Orchestrating Emerging Digital Ecosystems
Investigating the Establishment of an Open Data Platform in the Swedish Public Transport Industry

Hosea A. Ofe

Department of Informatics
Umeå 2020
To my son Marvin
Preface

This thesis consists of four research papers. The overarching aim of the cover manuscript and thesis is to provide insights into the processes through which new digital platforms ecosystems are established by identifying challenges in orchestrating emerging digital ecosystems and approaches through which these challenges can be navigated. Chapter 6 of the cover manuscript provides an extended abstract of each of the papers listed below.


Paper 4: Ofe H. A., & Sandberg, J. Navigating competing concerns in digital ecosystems through path channeling: Exploring the establishment of an open data platform (Manuscript)

Other related works:

# Table of Contents

Abstract .................................................................................................................. iii
Acknowledgements ................................................................................................. v

1. **Introduction** ................................................................................................. 1
   1.1. Research Motivation ..................................................................................... 1
   1.2. Problem Statement ....................................................................................... 6

2. **Digital Platform Ecosystem Orchestration** .................................................. 10
   2.1. The Background to Digital Platform Ecosystems ....................................... 10
   2.2. Perspectives on Digital Platform Ecosystems ............................................. 12
   2.3. Orchestrating Digital Platform Ecosystems ................................................. 14
        2.3.1. Attracting Users and Generating Network Effects ......................... 15
        2.3.2. Control and Coordination ................................................................. 16
        2.3.3. Creating and Capturing Value ......................................................... 18
   2.4. Digital Ecosystem Life Cycle ...................................................................... 19

3. **A Literature Review of Digital Platform Ecosystem Establishment** .......... 22
   3.1. Descriptive Analysis of the Literature ....................................................... 23
   3.2. Challenges in Establishing Digital Platform Ecosystems ......................... 26
        3.2.1. Attracting and Generating Network Effects ......................................... 26
        3.2.2. Control and Coordination ................................................................. 29
        3.2.3. Creating and Capturing Value ......................................................... 31
        3.2.4. Summary of Digital Platform Ecosystem Establishment ................. 34

4. **Research Context** ......................................................................................... 39
   4.1. Open Data .................................................................................................. 39
   4.2. Samtrafiken and the Trafiklab Platform .................................................... 41
   4.3. Evolution of the Trafiklab Platform Ecosystem .......................................... 44

5. **Methodology** ............................................................................................... 48
   5.1. Ontological and Epistemological Considerations ....................................... 48
   5.2. An Interpretivist Stance ............................................................................... 49
   5.3. Interpretive Case Studies ............................................................................ 50
   5.4. Data Collection ............................................................................................ 54
   5.5. Data Analysis ............................................................................................... 58

6. **Summary of papers** ..................................................................................... 61
   6.1. Extended abstract Paper 1 .......................................................................... 62
   6.2. Extended abstract Paper 2 .......................................................................... 63
   6.3. Extended abstract paper 3 .......................................................................... 64
   6.4. Extended abstract Paper 4 .......................................................................... 65

7. **Discussion** ................................................................................................... 67
   7.1. Key Challenges in Orchestrating Emerging Ecosystems ......................... 70
        7.1.1. Attracting Users and Generating Network Effects in Ecosystem Establishment .................................................................................................................. 70
7.1.2. Control and Coordination in Ecosystem Establishment ................. 71
7.1.3. Creating and Capturing Value in Ecosystem Establishment .......... 73
7.2. The Nature of Orchestration in Emerging Digital Ecosystems .............. 74
7.3. Implications for Navigating Challenges in Emerging Ecosystems .......... 80
8. Conclusions ......................................................................................... 84
  8.1. Study Limitations and Suggestions for Future Research ................... 85
9. References ........................................................................................... 87
Abstract

Digital platforms are affecting most contemporary organizations as they mediate an increasing range and number of interactions in their ecosystems. While the discourse on digital platform ecosystems has gained in interest over the years, it often revolves around dominant global firms and how they utilize their control over governance and architecture configurations to exercise power in shaping trajectories. This dissertation seeks to provide insights into the processes through which new digital platforms ecosystems are established by identifying challenges in orchestrating emerging digital ecosystems and approaches through which these can be navigated. To this end, my research focused on the establishment of an open data platform in the public transport industry in Sweden.

My theoretical and empirical investigation provides three contributions to our understanding of orchestration of emerging digital ecosystems. The first contribution is the identification of key challenges in orchestrating an emerging ecosystem through a review of extant literature. The review suggests that challenges in orchestrating emerging ecosystems revolve around three goals: (1) attracting and generating network effects; (2) control and coordination; and (3) creating and capturing value. Thus, whether ecosystem establishment is successful or not depends in large part on how providers are able to address these challenges. The identification of challenges and remedies could be helpful for practitioners and scholars when assessing and diagnosing emerging ecosystems. However, I suggest that the different challenges and proposed solutions should not be treated as fixed and isolated guidelines in assessing ecosystems. Instead, providers should consider the challenges holistically in their ecosystem since there are interplays and interactions between their underlying socio-technical aspects. The second contribution is a conceptualization of the nature of orchestration in emerging digital ecosystems. I demonstrate that orchestration in an emerging ecosystem is inherently embroiled in a web of fragile power relationships among
actors, unbounded participation, unbounded control, emergent outcomes, and persistent competing concerns. The third contribution of my thesis is the practical implications for how providers can approach orchestration and address challenges in emerging digital ecosystems. The fragile nature of emerging ecosystems suggests that orchestration is not limited to arm’s length measures but also stands to benefit from social interactions and relationship-building among actors with distinctive interests and understanding of their own rights.

Keywords: Digital platform ecosystem, platform establishment, emerging ecosystems, orchestrating, control, coordination, generating network effects, creating value, capturing value, attracting users
Acknowledgements

I want to express my appreciation for the work of my supervisors – Johan Sandberg, Henrik Wimelius, and Jonny Holmstrom. I lack words to express my sincere gratitude to you Johan for the patience and continuous support you showed to me even in my moments of deep confusion and doubts. Thanks so much. Johan, the discussions with you and the constructive feedback you provided contributed much to shaping my ideas; our exchanges have continued to help me develop as a researcher. Thank you for the patience and kindness you showed to me throughout my studies, especially in the beginning when I felt so much insecure on my progress but trying to keep it within. Many thanks to Henrik for the encouragement you gave me during your time as supervisor for my master thesis. Most of what I can do today goes back to that courage and interest you showed in my work even when I just looked confused and lacked confidence. To Jonny, I want to say thank you. I remember the first meeting I approached you after a lecture and looking quite shy to ask about having a meeting in your office to talk about my interest in research work. Thanks, so much Jonny for every opportunity you provided to me afterwards. Much appreciation also goes to all members of the Swedish Centre for Digital Innovation for the opportunity to be part of the centre. Many thanks equally to the Swedish Research School of Management and Information Technology (MIT) for the financial support and opportunity to be part of the school throughout my studies.

I am equally thankful to Daniel, Katrin, Fredrik, and Patrik for the time you spent reading through the initial draft and providing constructive feedback during the pre-seminar. To Katrin, thanks a lot for the extra meeting in my office to discuss the pre-seminar draft of thesis and suggestions for improvements. To Patrik, thank you for the outings we had. They were good for distracting the mind and refocusing on the thesis. To Ted, thank you for your support and tips as I put together the thesis. To Ulrika, thanks so much for the inspirational discussions: they might have been short, but they
were inspiring, providing me with a sense of perspective to think of the positive aspects of every challenge throughout the PhD process. Lars, your critical thoughts have been very useful in encouraging me to take away paradoxes as the initial lens of the thesis! Taline, I want to thank you so much for your thoughts and advice on many issues. Thank you Åke, for your support and swift feedback on technical aspects that helped in my studies. To all my colleagues at the Informatics Department, I want to sincerely thank you for your support during my studies and the opportunities your all provided to me. I wish I could mention you all, but from the bottom of my heart I want to say thank you to the department of Informatics. Your support throughout my studies has been invaluable.

This thesis would not have been possible without the help I received from the management of Trafiklab and Samtrafiken. I want to use this opportunity to say thank you so much to Elias at Trafiklab for giving me the opportunity to spend time at the offices throughout my studies. Many thanks to Kenneth for guiding me throughout my stay at Trafiklab and in preparation for the hackathons. I want to thank all the personnel at Trafiklab and Samtrafiken. Your kindness and support during my visits at Trafiklab and Samtrafiken have contributed much to the completion of this thesis.

Many thanks to my siblings and parents for the encouragement throughout my studies. To the Ofe’s and Ofeh’s families, I want to say thanks for every support you provided throughout my studies. Special thanks to my Dads David and Moses. To my mums; Elizabeth, Diana and Susan, you remain special in my heart and will always be. Thank you.

To Emma, I want to thank you so much for your kindness and help throughout my studies. I want to appreciate the help and support you showed throughout my studies in your care and support for Marvin. This thesis would not have been completed without your help and support. Thank you so much.
1. Introduction

1.1. Research Motivation

Digital platform ecosystems are affecting most contemporary organizations. Most can, for example, leverage peripheral actors in innovation processes by enabling them to combine and recombine data across different use contexts (Yoo et al. 2010; Lusch and Nambisan 2015; Henfridsson et al. 2018). Generally speaking, platforms are "evolving organizations or meta-organizations that: (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 technological architecture that is modular and composed of a core and a periphery" (Gawer 2014, p. 1240). Federation signifies a high degree of autonomy of actors and decision-making in an ecosystem. Coordination, on the other hand, recognizes the need for synergies in organizing the activities of distinct actors since decision-making pertaining to issues in an ecosystem is held among few or multiple actors. In terms of scope, platforms can range from those which are internal to the firm to those which are completely open toward external actors (Gawer 2014; Thomas et al. 2014). Lately, platforms with varying degrees of openness have spurred the emergence of a range of ecosystems, leading scholars to argue that we are witnessing new organizational forms and even the inversion of organizations (Parker et al. 2017).

Digital platforms mediate an increasing range and number of interactions and often blur organizational boundaries (Santos and Eisenhardt 2005; Nambisan 2016; Nambisan et al. 2017). As digital platforms become pervasive, some scholars suggest that platforms are fueling a regulatory conundrum surrounding the sharing economy through dissolving the distinction between activities ("organizing as a process") and legal boundaries ("organization as an entity") (Acquier 2018, p. 19). The socio-political context of organizing in digital platform ecosystems is made additionally
complex and interesting, since the digitality of resources upon which organizations organize and seek to influence the ecosystem may result in unpredictable changes. For example, participating in an ecosystem invariably spurs a reshaping of organizational identity since it involves adapting and collaborating with actors with distinct identities (Lindgren et al. 2015). Another source of boundary blurring is distributed agency, since digital technologies often enable actors in the ecosystem to exercise influence by modifying them (Eaton et al. 2015).

Digitalization, i.e. the “sociotechnical process of applying digitizing techniques to broader social and institutional contexts” (Tilson et al. 2010, p. 749), is a key driver of transitions toward active participation in a digital platform ecosystem (Von Hippel 2005) as it changes interaction rules, design control, and the complexity organizations need to cope with (Sandberg et al. 2020). Thus, it pushes existing internally centered organizational arrangements toward involving external value creation among loosely coupled actors (Nambisan et al. 2017; Parker et al. 2017; Yoo et al. 2012). For example, the open-ended value landscape of digital resources (Henfridsson et al. 2018) enabled by reprogrammability, implies that many organizations will increasingly rely on resources spread out across many different organizations (Yoo et al. 2010; Yoo et al. 2012; Nambisan 2016). For externally oriented digital platforms, value arises from, and is dependent on, coordination and federation of loosely coupled actors in ecosystems leveraging shared resources (Iansiti and Levien 2004). Since actors in these ecosystems can innovate and compete, and are not necessarily guided by a common understanding and objective(s), previous studies have emphasized that managing ecosystems is a challenging task (Wareham et al. 2014; Eaton et al. 2015).

While the discourse on digital platform ecosystems has gained in interest over the years, it often revolves around dominant global firms and how they utilize their control over governance and architecture configurations to exercise power in shaping
interactions and innovation. For example, “Don’t be evil”, the motto that was used by Google, suggests a substantial capacity to introduce and implement measures to steer developments in the ecosystem in ways that are not necessarily approved by, or desirable for other actors. However, most digital platform providers do not hold power positions like Google, nor are the specifics of their context (e.g. size, resources, industry) similar. Studies of digital platforms have largely focused on incumbents (see e.g. Gawer and Cusumano 2008; Ghazawneh and Henfridsson 2013; Selander et al. 2013; Eaton et al. 2015; Oh et al. 2015). One effect of this is that less attention has been paid to the early life of digital platform ecosystems (de Reuver et al. 2018) and the dynamics associated with orchestrating immature platform ecosystems.

In general, platform providers seek to orchestrate the ecosystem through architecture and governance configurations. In brief, ecosystem-wide governance refers to “standards that uniformly apply for all complementors and that express how things should be done in the ecosystem” (Huber et al. 2017, p. 564). Architecture, on the other hand, refers to “a conceptual blueprint that describes components of a technology solution, what they do and how they interact” (Tiwana 2014, p. 25). The extant literature generally depicts ecosystem orchestration as hinged on the configuration of at least one or both aspects (Ghazawneh and Henfridsson 2013; Tiwana 2014; Eaton et al. 2015; Boudreau 2017; Saadatmand et al. 2019). Although research on platforms provides insights on the influence of architectural and governance configurations, most studies have predominantly focused on incumbent and mature platform ecosystems. As a result, this body of literature provides limited insights into the effects of platform configurations on ecosystem evolution in the early stages of their life cycle (de Reuver et al. 2018). Furthermore, the literature often assumes a hierarchical relationship in which platform providers exercise substantial power over independent complementors based on their control of access over essential resources (Eaton et al. 2015). For example, Apple’s attractive user-base, coupled with its influence
over its app store ecosystem and iPhone device (Eaton et al. 2015), allows it to exclude apps deemed undesirable in its ecosystem (Ghazawneh 2012; Ghazawneh and Henfridsson 2013; Eaton et al. 2015). Such control points (Pagani 2013) afford incumbents the power to shape the development of their ecosystems since they can prescribe rules and enforce procedures that prospective actors must adhere to if they are to participate in the ecosystems. However, most digital platform providers are nowhere near as powerful as Apple or Google when it comes to developing rules and standards that can be applied and enforced across the ecosystem.

In this thesis, I explore the emergence of a new digital ecosystem revolving around the Trafiklab platform providing open data in the Swedish public transport sector. As illustrated by the quote below, the establishment of Trafiklab involved significantly different orchestration challenges compared to the incumbents described in the extant literature:

“We don’t have any leverage or power to act as a standardization body, we only ask what they [actors] want and how they want it to be done. That is the only way we can get the mandate. We do not have the position to say that we will steer it in a certain direction. We need to ask. So, we do not have any mandate to enforce...we cannot push the different actors.” [Business Strategist, Trafiklab, 2015]

Orchestrating Trafiklab’s ecosystem turned out to involve significant challenges around the perceived lack of leverage to enforce control. Trafiklab could do little or nothing by itself as it became heavily dependent on actors in the ecosystem who could shape in substantial ways the direction of the platform and resultant output in the ecosystem. Trafiklab was formed in 2011, initially as a project within the context of the public transport industry in Sweden, to investigate open data. Its aims involved exploring avenues for new digital services while simultaneously addressing the practical challenge posed by external developers
scraping data from the web portals of public transport operators to develop services. These services were not approved, nor quality assured, by public transport organizations (PTOs). Overall, the ambition was that Trafiklab would facilitate digital service innovations from data generated across the diverse context of PTOs by leveraging the skills, resources, and competence of external developers. However, over time, while Trafiklab sought to coordinate the activities of distributed actors, the focus of constituent organizations did not just move beyond the initial focus of coordination with external developers in service development. The drive toward establishing the ecosystem came to be associated with participating organizations reconsidering their commitment as ever-newer concerns and ambiguous needs became important. Such concerns were, for example, related to the quality of services that could be generated from the data, the costs involved, and the socio-political priorities of the different contexts in which the actors operated. More importantly, the role of Trafiklab as a potential lead actor in developing the ecosystem was often questioned. For example, a key organization in the ecosystem exercising control over essential resources had increasingly sought to shift toward creating their own portal to handle external developers’ concerns. Since the development of the ecosystem was tightly connected to Trafiklab’s future, its survival became increasingly dependent on actors upon which it had little leverage.

Trafiklab’s story might seem inconsequential in a landscape dominated by giant incumbents in the likes of Apple, Google, Uber, and Facebook. However, Trafiklab’s story illuminates the vulnerability many organizations and emerging ecosystems grapple with during the fundamental shift in focus from internal resource control toward coordination of distributed resources and actors. This thesis seeks to contribute insights into such shifts in general.
1.2. Problem Statement

Most studies on digital platform ecosystems are grounded on the premise that platform providers hold considerable influence over the actors in the ecosystem. This assumption stems from the nature of the ecosystems typically under investigation, i.e. mature and large-scale digital platform ecosystems. In mature ecosystems, platform providers often possess substantial influence due their control of the infrastructure upon which participants in the ecosystem rely (Eaton et al. 2015). Platform providers in mature ecosystems are normally in control of one or more critical bottlenecks. This control grants the platform provider bargaining power that most often towers above that of the independent suppliers of complementary components (Gawer and Henderson 2007; Boudreau 2017). Since the platform provider holds control over key access points associated with value creation and capture in the ecosystem, they have the so-called “bouncer’s rights” (Strahilevitz 2006). Through the threat of exclusion, they can regulate access to the platform and are thus able to set the rules governing interaction among actors in the ecosystem. Furthermore, due to the position such incumbents hold, they are powerful and thus are deliberately able to orchestrate the ecosystem and its trajectory: they can “craft rules and shape the process of ecosystem development to tie in complements and make complementors abide to them” (Jacobides et al. 2018, p. 2263). A significant advantage with the maturity of platform ecosystems comes with the expansion of their attractive user-base; the power to govern and steer potential outcomes increases and development of the ecosystem is further enhanced. Since the size of the user-base is to a large extent linked to network effects in the ecosystem (Eisenmann et al. 2006; Tiwana 2014), mature ecosystems tend to have accumulated advantages based on their sizeable share of the market and attractiveness of the user-bases, which in turn generates more network effects. Network effects are described as the value of complementary goods and services when the value of a product or service for a specific user is dependent on the number of other users of similar products or
services (Katz and Shapiro, 1985). For example, the value of a telephone depends on the number of other telephones users, while the value of a dating app depends on the number of users of either sex. Growth of the associated ecosystem has been suggested to increase the power of platform providers in terms of shaping rules or erecting barriers for entry (Gawer and Cusumano 2014; Jacobides et al. 2018), and bargaining power in negotiating value appropriation in relation to other actors in the ecosystem (Oh et al. 2015).

Taken together, the extant literature provides significant insights into how providers in incumbent and mature platform ecosystems shape their development. However, most of these insights are useful only after the platform’s ecosystem has been established and overcome challenges during the emerging stages. Furthermore, the emphasis on mature and industry-leading platform ecosystems potentially provides rather narrow insights on ecosystem orchestration for at least two reasons. First, since successful digital platform ecosystems constitute the “exception” rather than a normal case (Hagiu 2014, p. 11), the applicability of findings in these studies is probably limited in relation to other contexts. Second, the findings from the extant literature might simply reinforce existing knowledge on mature platform ecosystems, rather than provide new theoretical insights for emerging ecosystems; many establishment efforts fail (Hagiu 2014, p. 11), probably accounting for the tendency in the literature to focus on more successful cases of platform ecosystem. Taken together, the focus on mature ecosystems has led to a relatively low degree of understanding of emerging digital ecosystems. This is problematic considering the many new opportunities that drive today’s digital economy are increasingly built around digital platforms (Yoo et al. 2010; Nambisan 2016). In addition, digital ecosystems are not only technical artifacts, they are associated with socio-political underpinnings since their influence extends well beyond the formal boundaries of organizations (Santos and Eisenhardt 2005). For example, studies have demonstrated how actors exercise varying
levels of power *vis-à-vis* other actors in the ecosystem (Eaton et al. 2015). It has been argued that such asymmetric relationships among actors plays a substantial role in the demise of many nascent ecosystems (West and Wood 2013).

Thus, although scholars have identified challenges associated with digital platform ecosystems, most have focused on the mature stage of their development; few connective synergies exploring these challenges are made across platform ecosystems research. Comparison is made even more difficult by the multiplicity of perspectives – e.g. multi-sided markets (Hagiu and Rothman 2016; Van Alstyne et al. 2016; McIntyre and Srinivasan 2017), technological (Gawer and Cusumano 2014, Tiwana 2014), and organizational (Gawer 2015, 2014) – related to the discourse on platforms. A resultant outcome is a lack of thorough understanding of digital ecosystems and key challenges in their early life cycle (de Reuver et al. 2018). Against this backdrop of rather patchy knowledge, this thesis explores the following research question:

**What are the challenges in orchestrating emerging digital ecosystems and how can platform providers navigate them?**

Addressing the research question is important for several reasons. First, digital platform ecosystems are increasingly important as a mode of organizing through which many new ventures seek innovation opportunities across multiple industries (Yoo et al. 2012; Tiwana 2014; Nambisan 2016; Parker et al. 2016). With the escalating increase in digitalization, the influence digital platforms exert over many organizing endeavors will extend beyond the boundaries of any single organizational and technical entity (West and Wood 2013; Sandberg et al. 2020). Furthermore, digitalization of physical products is triggering new actors to explore the possibilities of creating new ecosystems. Since digital ecosystems depend on resources controlled and distributed across multiple actors and contexts (Kallinikos et al. 2013), their orchestration is subject to considerable uncertainty (Dattee et al. 2018). The
resulting outcome is an unprecedented level of uncertainty of innovation in ecosystems, requiring a need for a more detailed understanding of their orchestration. Third, a focus on emerging digital platform ecosystems is important considering that platforms, as with many other technologies, are associated with a high degree of path dependencies (David 1994). For platform ecosystems, path dependencies are reinforced by network effects that cause “winner takes all” outcomes. Understanding the orchestration challenges during the formative stages of small-scale ecosystems that involve relatively few actors with limited available resources can provide valuable theoretical insights (Jacobides et al. 2018).
2. Digital Platform Ecosystem Orchestration

This chapter provides essential background on platform ecosystems. Given the multi-faceted views on platform ecosystems in the literature, I first provide a summary of the different conceptualizations of platforms and ecosystems. Second, I outline generating network effects, balancing control and coordination, and triggering value creation and capture as three key goals of digital platform ecosystem orchestration. Third, I explore the life cycle of ecosystems with a focus on the early stages of birth and expansion.

2.1. The Background to Digital Platform Ecosystems

The concept of an ecosystem is widely used in ecological studies, with its early use traced back to the 1930s and the work of A. G. Tansley, a British biologist who used the concept to depict organisms as inseparable parts of their environment. Tansley noted that “there is a constant interchange of the most various kinds within each system, not only between the organism but between the organic and inorganic” (1935, p. 229). Outside of ecology studies, the concept of ecosystems has also been adopted by scholars in the areas of business, innovation, and strategy (e.g. Moore 1993; Adner 2006; Adner and Kapoor 2010). For example, Moore (1996, 1993) suggested that competition among firms and their survival or demise is largely dependent on the business ecosystem in which they operate.

The term “business ecosystem” refers to multiple organizations, innovating, competing, and relying on resources distributed across multiple industries (Moore 1993). Since constitutive organizations in an ecosystem tend to be reliant on resources distributed across multiple actors and contexts, business ecosystems exhibit interdependencies (Iansiti and Levien 2004; Peltoniemi 2006). As pointed out by Iansiti and Levien (2004, p. 1), these
interdependencies affect outcomes for all actors in the ecosystem: “Like an individual species in a biological ecosystem, each member of a business ecosystem ultimately shares the fate of the network as a whole, regardless of that member’s apparent strength”. Drawing on the strategy literature, scholars have construed organizations participating in such business environments as platforms (Ciborra 1996). In contrast to a fairly stable organizational setting where actions are guided by relatively predefined goals, Ciborra (1996) characterized the platform organization as one that entails the shifts of attention toward ensuring flexibility to harness surprises. Ciborra's (1996) main idea was that practitioners and strategists need to consider how to design structures in organizations which favored flexibility over rigidity and surprises over certainty. In this perspective, adaptability is seen as the cornerstone for strategizing in a rapidly changing and volatile environment.

In most information systems (IS) literature, ecosystems are described as tightly linked to technology platforms that are open and can be extended to create value by external actors (Yoo et al. 2012; Gawer and Cusumano 2014; Tiwana 2014; Henfridsson et al. 2018). As illustrated by, for example, special issues on platforms in journals and conferences (see e.g. Schreieck et al. 2016; Constantinides et al. 2018; de Reuver et al. 2018), research on platforms and ecosystems has grown substantially lately with accelerating digitalization. For example Yoo et al. (2012), emphasize the importance of platforms for organizing heterogenous groups of actors, digital components, and shared resources to spur innovation. Constantinides et al. (2018) emphasize the importance of digital infrastructures in dictating new businesses based on platforms. Extensive research across other fields such as strategic management and economics provides further insights into platforms (see e.g. Thomas et al. 2014; McIntyre and Srinivasan 2017).
2.2. Perspectives on Digital Platform Ecosystems

There exist several reviews of the theoretical perspectives of platforms (see e.g. Thomas et al. 2014; McIntyre and Srinivasan 2017). For example, the review by Thomas et al. (2014) categorizes extant platform literature into market intermediary, product, organizational, and platform ecosystem perspectives. McIntyre and Srinivasan (2017) identify the industrial organization, technology management, and strategic management perspectives. The objective of this section is to draw on insights in the existing literature to provide a basis to understand key aspects of orchestration in the context of digital platform ecosystems, rather than seeking to conduct an additional review of platform perspectives. To do so, I focus on three main perspectives – market, organizational, and technology.

The market perspective is rooted in the field of economics (e.g. Rochet and Tirole 2003; Eisenmann et al. 2006; Hagiu and Rothman 2016). Within the market perspective, platform ecosystems are mainly conceptualized as multi-sided mediated markets connecting groups of distinct actors. The platform ecosystem gains its value from the number of actors using the platform and the network effects generated. For example, according to the market perspective a credit card is a type of platform, since it connects different actors (merchants, banks, and users). The value of the card as a platform grows as many banks or merchants enroll to issue the card to users. Thus, the value of the card and its ecosystem (users, merchants, and banks) grows as the card is used or adopted across many use contexts. The card is of more value to users as it enables and facilitates transactions across many use contexts. Taking the case of Uber, for example, it provides different users the ability to book their trips. The value of the company comes from its role in efficiently allocating idle drivers with would-be travelers. Thus, the focus in the market perspective is the mediating role platforms fulfill through facilitating searches and transactions.
The *organizational* and strategy perspective as identified by Thomas et al. (2014), includes multiple definitions of ecosystems, possibly because this conceptualization is focused at the level of a local firm. For example, Teece (2007) broadly conceives of an ecosystem as constituting institutions and the external environment that impacts the firm. Similarly, Iansiti and Levien (2004) refer to ecosystems as “loose networks – of suppliers, distributors, outsourcing firms, makers of related products or services, technology providers, and a host of other organizations – [which] affect, and are affected by, the creation and delivery of a company’s own offerings” (p. 1). The broad view of ecosystems and focus on organizations in this strand of the literature may arguably have grown out of earlier studies such as Moore (1996, 1993) that focused on strategy and competitiveness at the level of firms. The inattention to the role of platforms is also visible in the lack of focus on the specifics of any underlying technologies that support, coordinate, or enable value creation in the ecosystem. Rather, these studies emphasize the interdependence of relations among organizations and how it may affect their market offering. The emphasis on interdependence among actors is also highlighted by conceptualizations suggesting that for ecosystems to create value, a “specific structure of relationships” and alignment are needed (Jacobides et al. 2018, p. 2263).

The *technology perspective* varies as well in definition of platforms and their associated ecosystems. For example, Gawer and Cusumano (2014, p. 417) define industry platforms as “products, services, or technologies that act as a foundation upon which external innovators, organized as an innovative business ecosystem, can develop their own complementary products, technologies, or services”. Successful platforms as per this definition will provide possibilities for external actors constituting the ecosystem to develop complementary products and services. Selander et al. (2013) also highlight this aspect when emphasizing the collective goals in the ecosystem, while also recognizing the individuality of the goals of the actors brought together by the
presence of an underlying technology. Thus, an important insight from this literature is the presence and recognition of technical aspects of platforms as central to supporting value creation in the ecosystem. An important aspect in the technological literature on platform ecosystems is generativity – i.e. a “technology's overall capacity to produce unprompted change driven by large, varied, and uncoordinated audiences” (Zittrain 2006, p. 1980). Since generativity may result in the emergence of unanticipated outcomes beneficial to the ecosystem or outcomes inconsistent with the goals of providers, it is suggested that providers need to simultaneously ensure control and generativity in the ecosystem (Ghazawneh and Henfridsson 2013; Wareham et al. 2014; Eaton et al. 2015). For example, using boundary resources to constrain and grant access to the external actors to regulate control and generativity is a commonly cited mechanism for providers in the ecosystem (Ghazawneh and Henfridsson 2013; Eaton et al. 2015). Thus, technological studies of digital platform ecosystems emphasize both the interdependency between actors and the core technology upon which actors depend for the creation of value.

2.3. Orchestrating Digital Platform Ecosystems

As is evident across the various perspectives of platform ecosystem research, scholars vary in their definitions of platforms and ecosystems. However, most conceptualizations in one way or another indicate a meaningful analysis of digital platform ecosystems is likely to be incomplete without reflecting its multifaceted nature as related to the market, organizational, and technological perspectives. In this thesis, platforms are considered as “evolving organizations or meta-organizations that: (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 technological architecture that is modular and composed of a core and a periphery” (Gawer 2014, p. 1240). In adopting such a definition, I recognize that while digital platforms may vary in their underlying
architecture, inherently they remain organizing vehicles through which actors in an ecosystem seek to channel and materialize their goals. Such a framing signifies that to understand orchestration one must look beyond the technology as an end-in-itself and focus on the overarching goals of ecosystems. I use orchestration in this thesis as an action or series of actions aimed at addressing three goals: control and coordination; creating and capturing value; and generating network effects. These aspects – discussed in detail below – are closely linked since they build upon the underlying technological architecture and governance of the platforms.

2.3.1. Attracting Users and Generating Network Effects
A key aspect of orchestrating a digital platform ecosystem is attracting users and triggering network effects. These goals are closely linked; both build from the multi-sidedness of platforms where distinct groups, e.g. producers/consumers (demand/supply), need to be present for a platform to be considered valuable. Thus, attracting and generating network effects alludes to the viability of the ecosystem and its value as dependent on the number of actors in it, something which is emphasized in the market perspectives of platforms. Network effects can be two-sided/cross-sided or one-sided/same-sided (Katz and Shapiro, 1985). Same-side network effects arise as an increase of users of the same type spurs further users to enroll on the platform. For example, the more people using Facebook as a means of disseminating information, the more likely you will be enticed to join Facebook to reach out to a wide audience of friends. In contrast, cross-side network effects refer to a situation where the value each side enjoys from the platform increases with more users on the other side (Rochet and Tirole 2003; Eisenmann et al. 2006; Hagiu and Rothman 2016). For example, the more employers that use LinkedIn for job postings, the greater are the available options for job seekers using the platform. But this also means that employers can have a larger pool of job seekers to choose from by using LinkedIn, causing reinforcing cycles of network effects. Since
Platforms generally aim to bring on board different user groups, a central concern in platform ecosystem orchestration is the generation of network effects that benefit both sides of the platform. So because the platform’s value arises from the participation of multiple groups of users, attracting or courting distinct groups of users is generally a key component to trigger network effects (Eisenmann et al. 2006; Evans and Schmalensee 2010; Hagiu and Rothman 2016; Van Alstyne et al. 2016).

2.3.2. Control and Coordination

Control and coordination as orchestrating goals in platforms arise from the peculiarities of platform ecosystems as consisting of actors with a high degree of autonomy and decision-making potential. Control in the context of digital platform ecosystems refers to encouraging and ensuring “desirable behaviors” (Tiwana et al. 2010, p. 680). Instigating control involves both the use of formal and informal mechanisms. Formal control seeks to encourage desirable behavior through rules and standards which actors are expected to follow in the ecosystem (Tiwana 2014). Rules, for example, may describe prespecified conditions or criteria for admittance (gatekeeping) into the ecosystem (Tiwana 2014). Formal control may also include regulations specifying how the performance of actors, or output, is evaluated or rewarded/penalized (Tiwana et al. 2010). For example, rules and procedures to guide actors in ensuring desirable processes in value creation activities can be fostered through developer’s toolkits, an appropriate environment for testing (Tiwana 2014), and templates (Wareham et al. 2014). Such rules can also stipulate restrictions on contents (Ghazawneh and Henfridsson 2013). In most cases, formal control through rules aims to sustain an arm’s length relationship between platform providers and actors in the ecosystem. However, strictly viewing governance in terms of an arm’s length relationship between platform providers and actors has been described as relatively limited, since actors and their context-specific needs vary (Huber et al. 2017). In seeking to create desirable behavior in
ecosystems, orchestrators can draw on informal control based on the use of norms to influence and encourage desirable behaviour. Such governance typically aims to leverage the context-specific needs and values of the ecosystem. Examples include building common frames of understanding, collective goals, and a distinct identity for the ecosystem (Tiwana 2014). Building such mutual goals and an identity in an ecosystem may arguably be important since actors will inevitably vary in their composition and worldview and understanding (Lusch and Nambisan 2015). Given its reliance on measures such as rules, standards, and values, which are mostly social in nature, encouraging desirable behavior control in the ecosystem is described as broadly aimed at addressing behavioral complexity (Tiwana 2014).

Coordinating in digital platform ecosystems on the other hand, recognizes the need for synergies in organizing the activities of distinct actors, since decision-making pertaining to issues in the ecosystem is held among few or multiple actors rather than structured in the form of a principal and an agent (Tiwana 2014; Gawer 2014). Modularity refers “to the degree to which changes within a subsystem do not create a ripple effect in the behavior of other parts of the ecosystem” (Tiwana et al. 2010, p. 678). In platform ecosystems, modularity is suggested as essential to foster coordination and is achieved through partitioning technology into core platform components that are kept relatively fixed, while peripheral components are allowed to vary (Baldwin and Woodard 2009). Core components may constitute functionalities that are interoperable across the wider ecosystem and are kept relatively fixed to enhance reusability. The peripheral components are loosely coupled to encourage diversity of outcomes in the ecosystem. Besides enabling actors to independently specialize in distinct tasks in the ecosystem, modularity of platform architecture reduces coordination cost, since actors simply need to comply with design rules to ensure interoperability and coordination (Tiwana 2015).
Platform architecture is essentially the “conceptual blueprint that describes how the ecosystem is partitioned into a relatively stable platform and a complementary set of modules that are encouraged to vary, and the design rules binding both ” (Tiwana et al. 2010, p. 677). Tiwana et al. (2010) suggest that platform ecosystem architecture can be examined along the lines of three properties – decomposition, modularity, and design rules. Decomposition entails breaking down components of the ecosystem into subsystems (e.g. platform core and apps) to minimize interdependence. Since a vital aspect of platform ecosystems is value creation among actors varying in the specifics of their needs and operating context, decomposition seeks to reduce interdependencies in the ecosystem. The primary function of the platform’s architecture is to ensure coordination and integration (Tiwana 2014).

2.3.3. Creating and Capturing Value
Creating and capturing value is a generally recognized goal of orchestration as innovation shifts toward involving multiple actors and networks (Nambisan and Sawhney 2011). Across the extant literature value creation is described as subjective since the platform enables possibilities for different uses. In digital ecosystems, value creation and capture is linked to the architecture of platforms and interdependencies (Adner and Kapoor 2010). Actors create value by leveraging the underlying technologies of the platform to extend or create new services (Gawer and Cusumano 2014). For example, an external developer developing a service or an application may leverage resources such as source codes or application programming interfaces (APIs) provided by the platform to extend the functionalities of an existing application or create wholly new ones. A platform’s architecture is considered as an essential in this regard since it enables prospective actors engaging in the ecosystem to operate as independent actors while being able to piece together their work (Tiwana 2014). The platform architecture facilitates integrating task and interdependencies
among constitutive agents (Tiwana 2014). In the context of digital platform ecosystems, appropriate architecture is essential as it enables coordination of the work of autonomous actors by encompassing arrangements and rules governing exchange among the actors (Jacobides et al. 2006). The architecture generally provides the basis for how actors interact, i.e. “the contours for action”, and by extension rules and interfaces (e.g. technical, institutional, or social artifacts) that enable and constrain actions (Jacobides et al. 2006, p. 1203).

2.4. Digital Ecosystem Life Cycle

In what follows, I describe the life cycle of an ecosystem. Life cycle perspectives on how organizations evolve broadly assume change and development over time to follow a progression of stages involving distinct development activities (Van de Ven and Poole 1995). Distinct developmental activities explain the trajectory of an entity in terms of a historical sequence of events, what Gennep (1960) refers to as “rites of passage”. For example, the gradual transition of a new-born child to an adolescent, and from adolescence to attainment of adulthood – these are distinct stages of an individual’s development.

The life cycle of an ecosystem can be described in many ways. Tiwana (2014, p. 24) describes the life cycle of a platform or its entire ecosystem as including, but not limited to, its “progression along a technology maturity curve, penetration among prospective end-users”. Tiwana (2014) further suggests that the maturity of a platform ecosystem could be evaluated based on its progression from an initial phase of introduction, its ascent, maturity, and decline. Moore (1993) describes the evolutionary life cycle of an ecosystem as following an s-curve with four main stages – birth, expansion, leadership, and self-renewal. Although Moore’s description takes a business ecosystem perspective (i.e. the focus is on competition and strategy), it is aligned with related studies that adopt a more technological interest in platform ecosystems. I adopt
Moore’s (1993) description of birth, expansion, leadership, and self-renewal stages. The birth stage is described by Moore (1993) as mainly involving “defining what customers want, that is, the value of a proposed new product or service and the best form for delivering it” (p. 76). Expansion focuses on coordinating with actors to extend the new value proposition and the quest for dominance in the ecosystem. The leadership stage constitutes a mature ecosystem with an underlying set of actors who share a clear vision, business model, and understanding of how the ecosystem evolves. At this stage the ecosystem has largely developed beyond the uncertainties in value propositions and vulnerabilities in the birth and expansion stage. The self-renewal stage focuses on redefining and bringing new ideas into the existing ecosystem (Moore 1993).

I view emerging ecosystems as related to the early development stages of birth and expansion and characterized by a high level of ambiguity on the value proposition of the platform. Emerging ecosystems normally involve a high degree of uncertainty. For example, their value propositions often remain ambiguous, requiring trial-and-error and experimentation (Moore 1993; Tiwana 2015). Furthermore, because of the uncertainty during the birth stage of an ecosystem, Moore argues that it is often undermined by alternative value propositions.

The literature is often silent on the specifics associated with the orchestration of emerging platform ecosystems. However, some notable exceptions can be found. Evans and Schmalensee (2010), for example, provide a general model pointing to customer taste, customer behavior, and the nature of network effects as crucial in attracting a critical mass of platform users. Evans (2009) suggests a range of specific strategic approaches such as focusing on one side of the platform, acquiring influential actors to enroll on the platform, building incremental participation on both sides of a platform, etc. Gawer and Cusumano (2012), in contrast, recommend establishing a core product or service to entice multiple
actors. Besides the overwhelming focus on exogenous factors in cultivating the ecosystem, most studies are mainly snapshots that do not capture the dynamics and interplay associated with orchestrating emerging digital ecosystems over time.

The lack of thorough understanding surrounding emerging digital platform ecosystems has intrigued some scholars, who broadly question whether platform ecosystems emerge as an evolutionary outcome of products or services, or as the end result of a conscious design (de Reuver et al. 2018). I posit that whether construed as an evolutionary outcome of products/services inheriting characteristics of digital technologies, or/and indigenously designed, platform research stands to benefit from examining emerging ecosystems for two simple reasons. First, many efforts surrounding the development of digital platform ecosystems fail relatively early in their life cycle (Hagiu 2014) due to, for example, lack of critical mass (Evans and Schmalensee 2010). Furthermore, since unclimbable hurdles may be created in the early stages in the development of a technology due to path dependencies (David 1994; Klofsten 1994; Andersson 2016), emerging platform ecosystems provide a useful context to proactively identify and address challenges that can affect ecosystems as they evolve to maturity.
This literature review examines publications that (1) address digital platform ecosystems and (2) offer explicit or implicit insights on their establishment. The scope of the literature search was intentionally broadened beyond the AIS basket of eight journals, the motivation being that central publications on platforms (e.g. Gawer, 2002, 2014) are published in journals not included in the the AIS basket. Secondly, it has been suggested that literature reviews on IS topics should look to other disciplines given that IS is a field which itself draws across other disciplines (Webster and Watson 2002). I used 1993 as a baseline for the literature search since one of the earliest conceptualizations I found describing an ecosystem in the business context of organizations was published in that year (Moore 1993). I searched for platform* AND ecosystem* in EBSCOHost/Business Source Premier, and Web of Science: Core Collection. The search resulted in 683 articles (450 articles from EBSCOHost/Business Source Premier, and 233 from Web of Science: Core Collection). Of the 683 articles, 155 duplicates were removed, leaving 528 papers. I briefly read the abstracts of the articles and excluded a total of 240 as off-topic (see Figure 1), thus leaving 288 articles. Articles that mainly used platform and/or ecosystems as a catchword in the abstracts or keywords without it being a central concern were also excluded. Based on this, 73 papers were excluded, leaving 215 articles. Subsequently, I followed Gawer’s (2014) notion of the “industry platform” (i.e. a platform ecosystem) as one open to external actors and not limited to the

1 EBSCO: Find all my search terms - platform* AND ecosystem*
internal working of a firm. Thus, articles mainly discussing platforms focusing on use internally (e.g. production line) were excluded. 85 articles were excluded, leaving 130 articles. In the final step, I excluded articles that did not meet criteria 1 and 2. This process resulted in 64 papers. Since AIS conference papers are not indexed in Web of Science, I went through the ICIS, AMCIS, HICSS, and ECIS proceedings. Using criteria 1 and 2, an additional 14 papers were added to the sample, making a final total of 78 papers.

<table>
<thead>
<tr>
<th>Total number of articles in initial search</th>
<th>Duplicates excluded</th>
<th>240 articles considered as off-topic, i.e. not related to Mgt, business, information science library or computer science information systems as follows</th>
</tr>
</thead>
<tbody>
<tr>
<td>683</td>
<td>155</td>
<td>39-regional development</td>
</tr>
<tr>
<td></td>
<td></td>
<td>71-biodiversity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>43-climate change</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21-antitrust law</td>
</tr>
<tr>
<td></td>
<td></td>
<td>41-energy policy/planning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12-costal management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18-environment/oil drilling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>26-regional development</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10-academic publishing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7-others</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>85 articles not addressing platform ecosystems</th>
<th>64 articles were excluded that do not focus on the early stages of the platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-product development methods</td>
<td>78 papers for review i.e. 64 journal papers 14 conference papers</td>
</tr>
<tr>
<td>12-supply chain</td>
<td></td>
</tr>
<tr>
<td>2-autonomous systems</td>
<td></td>
</tr>
<tr>
<td>7-culture and trust</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1: Process for excluding articles

3.1. Descriptive Analysis of the Literature
This section provides a descriptive analysis of the literature. I relied on Vosviewer (Van Eck and Waltman 2010), software used for bibliometric data analysis. Based on an examination of recurrent keywords and concepts used across the selected articles as shown in Figure 2, the literature can be assigned distinctive labels and builds from key authors as seen in Figure 3. The categories of reviewed literature described in this section are inductively generated but bear remarkable similarity with those found in other literature reviews (e.g. Thomas et al. 2014). The red cluster shown in Figure 2...
represents two-sided markets, multi-sided markets, indirect network effects, platform competition, and platform ecosystems. These concepts align with the market perspective on platforms which generally emphasizes networks as critical for the establishment of platform ecosystems (e.g. Eisenmann et al. 2006; Evans and Schmalensee 2010; Hagiu and Rothman 2016; Van Alstyne et al. 2016). In this strand of the literature, platforms are seen as multi-sided/two-sided markets, facilitating transactions between distinct groups and actors (e.g. producers and consumers) on both sides of the platform.

Figure 2: Distribution of platform perspectives based on key subject domains and focus
The green clusters in Figure 2 represent the organizational stream of platform ecosystems, which mostly treats platforms as a set of capabilities and resources leveraged for value creation. The emphasis on capabilities reflects the roots of this perspective in the resource-based view focused on the role of dynamic capability (Helfat and Peteraf 2003; Helfat et al. 2007; Teece 2007), as seen in the blue clusters in Figure 3. The technology stream of platforms constitutes the bulk of the reviewed literature (79%, n=59). It draws on aspects from across the other perspectives of platform literature; however, some particular elements of this literature (e.g. Gawer and Cusumano 2008; Gawer 2009; Gawer and Cusumano 2014) provides an essential orientation for this stream. Although the technology perspective shares key aspects (e.g. value creation) with other perspectives of platform research, it has a distinct (as shown in the green cluster in Figure 3), and greater degree of focus on innovation, value co-creation, and services (Iansiti and Levien 2004; Vargo and Akaka 2012; Lusch and Nambisan 2015). Herein, the platform serves to support such value creation and complementary innovation (Gawer 2009). The ecosystem is
constituted by modules, third-party developers, and organizations reliant on services that are interoperable with the platform (Tiwana 2014). Although the contexts of the studies informing this conceptualization vary, most build on the technology sector and in particular the telecommunication and e-commerce sectors, e.g. Intel (Cusumano and Gawer 2002; Rong et al. 2013), Cisco (Li 2009), or Amazon (Dalle et al. 2017).

3.2. Challenges in Establishing Digital Platform Ecosystems

This section of the thesis summarizes the core challenges in orchestrating emerging digital platform ecosystems. In describing the challenges, I also discuss suggestions from the literature on how to handle them. The challenges are categorized along the key orchestrating goals outlined in the previous section: attracting users and generating network effects; control and coordination; and creating and capturing value. Although these challenges are broad, they all relate to the socio-technical underpinnings of governance and architecture as the two main vehicles for success in establishing a digital platform ecosystem. Salient challenges and suggested solutions to address the challenges are summarized in Table 1.

3.2.1. Attracting and Generating Network Effects

Generating network effects is a prominent concern among many studies that view ecosystem establishment mainly in terms of courting a critical mass of actors on both sides of a platform (Evans 2009; Evans and Schmalensee 2010; Van Alstyne and Parker 2017). A critical mass of users is described in terms of the number of users deemed essential to ignite and sustain growth (Evans 2009; Evans and Schmalensee 2010). An issue often discussed in association with attracting a critical mass is overcoming the “chicken-or-egg” dilemma (Caillaud and Julien 2003). This depicts the general situation where each side of a platform ecosystem expects other users to enroll before doing so themselves. Digital ecosystems in their birth stage generally lack a defined value proposition and thus
the challenge of achieving a critical mass for network effects is particularly salient (Evans 2009; Evans and Schmalensee 2010). Besides the challenge of achieving critical mass for network effects, it has been found that without it new platform ecosystems are likely to decline rapidly, owing to their novelty and lack of name recognition (Inoue and Tsujimoto 2018). Lack of recognition plays out negatively for new platform providers as complementors perceive a higher risk of not having a market for their products or services (Inoue and Tsujimoto 2018). Accordingly, coordination of distinct groups of actors who must each perceive the platform to be valuable hinges on the credibility of platform providers. A lack of credibility on the part of new providers may also lead to a higher risk of exits from the ecosystem (Chen et al. 2017).

Inquiries into solutions for building a critical mass to generate network effects emphasize incentivizing users through pricing subsidies (Eisenmann et al. 2006; Evans and Schmalensee 2010; Hagiu and Rothman 2016; Van Alstyne et al. 2016). Subsidizing through pricing involves providing access to one or both groups of users at little or no cost. For example, digital platform ecosystems based around searching as their core value (e.g. Google) are likely to opt to subsidize users to engage in searches while charging advertisers for displaying content on their platform (Evans 2009). Suggestions regarding which side of the platform to subsidize varies across studies and contexts. A recurring theme is, however, that subsidies are often directed to user groups in the ecosystem that are perceived to benefit less from the platform (Evans 2009). Other strategies include eliminating constraints for participation (Hagiu and Spulber 2013), enrolling influential actors to attract users and to gain legitimacy (Gulati et al. 2012), increasing in-house complements, and encouraging the enrolment of external actors (Cennamo 2018).

Besides increasing the size of the user-base to achieve critical mass, other studies suggest considering the heterogeneity of use and the context in which platforms are situated (Hanseth and Aanestad
For example, Hanseth and Aanestad (2003) in a study based on the health care industry argue that the critical need to pay attention to users (patients in this case) results in a situation where an increase in the number of users in the early stages of platform ecosystem development does not necessarily benefit all users. They suggest that for critical emergency use situations (such as health care), gradual growth framed as ‘bootstrapping’ may be useful to scale platforms rather than rapid growth (Hanseth and Aanestad 2003). The term bootstrapping refers to endogenous-driven growth with limited resources and without much external support. Kim (2018) finds that core users' activities (e.g. uploading content and comment activities) are important for increasing the user-base of the platform and network effects. Other suggestions include facilitating interactions of core users (Chen et al. 2017), investing in initial content of a platform (Hagiu and Spulber 2013), and considering the composition of the installed base and dynamics in related industries (Rietveld and Eggers 2018).

Another group of studies, while not directly pointing to network effects, suggests the need to pay specific attention to the role of digital technologies in increasing the user-base of emerging ecosystems. Providers can, it has been suggested, leverage data generated on a platform to enable operations or quickly respond to users that help to scale platform ecosystems (Huang et al. 2017). So-called data-driven operations refer to leveraging data generated from the interaction of users on the platform to refine and reframe potential offerings. The establishment of an ecosystem is not confined to a homogenous group of actors, and as such it has also been suggested that providers pay attention to identifying and forging strategic partnerships with stakeholders in the ecosystem. For example, in studying the development of an ecosystem Jha et al. (2016) found partnership with different actors to be essential in building the user-base of the platform. Parida et al. (2019) emphasis the importance of paying attention to external trends, and business opportunities in the ecosystem as important consideration as orchestrators engage with actors and partners in an ecosystem.
3.2.2. **Control and Coordination**

Digital ecosystem establishment goes far beyond simply attracting users to generate network effects. It entails changes and alterations of relationships across multiple actors and organizations in the ecosystem (Hu et al. 2016). Cusumano and Gawer (2002) identify the development of structures for managing conflicts and relationships with external complementors as a key consideration. It is argued that relationships and strategic partnerships at the birth stage of the ecosystem help to reveal risk and the specific needs of different actors in the ecosystem (Jha et al. 2016).

A distinct aspect of digital platform ecosystems is that they transcend boundaries of multiple organizations, thus requiring providers to adapt to multiple collaborations. In adjusting to new relationships during ecosystem establishment, organizations adopt new roles – “characteristic behaviors enacted by entities (or actors)” as the ecosystem evolves (Dedehayir et al. 2016, p. 4). This adaptation is observed to require changes in structural organization and relationships. As noted by Lindgren et al. (2015) this may result in organizations facing two conflicting identities as they seek to adjust to new relationships and collaborations while maintaining their inherent identity. It is therefore said that as ecosystems evolve from birth to expansion they are vulnerable to ambiguity in their identity as expansion involves engaging with a diversity of ideas and new actors with divergent views (Tan et al. 2015). Furthermore, West and Wood (2013) observed that asymmetries in relationships among actors in an ecosystem can contribute to its demise since strategic goals among partners and values may differ considerably, resulting in damaging and distracting conflicts as the ecosystem evolves. The development of common and standardized structures to manage conflicts is also challenged by philosophical differences prevalent among actors at the birth stage of an ecosystem; this can result in a lack of unified focus in the ecosystem (Hu et al. 2016).

The literature suggests different measures for how providers can address conflicting goals and values in the ecosystem. To promote
a collective identity and relations with external actors, Tan et al. (2015) suggest delegating authority and self-organizing. Cusumano and Gawer (2002) advocate maintaining firm leadership over complementors to provide a coherent vision for the ecosystem. Attour and Barbaroux (2016), in their study on the development of an ecosystem, found providers to rely on negotiations as the basis of governance, rather than ceding control to a dominant actor. It is argued that collaboration between different actors is essential to encourage interaction, exploration of ideas, and the promotion of compromise in defining the value of the platform (Attour and Barbaroux 2016; Banoun et al. 2016). For example, van de Kaa and de Bruijn (2015) emphasize governance as building on consensus: they found organizations involved in the development of platform ecosystems were allocated voting rights and offered other incentives for compromise.

Since ecosystems comprise actors with varying degrees of influence, it is also suggested that coordination led by firms with social influence can guide other actors in the ecosystem (Davis 2013). For example, as recorded by Breznitz et al. (2018) in a study involving entrepreneurs in new platform development, entrepreneurs backed by venture capitalists (VCs) had a 7.3% probability of building a new platform as opposed to the 6.8% probability for entrepreneurs without support from VCs. They attribute these differences to the coordination, experience, and legitimacy role of VCs in providing assurance to potential actors regarding the viability of the ecosystem. Managing relationships with external actors during the establishment of platform ecosystems is also argued to be important since ongoing interaction among actors is important to entice other actors to the ecosystem (Saarikko et al. 2019). In the next section, I address challenges to value creation and capture associated with the establishment of the digital ecosystem, and discuss some of the insights gleaned from the extant literature.
3.2.3. Creating and Capturing Value

The establishment of a digital platform ecosystem entails providing a core platform offering essential services for multiple actors (Gawer and Cusumano 2008). A core offering may be an unmet need related to a business or a technology problem for an identified group of actors. However, in making sense of prospective value offers in ecosystems, actors tend to ensure changes required in advancing the ecosystem are aligned with their own interests (Hu et al. 2016). As digital platform ecosystems evolve, it is also argued that value is a largely temporary phenomenon, requiring orchestrators to continuously shift configurations and descriptions of value in relation to the relevance of actors, context (Saarikko 2016), and uncertainty (Dattée et al. 2018). The temporary nature of value in platform ecosystems arises from shifting control points (interfaces) and variation among the actors generating relatively unpredictable future benefits (Hein et al. 2016).

Finally, platform providers need to address short-term viability and long-term market relevance (Saarikko et al. 2019). Short-term viability arises from the need to engage in exploitation to generate outcomes that address the current needs of actors in the ecosystem. However, ecosystems evolve, and for platforms to remain relevant providers equally need to position themselves to address long-term needs by exploring new avenues for services. Furthermore, since the mere potential of a value that is compelling to multiple actors does not necessarily translate to operationalization, it is suggested that ecosystem establishment also entails the development of IS capabilities (Tan et al. 2015). IS capabilities are discussed as enabling platform providers to define value and gain market relevance across different stages of the ecosystem (Tan et al. 2015). For example, the focus on capabilities is reflected in the birth stage of the ecosystem with an emphasis on sensing capabilities, while seizing and transformative capabilities are relevant in the expansion stage (Teece 2017). Sensing capabilities is relevant at the birth of the platform to enable searching for and testing of plausible alternatives. Searching and testing are geared toward narrowing the
search space of potential value propositions in the external environment. Seizing and transformative capabilities aim to position platform providers to enable execution and adaptation to new opportunities in the expansion stages (Teece 2017).

Prior research points to the tension between openness and control as central to the establishment of an ecosystem. Openness in the context of digital platform ecosystems is a generally wide term. However, in the literature it is generally described in terms of two aspects – the access granted to external actors (e.g. developers) and/or the control relinquished to actors to contribute to the development and commercialization of the platform (Eisenmann et al. 2009; Boudreau 2010; Benlian et al. 2015). Access to stimulate innovation and value creation in the ecosystem is encouraged through use of interfaces to engage external actors in complementary innovation, while relinquishing control seeks to foster commercialization and development of the platform ecosystem and takes the forms of licensing and sponsoring agreements with partners (Eisenmann et al. 2009). In the particular context of emerging ecosystems, the rationale for opening the platform is to enable actors in the ecosystem to explore avenues for potential services, facilitate creativity (Banoun et al. 2016), and encourage the participation of external actors (e.g. developers) in innovation (Boudreau 2010) or experimentation (Muzellec et al. 2015).

It is also reported that ecosystems in their birth and expansion stages frequently adopt an open strategy (Rong et al. 2013). An open strategy basically means opening up the interfaces of the platform and tools to support partners in the ecosystem. Interfaces include a broad set of application tools – e.g. APIs – that enable actors to create value in an ecosystem. Opening interfaces is also said to be influenced by uncertainty of the context and industry in which digital platforms operate. In industries where uncertainty is more prevalent, it is suggested that opening interfaces is preferable as it encourages complementary partners (Rong et al. 2013). Control of
technical interfaces is also thought to be important for appropriating value from the ecosystem since it gives platform providers a bargaining position in negotiations with external actors (Oh et al. 2015). Furthermore, it has been asserted that control of interfaces is important to protect the platform from free riding (Williamson and De Meyer 2012). Free riding in the context of digital platform ecosystems refers to when “the architecture established by the [platform provider] creates value for participants but fails to capture value for itself” (Williamson and De Meyer 2012, p. 33). Maintaining control of interfaces also helps to avoid exploitation by hostile firms (Karhu et al. 2018). However, while control of interfaces enables providers to exert influence over the actors in the ecosystem, the literature also suggests that it is necessary to ensure generativity to encourage value creation (Dattée et al. 2018). The simultaneous need for control and openness is further emphasized at the birth of the ecosystem since it is argued to reveal new ideas and innovation while protecting the platform as it evolves (Teece 2017; Skog et al. 2018).

To avoid constraining generativity in ecosystems, studies suggest that providers need to exercise dynamic control (Dattée et al. 2018). Dynamic control means “influencing the direction of ecosystem evolution toward a clarified vision and coveted control points, monitoring the evolution of the ecosystems and likely realization of future control points, and updating strategies in case of mismatches” (Dattée et al. 2018, p. 487). Influencing consists of activities providers engage in to narrow and establish a vision for the ecosystem. Influencing is a prominent aspect in any ecosystem since a platform's interfaces are open for multiple reconfigurations by external actors. Monitoring builds on the need of providers to know what is happening in the ecosystem, based on which it enables providers to influence and reshape the ecosystem. According to Dattée et al. (2018) dynamic control is based on control points (Pagani 2013). These are positions that providers can leverage to exercise influence in the ecosystem over value creation and capture, for example, interfaces on which the actors involved rely to create
value such as APIs. According to Attour and Barbaroux (2016) the birth and development of an ecosystem requires paying attention to architectural knowledge, in other words “aligning heterogenous business and technical elements” (Andersson et al. 2008, p. 20). An important aspect of architectural knowledge is that it does not limit architecture in digital platform ecosystems to technicalities. As Gawer (2015) argues, “technological interfaces act not only as a physical connector between material artifacts, but that they also embody a demarcation and articulate modes of interaction between different categories of social actors” (p. 31).

3.2.4. Summary of Digital Platform Ecosystem Establishment
Considering the body of literature as a whole, it is evident that research on platform ecosystems varies considerably when considering the challenges in orchestration. For example, a primary challenge often emphasized is achieving the critical mass necessary to generate network effects. Accordingly, a main concern of the literature focuses on the incentives that can bring on board distinct groups of actors. For example, focusing on core users to increase the heterogeneity of the user-base (e.g. Hanseth and Aanestad 2003; Rietveld and Eggers 2018), gaining participation of influential actors e.g. VCs (Breznitz et al. 2018), and pricing incentives (Eisenmann et al. 2006; Evans and Schmalensee 2010; Hagiu and Rothman 2016; Van Alstyne et al. 2016). A key takeaway from this literature is a focus on attracting actors to sustain and scale the ecosystem. However, the emphasis on exogenous factors (e.g. pricing and subsidizing, legitimacy) – while relevant in addressing critical mass and network effects – leaves key aspects unaddressed. For example, it downplays the role of technologies and architecture, identified as intertwined with governance in digital platform ecosystems (Constantinides et al. 2018; Saadatmand et al. 2019).

Furthermore, it is apparent from the literature that digital platform ecosystem establishment does not occur in isolation; it involves collaborations with diverse partners and across organizational
boundaries. Accordingly, ecosystem emergence involves the formation of new relationships, adapting to new roles or extending existing ones. As the ecosystem evolves, providers need to alter existing governance configurations to develop holistic relationships as they confront new external partners with distinct interests. A consequence of this is that ecosystem establishment inherently involves reframing the identity of organizations and meeting the need to develop new capabilities and transform new value creation opportunities. However, few studies (e.g. Lindgren et al. 2015) adopt a longitudinal account of emerging ecosystems. Furthermore, while it is emphasized that the formation of partnerships is essential for the development of the ecosystem, there is little discussion of the effects of such asymmetric partnerships on the ecosystem as it evolves. The literature for the most part merely addresses the evolution of the platform itself rather than the influence such partnerships have as the ecosystem changes. A resultant outcome of this is a lack of understanding of the dynamics of the evolving relationships between actors and resource control in digital platform ecosystems. This rather narrow view of governance excludes the multitude of ecosystems that increasingly rely on digital artifacts that are distributed and controlled by multiple actors (Kallinikos et al. 2013).

The literature has also mostly focused on ecosystem establishment in commercial settings, where the goals of platform providers are often construed around maximizing value in terms of financial benefit. Although recent studies argue that governance in profit-seeking digital platform ecosystems differs from that in non-profit ecosystems (Schreieck et al. 2017), few studies address orchestrating emerging digital platform ecosystems in the latter context. Furthermore, with the exception of Attour and Barbaroux (2016) most of the literature typically limits the definition of architecture to the technical boundary resources (technical interfaces) held by a platform provider. The origin of this technocentric view may arguably have been inherited from a view of platform ecosystems as centered around products or devices –
for which a platform provider has a substantial impact on the design. However, since ecosystems are increasingly based on digital artifacts that are relatively open to multiple actors across multiple contexts (Kallinikos et al. 2013), a more encompassing view of the ecosystem that takes into consideration the fluidity of control is important. Such a view will require consideration of the role which external actors are likely to have in influencing the orchestration of digital platform ecosystems. Although research has started to address the interplay of different actors and power dynamics in influencing ecosystems (e.g. Eaton et al. 2015), the literature is mainly limited to analysis of mature platform ecosystems.

From the reviewed literature it is apparent that establishing a digital platform ecosystem involves relating to a multitude of inconsistent demands; for example, maintaining control of interfaces to ensure coordination and opening interfaces to spur generativity and exploration of value in the ecosystem. Furthermore, the literature also suggests tension that evolving boundaries between organizations, technologies, and relations in the ecosystem imposes on actors forced to reconsider their identity as digital technologies and new services emerge and evolve (e.g. Lindgren et al. 2015). The potential need to address short-term viability and ensure the long-term relevance of the ecosystem (Saarikko et al. 2019), controlling of interfaces to ensure value creation and capture (Dattee et al. 2018) are all of compelling interest. However, I find that the literature often discusses competing concerns in isolation – i.e. with relatively little attention given to the interactions across competing concerns or the wider effects in the establishment of platform ecosystems. Specifically, few studies address multiple competing concerns and how they affect emerging platforms ecosystems. Although some researchers (e.g. Svahn et al. 2017) have examined multiple competing concerns in innovation processes, the focus has been on incumbent product manufacturing firms that can draw on existing relationships. In the next section, I detail the context in which the empirical study underlying this dissertation was undertaken.
# Table 1: Summary of challenges and suggested solutions in orchestrating digital platform ecosystems

<table>
<thead>
<tr>
<th>Goals</th>
<th>Key Challenges</th>
<th>Description</th>
<th>Suggested solutions</th>
<th>Example Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attracting Users and Generating Networks</td>
<td>Achieving critical mass</td>
<td>Establishing a digital ecosystem entails attracting a minimum number of users to ignite network effects and become self-sustaining.</td>
<td>Providing pricing incentives to subsidize user participation</td>
<td>Evans and Schmalensee (2010), Evans (2009)</td>
</tr>
<tr>
<td></td>
<td>Enabling scaling</td>
<td>Establishing ecosystems involves increasing the user-base and services to stay competitive as the ecosystem evolves.</td>
<td>Leveraging data generated on the platform to refine scale</td>
<td>Huang et al. (2017)</td>
</tr>
<tr>
<td>Control and Coordination</td>
<td>Asymmetric dependencies and relations among actors</td>
<td>Establishing collaboration with, and formation of partnerships with often distinct interests, capabilities and resources resulting in asymmetric dependencies and exposure to exploitation.</td>
<td>Monitoring evolving relations, capabilities and goals of partners</td>
<td>Jha et al. (2016), West and Wood (2013), Hyysalo et al. (2019)</td>
</tr>
<tr>
<td></td>
<td>Conflicting values, vision, and identities</td>
<td>Establishment of digital platform ecosystems involves adapting to new roles. Adapting to new roles entails organizations reconsidering their existing identity, values, and interest as ecosystem evolves.</td>
<td>Building consensus, and negotiations of roles among actors</td>
<td>van de Kaa and de Bruijn (2015), Lindgren et al. (2015)</td>
</tr>
<tr>
<td></td>
<td>Balancing control and openness of interfaces</td>
<td>Opening interfaces to encourage value creation from external actors. Control of interfaces also ensures coordination and value capture but stifles generativity and value creation in the ecosystem.</td>
<td>Dynamic control of interfaces through constant monitoring of control points</td>
<td>Dattée et al. (2018)</td>
</tr>
<tr>
<td></td>
<td>Appropriating value</td>
<td>Establishing an ecosystem involves providing an offer that is valuable to multiple actors. It also entails capturing the value created in the ecosystem.</td>
<td>Retaining firm control of key architectural components and “interdependencies between platform and components”.</td>
<td>Gawer and Cusumano (2008)</td>
</tr>
<tr>
<td>Creating and Capturing value</td>
<td>Maintaining short- and long-term market needs</td>
<td>Ecosystem establishment entails maintaining a short-term focus to exploit value creation and a long-</td>
<td>Developing capabilities to sense, seize and transform opportunities for value creation as ecosystems evolve</td>
<td>Tan et al. (2015), Teece (2017).</td>
</tr>
<tr>
<td>Term focus as the ecosystem evolves to explore new value opportunities.</td>
<td>Maintaining relations and interaction with actors to detect new avenues for value creation</td>
<td>Saarikko et al. (2019)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. Research Context

In this section I discuss the context of my empirical study – the public transport industry in Sweden. The focus is on an initiative that aimed to leverage external developers for service innovation based on open data. I begin by briefly discussing open data.

4.1. Open Data

Open data is “non-privacy-restricted and non-confidential data that is produced with public money and is made available without any restrictions on its usage and distribution” (Janssen et al. 2012, p. 258). As digitilization becomes pervasive, large volumes of data are generated, resulting in increasing expectations from organizations, citizens, and governments around the world on the usefulness of such data in innovation processes, public services, and the development of services. According to Janssen (2011) public sector organizations hold vast amounts of data which are being increasingly made available to citizens through open data initiatives. It has been argued that making such data available ensures accountability and transparency (Bertot et al. 2010). The rationale being that accessibility and disclosure will enable citizens to proactively participate in the activities of local government; for example by ensuring transparency through keeping track of the expenditure and priorities of governments (Bertot et al. 2010). Open data also has an economic motive. According to a European Commission study conducted in 2006, public sector information, e.g. geographic data, tourist information, weather forecasts, traffic information, business data, is estimated to have a financial value of 27\(^2\) billion euros every year (ec.europa.eu/commission). It is estimated that the overall value of such data for the EU will be around 194 billion euros by 2030.\(^3\) As open data is expected to increase, innovations and societal challenges in the domains of

---

\(^2\) https://ec.europa.eu/commission/presscorner/detail/en/IP_10_801

pollution, education, and environmental disaster relief will need to leverage open data (Ortmann et al. 2011). Even service delivery and social services in urban areas (Ubaldi, 2013), together with complementing communications between governments and citizens, will increasingly rely on open data (Kassen 2013). In fact, with the rise of mobile computing, it is suggested open data could be leveraged to foster mobile e-services through the involvement of citizens in service life cycle (Johansson et al. 2015). The rationale for innovation based on open data is built on the premise that citizens and organizations with competent skills will leverage data in novel ways, e.g. through crowd-sourcing for innovation (Robinson et al. 2009; Lathrop and Ruma 2010).

With the growing pace of digitalization, open data’s potential value for innovation has grown substantially. For example, Desouza and Bhagwatwar (2012) identify open data to be of potential value in increasing the information capabilities of urban centers, transforming them into “smart cities”. Within the domains of health, transportation, and education open data is also seen as potentially useful (Janssen et al. 2012; Manyika 2013). The growth in capabilities to capture and process data through analytics has seen a rise of open data platforms and a variety of intermediary business models, and innovation challenges (Bakici et al. 2013; Janssen and Zuiderwijk 2014; Hellberg and Hedström 2015). While varied in purpose, a common goal of open data platforms is to bring together multiple actors and datasets across public and private sector organizations, to stimulate new services and innovations, or solve societal challenges: whatever the specific goal, the outcome is an open data ecosystem (Harrison et al. 2012). Because open datasets are expected to be in a “machine-readable form that can be freely used, reused, and distributed by anyone” (Ubaldi, 2013) it is expected that such data will be of substantial value to third-parties (e.g. citizens, developers, entrepreneurs, etc.) through use, reuse, and distribution. The use and reuse of open data with minimal restriction means that third-party developers could leverage such data in combination with other digital artifacts (Kallinikos et al.
2013). Digital artifacts include, for example, digital maps that could be used by developers to create novel services. Reuse and minimal restrictions placed on open data equally suggest its susceptibility to changes across multiple contexts since actors can possibly reconfigure the data in ways that goes beyond their initial scope.

Besides these opportunities, researchers have also identified challenges associated with open data: publication of datasets not in machine-readable format (Braunschweig et al. 2012), data interoperability (Janssen et al. 2014), fragmented data sources, data quality, and lack of standardized data formats (Janssen et al. 2012). Some researchers have even argued that open data will more likely be useful and of greatest value to corporate and commercial stakeholders rather than to the citizenry (Gurstein 2011). Open data initiatives face a challenge in trying to live by both ethical values such as transparency and accountability and the need to generate monetary value (Sieber and Johnson 2015). Suggestions for improving open data include: improving reliability of datasets, providing datasets in various formats (Zuiderwijk et al. 2013), and standardizing data (Janssen et al. 2012). Other studies point to the need to consider the variety of groups which each have different interests and expectations as important considerations that could be taken to support open data use (Lassinantti et al. 2019). I now provide the specific context of the case in which research for this thesis was undertaken within the public transport industry in Sweden.

4.2. **Samtrafiken and the Trafiklab Platform**

Samtrafiken is a union of 36 transport companies. One of its main objectives is to enable cross-usage of services across different transport modes. An important example of this is how Samtrafiken enables the combining of tickets from different modes of transport, labeled Resplus tickets. The Resplus combined single ticket is provided to travelers when they book a journey that involves usage of different transport modes, for example buses or trains. The
objective is to ensure that Samtrafiken will take charge if there are disruptions on the trip. The PTOs in Samtrafiken share the goal of facilitating transportation of citizens across regional borders. However, as autonomous organizations they have different resources and interests, and operate within different regions and counties whose socio-economic needs vary. It is in this general context that this thesis was undertaken, focusing on the specific case of Trafiklab.

In September 2011, Samtrafiken, together with various other stakeholders (e.g. the county of Stockholm and Viktoria Swedish ICT), launched an initiative named Trafiklab. This initiative was an effort by the PTOs to respond to the changes brought forth by the emergence of smartphones that disrupted and challenged the logic of their core operations. Before Trafiklab’s initiation, most PTOs relied on static time schedules to communicate with users. While these schedules were well presented, their use was limited as they could only be used to announce the departure/arrival time of buses or trains. In the case of delays, for example, users would be unaware as no real-time data was available. Moreover, the internal development teams of different PTOs independently developed trip planners. These aspects were characteristic of the dominant logic of most PTOs; however, third-party developers saw such a bureaucratic environment and parochial in-house approach to the development of services as inefficient in addressing the diverse needs of users. This resulted in the unauthorized scraping of data from different operators to develop more appropriate services that could be installed on smartphones.

Initial efforts to confront developers to reframe from scraping by the Union were unsuccessful as developers considered the control of the Union to be unnecessary. For the Union, the services being developed based on scraped data were exposed to significant risks, e.g. the use of incomplete information or the development of low-quality services. Samtrafiken initially sought to control these services. However, this did not turn out as expected as a growing
number of users of public transport were increasingly switching to the use of these third-party services even though they were not officially sanctioned. On the one hand, Samtrafiken could not shut down these services entirely, but they could also not ignore the plausible disruptions that these third-party applications could pose for public transport in case of failures. This set the need for the development of Trafiklab as a platform to initiate a new model of organizing.

In contrast to the established process of delivering services to the public, Trafiklab was based on an organizing logic whereby free access was to be provided to third-party developers, with little or no charge. Developers could make use of such data to provide services to public transport users, thus acting as an interface or an alternative channel complementing the services offered by the PTOs. Based on this new logic of enlisting the public to engage with creating service innovations, the PTOs had to relinquish and depart from some of their formal control structures and instead rely on and seek for means to leverage the different developers and the unique competencies they offered.

Trafiklab offers several interesting illustrations when it comes to understanding ecosystem establishment. For example, it is still at a relatively youthful, emerging stage where it currently struggles to develop a user-base for the ecosystem. This provides a useful case to trace how platform ecosystems emerge to facilitate innovation. It thus serves as an illuminating case study in tracing the challenges associated with kick-starting an ecosystem. Literature focusing on two-sided platforms assumes that the use of some market incentives, e.g. subsidization, spurs growth on the platform. In the case of these platforms, such incentives are absent as developers are mostly engaged in self-organizing to sustain innovation and attract innovators. Secondly, Trafiklab is also in its early stages in terms of its value proposition and structures, which are relatively fragile and uncertain and thus are more likely to be open for multiple negotiation and contestation by actors. Furthermore, the use and
reuse of open data with minimal restriction also makes Trafiklab an interesting case. Particularly so since established views on governance in digital ecosystems have long been construed around platform providers influencing the ecosystem based on their ability to exercise direction and coordination that is reliant on the rigorous control of artifacts or resources.

4.3. Evolution of the Trafiklab Platform Ecosystem
This section provides a summary of Trafiklab’s background. It aims to provide a summary of the chronology of events drawing from exploratory study surrounding the development of Trafiklab (Ofe and Johan 2019)
2008–2010: External service developers resort to scraping data from different operators to develop services that could be installed on smartphones. Their initial complaint was that the bureaucratic environment and in-house approach to the development of services was inefficient in addressing the diverse needs of users. This unsanctioned activity results in efforts to confront developers and get them to refrain from such scraping practices. Samtrafiken was, however, unsuccessful as developers considered its control to be ineffectual.

2010: To enable Trafiklab, there was a need to develop an architectural layer that could facilitate any data transformation from the different providers that could constitute the prospective ecosystem. Arising out of the collaboration was the development of an architectural layer that aimed at transforming data. This was motivated by the realization that all of the data providers operated with systems in their own organizations that were different. Thus, a need to develop an architecture that could synchronize the different data formats and make them compatible was necessary.

2011–2012: Trafiklab emerges, initially a project involving Samtrafiken, Storstockholms Lokaltrafik (SL), and RISE Viktoria. Its aim is to explore avenues for digital services development and delivery based on public transport data (open data), and, as well, a practical need to address the concerns of external service developers who had resorted to data scraping practices to develop services not sanctioned by PTOs. Trafiklab is based on an organizing logic whereby free access was to be provided to external service developers. Based on the data, external service developers could create services complementing the services offered by the PTO. The rationale was that Trafiklab would emerge and build an ecosystem where developers, data providers, researchers, entrepreneurs, and users created new services based on open APIs. Consequently, this meant that Trafiklab had to continuously adapt to the needs of both developers and PTOs. However, most PTOs by then considered external developers' involvement in service development as
devolving formal control on ensuring quality and standards of the services developed. Besides this, there were other concerns. Although the different transport actors that operated under the umbrella of Samtrafiken broadly share the goal of facilitating transportation of citizens across regional borders (through the commission of Resplus tickets), they do, however, exercise a large degree of autonomy over resources, and their interests are largely aligned to the socio-economic needs of their respective regions. Consequently, not all actors share in the logic of Trafiklab, as some considered that they stood a better chance of responding to the needs of external service developers in their respective regions.

**2013:** A preliminary consideration on the part of Trafiklab is to engage external service developers with the selling of tickets. The belief at the time was that enabling APIs with functionalities to sell tickets would act as an incentive to external service developers to ensure participation of actors in the ecosystem, and extend the possibilities even for actors within and beyond the public transport system to highlight their data. It was thought that Trafiklab could be made distinct not just as a portal for publishing data but also as one providing an attractive offering for users both on the external service developers’ side (through the commission they would earn from selling tickets) and the data providers’ side (through exposure of their data and services to a large audience). This was, however, a major issue as it did not just entail extending a key aspect of the operations of PTOs to developers. Indeed, it was deemed highly unlikely to even occur as the arrangements surrounding such moves were far from detached from the complex political and regional needs different operators wanted to focus on. Besides, as mentioned earlier, Samtrafiken relied on the commission from the sales of its Resplus tickets. It was even thought whether the idea of engaging developers in selling tickets could challenge the very source of income that Trafiklab’s parent company relied on. Thus, the idea was quietly shelved – it was not even discussed with the different actors.
2014: One of the major actors engaged in Trafiklab is involved in a major internal reorganization, part of which saw the development of a key architectural layer that had been used by different organizations to transform data sources while leaving them under the control of the umbrella organization. Maintaining costs and developing the required competence to take charge of the architectural layer had become increasingly challenging for Trafiklab and its parent company. One consequence of this reorganization involved shutting down the layer that had been relied upon to transform data. 2015–2016: Trafiklab engages over 3000 users and sees the development of about 2200 service applications including application prototypes (estimates as of January 2015). 2018: Trafiklab has had over 8000 users and over 2200 service applications, and an approximately 50 000 000 million API requests a week. The initiation of Trafiklab was an effort to tap into ongoing digitalization opportunities.
5. Methodology

This section of the thesis provides an overview of the research approach. How academic research proceeds depends – as with most other social endeavors – on certain choices. In academic research, philosophical considerations are particularly useful since they constitute an integral part of the research process, enabling us to see how findings are interpreted and the implications that can be generated from them (Guba and Lincoln 1994; Snape and Spencer 2011). Two main philosophical considerations in academic research include ontological and epistemological choices.

5.1. Ontological and Epistemological Considerations

Ontological considerations seek to address the question “what is the form and nature of reality and, therefore, what is there that can be known about it” (Guba and Lincoln 1994, p. 108). In other words, ontological considerations address whether social entities are objective entities “that have a reality external to social actors, or whether they can and should be considered social constructions built up from the perception of social actors” (Bryman and Bell 2011, p. 20). In this thesis, I assume a constructivist stance. A constructivist stance considers a digital platform ecosystem as not solely socially constructed or embedded within a system, but both as an inherent part in complex systems and as socially constructed. Thus, for digital platform ecosystems, adopting a constructivist stance implies that multiple actors bring to bear multiple interpretations into their understanding of the challenges they perceive from the ecosystem. Epistemological considerations address issues related to “what is the nature of the relationship between the knower or would-be knower and what can be known?” (Guba and Lincoln 1994, p. 108). In essence, it dwells on the appropriateness of ways in which knowledge about the phenomenon under investigation can be known (Orlikowski and Baroudi 1991). Among scholars across different fields of social sciences, epistemological considerations have often been
considered along three broad spectrums: interpretive, positivist, and critical (Chua 1986; Orlikowski and Baroudi 1991).

Orlikowski and Baroudi (1991) examined over 155 articles on the study of IT in organizations and found that the predominant epistemological approach adopted by IS researchers was positivist. They attributed this mainly to the predominant influence of science in the West, which had its earlier roots in logical positivism. A positivist stance views reality as an objective truth, constituted of facts which can be tested through hypotheses with variables which can be measured and quantified (Klein and Myers 1999). The main goal of inquiry adopting such a stance is often described as aimed at providing an explanations, or theory testing to predict the accuracy of a phenomenon (Guba and Lincoln 1994; Myers 1997). However, a key critique of positivist philosophy in IS research is that it neglects the specificity of the context, use, and implementation of IT in organizations (Orlikowski and Baroudi 1991). A critical stance seeks to build a “critique and transformation of social, political, cultural, economic, ethnic, and gender structures that constrain and exploit humankind, by engagement in confrontation, even conflict” (Guba and Lincoln 1994, p. 113). An interpretive stance means that our knowledge of reality is best understood through interpretation of the meaning and utterances of social actors. Orlikowski and Baroudi (1991) contend that each philosophical stance offers insights into our understanding of information research. This thesis is largely informed by an interpretivist stance, the relevance of which for my research I will explain in more detail in the following sections.

5.2. An Interpretivist Stance

According to Bryman and Bell (2011, p. 17) an interpretivist view is predicated on the view that knowledge around us can best be understood through “the subjective meaning of social action”. It is through the social constructions gained through a shared understanding and meanings that different actors assigned to a phenomenon that we better comprehend a phenomena (Myers
To make sense of the world, an interpretivist stance thus asserts that knowledge about the world and reality can not be understood independently of the social actors (Orlikowski and Baroudi 1991). As Klein and Myers (1999, p. 69) put it, “knowledge of reality is gained only through social construction such as language, consciousness, shared meanings, documents, tools, and other artifacts”. I subscribe to an interpretivist stance in this thesis. By this I mean that what constitutes digital platform ecosystems and challenges associated in their orchestration are not merely given. Rather the challenges and how different actors perceive the platform is equally construed through their interaction with other actors, the context, and platform. Thus, the researcher adopting an interpretivist stance must be able to interact and understand the views of multiple actors who vary considerably in interests. Thus, within my research I view digital platforms – though having some specificities resulting from their underlying base – as technical components; digital platforms are subjected to varying use and constraints in the specific context of the actors as they evolve. Thus, the challenges associated with orchestrating emerging ecosystems can be studied through close interactions and engagement in the context while taking into consideration that technology use can lead to unintended consequences (Markus and Robey 1988). It also entails taking into consideration the use of IT and its consequences, and deeply involves social contexts in generating outcomes that are emergent rather than solely driven by the different actors and the technology (Markus and Robey 1988). Accordingly, digital platform ecosystems, such as infrastructure, are phenomenon with social, technical, global, and local dimensions (Bowker et al. 2010). Seen from this view, digital platform ecosystem establishment is thus a complex phenomenon that cuts across social and technical aspects.

5.3. Interpretive Case Studies

The case study as a research method is an “empirical inquiry which focus is on a contemporary phenomenon within its real-life context and boundaries between phenomenon and its context are not
clearly evident and suitable for studying complex social phenomena” (Yin 2009, p. 18). Accordingly, a distinctive aspect of the case study as a research method lies in its emphasis on capturing a phenomenon (the case) and paying specific attention to its particulars in all respects. Case study research is described as generally suitable to address questions that seek to provide rich descriptions and explanations. For example, “what is happening or has happened? [...] how or why did something happen?” (Yin 2011, p. 5). The design of a case study can be based on a qualitative and/or quantitative approach (Yin 2003). In a qualitative case study, which is the approach I adopt in this dissertation, the researcher is involved in exploring the phenomenon under interest through multiple sources of data such as observations, interviews, documents and reports (Creswell 1998).

A qualitative research strategy aligns with my interpretivist epistemological stance. A qualitative research approach is described as useful for a researcher to gain insights into social and cultural phenomenon (Myers 1997). The need for an interpretive stance predicated on the ontology that knowledge about the world is socially constructed is reflected in the qualitative research approach through the multitude of data sources and the richness of data. Observations, group discussions, narratives, in-depth interviews, case descriptions, reports, audiovisual material, etc. – are commonly associated with a qualitative research strategy (Creswell 1998; Snape and Spencer 2011). Within IS, Klein and Myers (1999) outline seven principles that characterize qualitative research which adopts an interpretivist stance. These principles outlined by Klein and Myers (1999, p. 72), and their application in my research are now outlined below.

**Principle 1** – The fundamental principle of the hermeneutic circle “requires that understanding is achieved by iterating between considering the interdependent meaning of parts and the whole that they form” (Klein and Meyer 1999, p. 72). In my thesis, this principle was mainly reflected in my approach to data collection and
analysis. Data collection was mainly done through interviews involving interaction with the interviewees. Data collection in this study was broad in the first instance as it initially involved different stakeholders in a bid to get their general views. Later, through multiple iterations, the focus was shifted to key actors in the ecosystem, looking at their actions and how these explained the dynamics at work in the ecosystem.

**Principle 2** – The principle of contextualization “requires critical reflection of the social and historical background of the research setting” (Klein and Meyer 1999, p. 72). Throughout my research, efforts were made to understand the historical background of Trafiklab. This can be particularly seen in Section 4, which lays out the context of Trafiklab and a narrative of key events that surrounded its initial development. Also, the focus on a single case provided me with ample opportunity to study most of the organizations in the ecosystem. For example, most of the interviews were conducted at the site of the various organizations involved. Besides sites visits, I also spent a week at the offices of Trafiklab and Samtrafiken observing and taking field notes. I had site visits at the offices of SL and Trafikverket, and participated in activities such as travel-hacks and meet-ups. Taken together, these site visits, participation in activities, and sourcing publicly available data provided a detailed background to the research context of my case.

**Principle 3** – The principle of interaction between researchers and the subjects: “Requires critical reflection on how the research materials (or “data”) were socially constructed through interaction between the researchers and participants” (Klein and Meyer 1999, p. 72). During my research, feedback was provided to interviewees about my current understanding of the research context. In my initial outing for interviews, I was not familiar with most of the working of the communities of developers. However, through participation in meet-ups I was able to discuss things with the different stakeholders and present preliminary aspects of my work. Also, in analyzing the data and timing of activities, I provided a draft
timeline of historical events to the management of Trafiklab to ensure that it was accurate. During the site visits at the offices of Trafiklab, I was equally able to meet different staff involved in various aspects of Samtrafiken; they were able to talk to me and respond to questions on their day-to-day activities.

**Principle 4** – The principle of abstraction and generalization: “Requires relating the idiographic details revealed by the data interpretation through the application of principles one and two to theoretical, general concepts that describe the nature of human understanding and social action” (Klein and Meyer 1999, p. 72). Generalization is an essential part of research efforts. This is essential to create knowledge that goes beyond mere description. Generalization in interpretivist research can be made based on the “development of concepts, the generation of theory, the drawing of specific implications, and the contribution of rich insights” (Walsham 1995, p. 79).

**Principle 5** – The principle of dialogical reasoning requires sensitivity to possible contradictions between the theoretical preconceptions guiding the research design and actual findings with subsequent cycles of revision. I address this problem by reflecting together with co-authors with whom I wrote the papers. This involved discussions with different actors in the organizations (such as the manager of Trafiklab) in which we considered my overall coding process, and cross-checking by the other author to examine the rationale behind the code.

**Principle 6** – The principle of multiple interpretations requires sensitivity to possible differences in interpretations among the participants as may be typically expressed in multiple narratives or stories of the same sequence of events under study. I interviewed different participants, for example staff working on strategy and technical support. These different interviewees expressed various concerns on how they perceived the platform and what was essential and critical for its development. This helped me in
understanding the different challenges as perceived by different actors both at the level of Trafiklab and organizations constituting the ecosystem.

**Principle 7** – The principle of suspicion requires sensitivity to possible “biases” and systematic “distortions” in the narratives collected from the participants. Throughout the data collection process and analysis, my role as a researcher was to reflect on the data critically. I ensured that the data collected was also checked with other relevant sources. For example, I developed a timeline which was checked with the management of Trafiklab to ensure that it was accurate. I also ensured that I informed the different interviewees that my role was merely a researcher rather than some investigator or consultant seeking to influence their work in the organization. This enabled the interviewee to discuss relevant aspects that were important for my research.

### 5.4. Data Collection

I collected data from Trafiklab, Samtrafiken, developers, and different public transport organizations. When conducting case studies, researchers are encouraged to use data from multiple sources so as to get a rich description and understanding of the phenomenon under consideration (Creswell 1998; Miles et al. 2014). In my research, data collection sources included interviews, observations, documents, and archival records, which are all considered as vital sources for collecting data in qualitative research (Yin 1989; Walsham 1995). Overall, the data collection process spans from 2015 to 2019. Throughout this period, I focused on different aspects of my research. However, it all enhanced my understanding of the establishment and recursive challenges involved in platform establishment. Table 2, below, provides an overview of the data collected and its use in analysis.

<table>
<thead>
<tr>
<th>Table 2: Collected data used for analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data types and period</td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td><strong>Interviews:</strong> Mar 2015–Dec 2018. Semi-structured interviews with management of Trafiklab and Samtrafiken.</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td><strong>Interviews:</strong> Mar 2015. Interviews with external service developers.</td>
</tr>
<tr>
<td><strong>Interviews with PTOs:</strong> Mar 2015–Dec 2018. Semi-structured interviews with providers of data, e.g. Swedish transport administration, Samtrafiken.</td>
</tr>
<tr>
<td><strong>In total</strong></td>
</tr>
<tr>
<td><strong>Observation:</strong> 13–15 Apr 2018. Participation in travel-hacks</td>
</tr>
<tr>
<td><strong>Site visit and interview:</strong> 23 Apr 2018. Trafikverket - Borlange</td>
</tr>
<tr>
<td><strong>Observations:</strong> 12 June and 6 Dec 2018. Participation in meet-ups with third-party developers and public transport authorities</td>
</tr>
<tr>
<td><strong>Observations:</strong> 13–16 Mar 2018. Fieldwork conducted at the Trafiklab office in Stockholm</td>
</tr>
<tr>
<td><strong>In total</strong></td>
</tr>
<tr>
<td><strong>Online source:</strong> BloggTrafiklab, Trafiklab/Nyheter, Trafiklab.se, Samtrafiken: Support forum</td>
</tr>
</tbody>
</table>
| **Archival Data** | - Milestone reports  
- Project presentations  
- Annual reports | Additional sources of data to provide more depth to the case, context and analysis. |
Interviews were the primary source of data collection. According to Walsham (1995, p. 78), interviews provide an essential source of data for interpretive researchers to “access the interpretation that participants have regarding the actions and events which have or are taking place, and the views and aspirations of themselves and other participants”. In my research interviews provided insights on events and actions taken at Trafiklab. The first rounds of interviews were conducted between March of 2015 and 2016. This round of interviews mainly focused on gaining an understanding of my research context. Significant efforts were therefore made to understand the historical background of Trafiklab. Section 4, for example, lays out the specifics of Trafiklab within the broader context of open data, Samtrafiken, and the public transport industry. It is through this initial understanding of the context that relevant events surrounding Trafiklab were identified. Also, I conducted most of the interviews at the home sites of the various organizations, further enriching my understanding of the context. For example, I spent a week at the offices of Trafiklab and Samtrafiken, made site visits to the offices of SL and Trafikverket, and participated in travel-hacks and meet-ups with different stakeholders. All told, the interviews, site visits, and observations helped to provide me with knowledge of the background and research context.

During these first rounds of interviews, I followed suggestions gleaned from initial interviews on additional persons or organizations that I could interview who might have insights on developments surrounding the research context and phenomenon under study. The early focus of the interviews was on open data, where I sought to explore why there was a need for a platform. This initial focus on understanding open data is expressed in Paper 1, exploring the perceived value of open data marketplaces. However, as I gained more insights from the initial interaction with the research context, I understood more of the underlying aspects that
were not limited to the provision of data. The focus of subsequent interviews gradually shifted away from open data as a central phenomenon, instead viewing it as a label for the context. Thus, I started looking at the rationale behind the different actions taken in the context. In the later rounds of interviews, I continued to follow up on some of the issues that were raised in earlier rounds of interviews – in particular understanding the different organizations involved in Trafiklab. Over time, the various aspects raised in my initial interviews were not limited to the internal workings of Trafiklab but were extended as well to the broader context of multiple organizations involved in its development. In later rounds of data collection, I focused on understanding the ways that different concerns raised in my earlier interviews were handled. This shift in focus was also prompted as I gained more insights from the interviews on the close connection of Trafiklab and organizations in the ecosystem. It is equally suggested that interviews are a useful way of gaining first-hand account of the experiences of different stakeholders (Legard et al. 2003; Schultze and Avital 2011). Overall, interviews were conducted with the management of Trafiklab, third-party developers, and other organizations.

Other data sources included archival data (e.g. minutes from meetings, milestone reports, annual reports of Samtrafiken, project presentations, and reports on Trafiklab). These data sources complemented interviews, weblogs, and data from developers’ support forums. Weblogs, for example, were mainly helpful in tracing activities that were reported on the Trafiklab website. While interviews helped in providing information on why certain events occurred, weblogs provided precise timings for Trafiklab’s different activities since they had timestamps. By using data from various sources, it was possible to understand changes over time and how Trafiklab evolved. In later rounds of data collection, I participated in observations. This included taking part in hackathons with developers and providers of data in the public transport industry, meet-ups, and travel-hacks organized for the developers and actors.
involved. Between 13 and 16 March, I also spent 40 hrs at the offices of Samtrafiken and Trafiklab with personnel, observing the processes involved in handling different API requests.

5.5. Data Analysis

Data analysis was mainly done using ATLAS.ti, which is software suitable for qualitative data analysis. The specific approach used in the analysis of data varied across the different papers. However, in all cases the analysis was both informed by themes (i.e. theoretical concepts) from the literature and themes grounded in the data (Charmaz 2006; Strauss and Corbin 1990). The analysis generally began by reading the transcripts of the interviews. Initial phases of analysis helped in providing a general understanding of the context of the study. This is in line with Klein and Myers (1999) and their principle of contextualization of qualitative research that requires reflection of the social and historical background of the research setting. In each paper, initial rounds of analysis were generally descriptive. The essence was to understand both the context and the phenomenon of interest. Following Charmaz (2006) and Strauss and Corbin (1990), initial coding processes generally took the form of open coding. Open coding involves the researcher assigning codes to portions of the transcribed interview (Charmaz 2006). It is expected that assigned codes are precise and short, seeking to capture actions (Charmaz 2006). In later rounds of analysis, emerging themes grounded in the data and informed by the literature were grouped into different categories. The categorizations of the themes emerging from the data were groups based on the theoretical insights from the literature and intended to address the research question. In the section that follows, I use Papers 2 and 3 to provide illustrative examples of my data analysis.

Paper 2: In this paper, the aim was to understand the scaling of platforms. I used value-driven lock-ins as an analytical lens. Value-driven lock-ins are described in the literature as ways in which platform providers seek to make the platform valuable to entice
actors into the ecosystem (Tiwana 2014). Thus, in data analysis my focus was on identifying actions that were initiated by the platform providers. To be more specific, in my analysis and identification of actions and their roles, I construed value-driven lock-ins to broadly encompass actions that seek to provide an architecture for participation, foster interaction to reduce cognitive distance among actors, and encourage flexibility in innovation processes (Lusch and Nambisan 2015). Although the existing literature informed my approach to analyzing the data, the analysis was also grounded in the data itself. The initial phase of analysis was, as earlier described, open coding. The second phase of analysis was more focused; frequently occurring codes were grouped into categories (Charmaz 2006). Through constant comparison, these codes were placed into three main categories that were informed by my analytical lens.

**Paper 3:** In this paper, we (myself and my co-author) were interested in understanding the interaction of systemic and episodic power in the transformation of digital innovation processes. In the first round of the analysis, we broadly focused on understanding the context. Given that we were interested in a longitudinal process involving the transformation of digital innovation processes and the interplay of power in this process, the existing literature on platforms and power was used as an analytical lens to code data. We used the concepts of governance and architecture, which broadly encompass arrangements, rules, control, and influence of autonomous actors in an ecosystem (Jacobides et al. 2006; Tiwana 2014). In the initial phase of the analysis, I broadly coded transcribed data and traces from weblogs using ATLAS.ti. The first phase of this process was done following line-by-line coding (Charmaz 2006). Line-by-line coding mainly involves reading the transcribed interviews and extracted data from the weblogs, during which codes are assigned to portions of the text. Our coding was grounded in the data as well as informed by the literature. After the initial round of analysis, my co-author verified the coding to ensure consistency. During this process, we discussed the reformulation of some codes while discarding other codes that were deemed
irrelevant to our specific research interest. We categorized the codes under two broad themes – architecture and governance.

Given that we were equally interested in the interplay of power underlying actions, we used Cobb's (1984) framework on power, which provides a process perspective in analyzing episodic power. In the second part of the analysis, we sought to identify instances of actions and antecedent conditions triggering the changes and events that we had identified. This was done through an interactive process through which we were able to categorize actions across different time frames. Through a retrospective back-and-forth in analyzing the data and sequence of events, we identified changes and the interaction of systemic and episodic power in transforming innovation processes.
6. Summary of papers

In this chapter, I present a summary of the four papers (see Table 3) included in this thesis. While the papers do have different areas of concern, together they provide overarching insights that contribute to our understanding of the establishment and orchestrating of an emerging digital platform ecosystem.

Table 5: Summary of papers

<table>
<thead>
<tr>
<th>Area of concern</th>
<th>Paper 1</th>
<th>Paper 2</th>
<th>Paper 3</th>
<th>Paper 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research questions</td>
<td>How do open data marketplaces generate value for open data users?</td>
<td>How do digital platform owners leverage value-driven lock-ins to scale digital platform ecosystems?</td>
<td>How can platform providers establish power in their relationships with actors in coordinating emerging digital ecosystems?</td>
<td>How can orchestrators navigate competing concerns among collectives in the formative stages of a digital ecosystem?</td>
</tr>
<tr>
<td>Theoretical framing</td>
<td>Open data marketplaces</td>
<td>Value-driven lock-ins</td>
<td>Systemic power and episodic power</td>
<td>Path channeling</td>
</tr>
<tr>
<td>Unit of analysis</td>
<td>Developers</td>
<td>Samtrafiken/Trafiklab</td>
<td>Trafiklab</td>
<td>Trafiklab</td>
</tr>
<tr>
<td>Methodology</td>
<td>Qualitative</td>
<td>Qualitative</td>
<td>Qualitative</td>
<td>Qualitative</td>
</tr>
<tr>
<td>Contribution</td>
<td>The paper provides an understanding of perceived value propositions of open data marketplaces on adoption of open data in digital service innovation.</td>
<td>The paper shows the importance of considering cognitive distances across platform actors and suggests considering trust and progressive access to services as important in building the</td>
<td>The paper provides an understanding of the interaction of the systemic and episodic in the transformation of digital innovation processes. It illustrates the role of distribution agency in mediating the</td>
<td>Provides an overview of path channeling activities involved in navigating competing concerns in establishing digital platform ecosystems.</td>
</tr>
</tbody>
</table>
6.1. Extended abstract Paper 1


Keywords: Open data, marketplaces, value propositions, digital service innovation, open data barriers

Paper 1: The first paper presents the case of Trafiklab as a marketplace for open data. My specific contributions included data collection, initial analysis, and writing different sections of the paper. This paper builds on the recent scholarly interest shown in digital service based on open data. It focuses on the perspective of developers who rely on open data to develop services. The paper’s central argument lies in the fact that inasmuch as open data is considered as of value for innovation much of its value is latent until explored. The paper addresses the lack of understanding of value generation from open data by focusing on the role of marketplaces. In the classical economic sense, a marketplace often denotes a “physical location” or a meeting point for buyers and sellers to exchange goods or services. In this paper, however, open data marketplaces are platforms that provide structures for actors in the ecosystem to generate innovation based on open data. The paper explores specific ways in which open data marketplaces can address barriers associated with using open data for service innovation. The paper finds that open data marketplaces offer different value
propositions for developers. Examples include: support services, knowledge transfers, and lowering the threshold for participation. This paper contributes to the understanding of digital platform ecosystems establishment by pointing to specific value propositions attractive to actors in the ecosystem. The paper further advances our knowledge of ecosystem establishment and orchestration by suggesting the need for platform providers to consider an integral view of value propositions in an ecosystem to attract and sustain a broad range of actors. Furthermore, the paper also finds that while open data places offer value propositions, generating economic benefits from open data remains an issue that is yet to be addressed by open data marketplaces.

6.2. Extended abstract Paper 2

Keywords: Value-driven, lock-ins, platform ecosystems, scaling, user base, digital service innovation

Paper 2: Paper 2 focuses on the scaling of digital platform ecosystems. Here, scaling refers to qualitatively and quantitively increasing services and the user-base of digital platform ecosystems. The paper's main argument is that digital platform ecosystem research primarily explores strategies for scaling ecosystems in contexts in which platform providers exercise proprietary control over core platform resources. This paper extends the literature by providing insights on scaling in the specific context of an emerging digital ecosystem. Building on prior research, e.g. Lusch and Nambisan (2015), the paper identifies three classes of value-driven lock-ins associated in scaling emerging digital ecosystems. These include: value-driven lock-ins that seek to provide (1) a common understanding for actors in the ecosystem; (2) an architecture for participation; and finally (3) enhance
structural flexibility and integrity across actors (Lusch and Nambisan 2015). Value-driven lock-ins aimed at providing a common understanding for different actors in the ecosystem were mainly social (i.e. encompassing activities such as meet-ups that provided a medium for interaction among actors). Value-driven lock-ins to provide structural flexibility mainly included activities that sought to ensure appropriate behavior, e.g. the use of norms and rules. Value-driven lock-ins to foster participation included incentives to encourage experimentation, discovery, and exploration of possible services. Although value-driven lock-ins were found to be relevant in the scaling of platform ecosystems, this paper also calls for considering the dynamics and challenges platform providers face in their efforts to enable successful resource configuration. It suggests the importance of considering the interplay of power in resource configurations among competing actors.

6.3. Extended abstract paper 3

Ofe, H. A., & Sandberg, J. Dynamics of episodic and systemic power in digital ecosystem emergence: Exploring the transformation of digital innovation processes in the Swedish public transport sector

Keywords: power, digital ecosystem, digital innovation, digital transformation, episodic, systemic

Paper 3: Digital innovation is a pervasive source of change in contemporary society, challenging the very core of many industries. Through a case study of the orchestration of a digital platform promoting innovation from open data in the Swedish public transport sector, the paper focuses on the role of episodic and systemic power in the emergence of digital ecosystems. I, together with my co-author, argue that while properties such as network effects spur centralization of power, characteristics of digital artifacts such as re-programmability and loose coupling often work in the opposite direction. We base our argument on the point that
the distribution of agency across actors in digital ecosystems alters in profound ways how organizations can use the power of resources to control and coordinate digital innovation processes. The paper illustrates the specifics of digital technologies and their distinct characteristics that challenge episodic and systemic power. By doing so, we illustrate the fragile nature of the power that platform providers hold regarding control and coordination in the early phases of digital platform ecosystems. To that end, the paper shows different instances of the exercise of episodic power by the management of Trafiklab to shape the development and formation of the platform. We explain why control and coordination, as grounded in mature ecosystems, provide a rather narrow understanding which ignores the distinct role that distributed actors and digital technologies play in the emerging stage of digital platform ecosystems. We illustrate the underlying resources which platform providers draw upon in seeking to control and coordinate the activities of distributed actors in the early phases of digital platform ecosystems. The article contributes to the IS literature by providing a more nuanced understanding of the interaction of systemic and episodic power in the early phases in the formation of digital platform ecosystems. We observe that episodic power is essential in initiating changes in innovation processes in the early development of the emergence of a digital ecosystem. However, the findings also show that platform providers generally lack systemic power at this initial stage. Thus, we point out that systemic power (mainly social activities and norms) shared across actors in the ecosystems provides important leverage to influence innovation processes.

6.4. Extended abstract Paper 4

Ofe H. A., & Sandberg, J. Navigating competing concerns in digital ecosystems through path channeling: Exploring the establishment of an open data platform
Keywords: digital ecosystem, ecosystem establishment, digital innovation, platform, combinatorial innovation, digital resources, path channeling

Paper 4: Prior studies on digital ecosystems focus on what they are, how they operate, and why they arise. We complement this literature by exploring how they emerge and how orchestrators can navigate competing concerns within and among the organizations involved in the establishment of digital ecosystems. Establishing new digital ecosystems involves imposing new coordination arrangements and can lead to negotiations of competing concerns as organizational arrangements are subject to change. Such competing concerns include tensions between existing versus required capabilities, product versus process focus, internal skills and relationships versus external collaboration, and control versus flexible governance. Based on a longitudinal qualitative study over seven years, we investigate the formation of a digital ecosystem requiring a collective of organizations to embrace new digital innovation approaches through a shared platform in the Swedish public transport industry. Our study comes up with at least two contributions. First, the analysis illuminates the emergent and fragile nature of change in digital ecosystem establishment processes where users hold substantial design decision rights. Second, it identifies specific orchestration objectives, underlying competing concerns, and specific path channeling activities to address them.
7. Discussion

As digitalization permeates across multiple contexts, organizations shift outwardly, relying on actors, resources, and innovation processes formed around platforms (Yoo et al. 2012; Tiwana 2014; Van Alstyne et al. 2016; Van Alstyne and Parker 2017). This shift toward ecosystems is likely to increase, and we are yet to fully understand its scale and scope as an increasing number of born-digital organizations (Tumbas et al. 2017), come into being. The implications of these developments are wide-ranging and not restricted to prospective platform providers. Mature ecosystems will have to adapt as well to the fast pace and scale of change or face being outcompeted. The rapid rise of new giants such as Airbnb and Uber, previously obscure digital platforms founded little over a decade ago but now with substantial market size, is testament to this fact.

However, the extant literature indicates that established ecosystems can exert considerable power and thereby mitigate challenges in ways that are compatible with their own interests (Eaton et al. 2015; Oh et al. 2015). In their orchestration, platform providers in mature ecosystems tend to draw on their ability to invoke the “bouncer’s rights” associated with an attractive user-base and network effects. One might be tempted to construe the establishment of ecosystems formed around such platforms as trivially handled through managerial guidelines replicated in venture development or entrepreneurship literature. However, providers in emerging ecosystems must navigate an ever-evolving landscape that criss-crosses multiple organizations, norms, and practices. In fact, the establishment of ecosystems around these platforms might to some extent be an echo of the remnants of what Cohen et al. (1972) described as operating in an organized anarchy: a context in which multiple agendas, conflicts, fluid choices, and participation of actors are at play and impacting decision-making. However, in an evolving digital and complex setting – as is the case of the digital ecosystem – choices and the resultant trajectory they set are complex problems.
(Tanriverdi et al. 2010). A characteristic aspect of digital technologies is that they are prone to change and open to multiple reconfigurations spurred by their incompleteness (Garud et al. 2009) and generativity (Zittrain 2006). This implies fluid, evolving choices and relationships among actors. The consequence of this being that textbook managerial guidelines of unity of command and control, planning, and a clear span of authority are often misaligned with the actual dynamics of digital ecosystems. The literature has instead suggested the notion of orchestration to better reflect these dynamics. Orchestration refers to the “deliberate and purposeful actions undertaken by a hub firm as it seeks to create [...] and extract value [...] from a network” (Dhanaraj and Parkhe 2006, p. 659). Orchestrating an ecosystem can thus be broadly understood as the ways in which platform providers seek to shape the trajectory of a platform ecosystem’s development.

The significant hurdles posed by this evolving landscape of many unknowns are acute and manifested in the numerous fatalities of platforms that fail woefully or unsuccesful early in their life cycle (Hagiu 2014; de Reuver et al. 2018) and in the inability of many aspiring platforms to attain leadership positions in their industries, ultimately crumbling (Gawer and Cusumano 2008). In fact, given the speed of change in the digital arena, we are likely to have narrowed our attention toward considering the few successful cases that make it through when the dust has settled. The consequence of this is that the many platforms which are on course to emerge but for some reason remain obscure or die off suddenly, are forgotten about. Such a bias toward mature ecosystems is reminiscent of the platform literature which has long been shaped by accounts drawn from close study of mature ecosystems (Ghazawneh and Henfridsson 2013; Selander et al. 2013; Wareham et al. 2014; Eaton et al. 2015). The focus on the mature ecosystem in my view provides a rather narrow window onto the life cycle of many digital ecosystems; it can not help being other than an unrepresentative and incomplete picture—an effort largely geared at capturing the heroic acts of the righteous few only after the turbulent moments of
trial have settled weaning out many. In fact, mature and successful platform ecosystems are probably rare cases rather than the norm (Hagiu 2014).

The limited attention devoted to the early stages of digital ecosystems should be of concern for our field for at least two reasons. First, it goes against the long-held opinion of many scholars that suggests new, emerging technologies and forms of organizing provide a useful avenue for advancing IS research (Lyytinen and Yoo 2002). Second, it also stands in contrast to the recognition that new organizations will increasingly be based on digital platforms (Nambisan 2016; Parker et al. 2016; Van Alstyne et al. 2016; Cenamor et al. 2019). A result of this is a lack of knowledge that could helpfully inform research and practice on the nature of the challenges and their implications for the orchestration of emerging ecosystems.

To investigate the challenges and see how they are resolved in emerging ecosystems, my research focused on the establishment of an open data platform in the public transport industry in Sweden. My theoretical and empirical investigation provides three key contributions which can be summarized as follows. The first contribution is the identification of key challenges in orchestrating an emerging ecosystem. The review suggests that challenges in orchestrating emerging ecosystems revolve around three goals: (1) attracting and generating network effects; (2) control and coordination; and (3) creating and capturing value. Thus, whether ecosystem establishment is successful or not depends in large part on how providers are able to address these challenges. The challenges and remedies identified could be helpful for practitioners when assessing and diagnosing emerging ecosystems. The outcome of the review (see Table 1), can also be considered as a plausible template for assessing the failure and/or success of platform ecosystems in other contexts. However, I suggest that the different challenges and proposed solutions should not be treated as fixed and isolated guidelines in assessing ecosystems. Instead,
providers should consider the challenges holistically in their ecosystem since there is an interplay and interaction between their underlying socio-technical aspects.

The second contribution of my study is a conceptualization of the nature of orchestration in emerging digital ecosystems. I demonstrate that orchestration in an emerging ecosystem is inherently embroiled in a web of fragile power relationships among actors, unbounded participation, unbounded control, emergent outcomes, and persistent competing concerns. The third contribution of my thesis is the practical implications for how providers can approach orchestration and address challenges in emerging digital ecosystems. The fragile nature of emerging ecosystems tilts toward orchestration being reliant on social interactions/relationship building among actors with distinctive interests and understanding of their own rights. In what follows, I point to the specific findings of my thesis in relation to the extant literature.

7.1. Key Challenges in Orchestrating Emerging Ecosystems
Challenges in emerging digital ecosystems can be framed around attracting users and generating network effects, control and coordination, and capturing and creating value.

7.1.1. Attracting Users and Generating Network Effects in Ecosystem Establishment
Attracting users and generating network effects are critical orchestrating goals. A solution proposed in the extant literature is incentivizing actors in the ecosystem through pricing subsidization (Eisenmann et al. 2006; Evans 2009; Evans and Schmalensee 2010). Price subsidization as a remedy is manifested mostly through the provision of “free” access to some users’ groups while charging others. While useful, price subsidizing implicitly assumes a high level of homogeneity of users’ motives aggregated in terms of pricing. Thus, a sole focus on price mechanisms neglects more specific needs and variations that exist among actors. My research
suggests that social interactions/relationship building and avenues for knowledge sharing among actors comprise an overlooked but critical remedy which providers in emerging ecosystems could draw upon to court users. This is shown in Paper 1, which identifies multiple different value propositions to varying degrees considered useful by different actors. Paper 2 shows more socially inclined value propositions leveraged to increase the quantity and quality of services not necessarily construed in terms of a monetary nature. The fact that Trafiklab is a not-for-profit platform, with many users not primarily attracted by monetary value, also suggests that we need to consider a broader understanding beyond pricing when thinking about attracting users and generating network effects. Such a broader view of value creation might be even more critical for emerging platform ecosystems with limited resources. Instead, resources could be devoted to more critical aspects such as searching to reveal avenues for new services and values offered by actors not necessarily driven by financial motives. Thus, it is imperative for orchestrators of emerging platform ecosystems to take seriously a broad variety of ways, incentives, and understandings that can attract users. Such a perspective does not exclude but rather complements strictly economic factors (e.g. pricing and subsidizing). Taken together, I suggest that orchestrators need to move beyond monetary means to focus on non-financial motives that can be leveraged to attract users and generate network effects.

7.1.2. **Control and Coordination in Ecosystem Establishment**

Control and coordination have long been viewed as challenging when dealing with innovation in ecosystems involving multiple actors and digital resources (Zittrain 2006; Tilson et al. 2012; Ghazawneh and Henfridsson 2013; Dattée et al. 2018). The guidance in the existing literature on dealing with control is primarily based on utilizing boundary resources that are often aimed at constraining generativity (Ghazawneh and Henfridsson 2013; Wareham et al. 2014; Eaton et al. 2015). For emerging digital
ecosystems, the literature suggests that accurately gauging the dynamic control of interfaces (Dattée et al. 2018) or ensuring strong interdependencies between platform and associated components (Gawer and Cusumano 2008) is essential for the platform provider as the ecosystem evolves. However, my research suggests much more consideration needs to be taken when seeking to control and coordinate the ecosystem. First, stiff control may not necessarily constrain the activities of external actors in desirable ways. As with the conclusions of other researchers, e.g. Eaton et al. (2015), my work shows that attempts to enforce control might escalate problems by instigating counter-actions from actors in the ecosystem. The case of Trafiklab and the results of Papers 3 and 4 are illustrative of this. Change initiated by Trafiklab to stifle the actions of external developers were contested, and even pushed external developers into shifting their tactics to reconfigure and access the data in more sophisticated ways that bypassed established channels of control. These findings suggest that the outcomes of coordination and control efforts in emerging platform ecosystems are very hard to predict and fully comprehend.

One could attribute this elusiveness to the nature of the boundary resources which platform providers are likely to depend on for control and coordination of the emerging ecosystem; they are likely to be of little substantial value in enforcing or regulating the activities of actors in the ecosystem. And even if adequate boundary resources were under the control of platform providers, the uncertain viability of the ecosystem might prevent them from exercising that control as they seek to attract and retain actors rather than ensuring strict compliance to the rules of the ecosystem. For example, there were multiple instances in which Trafiklab resorted to completely overhauling key architectural control points, such as data transformation, triggered mainly by efforts to appease restive actors in the ecosystem. Similarly, and as discussed in Papers 2 and 3, social activities, such as meet-ups and close interactions with external actors, were important mechanisms for coordinating the ecosystem. These results suggest that our
understanding of boundary resources and their role in coordination and control should be linked to value propositions, the ecosystem life cycle, and the context in which platform providers operate. Distinct types of mechanisms should probably be used for control and coordination as ecosystems evolve through phases in the life cycle and across distinct contexts. For example, the openness associated with open data includes the expectation that data, the primary resource for innovation, be shared and redistributed with relatively little or no control over its usage. Such architectural requirements clearly have implications for the way coordination can be achieved.

7.1.3. Creating and Capturing Value in Ecosystem Establishment

Value creation and capture is a recognized challenge in platform ecosystem establishment. Dynamic control of interfaces enabling access to value creation and capture in the ecosystem is suggested as vital (Dattée et al. 2018). It has been asserted in recent literature that alignment of structure and relations among actors in the ecosystem is also vital to create value (Jacobides et al. 2018, p. 2263). For Trafiklab, alignment among actors or relationships to enable value creation was short-lived. For emerging ecosystems with strong dependencies on a multitude of distinct actors, the idea of alignment in the ecosystem is questionable since relations between actors are affected differently by design choices. Thus, in crafting responses to new goals, actors in the ecosystem might as well adopt new value capture and creation, although they might be constrained from doing so due to fundamental factors such as their identity. A resultant outcome is a constant need for providers to navigate competing concerns that arise as the ecosystem evolves and attracts new actors. For example, as Papers 3 and 4 illustrate, there is a constant change in the interests of actors in the ecosystem, resulting in a situation where platform providers encounter new demands from actors as old ones are assumed to have been resolved. My study of the initial phase of the platform suggests that providers may seek to ensure that the ecosystem is of value.
However, as digital platform ecosystems evolve, the focus becomes managing the relations among the actors involved.

7.2. The Nature of Orchestration in Emerging Digital Ecosystems

This section of the thesis provides insights into the nature of the forces underlying and shaping orchestration in emerging digital platform ecosystems. The insights provided are built from the specifics of the case described in Section 4, papers included in this thesis, and extant literature. In summary, orchestrating an emerging ecosystem can be understood as being enmeshed in an embryonic network of relationships characterized by: the unboundedness of participation, unbounded control and emergent outcomes, fragile power relations among actors in the ecosystem and persistent competing concerns. These factors are amplified in an emerging digital ecosystem in the specific context of open data due to the relatively weak control and minimal restrictions around open data. A consequence of this is that agency is distributed among multiple actors, and there is the generation of competing concerns in the ecosystem propagated and reinforced by the mass distribution of digital resources (e.g. open data and APIs). The four characteristics of orchestration in emerging digital ecosystems are now discussed.

Unbounded Participation: First, in orchestrating emerging ecosystems, providers seek to attract actors. As discussed earlier, attracting actors is intended to indirectly spur network effects arising from increases in interactions across the ecosystem. In emerging ecosystems and with regard to open data specifically, the focus on interactions as an intrinsic aspect of attracting is driven by two main factors. First, innovations and services based on an open data platform are particularly frail and shaped by an unbounded set of actors. Janssen et al. (2012, p. 258) define open data as “non-privacy-restricted and non-confidential data that is produced with public money and is made available without any restrictions on its
usage and distribution”. This definition essentially implies that open data is a public good, meaning unbounded participation and exclusivity in its control to restrict participation is rather weak. A consequence of the minimal restrictions placed on open data is that it lowers the threshold for an unbounded set of actors with unique understandings to participate in innovation processes. Lack of exclusivity of participation implies that governance and ways to entice actors are based on mutual discussions and interactions negotiated among actors. For example, in my research context, interactions with data providers took the form of updates, meet-ups, and newsletters detailing progress and prospective services. For external developers, interactions took the form of support-forum discussions, extending to hackathons, and innovation contests. The lack of restrictions on participation and control also means room for unlimited trial-and-error efforts, entry, and exits in the ecosystem. These characteristics create room for a loose set of actors to be involved in innovation processes distributed across the ecosystem.

Unbounded Control and Emergent Outcomes: Besides the unbounded participation of actors, the outcomes of design and interactions in the ecosystem are highly emergent. Control in ecosystems is not uni-directional i.e. from platform provider to actors; rather, it is bi-directional, extending both from and to external actors and platform providers (Tiwana et al. 2010). For platform providers, control of the ecosystem could be presumed to arise from the leverage of the underlying architecture in which resources (e.g. data) interoperate, enabling possibilities to frame value creation processes in the ecosystem (Eaton et al. 2015). In contrast, for actors in the ecosystem, control could be seen as stemming from capabilities, power, and competencies that enable them to achieve variety in the mix-match of resources, generate outcomes, instigate actions, and reject or engage in norms contrary to that of the ecosystem (Ghazawneh and Henfridsson 2013; Eaton et al. 2015). For example, in my research (paper 3 and 4), the platform provider’s initial efforts to curtail developers’ activities
through restrictive control resulted in counter-actions revealing the vulnerability in which “assumed” control is limited in a digital context.

Emergent outcomes are typically prevalent in the context of an emerging ecosystem, and particularly one based on open data. First, the minimal restrictions placed on open data use and reuse imply recombinations of resources (Henfridsson et al. 2018) extend beyond the control and context of data providers and platform providers. A consequence is that the digitality of open data generates outcomes that are emergent, a resultant effect being relatively low bargaining power for platform providers to assertively compel actors or aligned divergent interests in the ecosystem. In my case, the services generated from open data were tied to public transport services. This linkage with vital public services implies that errors in the mix-match of data by external developers can have consequences for the functioning of transport services or the information updates available to users. The criticality of unintended usage and outcomes of services based on open data is reflected in the initial unsuccessful attempt by transport operators to restrain the external developers who had resorted to data scraping. Comparing this to control in a more restrictive or physical product setting, it is distinctly different as control over product variants is tied to a large extent to the physical product components (Ericsson and Erixon 1999). This implies that product owners or producers hold substantial control over (re)design, and thus the evolution of the ecosystem.

Fragile Power Relations: In emerging platform ecosystems, power relations among actors are also fragile. This fragility is reflected in the results of Paper 3, in which we examine the coordination of innovation processes and actors in the ecosystem. The paper shows a constant interaction of systemic and episodic power in coordinating innovation processes. Systemic power is generally considered as power that "works through routines, ongoing practices to advantage particular groups without those groups
necessarily establishing or maintaining those practices" (Lawrence 2008, p. 174). In contrast, episodic power refers to "relatively discrete strategic acts of mobilization initiated by self-interested actors" (Lawrence et al. 2001, p. 629). In emerging ecosystems, the interaction of systemic and episodic power between platform providers and actors is fragile. One could attribute this to the unclear and uncertain value proposition, partly dependent on lack of an attractive user-base, which is generally considered essential in negotiations between platform providers and actors in the ecosystem (Oh et al. 2015).

However, the brittle nature of power in the ecosystem can also be understood in the broader context of digitilization and its effects. In general, malleability and programmability distribute agency and resources across a wide variety of contexts (Lyytinen et al. 2015; Nambisan et al. 2017); for instance through the ease with which digital resources can be accessed enabling mass participation and the democratization of innovation processes (Von Hippel 2005). The distribution of agency in the ecosystem enables actors to generate or instigate actions that subvert established practices or routines; an example would be creating channels for resource access (Eaton et al. 2015) such as data scraping or (re)design of open data in ways not foreseen by data providers or platform providers. In doing so, actors generate outcomes that are not only inconsistent with the platform provider's rationale and vision for the ecosystem, but also challenging to the established views of data and its usage. Such fragility is further enhanced through the repeated process of experimentation and trial-and-error efforts that characterize value creation in emerging ecosystems (Moore 1993; Tiwana 2015).

In the specific context of open data, weak power relations among actors are enforced by a high degree of autonomy in the ecosystem since actors can independently rely on standards considered fit in their particular context. This implies platform providers are in a relatively weaker bargaining position to set and enforce rules and standards that can be uniformly used to regulate access and
coordinate actors. Uniformity of rules and standards applicable across the ecosystem could have the downside of constraining innovation and generativity, limiting adaptation to the specific needs of actors (e.g. Huber et al. 2017). However, this should not be the case for open data since by default a substantial portion of open data is already subject to mass use and is thus devoid of control. Besides this, substantial level of control devolved to actors in the ecosystem does not necessarily translate to an increase in innovation outcomes (Boudreau 2010). Thus, the lack of rules in the ecosystem pushes coordination toward an emphasis on social boundary resources (Ghazawneh and Henfridsson 2013), and interactions (e.g. meet-ups and hackathons) which are rather fluid and highly subjective, shaped by plurality of views among actors and ease of data reconfiguration across various contexts. Paper 2 illustrates aspects of this emphasis by showing the importance of resource reconfigurations that are aimed at providing an architecture that can enable participation and bridge the differences in understanding of different actors.

Comparing the delicate digital ecosystem studied here to the organizational literature that lays emphasis on stabilization as a key mechanism in the formation of new organizations (e.g. Chiles et al. 2004), one can draw two key insights. First, the notion of stabilization as an aspect of emergence runs contrary to the highly contested and inherently fragile nature of an ecosystem based on open data. The propensity for open data to allow generation of new outcomes with high degrees of variation might be the very essence of why stabilization is counterintuitive in this context. The notion of stability in the emergence of new organizational forms refers to a situation where a new and emerging organization evolves to a different order and takes shape by building on settled norms or points of reference (Chiles et al. 2004). The implication of stability in digital ecosystems is that in orchestrating the ecosystem, providers should not simply seek to actively constrain generativity but also create standards that can be acceptable as anchors to scale the ecosystem. Such stabilization is likely to be elusive in the specific
context of an emerging ecosystem solely dependent on digital artifacts such as open data that lack relatively stable points of control. However, this is yet to be fully understood, as the limits and conditions under which stabilization is attained in a highly infused digital context will require more careful consideration.

Persistent Competing Concerns: The unboundedness in participation, the emergent nature of outcomes, and fragility in power relations among actors, implies that dealing with competing concerns is a key orchestration activity. The notion of competing concerns broadly refers to inconsistent demands. In digital ecosystems, competing concerns are particularly hard to resolve for a number of reasons. Relationships between platform providers, open data providers, and actors such as the external developers within the ecosystem are affected differently. The consequence of this is that as the ecosystem evolves or is subjected to minor changes, actors will constantly respond in diverse ways. This implies that constant loops of inconsistencies are created as platform providers seek to resolve concerns raised in the ecosystem, while actors in the ecosystem on their part are also making adjustments based on their strategic imperatives (Sambamurthy and Zmud 2000). Papers 3 and 4 illustrate that there is constant change in the interests of actors in the ecosystem; some arise mainly from the strategic considerations of actors far beyond the control of platform providers. The consequence being that platform providers encounter new competing concerns as old ones are assumed to have been resolved. An example would be the case of one of the organizations undergoing an internal reorganization resulting in a major reconfiguration of the platform.

Comparing this to the literature on ecosystem governance that separates and manages tensions distinctively (e.g. Wareham et al. 2014; Huber et al. 2017), one can draw one key distinction and similarity. First, my research shows, as has the work of others (e.g. Wareham et al. 2014; Huber et al. 2017), that competing concerns can be distinctive theoretically, but in practice they are enmeshed.
However, in practice, when they are confronted with concerns, providers in ecosystems do not approach them entirely distinctly (e.g. control vs stability, autonomously vs collectively). Rather, the distribution of resources across the ecosystem from its inception implies by default that these competing concerns are ever-present but tend to assume one form or another. This might be specifically related to the case of open data since the data is open for reuse subject to relatively little control. The consequence of this being that as digital resources are inherently open, we might move toward understanding the context-specific aspects that could be leveraged to manage competing concerns, rather than obsessing with established tensions such as control and generativity construed from the assumption that some individuals have exclusivity of control. In other words, viewing ecosystems as open will suggest that borrowing from previous work on the control of public goods might be useful. Addressing competing concerns in the ecosystem lies not necessarily in resource control but in the ability of platform providers to shape the context in which resources are used. This reasoning is developed further in Paper 4, wherein multiple and ever-evolving competing forces emerge as ecosystems evolve. To deal with such competition, providers resort to creating alternative paths that can shape the use of resources in the ecosystem. This thinking is reflected in Paper 4, where we draw on path channeling as a constructive way for providers to influence the ecosystem and navigate competing concerns. Path channeling has been referred to by other scholars working in the field as “the activity of steering value connections, and ultimately value paths, through one particular, or a combination of, resource/s to provide the potential for capturing value as it becomes more center-stage in a particular value space” (Henfridsson et al. 2018, p. 95).

7.3. Implications for Navigating Challenges in Emerging Ecosystems
The insights gleaned from examining the nature of emerging digital ecosystems have implications for our understanding on how
platform providers can approach challenges in digital ecosystems. First, control and coordination are much more elusive than previously assumed. The delicate nature of power relations among actors, unbounded participation, unbounded control, and emergent outcomes entail a shift in the focus of platform providers and actors toward more socially inclined activities through which the nature of mutually acceptable control and coordination can be negotiated. An implication of this is that orchestration moves toward, and is negotiated primarily through, interactions and involvement of platform providers in the communities of different actors. Regardless of the control that providers are presumed to have, I suggest that accounts of ongoing interactions and socio-technical configurations of resources at the peripheries of the ecosystem need to be center stage in our explanations for control and coordination in emerging ecosystems. A focus on interactions entails that platform providers approach control and coordination in a much more subtle way, one essentially framed as influencing. Influence refers to “the process by which a social actor frames others’ choices in the sense of its interests, while not being able to impose these interests by sheer force” (Castells 1998, p. 474). Such framing, in my view, will be useful since it will mean considering ecosystem establishment as not tied explicitly to resource control or ownership, but as an immersion in communities of distributed actors all seeking to mutually shape and negotiate outcomes. Such a view is even more relevant given that it is the collective of actors and relationships formed around the ecosystem that are likely to be central since they constitute key assets for platform providers (Parker et al. 2016; Van Alstyne and Parker 2017).

Secondly, the inherently fluid nature of emerging digital ecosystems equally suggests that in addressing challenges related to creating and capturing value, providers should avoid the erroneous goal of trying to create alignment between different actors. This might sound counterintuitive given that alignment in relations and structures could be essential with regard to creating value in the ecosystem (Jacobides et al. 2018). However, such alignment in the
very particular circumstances of an emerging digital platform and generally in a dynamic context will likely be short-lived, as has been suggested by others (e.g. Ciborra 2000). Asymmetry in power relationships among actors given their autonomy and interest in protecting their distinctiveness will likely persist, making any meaningful structures that could be used as leverage for collaboration precarious. This can be seen in related studies where the distinct interest on the part of participating actors to preserve their identities renders collaboration for new ecosystem services futile (Lindgren et al. 2015). Besides this, the distribution of control points (Pagani 2013) across multiple and ever-evolving sets of actors might not permit (Skog et al. 2018). Control points are avenues where maximum leverage could be applied to shape value creation. In an ecosystem based on open data, such control points can be thought of as unique datasets generated across the context of different data providers. While providing a value offering is key to creating awareness and attracting actors to the ecosystem, ecosystem establishment might instead be based on a deep understanding of how mutating relationships can be navigated as ecosystems evolve. Taking this into consideration, addressing value creation and capturing challenges will entail focusing on the varying contexts of the different actors and their distinctiveness.

Thirdly, interactions should be taken more seriously as a key way of addressing challenges related to attracting actors to emerging ecosystems. While interactions are also important in mature ecosystems, in the specific context of emerging ecosystems interactions are tied explicitly to articulating the value of the platform to distinct actors and building common understanding. The emphasis on interaction is necessary as the minimal restrictions placed on open data imply that the threshold barrier for the entry and exit of actors to and from the ecosystem is relatively low. This means that actors with distinct understandings are likely to be prevalent in innovation processes. A starting point of the forms such interactions take for attracting actors is partly exemplified in Paper 2, which uses the notion of value-driven lock-
ins. Previous literature has used this idea to mean activities platform providers leverage “to make a platform compelling for users to prevent switching to alternatives” (Tiwana, 2013). In the specific context of emerging ecosystems, however, value-driven lock-ins take the form of resource configurations that seek to foster interactions, reduce cognitive distance across actors, and facilitate participation through an enabling architecture (Lusch and Nambisan 2015). Such value-driven lock-ins will be even more relevant in the specific context of open data, to address different groups of actors identified to have distinct understandings of open data use (Lassinantti et al. 2019).
8. Conclusions

The main aim of this thesis was to investigate the challenges in orchestrating emerging digital ecosystems and suggest how platform providers can navigate them. To address my research question, I focused on the establishment of a digital ecosystem in the public transport industry in Sweden, referred to as Trafiklab. My study of Trafiklab began in September 2014, when I examined initial efforts to galvanize the various actors across the industry. The efforts of Trafiklab were in response to events initially triggered by external developers who had resorted to the development of unsanctioned applications based on data scraped from the webportals of PTOs. The results of my study provide three key contributions which can be summarized as follows: (1) the identification of key challenges in emerging ecosystems. These challenges revolve around (a) attracting and generating network effects, (b) control and coordination, and (c) creating and capturing value; (2) an understanding of the nature of orchestration in emerging ecosystems characterized by unbounded participation, unbounded control, emergent outcomes, fragile power relations among actors, and persistent competing concerns; and (3) the suggestion of ways in which platform providers, taking into consideration the nature of an emerging ecosystem, can approach the challenges which confront them. This section of the thesis discusses the limitations of the work and focuses on the implications for research, also suggesting possible avenues for future research.

As digitalization increases in speed and scope, an increasing number of empirical phenomena, products, and services will exhibit the characteristics of platforms (Tiwana 2014). The distribution of resources among actors and contexts will continuously challenge the role of providers who seek to deliberately curtail the activities of scattered actors. This shift toward the fringes of ecosystems requires researchers to consider unique ways of theorizing about how ecosystems emerge, take shape, and evolve. The limitations of
technical boundary resources to control and coordinate the ecosystem will become even more exposed as the distribution of resources and platforms will be subjected to regulatory frameworks imposed by state actors. Any such impositions will inevitably overshadow the role of platform providers to enforce compliance or mitigate contradictory demands in the ecosystem. It is my view that an encompassing view of boundary resource theory is needed to accurately reflect a form of control and coordination as actors at the peripheries of ecosystems take the center stage in innovation processes. Extending boundary resources to rules implemented at national levels will have far-reaching implications for how providers can attract and entice actors to the platform, control and coordinate them, and create and capture value in the ecosystem. Platform research and practitioners will benefit from these insights as the sheer pace of digitalization suggests that exclusivity in control and coordination, and creating and capturing value will need to be balanced with many competing considerations across multiple contexts.

8.1. Study Limitations and Suggestions for Future Research

This study was conducted within the specific context of the public transport. This means when looking at the conclusions and the possibility of applying my findings across other contexts we need to be aware of certain limitations. First, the specific types of challenges that emerged from the Swedish public transport industry could be applicable in similar contexts. It is, however, crucial to consider that platform providers' responses or mitigating strategies to the challenges they face could vary across other settings, even similar ones. The specifics (e.g. the developmental stage of the ecosystem) and the nature of the digitality of the resources under consideration all need to be factored in. Furthermore, one unique feature of my case is that it is situated within the public domain (though a few private actors were present). To some extent, then, Trafiklab’s operations are subsidized financially both by the state and the collective union of PTOs. While not minimizing the relevance of
Trafiklab, external support from the union might explain why Trafiklab remains sustainable despite its initial inability to provide substantial value in monetary terms for the different actors in the ecosystem. One might thus expect a different outcome if this was a case of a private and for-profit initiative. Indeed, undertaking a similar study in a profit-oriented setting could shed more light on the nature of ecosystem orchestration, and the possible responses of platform providers. Another avenue for research could be to explore how platform providers could successfully downscale an ecosystem. This could especially be the case where the frailty of the platform in relation to the actors in the ecosystem suggests that the emerging stage could go on for a prolonged period, resulting in scenarios where shutting down the platform is a plausible option (for example in scenarios where cost-profit considerations take center stage and multiple interdependencies or disruptions need to be contained in order to prevent spillovers as the ecosystem tilts toward a downward trajectory). For example, what kind of strategic moves, control, and coordination could platform providers take to kill a platform purposefully? The word "purposefully" used here suggests that in some scenarios scaling down the ecosystem in a controlled fashion might be beneficial for its greater good by preventing some uncontained degeneration. Take a situation where a platform provider wants to keep existing relationships in an ecosystem in order to facilitate the migration of actors to an entirely new and/or unrelated platform ecosystem. Further research along the lines suggested could provide insights into how digital platform ecosystems like in this scenario emerge, evolve, transform, and die.
9. References


Gurstein, M. B. (2011). "Open data: Empowering the empowered or effective data use for everyone?" First Monday 16(2).

Hagiu, A. (2014). Strategic decisions for multisided platforms, MIT.


on Foundations, Technologies and Applications of the Geospatial Web in conjunction with the ISWC, Citeseer.


Streaming. Hawaii International Conference on System Sciences (HICSS): 4564-4573


