiable due to the limitations of the extent of a master thesis but also grounded in previous research in the field of platform economics by Gawer and Cusumano (2008), Evans (2009) and Hagiu and Wright (2015), where strategic decisions and value creation are viewed from the angle of the MSP provider.

1.3   Research methodology and methods

The goal of the thesis is to create a model of factors that influence value co-creation through APIs in the MSP environment. The model should be applicable in practice by companies characterized as MSP in different industries. Hence the outcome of the thesis will be contributing to the body of knowledge and will have a practical use. As stated by Simon (1996) "design science attempts to create things that serve a human purpose".

More recently Hevner et al. (2004) introduced a framework and guidelines regarding the application of Design Science (DS) in Information Systems (IS) research. Figure 1 illustrates the framework that will be used as a basis for this thesis. The framework shows the interconnection of design science research with its environment. Business needs are the input and the applicability of the artifact is the output. Secondly, the interconnection of DS to the knowledge base, where existing theories are taken into use to create an artifact and the artifact itself contributes again to the knowledge base.
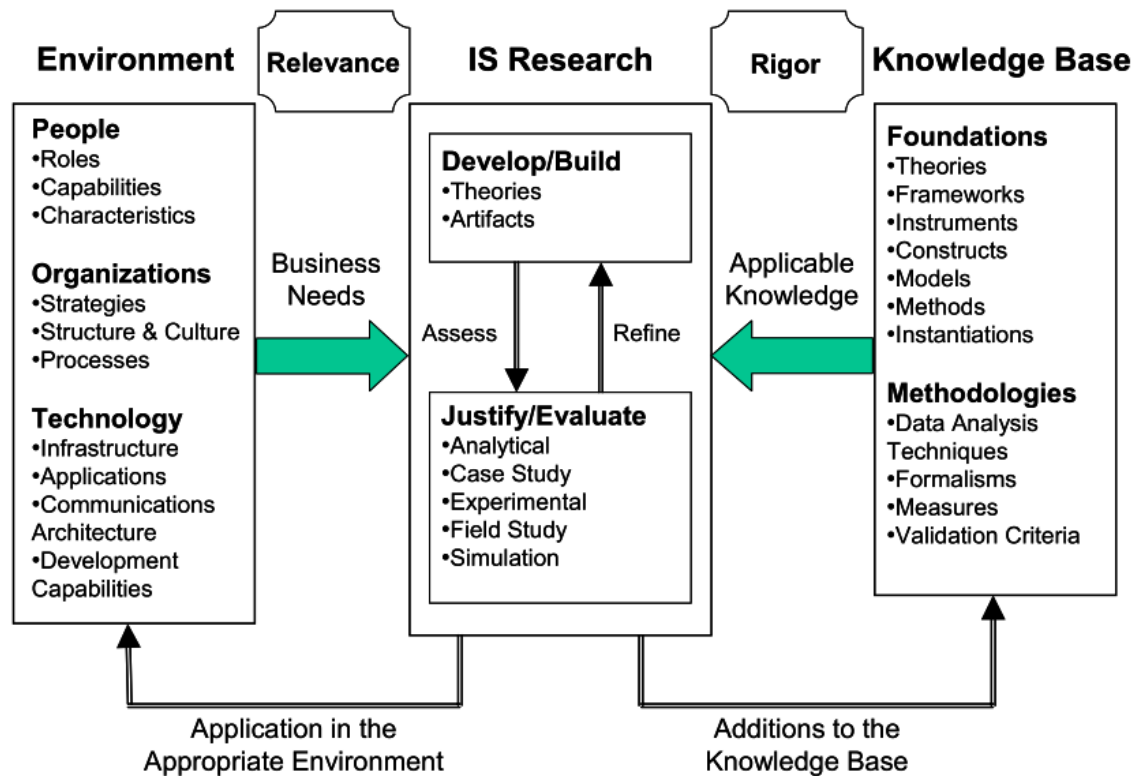
Figure 1: Design science research framework (Hevner et al. 2004, p. 80)

Furthermore, 7 guidelines for conducting design science research are depicted in Table 1.

Table 1: Guidelines for conducting design science research (Hevner et al. 2004)

Guideline	Description
Guideline 1: Design as an Artifact	Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.
Guideline 2: Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design Evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.
Guideline 5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
Guideline 6: Design as a Search Process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of Research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

Peffers et al. (2007) summarize in their research different theories of DS in Information Systems to a set of six activities that should be performed:

1. Identification of the research problem and justification.
2. Definition of objectives of the desired solution.
3. Creation of an artifact.
4. Demonstration of the artifact by solving a problem.
5. Observation of applicability of the solution.
6. Communication of results to the proper audience.

The activities identified by Peffers et al. (2007) will be used as a structure for this thesis. Steps 1 and 2 are performed in the introductory part. Step 3 – the creation of the artifact - will be performed in chapter 3 based on a literature review from chapter 2. The demonstration of artifact will be performed in chapter 4. Observation of the applicability of the solution is part of chapter 4 and will be done through 2 semi-structured interviews. One with the CTO of the case company and one with the Platform Business Director. As the last step, the communication of the results will be done through this master thesis.

The next chapter will introduce the theories and frameworks from previous research in platform economics and API economics. Those are used in chapter 3 to develop the synthesised model for API value co-creation in MSP environments.

2 THEORETICAL BACKGROUND

The literature analysis part will focus on two areas: Platform economics and API economy. In platform economics, the characteristics of MSPs and the key principles that contribute to the success or failure of a platform will be discussed. The theories will be analyzed critically and summarized into following categories: facilitators, drivers and blockers for the success of the platform.

Secondly, key principals of the API economy are evaluated and synthesized with the findings of the first part of the literature analysis.

2.1 Key characteristics of MSP

Let's start with the basic definition of a platform. As the review of prior literature on the topic shows, a distinction can be made between focusing on the technical or business view on the platform concept (Asadullah, Faik, and Kankanhalli 2018, p. 3). Asadullah, Faik, and Kankanhalli (2018) provide an overview of key definitions of previous literature on the digital platform concept.

Table 2: Technical and business views on Digital Platforms (Asadullah, Faik, and
Kankanhalli 2018, p. 4)

Conceptualization View	Definitions of Digital Platforms	Reference
Technical (e.g., software development & production)	"a building block that provides an essential function to a technological system and serves as a foundation upon which complementary products, technologies, or services can be developed"	(Spagnoletti et al. 2015, p. 364; Yoo et al. 2012, p.1400)
	"set of components used in common across a product family whose functionality can be extended by applications"	(Ceccagnoli et al. 2012, p. 263)
	"The extensible codebase of a software-based system that provides core functionality shared by the modules that interoperate with it and the interfaces through which they interoperate"	(Tiwana et al. 2010, p.676 ; Ghazawneh and Henfridsson 2013, p.3)
	"a set of subsystems and interfaces that form a common structure for/from which derivative applications can be developed and distributed"	(Xu et al. 2010, p. 1305)
Non-technical (e.g., B2B & B2C transactions)	"a commercial network of suppliers, producers, intermediaries, customers ….. and producers of complementary products and services termed "complementors" ….. that are held together through formal contracting and/or mutual dependency"	(Tan et al. 2015, p.249)
	"Two-sided networks ……that facilitate interactions between distinct but interdependent groups of users, such as buyers and suppliers"	(Koh and Fichman 2014, p. 977)
	"multisided platform …….exists wherever a company brings together two or more distinct groups of customers (sides) that need each other in some way, and where the company builds an infrastructure (platform) that creates value by reducing distribution, transaction, and search costs incurred when these groups interact with one another"	(Pagani 2013, p. 625)
	"…value is created by facilitating the interaction between two or more mutually interdependent groups of customers"	(Ye et al. 2012, p. 211)

The definitions of the technical view on platforms focus on the composition of the software. The characteristics of modularity and extensibility of digital platforms is a shared view of Xu et al. (2010), Ghazawneh and Henfridsson (2013), (A. Tiwana, Konsynski, and Bush 2010), Spagnoletti, Resca, and Lee (2015) and Y. Yoo et al. 2012). Starting from the research commentary of Tiwana, Konsynski, and Bush (2010) where they introduce a platform-based software ecosystem as the extensible codebase for third-party developers to develop modules that in turn make the ecosystem more attractive. A wide range of case studies into the technical domain followed. In their case study, Ceccagnoli and Forman (2012) tested the hypothesis if independent complementors benefit from participation in a platform ecosystem in the enterprise software industry. Their

findings show that complementors joining the platform ecosystem proved to be more successful by having higher sales and a greater likelihood of raising capital from public investors.

When looking at the non-technical view on digital platforms one key characteristic appears to be the facilitation of transactions between distinct sides of the platform (Pagani 2013, p. 625). Hagiu and Wright (2015) furthermore distinguish MSPs by the involvement of the platform in the facilitation of the transaction. Figure 2 shows the distinction between MSPs and other business models.
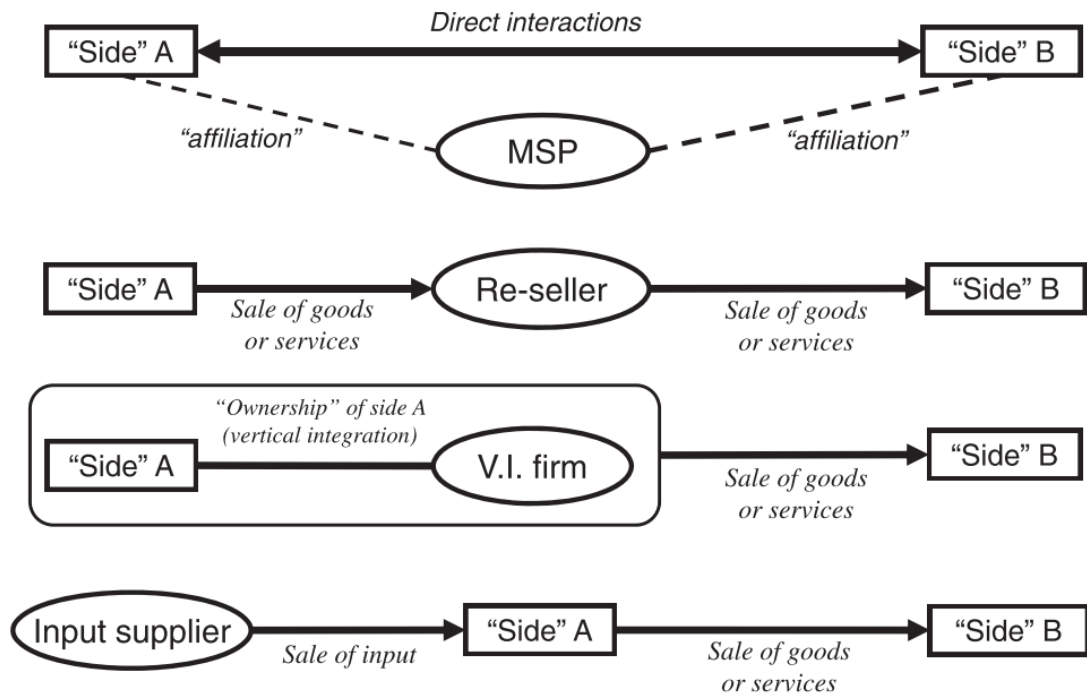
Figure 2: Destination between MSP and other business models (Hagiu and Wright 2015, p. 165)

Hagiu and Wright (2015) argue that the direct involvement of the intermediary in the sales of a good or service to the end customer makes the company a re-seller instead of a platform provider. On the other hand, the ownership of the supplier side makes it a vertically integrated firm. Lastly, a differentiation can be made between input suppliers and MSPs by checking if the company in question is affiliated with both sides. If not, the company can be categorized as an input supplier. Hagiu and Wright (2015) conclude, by comparing the difference between MSPs and the three similar business models, that MSPs have following unique characteristics: Direct transactions between two or more sides that are both affiliated with the same company – the MSP.

2.1.1   *Network effects*

An important driver that contributes to the success of an MSP is provided by the presence of network effects. Network effects describe the phenomena where the presence of one side benefits the other side and vice versa (Katz and Shapiro 1985, p. 424). In MSPs furthermore, distinctions are made between direct and indirect network effects[1]. Direct network effects affect the value of the network when the user base of the same side grows. An example that is illustrates the existence of direct network effects is the telephone network. The value of having a telephone increases directly with the number of other users also having a telephone.

Indirect network effects, in turn, come into place when the value of the network increases by the presence of the other side of the network. These indirect network effects are the focus of several studies (Caillaud and Jullien 2003; Armstrong 2006; Belleflamme and Peitz 2019) that investigate the influence of indirect network effects on its participants. Caillaud and Jullien (2003) propose that the existence of strong indirect network effects makes it harder for competing platforms to enter the market unless they heavily subsidize the supply side of the network. Rochet, Tirole and Industrielle (2003) and Parker and Van Alstyne (2005) confirm this theory and agree that subsidizing one side of the platform provides an effective strategy to tip the market into one direction. Ultimately, the strong feedback loops generated by indirect network effects lead to the conclusion that platform markets are characterized as "winner takes it all" markets (Eisenmann, Parker, and Van Alstyne 2006).

However, network effects are a subset of a concept called network externalities which also include negative influence through the presence of more users or producers (Shapiro and Varian 1999, p. 185). Direct network externalities can lead to increased competition within one side of the platform for resources, both on the supply and demand side. For example, more EV drivers joining a charging network increase the chance of charging stations being blocked by another EV driver. Or on the supply side: The more CPOs a platform join, the fiercer the competition will get between the providers of a charging service, which can, in turn, lead to a price drop of charging services.

2.1.2   *Engineering and economics view on MSP*

Gawer (2014) intended to form a bridge between the technical and business view on MSPs by providing a holistic framework that incorporates both viewpoints. Table 3 shows an overview of the different views in platform research. Gawner (2014) states that

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[1] Also referred to in literature as same side (direct) and cross-side (indirect) network effects

the technical view, focusing on fostering innovation, and the business view, focusing on the competition between platforms can't be separated as those objectives often interact with each other. She sees platforms as evolving organizations that are loosely coupled with its agents, following the definition of a meta-organization by Gulati, Puranam, and Tushman (2012).

Table 3: Technological and business view on platforms (Gawer 2014)

Literature	Economics	Engineering design
Conceptualization	Platforms as markets	Platforms as technological architectures
Perspective	Demand	Supply
Focus	Competition	Innovation
Value created through	Economies of scope in demand	Economies of scope in supply and innovation
Role	Coordinating device among buyers	Coordinating device among innovators
Empirical settings	ICT	Manufacturing and ICT

Gawer (2014, p. 1240) points out three shared trades of all technological platforms, as they

"(1) federate and coordinate constitutive agents who can innovate and compete;

(2) create value by generating and harnessing economies of scope in supply or/and in demand; and

(3) entail a modular technological architecture composed of a core and a periphery"

Additionally, when looking at the scope of a platform Gawer (2014) distinguishes between internal platforms, supply-chain platforms and industry platforms. Figure 3 shows the conceptualization of those three types of platforms.
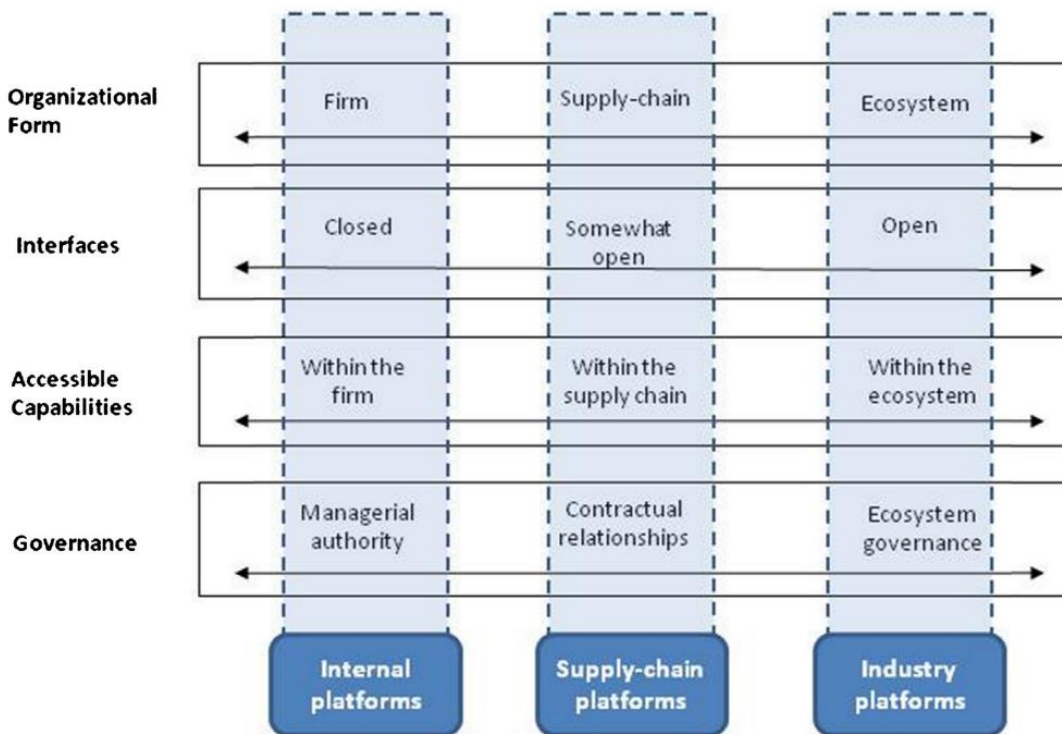
Figure 3: Scope of technological platforms (Gawer 2014, p. 1246)

It's important to note that a platform can evolve from an intra firm to an ecosystem platform and vice versa. If the platform provider, for example, recognizes that its interfaces are misused by complementors the decision can be made to close those interfaces and only provide them to complementors it has a contractual relationship with. Interestingly Gawer (2014) mentions governance as a key factor in capitalizing on innovation capabilities from opening up the platform to a wider audience. Types of governance strategies (Parker and Van Alstyne 2005) and their impact on value co-creation opportunities for the platform owner and complementors (Huber, Kude, and Dibbern 2017; Sarker et al. 2012) have been part of other studies. Due to its relevance to the thesis topic, there will be a whole chapter (see chapter 2.3) about API governance. In the next chapter, an overview is provided on how value is created in MSPs.

2.1.3 Value creation in MSPs

The previous chapter introduced the main characteristics of MSPs. There have been some notations about value creation by MSPs. In this chapter, the previous literature will be analyzed based on different forms and views on value creation in MSPs.

The examination of value creation by platforms has been part of several studies over the past years. This paragraph gives an overview about the findings from these studies. Before heading into the specifics, an older study that introduces a new paradigm of value creation is introduced. Normann and Ramírez (1993) introduced the concept of shared value creation that relies on two pillars: knowledge and relationships. The authors argue that companies need to constantly increase their knowledge base to reconfigure and enable value-creating relationships with their customers. They call this pursuit "value co-creation activities".

Pagani (2013) defines a platforms' value creation in the form of a reduction of transaction and search costs. Rochet, Tirole, and Industrielle (2003) and Evans (2009) go into the same direction by defining the value that is created by platforms as the enabler of transactions between multiple sides that would not otherwise make business with each other. Gawer (2014) adds to these approaches that platforms must effectively influence the terms of transactions by governance tools such as subsidizing one side of the platform. The examination of the effectiveness of these governance tools has been part of earlier case studies in the enterprise software industry (Ceccagnoli and Forman 2012), video gaming industry (Rochet, Tirole, and Industrielle 2003) and social networks (Evans 2009).

Summarizing the previous paragraph, value is created by platforms by

- enabling transactions between parties that would not otherwise interact with each other
- making transactions more efficient through diminishing transaction costs
- making transactions more effective by improving matching between potential transaction partners
- reducing the number of steps required to make a transaction
- improving the matchmaking process by providing better search tools

There is a second source of value generation that arises from the engineering view on platforms. Gawer (2014) states that platforms create value by enabling innovation and collaboration through a modular architecture and the existence of interfaces. Those interfaces can be used by customers and complementors of the platform to produce complementary services and products. The degree of openness of the interfaces of a platform provider has a direct influence on the number of innovation resources that are attracted to the platform and diminish the costs for innovation (Gawer 2014, p. 1245).

Despite the positive drivers that increase speed, reliability and likelihood of innovation and collaboration, trade-offs through imitation and competition of competitors and complementors arise as pointed out by Pil and Cohen (2006). According to Gawer (2014), a platform provider can use governance tools to avoid negative impacts from misuse. As

the topic of governance tools for APIs plays a crucial part in forming the model for this thesis there will be a whole chapter dedicated to this topic. Chapter 2.3 gives an overview of research in this domain.

The next chapter will provide an overview of drivers and blockers arising from open and closed platform strategies.

2.1.4 *Open vs. closed platform strategy*

As discussed in the previous chapter, value is generated by platforms in a dual way. Platforms enabling transactions between two or more supply and demand sides and foster innovation through customers and complementors by open interfaces. This chapter will focus on the latter by examining different kinds of open and closed platform strategies.

The technical requirement for a platform to innovate effectively is a modular architecture or how Katz and Shapiro (1994) puts it, a system that consists of individual components. As Gawer (2014) identified, a higher degree of openness leads to a higher degree of innovation. Eisenmann, Parker, and Van Alstyne (2009) describe an open platform as

- unrestricted accessible for third party contribution, use and commercialization
- indiscriminate in its pricing and conformity to technical standards.

Hence indicating that there are different degrees of openness that a platform can strife to, each with individual gains and tradeoffs. Those tradeoffs have been concretized as the balance between adoption and appropriability of the platform (West 2003, p. 1260). Eisenmann, Parker, and Van Alstyne (2009) describe the benefits of more widespread adoption as gaining momentum by increased network effects, less user concern about lock-in and increased production of complementary goods and services. On the contrary, reducing the appropriability of the platforms provider by reducing switching costs for users and increasing competition between rival platforms.

Boudreau (2010) distinguishes openness of a platform by two strategic decisions a platform provider can make: Granting access and devolving control. Granting access is defined as opening the platform for outside innovation while devolving control is the act of giving up control of the platform (Boudreau 2010, p. 1849). While the latter inevitably leads to a higher degree of openness of the platform, opening a platform can be governed by the platform provider without losing control completely.

Eisenmann, Parker, and Van Alstyne (2009) distinguish the degree of openness in more detail based on the interconnected roles in a platform ecosystem. Figure 4 depicts the different roles of the platform participants. Starting from the bottom with the platform

sponsor as a governing role. This role determines the extent of participation of the platform users to the technology and economic development of the platform and is executing IP rights. Second up the platform provider that acts as a communication hub to its two distinct user groups: The supply and demand side. For each role, individual decisions can be made towards a more open or closed platform.
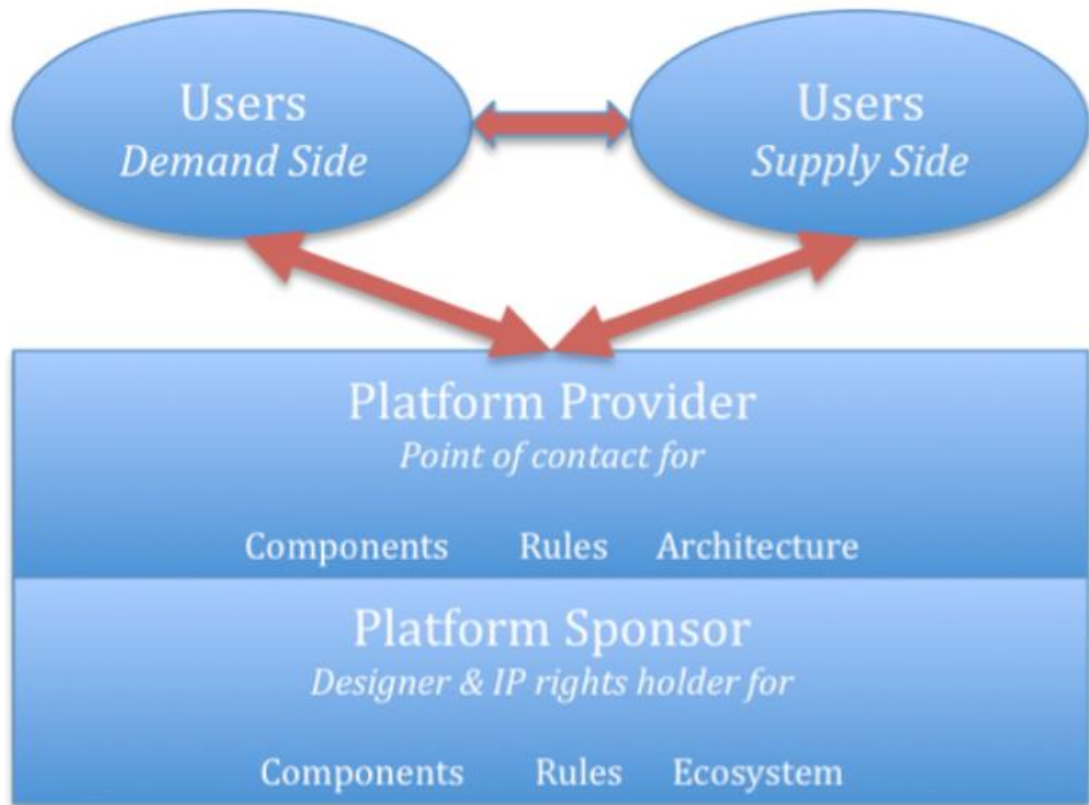
Figure 4: Roles in a Platform Ecosystem (Eisenmann, Parker, and Van Alstyne 2009, p. 134)

Additionally, Eisenmann, Parker, and Van Alstyne (2009) distinguish between vertical and horizontal openness. Vertical openness is described as openness towards the users of the platform and towards external contributors. Horizontal openness is described as the act of giving up a certain degree of control by the platform provider by making the following strategic decisions:

- fostering interoperability with rivaling platforms
- licensing the platform to other platform operators
- widening the platform sponsorship.

Eisenmann, Parker, and Van Alstyne (2009) furthermore introduce three strategies for each dimension of openness of the platform. Table 4 shows an overview of strategies affecting the openness of a platform.

Table 4: Vertical and horizontal platform strategies

Dimension	Strategy
Vertical	- backward combability - exclusive rights for complementary products or services - incorporating third-party products or services into the platform core
Horizontal	- Interoperability with competing platforms - Licensing of the platform to new providers - Broadening of platform sponsorship

Starting with the first strategy of the vertical dimension of platform openness, backward combability of the platform assures complementors that their applications will also run with newer versions of the platform. This area increases in importance if third party applications are an essential feature of the platform. However, Choi (1994) connects the backward combability of a platform with trade-offs due to higher development costs and limitations in the technologic development of the platform.

Continuing with the second vertical strategy, making sure that certain complementary products are just available via one platform has according to Eisenmann, Parker, and Van Alstyne (2009) two dimensions: First, the platform sponsor can agree with a complementor that the product or service is just offered on the platform. Second, the complementor can agree with the platform sponsor that the product or service of this category is the only one that is offered on the platform. The first right of exclusivity leads to competing platforms being less open. The second agreement of exclusivity leads to the own platform being less open.

The third strategy of vertical openness according to Eisenmann, Parker, and Van Alstyne (2009), incorporating complementary goods or services into the platform core, describes the process of gradually including complementary applications into the platform core as the platform matures. This strategy leads to the platforms being characterized

as less open, due to the bundling of the platform with the prior complementary applications.

Moving on to strategies for horizontal openness, Eisenmann, Parker, and Van Alstyne (2009) describe the first important factor to consider as the interoperability to competing platforms. Allowing users of one platform to interact with users of another rivaling platform is seen as a strategic move towards a more open platform. In young markets with strong user growth usually no interoperability is desired between rivaling platforms. However, if the user base doesn't grow that much anymore, interoperability is becoming an increasingly important factor to consider, especially in markets with high direct or indirect network effects. The most important factor to consider is the market size of each platform. Interoperability is usually desired between similar-sized platforms.

The second horizontal strategy described by Eisenmann, Parker, and Van Alstyne (2009) is licensing the platform to additional providers. This move makes the most sense when the user base of the platform has very different needs and licensees can adapt the platform to those unique needs. However, this strategy can impose severe pricing competition that can be mitigated by the platform provider by charging licensing fees from its licensees.

According to Eisenmann, Parker, and Van Alstyne (2009), a more extreme form of the licensing strategy is broadening the sponsorship of a platform. Whereas licensing the platform still retains the control rights of the platform sponsor over the platform core, broadening the sponsorship aims to give up the control rights of the platform sponsor over the core technology of the platform. This strategy proves to be effective when the platform operator generates more revenue through complementary products and services than through licensing of the platform.

In more recent research, Parker and Van Alstyne (2018) investigate the economic impact of innovation by examining the growth rate of the whole ecosystem depending on two decisions of the platform sponsor: Closing the platform to third-party innovators and disclosing Intellectual Property (IP). Their findings show that platforms should put their focus on designing contracts with third-party developers in a way that reuse of IP rights is granted within the ecosystem. This effectively leads to a larger innovation ecosystem that – although it limits the revenue the platform sponsor can generate from licensing IP – promotes spillovers of innovation that benefits the whole ecosystem and in return the platform sponsor.

2.1.5   Boundary resources

A widely adopted model for balancing platform control and innovation has been introduced by Ghazawneh and Henfridsson (2010) with the concept of boundary resources.

Through their case study of the iPhone ecosystem, Ghazawneh and Henfridsson (2010) deducted a model for governing third-party-development in software ecosystems.
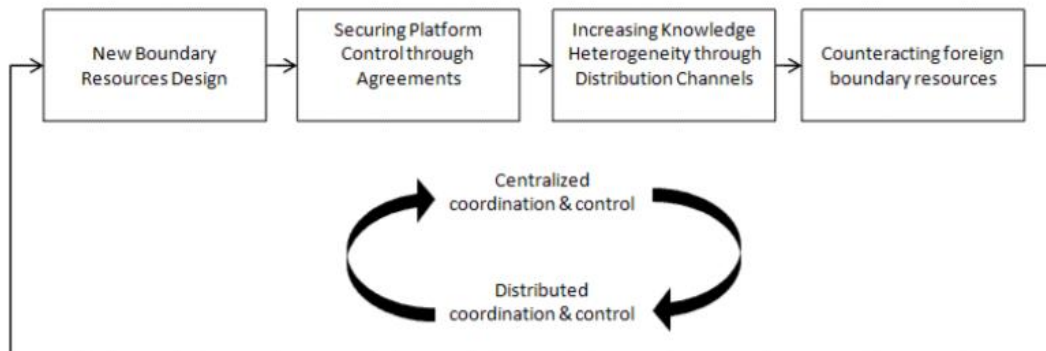
Figure 5: Boundary resource model (Ghazawneh and Henfridsson 2010, p. 13)

Figure 5 shows the four steps involved in governing third-party development. Those steps must be reiterated with every change in the boundary resources, as changing them leads necessarily to attracting different types of knowledge resources, which in turn can change the dynamics of control over the platform.

Ghazawneh and Henfridsson (2010) describe the goal of this process as opening boundary resources as a player in a software ecosystem without losing control. Choosing the option of opening up a platform versus devolving control has been identified by Boudreau (2010) as the preferred way a platform owner should operate, as it produces a higher amount of complementary goods and services according to his case study of sold handheld devices.

In the first phase of the boundary resource process, an increased need for openness is requested, typically by the ecosystem (Ghazawneh and Henfridsson 2010, p. 13). This proposition has been confirmed in later research by Bianco et al. (2014). Bianco et al. (2014) conclude that boundary resources are created for the innovator, rather than emerging out of the technical architecture of the platform owner. However more recently, the impact of regulations and policy changes, like the second Payment Service Directive (PSD2) regulation of the European Union, can be identified as an additional driver for companies to open their systems to outside innovation (Borgogno and Colangelo 2019, p. 3).

In the second phase of Figure 5, policies and agreements between the platform owner and its third-party developers must be updated to secure platform control. This step includes revising the terms of service on which complementors can use the boundary resources.

The next step involves opening distribution channels to a wider range of users. According to Yoo, Henfridsson, and Lyytinen (2010) attracting a wider variety of knowledge resources creates a greater variety of innovation.

The last step of the continuous process involves restricting certain applications and technologies from participating in the software ecosystem. For example, Gawer and Cusumano (2002) identified one tradeoff of open platforms that arises if a complementor and platform providers' innovation clashes. On the contrary, a wide range of complementary innovation can lead according to Gawer and Cusumano (2008) to a more secure market position by being an effective barrier for the entry of competitors.

In later research, Ghazawneh and Henfridsson (2013) divide the form of boundary resources into two distinct groups: Social and technical boundary resources. Defining technical boundary resources in the forms of APIs, SDKs, Scripts and Integrated Development Environments (IDEs). Those technical enablers are accompanied by social boundary resources that in turn focus on delivering knowledge about how to develop applications using the technical tools provided. Social boundary resources can come in the form of documentation, governance rules, incentives or IP. This model has been applied and developed further by Bianco et al. (2014). Their findings after applying the boundary resource model in a case study show that an additional distinction should be done between technical and development resources. Technical resources refer according to Bianco et al. (2014) just to the technical enabler: APIs. Development resources to tools that directly support the third-party developer in programming, testing, debugging, deploying, and maintaining the applications. Social boundary resources are according to Bianco et al. (2014) primary endeavors towards transferring knowledge from the platform owner to third-party developers. The second function of social boundary resources is the coordination possibility of the platform provider towards third-party contributors.

This chapter introduced APIs as the technical enabler of innovation in software ecosystems. The next chapter will provide a more comprehensive overview of how APIs are having an economic impact on software ecosystems.

2.2   API Economy

APIs are defined by IEEE (2019) as a way to share information between software systems. Another definition comes from Berlind (2015) who compares APIs with user interfaces, just with different users in mind: software instead of humans. However, the developer brings still the human perspective into play, which is well reflected in the social part of Ghazawneh and Henfridsson's (2013) boundary resource model.

Figure 4 shows the layers of the API Economy. Starting from the internal software architecture that is modular and interconnected through APIs. The first layer indicates

that APIs are used internally, or in the context of this thesis, the scope of the API offering and consumption indicates that of an internal platform. The second layer, the external API ecosystem, is distinguished by offering and consuming APIs solely within companies that have a contract with the platform. Following again the definition of Gawer (2014) the API offering is open to a firms' supply chain. The even wider ecosystem means offering and consuming APIs without limitations, which would define the company as an industry platform. In addition to the ellipses that define the degree of openness of a companies' APIs, Resch (2018) defines the circle of API business as monetization of the APIs of a company.
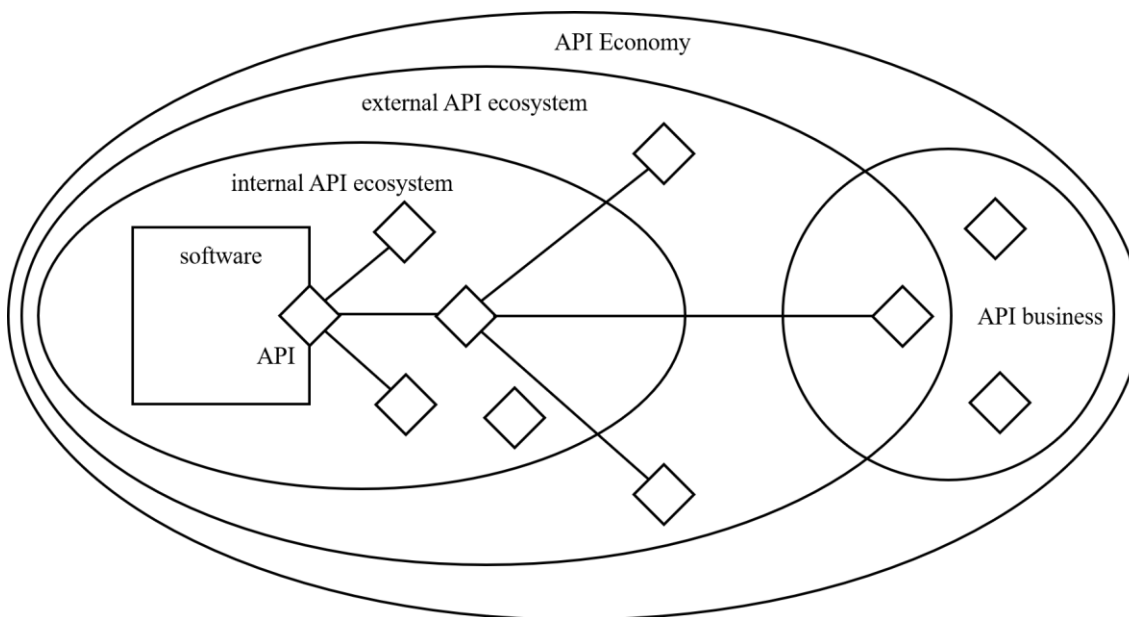
Figure 6: API economy (adapted from Resch 2018, p. 216)

Figure 4 combined with figure 6 leads to following categorization of APIs:

- **Degree of openness:** Private APIs are used within a firm. Partner APIs are made available to customers and complementors and public APIs to everyone. As mentioned in chapter 2.1. an industrial platform is characterized by the availability of APIs to everyone.
- **Monetization:** A company can offer their APIs for free or for a fee.

Gawer (2009) mentions as a driver that fuels the usage of APIs by complementors the so-called "Economy of Scope". Traditionally it has been viewed as an advantage from cheaper production costs in manufacturing when jointly producing a product is cheaper than manufacturing each output individually. Gawer (2009) brings the concept of "Economy of Scope" to the digital platform world by describing its influence on innovation.

Hence, the Economy of Scope in platform economics is archived by joint innovation between the platform and its complementors under the premise that innovation is cheaper by joint production in a network, than by each company separately. A prerequisite for effective joint innovation is a modular architecture and the use of interfaces between those modules (Gawer 2014, p. 1242). According to Chesbrough (2003), opening those interfaces to complementors have mainly two effects: Acquiring outside resources and knowledge and also independent knowledge. Yoo, Henfridsson, and Lyytinen (2010) emphasize the importance of diversity of knowledge resources in the innovation process as a competitive advantage.

However, there are also downsides to a modular architecture. Pil and Cohen (2006) propose that besides the positive implications on a firms' performance through increased speed, reliability and likelihood of innovation, there is the threat of imitation by competitors that distributes those innovations to competitors. There are strategies that can mitigate the risk of imitation. According to Lippman and Rumelt (1982) complex system design limits effectively the imitation capabilities of competitors.

Gawer (2014) additionally mentions the threat of complementors turning into competitors. These are the main two threads that could be identified through literature research. The next chapter will introduce the concept of API governance that includes a comprehensive review of mitigation tools and strategies for the previously mentioned negative effects.

2.3   API Governance

To maintain the necessary degree of control and limit the unwanted negative effects over the APIs of a platform provider it is necessary to govern them effectively. There is a limited body of research specifically on API governance. However, there is a substantial amount of research related to governance practices in platform ecosystems. Two main governance practices could be identified by literature research: The arm's length and the dyadic way.

The arm's length governance practice is described by Parker and Van Alstyne (2005) as uniform rules for all participants in the platform ecosystem. Choosing this type of governance style has the advantage of relatively low governance costs for the platform provider, but can limit the value creation opportunities with some partners, as it doesn't take local needs of certain partners into account (Huber, Kude, and Dibbern 2017, p. 3).

The alternative to the arm's length governance principle has been termed by Sarker et al. (2012) as the dyadic way of governance. It describes the process of taking specific local needs of partners into account and deciding based on those needs what kind of resources the partner can access and the conditions of accessing those resources. According

to the case study in the ERP ecosystem of Sarker et al. (2012), taking local needs into account can lead to greater value co-creation within the platform ecosystem, but it has the trade-off of higher governance costs. Huber, Kude, and Dibbern (2017) suggest two main decision criteria for opening resources towards complementors: High impact on emergent value-co creation and insufficient resources of the platform owner.

In practice, there are several tools (eg. Amazon API Gateway; Apigee; Azure API Gateway; WSO2 API Manager) available that support the API governance process. When it comes to managing a companies' API offering these tools provide solutions for information sharing, onboarding and securing APIs. Key elements of API Management tools are summarized by Fremantle, Kopecký, and Aziz (2015):

- Developer portal including API documentation, SDKs (Software Development Kits), onboarding guide
- User management by enabling registration of applications and user accounts
- Authentication and authorization through API keys
- Enforcement of specific Service Level Agreements (SLAs) through API keys
- Monitoring of client usage through API keys

Krintz et al. (2014) identify four additional topics specifically relevant for cloud platform API governance:

- **Change control:** Versioning of API and policies of the API provider that specifies the extent of changes to the API and the possibility to roll back to previous versions.
- **Policy specification and analysis:** Formulation of the degree of openness of the API and analysis of the enforcement
- **Consistent policy implementation:** Ongoing checks if the specified policies are implemented consistently
- **Implementation portability:** Renewing or removing modules should not impact the integrity of the APIs

In addition to the individual governance topics, Bonardi et al. (2016) urge the implementation of those governance tools through organizational roles and processes. Bonardi et al. (2016) suggest dividing API governance between three aspects:

- **Strategic governance:** Includes a plan on how to generate value from APIs, a set of objectives and Key Performance Indicators (KPIs)

- **Technical governance:** Definition of the technical architecture and standards, monitoring of technical trends and their implementation and following technical KPIs
- **Monitoring of partners:** Ongoing process of identification of partners in the API ecosystem

Complementing the identification of possible partners in the ongoing monitoring process Gawer (2014) identified two threats that might arise from open interfaces by partners: imitation and competition. Hence, she proposes also two effective strategies for dealing with those threads: Closing interfaces and/or enveloping the competing party. The enveloping strategy has been initially introduced by Eisenmann, Alstyne, and Parker (2007). It describes the process of one platform entering the market of another platform by leveraging its user base and making use of common platform components.

When looking at the classification of platforms according to scope by Gawer (2014) it can be seen that the lower the degree of openness of the interfaces, the lower the effects on innovation and the lower the governance requirements are for APIs. Table 5 indicates the interconnection between platform openness and the need for more governance.

Table 5: Mapping of governance tools to openness of APIs

	closed	partner	open
strategic governance	company hierarchy	contracts	partnerships, joint ventures, licensing
technical governance	modular architecture, usage of technical standards, design rules	SLAs, monitoring of usage, rate limits and throttling	scaling up
monitoring of partners	within the firm	within the contractual partners	within the ecosystem

When looking back to chapter 2.1.5 where the boundary resource model by Ghazawneh and Henfridsson (2010) was introduced, it gives a process view on how and why to adapt a companies' governance rules. It's based on the design of new boundary resources, which are in the scope of this thesis. Ghazawneh and Henfridsson (2010) state that the process is usually triggered by the need of ecosystem actors for a higher degree of openness of the boundary resources of the platform provider.

This adds a new dimension to the governance model by introducing a feedback channel for ecosystem actors. This feedback channel can be designed in a relatively simple way if the ecosystem just consists of internal innovation resources, as according to Gawer and Cusumano (2014) the hierarchy and roles and responsibilities within a company regulate the information flow.

When moving out to the partner mode, this feedback should be relatively easy to get through partnership managers and regular feedback loops. When governing the API ecosystem and getting feedback from there, more advanced methods of feedback generation should be applied, by for example providing forums, live chat or identifying key innovation resources and getting feedback from them. The case study of Bianco et al. (2014) furthermore emphasizes the importance of short feedback loops to avoid frustration on the API consumer side.

Another approach to designing the API offering of a company was introduced by Boudreau and Lakhani (2009). They argue that the innovation ecosystem can be organized by the platform provider either with the market or community approach. The market approach provides tighter control over its participants by imposing formal rules, whereas the community approach leads to more informal governance. Value for the platform provider is directly created through the market approach by contracts and sublicensing of the boundary resources of the platform. Whereas the community approach creates value for the platform provider indirectly through increased demand for the platform by leveraging outside innovation. Boudreau and Lakhani (2009) additionally recommend incorporating mixed approaches. They emphasize the importance of considering the mechanisms of innovation arising from the different needs of the diverse user groups of a platform.

Although using different terminology, Boudreau and Lakhani's (2009) model share the same traits as the arm's length (Parker and Van Alstyne 2005) vs dyadic (Sarker et al. 2012) way governing platform ecosystems. The market approach requires arm's length governance whereas the community approach should rely on the dyadic governance principles.

The next chapter introduces pricing as an additional way of managing access to the APIs of a platform.

2.4   API Pricing

This chapter will provide a short overview of pricing methods for APIs. Gawer (2014) mentions pricing as the only governance tool for open interfaces. Furthermore, gaining revenue from the API offering is directly related to value creation for the platform provider. Therefore, this topic is relevant to the research question of this thesis. However, this chapter will be kept short, because it's not in the scope of this thesis to define a pricing

method for an API offering, rather the various options about API pricing will be discussed.

Beginning with the first and simplest option, an API provider can choose is to offer the usage of its APIs for free. This is a common pricing model for platform providers where innovation from third-party developers is crucial and part of the supply side of the platform. Examples of these platforms are third party developers of apps in Android and iOS.

The second option for an API provider is to give access to API through a flat fee. This approach appropriates some rents for the platform provider. It, however, lacks the necessary scaling that the next approach brings with it. It can be however used if there is no possibility to manage and monitor the usage of a user account through API keys.

The third approach is the scalable approach of charging customers per API call which is a common practice used by cloud computing providers like AWS or selling contingents of API calls. Webservices like EBAY, Twitter or Facebook usually offer a combination of both, a free tier to get started and after the amount of API calls exceeds certain limits the user has to pay.

This chapter is intendedly short and stays out of common software pricing methods, as designing the pricing for a digital service of a company would be an entire research question in itself.

2.5   Value creation through APIs

This chapter will introduce the first instance of the API value creation model for MSPs. To reduce complexity, the common approach of depicting the MSP environment as two-sided markets is used. This means that the MSP is affiliated with only two sides in the model. The goal of the model is to answer the question of how (and if) APIs contribute to value co-creation in an MSP environment from the perspective of the platform provider.

The first component of the model is based on the degree of openness of the API and hence defines the ecosystem players that can access the API. Table 6 shows the distinction between closed, partner and public APIs.

Table 6: Potential innovation partners dependent on API openness

closed	intra-firm				
partner	intra-firm	complementor	customer		
open	intra-firm	complementor	customer	competitor	independent developers

   The second component is the degree of innovation a platform can capture by providing open interfaces. Figure 5 summarizes the hypothesis from Gawer (2014) where she shows the correlation between the innovativeness and increased competition of a platform. Gawer (2014) argues that open interfaces "*reduce the platform owner's search cost for complementary innovators and extend the pool of accessible innovative capabilities that will indirectly create value for the platform*" (Gawer 2014, p. 1245).
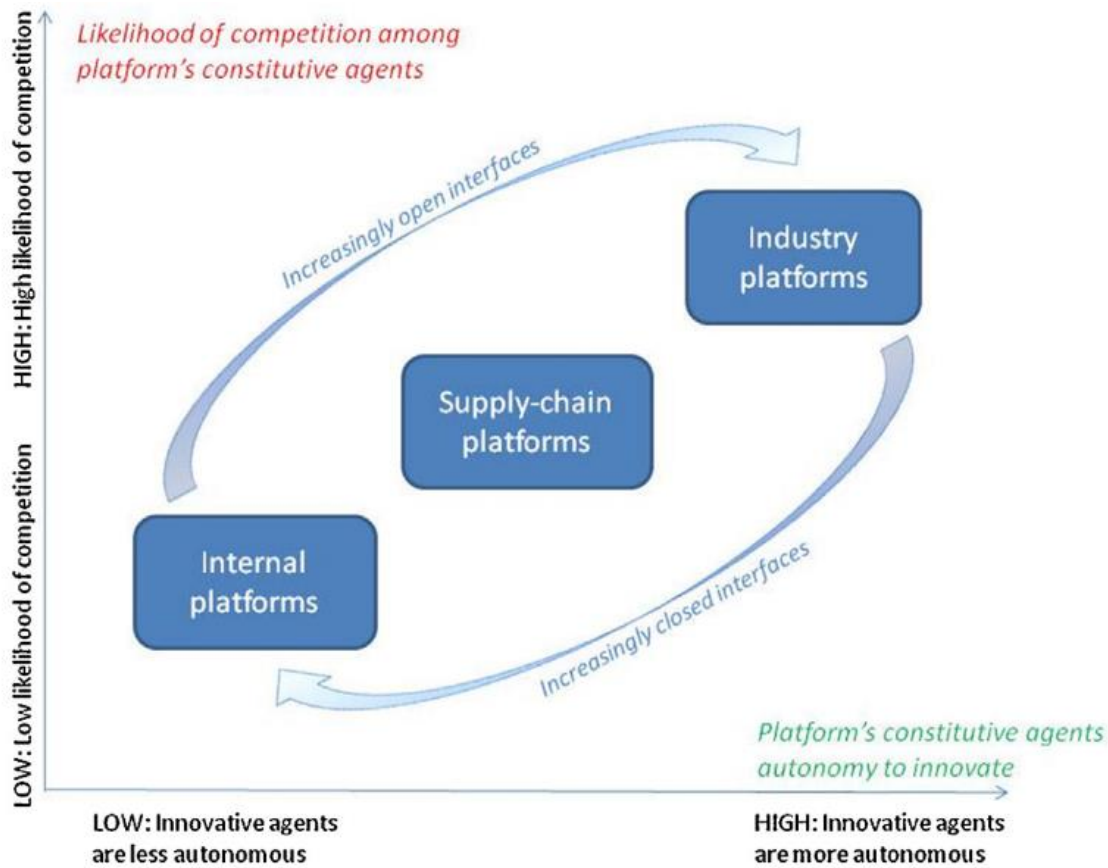
Figure 7: Correlation between open interfaces, innovation, and competition

The third dimension will introduce the view on value and value co-creation from the service perspective and three core processes of open innovation. As Vargo and Lusch (2008) argue, all goods and services are designated to benefit the customer and importantly, in the context of this thesis, all other parties in the process. Grönroos and Voima (2013) introduce a model that depicts the form of value creation between the provider and the customer.

From a production perspective

Producer: The provider
as producer of resources
to be used in the customer's
value creation

Co-producer: The customer
participates as co-producer
in the joint production process

PROVIDER SPHERE
• production
(potential value)

JOINT SPHERE
• value creation
in interaction
(real value)

CUSTOMER SPHERE
• independent value creation
(real value)

Customer's role

Value creator/ co-creator: The
customer is the value creator in direct
interaction, but when inviting the
provider into this process (a merged
dialogical process), value is
co-created with the provider

Value creator: The customer is
an independent value creator
outside direct interaction

Provider's role

Value facilitator: The
provider is a value
facilitator

Co-creator: The provider may get
an opportunity to engage in the
customer's value creation process
as a co-creator

Value facilitator: The provider
is a value facilitator

From a value creation perspective

Figure 8: Value creation model (Grönroos and Voima 2013)

Figure 8 shows that the provider of a service is just able to create *real value* by interacting with the customer. However, the customer can create value by independently using the services of a provider. In Grönroos and Voima's (2013) model the provider is the producer of resources and the facilitator of value.

This model shows a lot of similarities with Chesbrough (2003) three core processes of open innovation: Inside out, outside in, and coupled innovation. The inside out process refers to the usage of the APIs of a company through partners in different markets, focusing on leveraging the IP of a company. The outside-in approach refers to companies benefitting from outside innovation inside their market. And lastly, the third type, coupled innovation, where the company creates partnerships through sharing resources with complementors and other market participants to create innovation.

Another form of defining the value an API is creating is by following the Job To Be Done (JTBD) framework by Christensen et al. (2016). It works by identifying what a customer wants to accomplish under certain circumstances. Christensen et al. (2016) urge that understanding a customers' circumstances, meaning what hinders or enables the buying decision of the customer, needs to be taken into account to offer the right product or service to the customer. Consequently meaning that the JTBD framework intents to steer innovation in the right direction, which is a fitting definition for the main value proposition of open interfaces according to Gawer (2014).

According to Medjaoui et al. (2018), APIs should be treated as products that solve a business problem. Thus, co-creation of value in the context of the API offering of a platform means exposing the right resources to customers or complementors, who in turn collaborate with the platform provider to generate innovative products or services. The creation of value is facilitated by a platform provider by offering APIs to customers or complementors who in turn independently work on innovative products and services that open new markets for the platform provider.

When moving further into detail how co-creation of innovative products and services can be examined, a recent case study of Huber, Kude, and Dibbern (2017) sheds light on possible types of value co-creation. They introduce two categories of value co-creation: The immediate and emergent value-co creation potential.

Immediate forms of value-co creation:
- Extension of the platforms' functionality
- Revenue from implementation projects
- License fees

Emergent forms of value-co creation:
- Potential new future customers
- Potential to better serve existing and future customer needs

To conclude the third dimension of the value creation model through APIs the platform provider must provide APIs that get the customers' job done. According to Christensen et al. (2016), the requirement for getting the job done is knowing the customer. This can in turn just be accomplished in the industry context. Thus, this dimension will be reintroduced in the practical application part of the model.

However, increasingly open interfaces must be governed carefully. As Pil and Cohen (2006) identified, there is the threat of imitation and competition that negatively influences the value gained from innovation.

Table 7 summarizes the driving forces towards a more open or closed API strategy of an MSP. The facilitators list the entry ticket to the API economy, a modular architecture that is interconnected through internal APIs. If this condition is met, the platform provider can decide if and how far to move into the next circle of the supply chain or partner APIs or even further to the industry or open API ecosystem. The positive drivers show an overview of the drivers that let the MSP move to a more open API strategy. The blockers list all the negative drivers that limit the API offering of a platform and suggest a more closed API strategy.

Table 7: Value creation drivers, blockers and facilitators

Value creation	Dimension	Source
positive	additional innovation resources and decreased cost of innovation	(Gawer 2014), (Eisenmann, Parker, and Van Alstyne 2009), (Youngjin Yoo, Henfridsson, and Lyytinen 2010), (Boudreau and Lakhani 2009)
	higher adoption rate of platforms that increases network effects	(West 2003), (Eisenmann, Parker, and Van Alstyne 2009)
	less concern from users about lock in	(Eisenmann, Parker, and Van Alstyne 2009)
	additional revenue stream	(Boudreau and Lakhani 2009)
negative	imitation and competition from complementors	(Pil and Cohen 2006)
	lower appropriability through reduced lock in	(West 2003)
	limitations to technologic development of the platform	(Choi 1994b)
	duplicate innovation	(Gawer and Cusumano 2008)
facilitator	modular platform architecture	(Katz and Shapiro 1994)

The additional innovation resources that build applications and integrations on top of the platform providers' API offering lead to a higher vertical specialization of the platform. The vertical specialization towards special customer needs is broadening at the same time the knowledge base of the platform provider and additionally helps build relationships with customers. This can lead in turn to the usage of the platform in new markets by diversifying the user base of the platform and lead to additional revenue streams through leveraging on increased transaction volume.

On the level of technical development, fulfilling all special use cases by implementing them into existing applications and services might not be feasible resource-wise for the platform provider. However, a higher degree of openness of the APIs of a platform requires additional pricing and non-pricing instruments for the platform owner to capitalize

on the above described positive effects and limit the unwanted negative implications to a minimum.

3 SYNTHESIS OF API ECONOMY AND PLATFORM ECONOMY

The previous chapter sets the frame for designing the API value co-creation model. Its building blocks consist of elements of platform economy and API economy research. More specifically, a platforms' characteristics and the various forms of value co-creation through APIs.

When looking at the model shown in Figure 3, which depicts the three different types of platforms by Gawer (2014) and combine it with the view on the API economy of Resch (2018) an interesting new perspective develops. Figure 9 shows the synthesized model that describes the value co-creation possibilities through APIs in an MSP environment.
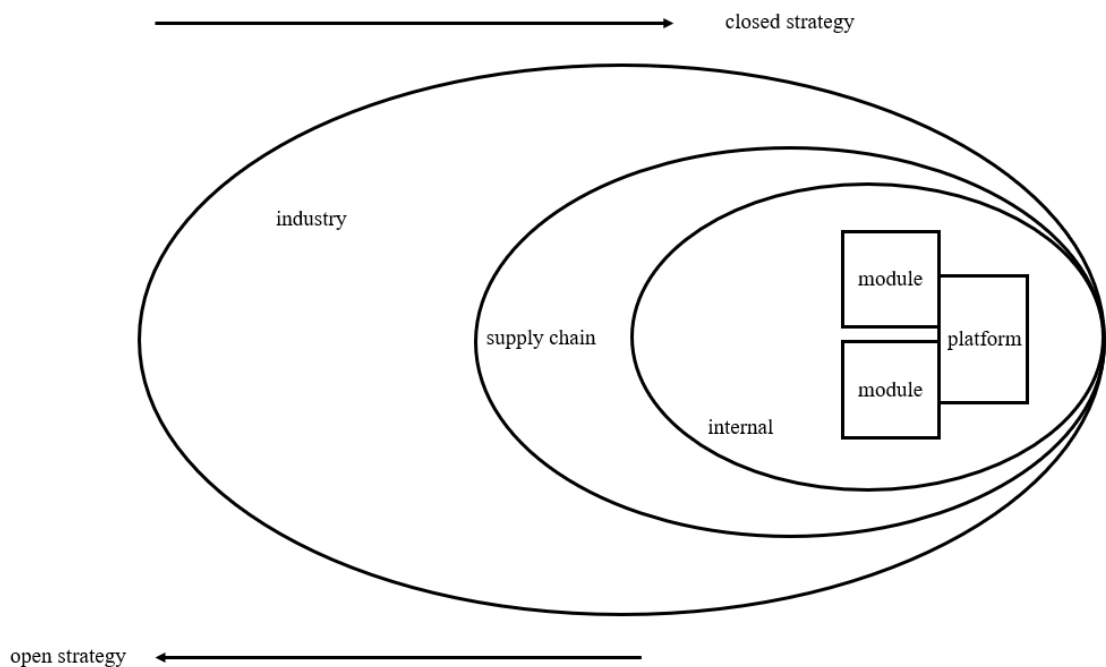
Figure 9: Synthesized model API and Platform Economics – horizontal openness

The further an MSP provider moves out in the circle, the more open its interfaces are. The more open a platforms' interfaces are, the higher the influence of innovation by complementors is (Chesbrough 2003; Gawer and Cusumano 2014). For the context of this thesis following assumption is used: If governed in the right way, innovation is always good for the platform provider. However, there are tradeoffs like imitation that can outweigh the gains from increased innovation capabilities (Gawer 2014).

According to (Resch 2018) negative effects of open interfaces can be limited through a higher degree of governance. Typical API governance tools are terms of service, technical restrictions such as rate limits and throttling,

Following the paradigm that an MSP generates value by facilitating transactions between the supply and demand side (e.g. Pagani 2013; Gawer 2014; Hagiu 2015) the goal of an MSP should be to make the strategic decisions to accelerate network effects between the two sides. As there are also network externalities that can be negative, those have to be evaluated in the context of the industry. This evaluation will be part of the application of the model.

The next hypothesis is based on the correlation between the degree of openness of the interfaces of a platform to the increased need for governance of the interfaces. As theorized in previous research by Gawer (2014), as a platform is expanding its focus from internal to supply chain and finally to the ecosystem, the amount of innovation resources increases and a value co-creation environment is established. When combining the view from Figure 9 with the identified drivers and blockers from Table 7, the following model is synthesized:

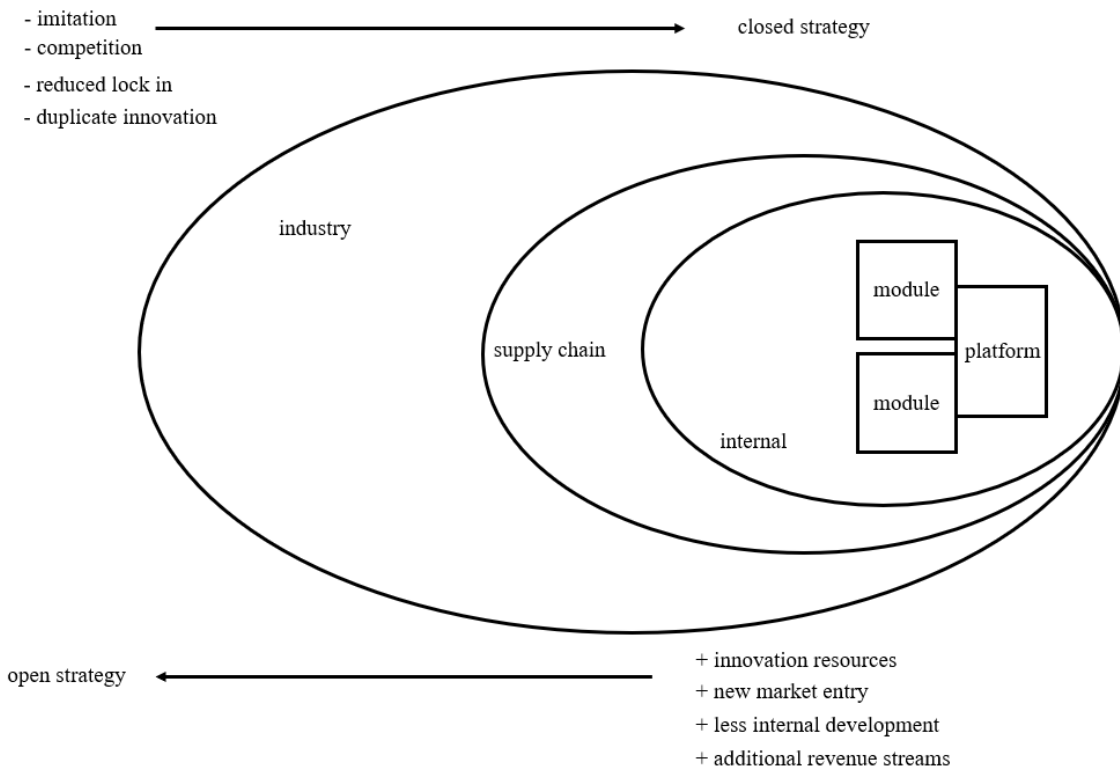Figure 10: Drivers and blockers for opening interfaces

The individual facilitators, drivers and blockers are explained in detail in Table 7. In the next chapter, this model will be applied to examine value-co creation through APIs in the context of an MSP in the E-Mobility industry.

4   APPLICATION OF THE MODEL

Following the paradigm of design science research, to serve a human purpose, the model should be applied in practice. This chapter includes the introduction to the ecosystem of the case company, the classification of the case company and the application of the previously introduced API value co-creation model.

To validate the findings, a single case study approach is followed. The research material is gathered through a workshop and a semi-structured interview. Due to the research area being located in the intersection of business and IT, one person from each area has been chosen. The workshop has been held with the platform business director. The interview has been held with the CTO of the case company.

A semi-structured interview, combined with a workshop has been chosen due to two main reasons:

- The theoretical framework consists of independent variables that influence the degree of openness of the interfaces of an MSP. According to Yin (1994), a semi-structured interview should give the practitioners the possibility to add to the theoretical knowledge through practical experience.
- The second reason for a semi-structured interview combined with a workshop is the two distinct interview groups that should bring in two different viewpoints to the discussed openness of APIs.

Yin's (1994) proposed analytical method of following up the theoretical propositions from the conceptual framework will be used to structure this paragraph. First, an overview of the EV charging ecosystem will be presented, partly based and prior literature on the subject but also on the practical experience of the researcher. Subsequently, the company and its services will be introduced in more detail before following up on the theoretical propositions from Figure 10.

4.1   The EV charging ecosystem

Earlier research (Korpelainen 2017; Madina, Zamora, and Zabala 2015; Säde 2019; Weeren et al. 2018) in the field of EV charging networks suggests several different roles in the EV charging ecosystem. However, all contributions so far use slightly different terminology. This thesis will use the most common definitions in the industry. Table 8 introduces the market roles in the supply chain of EV charging networks. Table 9 introduces the market roles in the wider ecosystem of EV charging networks.

To stay within the boundaries of the theoretical framework the roles will be divided between parties within the supply chain and within the industry. Parties within the supply chain have a contract with the marketplace operator. Parties within the industry might have a contract with one or several participants in the supply chain or play a vital role within the EV charging ecosystem. Table 8 shows an overview of market roles.

Table 8: Market Roles in the supply chain

Role	Description
EMP	The EMP is the contract owner of one or more EV drivers. An EMP offers a wide variety of different services to its end-customers.
CPO	A CPO operates and owns charging stations.
E-Mobility Clearing House	The party that facilitates transactions between EMPs and CPOs by aggregating Charge Detail Records (CDRs), managing authentication and authorization and handling settlements.
Search and Find Provider	Aggregation and discovery of charging station information
Smart Charging Provider	Scheduling and adaption of charge events based on energy, EV and EV driver information
EV driver	The party that consumes the charging service.
External roaming hub	The party that manages contracts and interoperability between EMPs and CPOs in different charging networks.
EV OEM	Producers of electric vehicles

Beginning from the core interaction in EV charging networks, charging cars, the involved parties are the EV driver and the Charging Station. The EV driver is an individual that uses either a BEV or a Plug-in Hybrid Electric Vehicle (PHEV). To charge the BEV or PHEV the EV driver needs the service of a Charge Point Operator (CPO[2]) who in turn operates, monitors and maintains one or more physical charging stations. Additionally,

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[2] also referred to in literature as Charging Station Operator (CSO)

an EV driver has a contract with an Electric Mobility Service Provider (EMP[3]) that offers services like registration, identification, payment and support to the EV driver.

The interconnecting role between the EV driver and its EMP and the charging station and its CPO is the marketplace operator (Madina, Zamora, and Zabala 2015; p. 285). The grey marked roles in Table 8 belong to the marketplace operator. As indicated by the multitude of roles, a marketplace operator offers a wide variety of services to its B2B market participants. This is also the key role of the case company that is examined further in the next chapter, where the services will be explained in more detail.

When looking at the roles in the wider ecosystem, additional market participants can be identified. Weeren et al. (2018) suggest connections to the following entities: City service provider, Vehicle Service Provider, Mobility Service Provider and Energy Service Provider. Out of the four participants in the wider ecosystem, the connection to the energy system has been identified as the most prominent (Korpelainen 2017). With the upscaling market size of EVs (demand), combined with the increased fluctuation of energy production of renewables (supply), there is also a growing interest in using the battery capacity of EVs as balancing element for the grid (Asaad et al. 2018; Lund and Kempton 2008; Madina, Zamora, and Zabala 2016). This value-added service helps Distribution System Operators (DSOs) to balance the voltage level of the power system through dynamic charging and discharging EV batteries (Eurelectric 2013, p. 8). Table 9 shows an overview of market participants in the wider ecosystem.

Table 9: Market roles in the ecosystem

Role	Description
Energy Service Provider	Energy supply and grid operation.
Mobility Service Provider	Services for EV drivers other than charging. For example, parking, route planning, car sharing, car rental
Vehicle Service Provider	Information about EV data like the state of charge or vehicle failures
City Service Provider	Information about local traffic conditions, public transport, etc.

The next chapter introduces the classification of the case company and its role in the EV charging ecosystem.

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[3] also referred to in literature as Electric Mobility Service Provider (EMSP)

4.2   Classification of the case company

The case company in focus of this study is a Finnish EV-charging platform provider that is operating worldwide and connects EV drivers with charging stations. It facilitates the transactions between those two parties by offering white label services to EMPs and CPOs. Table 7 shows an overview of the services and applications provided by the case company.

Table 10: Services and applications by role

Role	Applications and services
EMP	• Registration • Billing and receipt generation • Finding and starting charging stations • RFID handling • B2C Support • In special cases, when the EMP has B2B customers like fleets, electric busses or car rental companies also B2B support
CPO	• Building and maintaining charging infrastructure • Contract with energy supplier
MSP	• Development, maintenance and governance the technical platform, including APIs • Customizing of white-label applications for EMPs • Settlement between EMPs and CPOs • Facilitates connection to external roaming partners
EV Driver	• Registers to one or more EMP. • Uses mobile or web applications to find charging stations • Uses mobile or web applications to see the availability of charging stations • Uses RFID, mobile or web application to start a charging station • Pays the EMP for providing the charging service

As shortly described in the overview of the EV charging ecosystem, EMPs are the commercial contract owner of one or several EV drivers. Through affiliating with the EV charging platform provider, the EMP can offer services like mobile apps or web applications for finding and starting charging stations to automated billing for end customers. These services enable the EV driver to find and start charging stations of different CPOs, which in turn use the platform to manage their charging stations. Affiliated CPOs use the

platform mainly through a web application that allows them to manage smart charging stations that mainly support the Open Charge Point Protocol (OCPP) protocol. Through the web application CPOs can see different reports and statistics about the performance of their charging stations.

Furthermore, the EV-charging platform mediates transactions between EMPs and a multitude of different CPOs within the platform. This practice of mediating access of EMPs to multiple CPO-Networks is called in industry terms and scientific literature roaming (e.g. Madina, Zamora, and Zabala 2015). The e-mobility platform has a very open strategy towards roaming between EMPs and CPOs in their network. Every public station is reachable through a global revenue-sharing model for all EMPs in the network.

Outside of the platform, other EV charging networks exist. Access to these networks is agreed through bilateral agreements between the EMP and CPO, where the latter offers a price for its charging service to either all or a specific set of EMPs. Figure 11 depicts the business model of the target company. Following the theoretical framework, openness towards complementors and other third parties is defined by Eisenmann, Parker, and Van Alstyne (2009) as vertical openness.
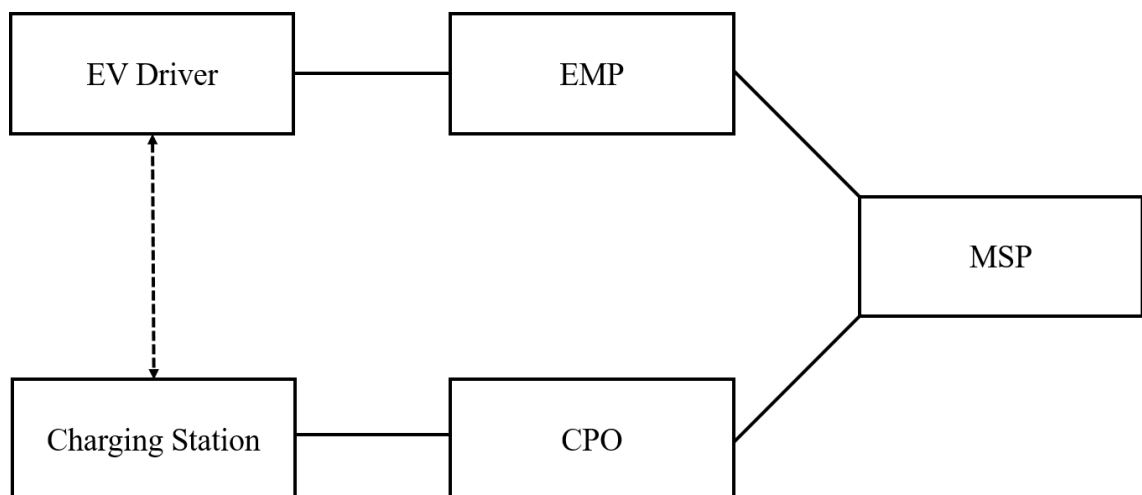
Figure 11: MSP business model in the EV charging industry

However, there is not only roaming within the platform but also inter charging network roaming, in industry terms called external roaming. There are three main interoperability standards: Open Charge Point Interface (OCPI), Open Intercharge Protocol (OICP) and Open Clearing House Protocol (OCHP). All of them are Open Source protocols with OICP moving to open-source quite recently, in May 2019 (Hubject 2019).

Other charging networks that are connected through roaming protocols can be seen as competing ecosystems. However, they are also complementing the service offering for both EMPs and CPOs. EMPs get access to a wider charging network for their EV drivers.

CPOs get access to a wider range of potential customers by offering their charging stations to external EMPs. The case company has implemented the technical interoperability standards and offers the possibility for external roaming to its participants. To come back to the theoretical framework, the openness towards competing ecosystems is labeled according to Eisenmann, Parker, and Van Alstyne (2009) as horizontal openness.

The next chapter will introduce how value is created in EV charging networks.

4.3   Value creation in the EV charging industry

The core interaction that is facilitated by the EV charging platform are transactions between EMPs and CPOs. Let's look initially at the network effects in place in the industry. As introduced in Chapter 2.1.1. there are direct and indirect network effects that strengthen the position of a platform. Two case studies on the importance of network effects in the EV charging industry have been conducted by Korpelainen (2017) and Säde (2019). Both case studies found no evidence of direct network effects on the EV driver side, rather the existence of weak direct network externalities derived from the possibility of waiting times at a charging station. Similar findings of direct network effects can be seen on the CPO side: No direct network effects due to more CPOs joining the platform, but interestingly no negative network externalities due to additional affiliation of CPOs. Säde (2019) argues that this is based on the geographic disperses of CPOs.

On the contrary strong indirect network effects have been identified by Korpelainen (2017) and Säde (2019). EV drivers and CPOs mutually benefit from the existence of each other. EMPs and their EV drivers value a higher amount of charging stations and greater network coverage. CPOs value a bigger number of EV drivers using their charging stations.

When looking at the EMP side of the platform, the existence of a wide range of companies from different industrial areas, from large energy utilities to small start-ups, can be observed. The same is true for the CPO part. Customers range from single households to large energy utilities and everything in between. As mentioned in the previous chapter, the case company offers a standard set of white-label applications for CPOs and EMPs to conduct their business. However, the high variety of industries and sizes leads to increasing requirements for those white-label locations. In addition to those requirements, country regulations like the German calibration law or country-specific money laundering policies have to be followed and supported by the platform provider.

On the positive side, having a lot of different complementors affiliated with the platform fulfills according to Chesbrough (2003) an important premise for open innovation to produce effective results.

However, when looking at value creation from the perspective of the engineering view on platforms, the overarching question is about how to form an ecosystem where innovation from software modules benefits the whole ecosystem. Tiwana, Konsynski, and Bush (2010) suggest that modules should be available through a marketplace. Ceccagnoli and Forman's (2012) case study in the ERP ecosystem suggest relying on the vertical expertise of complementors to create innovations. These extensions to the platform solve critical specialized business needs but rely still on the technical core of the platform owner. Value is facilitated by forming partnerships with innovation partners.

4.4   Openness of the platform

Linking back to Figure 10, where the drivers, facilitators and blockers towards a more open API offering have been introduced, it is time now to adapt the model to the practical environment. When looking and the supply and demand side of the platform two main actors have been identified: The EMP and the CPO.

The EMP as the party having the contractual relationship with EV drivers wants to offer its services to a wide variety of EV drivers. The platform provider supports EMPs by offering a CRM solution that can be adapted to the brand of the EMP. Furthermore, EMPs can get branded mobile apps where their customers can log in, find and start charging stations. To assist the EMP in collecting money from the EV driver, the platform provider offers a connection to a payment gateway. However, EMPs can also decide to invoice their customer based on transaction information they get from the marketplace operator.

On the supply side of the platform, CPOs build and maintain the charging infrastructure. CPOs buy charging stations from a wide variety of charging station manufacturers. These charging stations communicate with the cloud-based platform through the open-source protocol OCPP.

When looking at the vertical openness of the platform no restrictions towards CPOs and EMPs are imposed. In terms of openness of interfaces, the platform operator offers currently its interfaces to its supply chain participants for a fee.

Starting with the first driver, the number of innovation resources that are accessible for the platform, in the current setup the API offering can be described as partner APIs – so only available for partners that have a direct contract with the platform provider.

It is a good time to remind again about the scope of this thesis, as the research question is concerning the value co-creation opportunities through APIs offered by the MSP provider. Therefore, the upcoming analysis will be structured always from the viewpoint of the MSP provider towards its industry partners and later to its ecosystem partners. In addition to that, a distinction will be made between horizontal and vertical openness.

Summarizing the theoretical research on this topic, Eisenmann, Parker, and Van Alstyne (2009) characterize an open platform like this:

- unrestricted accessible for third party contribution, use and commercialization
- indiscriminate in its pricing and conformity to technical standards.

As discussed in the literature review section of the thesis, vertical openness is defined by Parker and Van Alstyne (2005) as the openness of the platform towards customers and complementors. As discussed in the last chapter, the platform provider has a very open approach towards its supply chain participants.

Table 11: Openness of the platform towards its participants

Role	Role in the platform	Openness
EV Driver	demand-side	open
EMP	demand-side	open
EV OEM	demand-side	open
CPO	supply-side	open
Energy Service Providers	supply-side	open

As Table 11 indicates, the platform is nondiscriminatory in its pricing and conformity to technical standards towards its supply chain participants.

Openness towards EV Drivers
The platform doesn't place any restrictions on what kind of EV Drivers can join or can't.

Openness towards CPOs
The platform doesn't place any restrictions if CPOs can join the platform or not.

Openness towards EMPs
The platform doesn't place any restrictions if EMPs can join the platform or not.

Openness towards EV OEMs
The platform doesn't place any restrictions on what cars can be charged through their CPOs.

Openness towards Energy Service Providers
The platform doesn't place any restrictions on what kind of energy service providers can participate in the platform

4.5   Current API offering

The platform provider currently offers its APIs in two versions: For admin users and for EV drivers. The distinction is made based on different user authentication. The EV driver API requires an EV driver account and thus a commercial contract with an EMP. The admin API requires an admin user account which is attainted by joining the platform either as EMP, CPO or in both roles. The authorization, that regulates what services and data the admin user can access depends on the role that is assigned to the admin user and to what organization the user belongs to. The following table gives an overview of use cases for each API version.

Table 12: API use cases

API version	Use case
Admin API	get, alter and insert customer information
	get, alter and insert RFID
	get transactions of EV drivers
	get a list of sub-organizations
	alter station information
	get a list of CDRs
EV driver API	Get and alter customer information
	Get information about the latest charge event
	Get, add and remove favorite charging stations
	Get a new password
	Start, stop and cancel a reservation
	Start and stop a charging session
	Get charging station information
	Add and remove a home charging station
	Get monthly charging history

The current API offering is classified as internal, but some customers have access to it by signing a separate agreement.

4.6 Design of API governance rules

The literature review part of this thesis suggests numerous dimensions that should be considered when designing governance rules for a platform provider. Each decision category has individual advantages and trade-offs. This chapter will reintroduce each dimension and propose an informed decision based on findings from the literature review and the practical context of the industry.

4.6.1 *Capitalizing on innovation*

Based on the findings of Boudreau and Lakhani (2009) two distinct strategies lead to value co-creation through outside innovation: The market approach and the community approach. As summarized in Table 13, the market approach leads to immediate value co-creation for the platform owner through the extension of platform functionality, revenue from implementation projects and licensing fees. Whereas the community approach co-creates value by potential new customers joining the platform and the premise that existing and future customer needs are served in a better way.

Table 13: Market vs. community approach

Area	Value co-creation for the platform owner	Approach
Immediate value-co creation potential	Extension of the platform functionality	Market approach
	Revenue from implementation projects	
	License fee	
Emergent value-co creation potential	Potential new future customers	Community approach
	Potential to better serve existing and future customer needs	

Based on Boudreau and Lakhani (2009) the decision of what approach to favor can be made by taking the following three topics into account:

- Which kind of innovation will be outsourced to third-party innovators?
- What are the motivations of the third-party innovators?
- What is the business model of the platform?

When looking at the type of innovation that should be coming from complementors and third-party contributors of the case company, the majority comes from special use cases in their markets. Although the platform provider offers a wide range of applications and services, special regulations in some markets and high vertical specialization on specific target customer groups create additional needs. Examples of regulations in some markets are, that the sales of electricity must be reported immediately to the financial authorities or money laundering regulations that require the EMP to directly report each sale of goods or services immediately. When it comes to vertical specialization different use cases arise from EMP customers like fleet operators, taxi companies or car-sharing companies. This also answers the motivation for open innovation by customers and complementors of the platform provider: It is usually the need to add functionality to the services and applications of the platform provider. When it comes to the business model, the case company operates as an MSP, which leads according to Boudreau and Lakhani (2009) to a high autonomy of the innovators.

Another approach of defining the value co-creation potential through APIs is by looking at the core interaction of the platform and the network effects that support the growth of the ecosystem. As identified in chapter 4.3. the core interaction that is facilitated by the platform is charging an EV. The charging transaction takes place between two distinct parties: The EV driver – supported and having a contract with an EMP – and the charging station – built and maintained by the CPO. When looking at the network effects, strong indirect network effects have been confirmed by previous studies (Korpelainen 2017; Säde 2019). Hence, the value of the ecosystem increases when more EV drivers or more charging stations are affiliated with the platform. The pragmatic conclusion, that can be deducted from this observation, is, that all use cases that lead to an increase in EV drivers or EMPs and charging stations or CPOs have a positive impact on the value of the ecosystem.

All in all, a clear tendency towards the market approach of governing open innovation can be deducted from the type of innovations that are requested by the ecosystem, the principal motivation of innovation and the business model of the case company.

4.6.2   *Dealing with imitation*

According to Pil and Cohen (2006) imitation is a threat that arises from modular architecture. Although modularity spurs innovation it can serve as a building plan for competitors. Ethiraj, Levinthal, and Roy (2008) suggest that not fully decomposing a system into individual modules can limit negative implications from imitation. From the technical architecture point of view, Baldwin and Woodard (2009) suggest a tightly coupled core with a loose periphery as an architecture principle.

Although the degree of modularity only affects the API governance indirectly, it should still be considered, especially if the API documentation is publicly accessible. To limit imitation by competitors, interfaces to only selected modules should be provided whereas interfaces to modules that currently see development investment should not be open. Key innovation areas of the case company can't be disclosed in this thesis but will be included as a concept.

4.6.3   Mitigating competition

Complementors that are using the APIs of the platform provider to produce innovative products and services can turn out to be competitors for certain customers. This problem has been already solved by the target company through partnership agreements with certain customers. The partnership agreements place the customer into the status of an official reseller of the platform. This just leads to the problem that the customers of the complementors don't have a contract with the platform provider. Therefore, it is necessary to include this special case to the governance rules of APIs. Although some customers do not have a direct contract with the platform provider, they are still affiliated with the platform and the same governance rules regarding usage of APIs should be imposed.

4.6.4   API Governance principles

Following the premise that the API offering should be as open as possible to benefit from immediate and emergent value co-creation and combining this view with the feedback circle of the boundary resource model, each API method should be assessed towards a specific checklist, answering first the question of what can be archived through the APIs from a technical viewpoint:

- Data sharing
- Integrations to third party systems
- Application development

After assessing the value co-creation potential of the companies' API offering, the decision between arm's length and dyadic governance style must be made. Due to the limited scope of the API offering (supply chain), the only disadvantage of higher governance costs can be neglected. However, when moving further out into the ecosystem, the type of governance should move more towards the arm's length governance principle.

As part of the artifacts of the application part of this thesis, a document about the evaluation of API requests that represent the arm's length approach and a request API key form is developed.

Common rules for accessing the API for complementors comprise of following topics:

1. Each application must be registered with the following information: (dyadic)

   User account name

   contact person

   type of application: (mobile or web application, integration to third party system)

   use case following the JTBD framework

   (When [context, situation], I want to [functional goals], So I can [emotional and social goals])

   endpoints that are called

   frequency of calls

2. The case company will accept or decline the request based on the following criteria:

Table 14: Value co-creation evaluation criteria

Category	Evaluation criteria	Value creation
innovation	The application leads to an extension of platform functionality.	positive
	The case company is innovating or planning to innovate in the same area	negative
	The case company has covered the use case already	negative
	The application leads to significant emergent value co-creation that opens new markets or access to large clients	positive
	The application better serves existing customer needs	positive
network effects	The use case leads to more customers joining the platform	positive
	The use case leads to more charging stations being connected to the platform	positive

competition and imitation	The application is competing with existing platform products or services	negative
revenue	The API is monetized, and revenue generated through usage.	positive

The same evaluation criteria can also be used to assess requests for opening additional resources towards external developers. As identified in the literature analysis, the main drivers that affect opening interfaces to customers and complementors are as following:

Ghazawneh and Henfridsson (2010) describe as the primary driver the need of the ecosystem for additional resources.

More recently Zachariadis and Ozcan (2017) propose regulations like PSD2 as a driver for platforms to open up APIs.

In the context of the EV charging industry, no such regulations are yet in place that would require open interfaces to access charging networks. However, there is the need of customers for opening up new interfaces to allow specific applications. The target company has already a feedback form for normal development requests that can be used for establishing a feedback circle for special use-case API requests.

4.6.5   Remodeling of API offering

To be consistent with the actual roles and applications in the EV charging ecosystem the API offering should be remodeled to better reflect the actual use cases for each role. As identified in chapter 4.2 there are several distinct roles in the EV charging ecosystem. The roles in the industry context are the following:

- CPO
- EMP

The roles in the ecosystem are:

- Mobility Service Provider
- Energy Service Provider
- City Service Provider

To archive a better API offering in terms of scope the following table illustrates the matching of use cases of Virta's APIs to the services and applications provided to their industry partners. The EV driver services are part of the EMP services and applications and therefore shown in the EMP role.

Table 15: Mapping of services and applications to API use cases

Role	Applications and services	API use cases
EMP	• Registration • Billing and receipt generation • Finding and starting charging stations • RFID handling • B2C Support • In special cases, when the EMP has B2B customers like fleets, electric busses or car rental companies also B2B support	• Get, alter and insert customer information • Get, alter, insert RFID • Get transactions of EV drivers • Get and alter customer information • Get information about the latest charge event • Get, add and remove favorite charging stations • Get a new password • Start, stop and cancel a reservation • Start and stop a charging session • Get charging station information • Add and remove a home charging station • Get monthly charging history
CPO	• Building and maintaining charging infrastructure • Contract with energy supplier	• Alter station information • Get CDRs
MSP	• Development, maintenance and governance the technical platform, including APIs • Customizing of white-label applications for EMPs • Settlement between EMPs and CPOs • Facilitates connection to external roaming partners	• No partner or public APIs
EV Driver	• Registers to one or more EMP.	• Part of the EMP services and applications

- Uses mobile or web applications to find charging stations
- Uses mobile or web applications to see the availability of charging stations
- Uses RFID, mobile or web application to start a charging station
- Pays the EMP for providing the charging service

Integrations of the charging service or data exchange with ecosystem partners should be in principle a desired goal for the platform provider. However, looking at envelopment strategies, there might be a possibility for the platform to move into markets that are not purely EV charging related. A good example are Parking Service Providers like Easypark. The target company can leverage its user base and offer a parking service within its mobile app. But the same is also true vice versa. The company has to carefully consider the threat of being enveloped by a third party.

In the next chapter, the model is presented to industry professionals. The feedback will be incorporated into the value-co creation model.

5 FEEDBACK AND REITERATION

This chapter proceeds with the evaluation of the API value co-creation model through the generation and evaluation of primary data. Following the DS research methodology, the artifact must be evaluated by demonstrating its applicability in practice (Peffers et al. 2007). The evaluation is conducted by presenting the model to two employees of the case company. One from the technical side and one from the business side.

The first feedback round has been held as a workshop with the platform business director of the case company. During the workshop, the API value creation model has been presented and using a PowerPoint presentation. The main goal of the workshop is to foster an understanding of how APIs can create value for the target company in the EV charging industry.

After the workshop, the same presentation has been used to introduce the API value co-creation model to the CTO of the case company. Subsequently, a semi-structured interview was conducted. According to Yin (1994), an explanatory case study should be conducted when a present phenomenon should be described and evaluated. The goal of the interview is to understand if the identified categories from literature and its application in the case company are solving a practical problem. Furthermore, the semi-structured interview should encourage the participants to bring in their ideas about the topic.

For the workshop and the semi-structured interview, 45 minutes are reserved for presenting the artifact and discussing its applicability in practice. For the semi-structured interview, the same PowerPoint presentation was presented for 15 minutes and after the presentation, a 30 minutes semi-structured interview was conducted. The interview guide can be found in Appendix I.

5.1 Workshop results

When presenting the findings from the literature research and the API value co-creation model to the Director of Platform Business, the PowerPoint presentation has been presented and the participant was encouraged to give feedback whenever something is unclear or when the need for a discussion arises.

The main goal of the meeting was to foster an understanding of potential pricing models for the API offering of the target company. During the meeting a decision was made for value-based subscription fee with following pricing parameters:

- Monthly quota of API calls
- Throttling limit

Details about pricing have been discussed in later meetings. As all questions about pricing methods are out of scope for this thesis, no further information will be given on this topic.

5.2   Semi-structured interview results

Same as for the workshop, 45 minutes were reserved for the semi-structured interview. The agenda included 15 minutes of presentation from the researcher and 30 minutes for the interview with the CTO of the case company. However, due to time restrictions, the first semi-structured interview only lasted for fifteen minutes. This was not enough to cover the whole interview, so another interview round was scheduled. The second interview was conducted on the 12.12.2019 (Interview CTO 2019). It has been recorded and lasted for 30 minutes. The detailed interview guide can be seen in Appendix I. The interview covered the three main dimensions of the API value creation model:

- Facilitators
- Drivers
- Blockers

For each category, open questions have been prepared by the researcher that check the validity of the model that was derived from the literature research and that has been applied in the context of the EV charging industry.

5.2.1   Feedback on facilitators

Three open questions have been asked in the context of facilitators – which are in other words the prerequisite of opening APIs to the supply chain and beyond. The platform follows modular architecture guidelines, is however in a transition period from a more monolithic approach. The future direction is clearly towards a system comprising of multiple independent modules. In addition, the company has set API design guidelines that are being followed by its developers. When asking for the core capability of the platform, the whole platform concept of connecting EV drivers with charging stations is seen as the main core capability.

5.2.2 Feedback on drivers

The main drivers for opening APIs to complementors are seen by the CTO as following:

"*The key motivation is large professional customers that already have a set IT infrastructure, like CRM, invoicing systems. Offering them a possibility to integrate EV-charging as one service of many they are offering is seen as an important part of the target companies' capabilities. In addition, traffic management, and smart cities are a place where APIs will be used in the future.*" (Interview CTO 2019)

The next paragraph summarizes the feedback on the individual drivers of the API value co-creation model.

Innovation

Innovation is seen as a natural component of companies. When looking at the EV charging industry, from the perspective of is maturity, most companies in the same field as the target company are five years or younger. Therefore, the industry is still moving very quickly as nothing is set in stone. Innovation is essential for the target company to stay ahead of the game.

Local specialization based on the needs of EV drivers is low. The basic interaction of EV-Driver to charge point is the same in all countries. However, local specialization based on the country of the EV driver is high when it comes to the areas of money handling and selling energy. There are many special regulations when it comes to invoicing the EV driver and what form of receipt is displayed. In addition, energy selling is highly regulated in some countries and therefore some special requirements arise.

The target company wants to be compliant with all the regulations in each country they operate, however developing products for every single market is very expensive and time-consuming. Therefore, the growth of the market in certain areas is used to decide whether the target company is implementing products based on local requirements or APIs are provided to partners to fulfill these requirements by themselves. The target company also doesn't have enough resources to fulfill not only country-specific requirements but also customer-specific requirements. In addition, each requirement and special development leads to higher maintenance costs. Special developments that don't make sense for existing customers should be built by the customer based on a standardized API offering.

New Market entry

The CTO sees fleets as one of the most interesting new industries the company should offer its services to. One big trend in the future is that individuals will not own private cars anymore but use a service that provides mobility in different forms to them.

When it comes to the decision if the EV charging service should be integrated into the complementors service or vice versa, the ideal approach would be to integrate the complementors service into the own service. Reality shows, however, that fleet management companies already have their mobile apps and integrations to a multitude of services, like showing a map of gas stations and offering a loyalty bonus when fueling up the car at certain providers. Therefore, it is unrealistic to incorporate services of fleet providers into the EV charging service, but rather integrating the EV charging service through APIs into fleet provider applications is seen as strategic more relevant.

The main disadvantage seen in this approach is that the end-customer is not owned by the company, which has the implication that additional services can't be offered so easily in the future to an existing customer base.

Additional Revenue stream

Revenue generation through APIs is not seen as the main priority. However, revenue generation through APIs should be linked with the existing product and service offering of the platform. This means that if the company is offering a product or service, the API offering shouldn't directly compete with this service in terms of pricing. For example, customer management: The possibility to create customers in the system can be either done via APIs or a UI. There shouldn't be any difference in pricing this feature.

Network effects

A direct correlation can be seen between EV drivers the APIs of the platform. Big customers are calling the target API of the target company to add new customers to the service.

There is no direct correlation between API usage and additional charging stations. Indirectly it there might be a correlation by offering APIs as part of the companies' service offering. This can help winning deals with new customers. This leads to more charging stations and EV drivers using the platform.

5.2.3   *Feedback on blockers*

The main disadvantage of offering APIs to customers comes from the situation when customers want to build their own value-added services, like energy management systems, on top of the APIs of the company. There have been questions about opening certain

APIs to complementors so they can build services on top of them that are directly competing with a premium service offering of the target company. One example that was given is about an energy management system that would allow a complementor to control the charging power of devices based on input from their own developed system.

Technical misuse is possible with the current API offering. There has been the case that APIs of the target company were called by a third-party system that led to a substantial increase in system load. In addition, the current API governance mechanisms rely a lot on customers informing the company about the usage of the API. There are currently no technical restrictions in place that can govern access to APIs. More control is needed in this area.

Competition
B2B customers are not competing with the platform.

Imitation
There is no risk in exposing the technical architecture of the company through publishing partner APIs and having the API documentation available publicly. However, a risk exists if APIs are available publicly through data mining activities of unknown sources.

Reduced lock-in
No examples from the past have been identified that would lead customers switching to competing platforms.

Integrations through APIs lead, according to the CTO, to increased switching costs for customers. However, if a standard evolves in the future and the partner APIs are compliant with this standard, then this threat of reduced switching costs could come into place. Custom APIs don't have this threat.

5.2.4 Types of Openness

Vertical openness
The platform doesn't place any restrictions towards EMPs and CPOs joining the platform.

Horizontal openness
The openness of the platform towards other EV charging networks is described as open. The company has connections to several roaming networks. However, in the future, this might change, due to strategic reasons. There might be the case where other EV charging networks grow bigger, and the position of the target company might change.

The horizontal openness of customers of other charging networks accessing the target companies charging stations must be closely followed. The logic behind this is that it is quite cheap to develop an EMP offering. It's however much more expensive to develop a charging station network.

Openness towards the ecosystem

So far there have not been many requests from ecosystem partners. Existing requests have been however viewed quite critically, as it is important for the target company to keep the end-customer relationship and not just a technical service in the background.

5.2.5 *Wrap up*

This part is the most open one of the interview and summarizes the three main points of how the target company can generate value through APIs:

1. Businesses can create services that the target company doesn't want to create.
2. Other companies can create additional services that are offered by the platform to its existing customers. This leads to an increased value of the platform.
3. Offering limited APIs completely public. This leads to third-party developers creating innovative products and services, that can be used as a blueprint to incorporate those innovations into the companies' own product and service portfolio.

5.2.6 *Implications on the API value-co creation model*

To summarize the feedback, each category of the API value creation model is examined in detail based on the interview results. The basis for this chapter is the API value co-creation model described in Figure 10, which summarizes the drivers and blockers towards an increasingly open API offering. In addition to the high-level view on value co-creation through APIs, Table 13 shows the individual evaluation criteria that should be used to categorize each request of API usage. Table 16 shows each dimension of the API evaluation criteria.

Table 16: Incorporation of feedback to the value creation model

Category	Dimension	Feedback
facilitators	Modular architecture	Modular architecture is a goal of the company, but not fully followed due to legacy reasons
	API design guidelines	API design guidelines are existing and followed
	Platform concept	The core of the platform is to connect EV drivers with charging stations
drivers	Innovation	Innovation is seen as a do or die category. Attracting and capitalizing on third party innovation is seen as an important future issue, where APIs play a key role.
	New market entry	Ideally, APIs of third-party systems should be used to incorporate a service into its own service. It is, however, crucial to know the companies' place in the market. Larger market players with a larger customer base require the own service to be integrated into theirs.
	Additional revenue stream	Not seen as the main driver. It is however important to no cannibalize the own service offering by offering too cheap APIs
	Network effects	No direct link between offering APIs and increased network effects could be identified.

	Less internal development	This was mentioned as the top reason for opening APIs. Customers can create features that provide little value to other customers. Especially maintenance of many different features has been mentioned as an important factor to consider.
blockers	duplicate innovation	Aligning internal development with external development is crucial. If both, the company that offers an API and its customers are planning to build the same service, a conflict in interests arises.
	imitation	No threat is seen in having open API documentation available.
	competition	The platform provider hasn't seen that complementors are suddenly turning to competitors. This was considered a very unlikely scenario.
	reduced lock-in	The thread of customers being able to switch more easily to competitors when using APIs instead of ready-made products was conceived very low. This could, however, be a thread when standardized interfaces are emerging in the industry.

The grey marked fields indicate that these items received special importance during the interview.

5.3   Reiteration of the API value co-creation model

Considering the feedback from the workshop and the semi-structured interview, adaptions to the API value creation model can be considered. Figure 12 shows the reiteration of Figure 10.
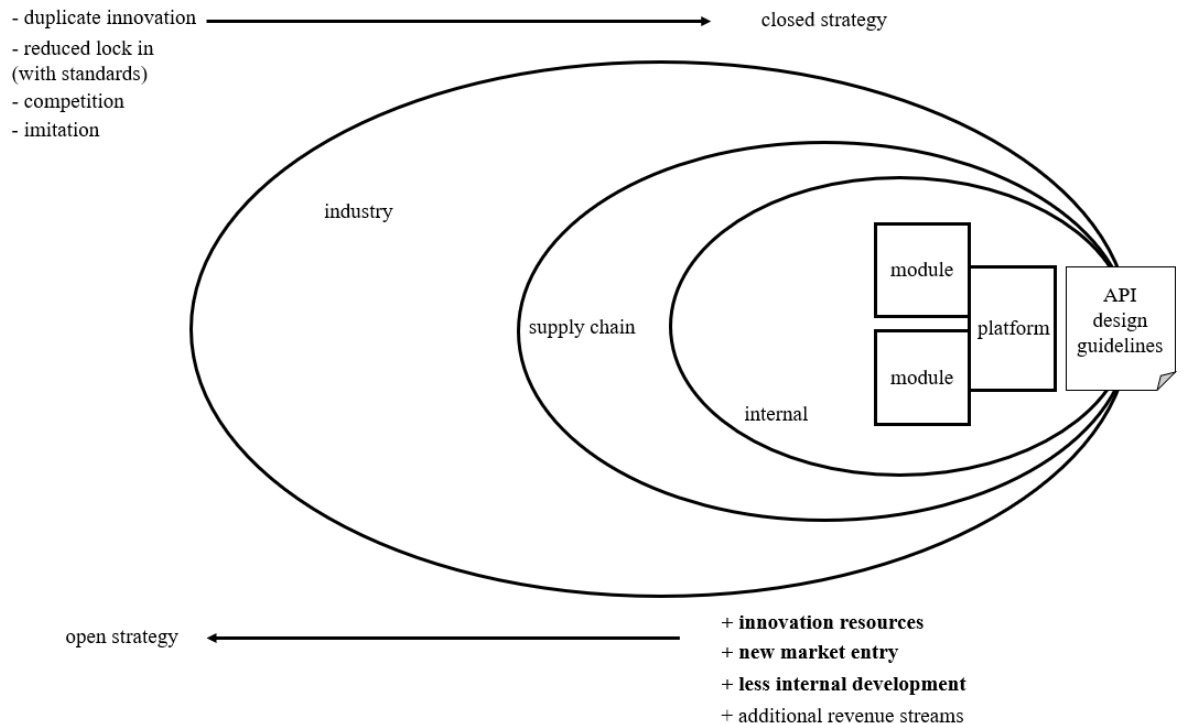

Figure 12: Adapted facilitators, drivers and blockers

When starting from the internal API ecosystem, in addition to the whole platform concept and the modular architecture the third faciliatory, API design guidelines, have been added. The drivers and blockers for a more open or closed API strategy have been rearranged according to their importance. Starting with the number one of the drivers: Innovation resources.

> *"The question is not if innovation is important for our company but rather how we can be innovative"* (Interview CTO 2019)

Innovativeness and capitalizing on third party innovations is seen as the key driver for an open API strategy. This is in line with the literature on this topic (e.g. Boudreau and Lakhani 2009; Eisenmann, Parker, and Van Alstyne 2009; Gawer and Cusumano 2014; Yoo, Henfridsson, and Lyytinen 2010).

When moving on to the next driver, new market entry has been mentioned as another key driver for a more open API offering. Naturally, the desired direction should be to

integrate services into a companies' own service. But practically, companies with a larger user-base usually integrate smaller services of companies with a smaller user-base. This is in line with previous literature, that emphasized the importance of strengthening the user base of the platform through integrations by West (2003) and Eisenmann, Parker, and Van Alstyne (2009).

Third up in the list of drivers, and marked as important, is the benefit of less internal development. Especially considering the international focus of the case company, combined with various stakeholders on both sides of the platform makes, it is hard to comply with every special requirement. This topic can be interpreted as a part of the decreased search costs for innovation resources that emerge from opening interfaces to a wider ecosystem (Gawer 2014, p. 1245).

The last driver, that didn't receive as much attention as the others, is the additional revenue stream from commercializing a companies' API offering. According to the interview results and the workshop with the platform business director, the most crucial factor to consider in the commercialization is to not cannibalize the platform providers' own products and services that generate revenue. Similar findings have been identified by Boudreau and Lakhani (2009).

When moving on to blockers, the interview results show that they received, in general, less emphasis than the drivers. As number one blocker the duplicate innovation was mentioned. It requires constant governance to avoid the risk of exposing resources that can be used by the innovation ecosystem to develop products that are already under development by the platform provider. This thread has also been identified by Gawer and Cusumano (2008).

The second blocker of reduced lock-in has been discussed in the interview and was considered in the context of the case company as a benefit. Partners that integrate an EV charging service to their own systems must do a substantial amount of integration work and a lack of standardized interfaces in the industry lead to an increased lock-in. This point should be however considered from industry to industry and can't be generalized as driver or blocker.

The third blocker of complementors turning into competitors has been discussed in the interview but didn't receive a special notion. It might be different in other industries.

The last point of imitation by competitors through open interfaces was not confirmed by the CTO. However, a mature enough platform should be able to deal with imitation well enough due to network effects being already in place.

Based on the reiteration of the API value creation model, the next chapter will introduce artifacts created by the researcher. These artifacts include an API documentation that is structured based on use-cases, a sign-up form that helps with managing partners and governing the API ecosystem.

5.4   Creation of API governance and management tools

This chapter will introduce the hands-on work that has been done during the master thesis. First, the remodeled API documentation is introduced. Based on the findings of chapter 4, EMPs and CPOs have both standard use cases they want to usually cover using the companies' partner APIs. Figure 13 illustrates the first part of the adapted API documentation that is structured according to the use-cases of B2B customers. On the left bar in the picture, the technical API description is structured under 5 use cases:

- Authentication
- Integration of external CRM systems
- Charge card handling
- Integrate external invoicing system
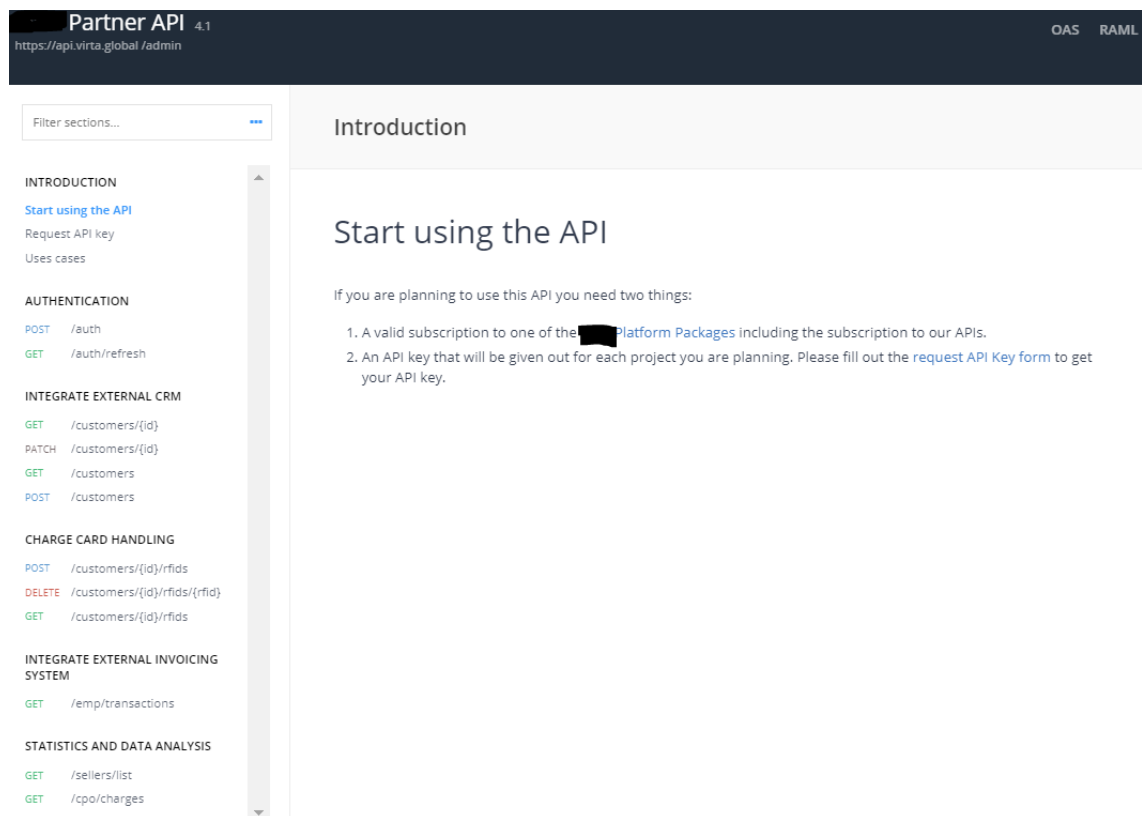- Statistics and data analysis

Figure 13: API documentation part 1 according to use cases

Part of the management process of the standard partner APIs is a sign-up form that is illustrated in Appendix II. The main reason for the sign-up form is to get company details (see Appendix II, Page 1) and information of the partner how often the APIs are called and what project the APIs are being used in (see Appendix II, Page2). After completion

of the sign-up form, each request will be checked according to the evaluation criteria introduced in Table 13.

The second part of the companies' API has the use-case of displaying information about chargers and allow interaction through UIs like mobile or web applications. This API is also structured according to its most common use cases:

- Authentication
- EV driver account management
- Charging
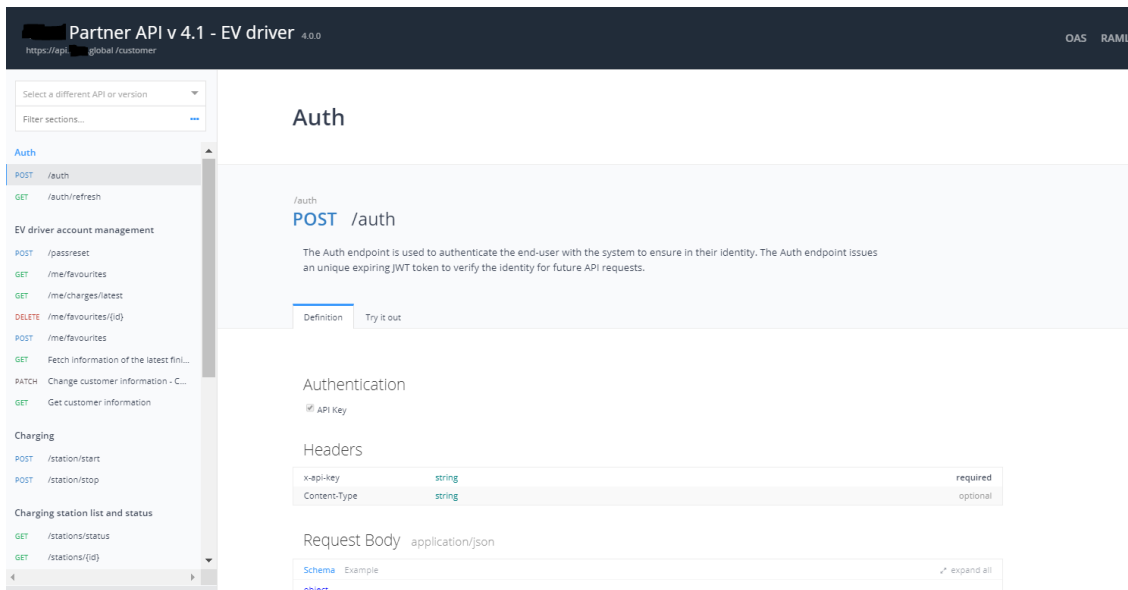- Charging station list and status

Figure 14: API documentation part 2 - EV driver interaction

In addition to the standard use case documentation, the company has a large set of internal APIs. When describing the above mentioned standard APIs, those have been best described by Eisenmann, Parker, and Van Alstyne (2009) as the market approach to managing outside innovation.

The second approach described by Sarker et al. (2012) as the dyadic way of managing outside innovation requires a different approach. Due to the highly local needs of platform participants, a lot of requests arise that don't fit into the standard use cases. As recommended by Boudreau and Lakhani (2009) a mixed approach to managing outside innovation should be applied in those cases. Therefore, an already existing development request form is reused. All platform participants can request the platform provider to be more open. Each of these requests is, before opening APIs in a sort of bilateral way to one or more of the platforms participants, checked according to the evaluation criteria of Table 13.

6   DISCUSSION AND CONCLUSION

During this thesis, various elements of value co-creation through APIs in the context of MSPs have been discussed. Furthermore, a model has been developed, applied and reiterated in a real-world context.

When looking back at the starting point of the thesis, the main research question was:

How value is co-created through APIs in a Multi-sided platform environment?

To answer the question a design science research methodology was followed. Starting with theoretical foundations in platform economics and API economy a model has been built that was applied in the context of the EV charging industry. During the case study, one interview and a workshop have been conducted with professionals of the industry that gave feedback on the first iteration of the model. The feedback has been incorporated in the model and the main findings are presented in this chapter.

6.1   Main findings

The answer to the research question is two-folded. One the one hand there is enough evidence that open APIs stimulate an innovation environment that not only benefits the platform provider but the whole platform ecosystem. Complementors can serve customers in various markets better than one centralized organization. Integrating a service through APIs into another service has a positive impact on network effects and generates a competitive advantage for the platform provider that offers easy to use and open APIs.

On the other hand, a high degree of openness of APIs of an MSP can cannibalize a platform providers' service offering and lead to a negative impact on the revenue of the platform provider. It can – in certain situations – reduce lock-in and turn former complementors to competitors. In addition to those blockers, an organization can also just not be ready to open its APIs to its environment, as certain facilitators like modular architecture and API design guidelines are not yet being used in the company.

Therefore, the platform provider must find a middle ground between opening up the right resources to the right parties and thus finding a fitting degree of openness. Although this step is highly dependent on the industry the platform is operating in, a set of management practices and governance guidelines have been identified and presented in chapter 4.

The further a company decides to open its API offering, the stricter the degree of governance and the higher the effort in managing the API ecosystem is required. At some

point, the dyadic way of governing APIs is simply not scalable anymore and the arms-length governance principle has to be applied.

As discussed in the context of the case company a mixed approach provided to be the best solution. This leads to a scalable standard API offering for the whole ecosystem without losing the flexibility that dyadic governance provides for special cases. Those special cases, in turn, can be easily adapted to the standard offering once the value co-creation potential for the platform provider is clear.

6.2   Theoretical contributions

This thesis combines the two research streams of platform economy and API economy. Both bridge technology and business domains and are therefore relevant for the main focus of the researchers' master studies in Global IT Management.

The findings of the thesis lead to a better understanding of ways of governing APIs by taking external stakeholders into account for MSP providers.

When looking at previous literature, Eisenmann, Parker, and Van Alstyne (2009) have identified the importance of outside innovation for platform providers. APIs have been seen by multiple authors (eg. Gawer 2014; Ghazawneh and Henfridsson 2013; Seny, Guérin, and Hosanagar 2011) as key drivers to support an innovation environment around digital platforms. This leads to the term API economy that has been evolving during the past couple of years.

This thesis contributes to the understanding of how opening up or closing interfaces affect in positive and negative ways the factors that contribute to the success of an MSP. Through the possibility to conduct a design science research in the context of an MSP in the EV charging industry, several factors like innovation, higher adoption rate and limitation of technological development (see Table 7 for details) have been identified.

One negative factor, identified by Pil and Cohen (2006), as imitation and competition from complementors couldn't be confirmed during this thesis. In addition, another negative factor, lower appropriability through reduced lock-in (West 2003), could be clarified to be, in the case of standard interfaces, a threat, but without standardized interfaces an actual positive factor for a platform provider.

6.3   Limitations and further research

As a critical observer might have noticed, during this thesis, the term value co-creation describes the creation of value for customers not by one single company, but a whole ecosystem of businesses and even individuals working together to offer an optimal mix

of services to the customer. This thesis has been mainly focusing on the viewpoint of an MSP that orchestrates and controls who can contribute to the value co-creation activities together with them. For a more holistic approach, all potential ecosystem roles should be taken into account.

This observation leads also to the first suggestion for further research on this topic. When looking at an ecosystem, like the EV charging industry, many potentials players are being involved. Conducting a study with the viewpoint of a charging station manufacturer or a parking service provider could offer valuable insights into how value co-creation affects their business model.

Furthermore, one interesting research stream opens up when looking at the two ways of governing APIs: The arm's length and the dyadic way. This research took it as granted that, at some point, the governance and management effort of the dyadic way of governing APIs creates too much effort. It would be interesting to see more research on this topic that examines the problem in more depth.

Another suggestion for further research and a topic that has not been discussed in great depth in this thesis is the pricing of APIs. When does it make sense to offer APIs for free? What pricing models can be developed and how can they be optimized? Those questions could provide interesting starting points for further research.

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8 APPENDIX I: INTERVIEW GUIDE

Basic information about the research

Introduction of the researcher

Introduction of the API value creation model through a PowerPoint presentation

Privacy Information

This interview will be recorded but the record can be deleted

Names will not be used, but the title

Can the company name be used in the study?

Information about the interviewee

Name

Position

Platform provider interview:

Facilitators:

Does your platform follow modular architecture guidelines or is it more comprised of integrated systems?

Do you have API design guidelines?

If yes, are they being followed?

What do you see as the core capability of Platform?

Drivers:

General:

What is the main advantage of opening your APIs to customers? (innovation, new market entry, less internal R&D, additional revenue stream, other?)

How important is innovation for your company?

Do you have enough resources to work on innovative products and services?

New market entry:

What market would you wish your platform to be in? How do you think your APIs can help you to get into new markets?

Less internal development:

Do you have enough development resources to work on customer requirements?

Additional revenue stream:

Besides the previously discussed advantages, how important is it for you do generate direct revenue from your API offering?

Network effects:

Have you experienced that more EV drivers are joining your platform directly through API calls?

Have you experienced that more EV drivers are joining your platform indirectly through a complementor offering an innovative application or service that builds upon your APIs?

Have you experienced that more charging stations are connected to your platform directly through API calls?

Have you experienced that more charging stations are connected to your platform indirectly through API calls?

Blockers:

General:

What are the main disadvantages of opening your API? technical, strategic

Competition:

Do you see a risk of competitors misusing your APIs?

Are some of your B2B customers directly competing with you in some markets?

Imitation:

Do you see a risk of exposing your technical architecture to competitors?

reduced lock-in:

Have you experienced that customers using your APIs tend to exchange your platform with another one more often?

Do you think the reduced lock-in negatively affects the amount of CPOs and EMPs in your platform?

Duplicate innovation:

Do you see the risk of customers investing in their own development and not ordering features from you?

Types of openness:

Vertical:

How open would you categorize your platform towards CPOs and EMPs?

Horizontal:

How open would you categorize your platform towards other EV charging networks outside your platform?

How open would you categorize your platform towards other ecosystems (MaaS, OEMs, Energy Service Providers and City Service Providers)

Wrap up:

Please share your three main points on how your platform can generate value from its API offering.

9 APPENDIX II: REQUEST API KEY FORM

Figure 15: Request API key form page one

Figure 16: Request API key form page two