

Enabling Collaboration in Innovation Networks

Exploring the Role of Innovation Orchestrators in the Dutch Aviation Industry

Master Thesis Project
Irene Elfring

Delft University of Technology

Enabling Collaboration in Innovation Networks

Exploring the Role of Innovation Orchestrators
in the Dutch Aviation Industry

by

Irene Elfring

Program:	MSc Management of Technology
Student number:	5882222
First supervisor:	Sander Smit
Second supervisor:	Maarten Kroesen
Project Duration:	March, 2025 – August, 2025
Faculty:	Faculty of Technology Policy and Management, Delft
Cover:	Amsterdam Airport Schiphol (Royal Schiphol Group, 2025a)

Preface

This master thesis titled: "Enabling Collaboration in Innovation Networks: Exploring the Role of Innovation Orchestrators in the Dutch Aviation Industry" has been written as the final part of my Masters' program "Management of Technology" at Delft University of Technology. The research has been conducted in collaboration with consultancy company *nlmtd*, being the innovation partner of Schiphol Airport.

To combine my passion for aviation with my current studies on innovation management has been a pleasure. Therefore, I want to thank *nlmtd* for offering me the opportunity to work on this project. I am also grateful to Schiphol for their openness and for allowing me to dive into their innovation network. I appreciate their willingness to facilitate this research. Special thanks to all interviewees who shared their perspectives and time with me. Finally, I would like to thank my university supervisor, Sander Smit, for his guidance and valuable feedback meetings, these have been really helpful.

Lastly, of course, I would like to thank my family and friends for their support throughout my Master's program and encouraging me during the writing process.

Enjoy reading!

Irene Elfring
Amsterdam, August 2025

Abstract

Organizations in complex and interdependent sectors, such as the aviation industry, are increasingly dependent on innovation networks to address major transitions. Although network governance and orchestration are key in steering such networks, research rarely examines both in innovation contexts. This qualitative case study explores how Schiphol Airport and its external innovation partner coordinate and manage collaboration in Schiphol's innovation network. The findings show that a hybrid governance structure, combined with adaptive orchestration practices, ensures alignment, trust, and facilitates collaboration in the innovation network. The study shows how different collaboration settings require different orchestration approaches and offers practical steps to strengthen collaboration.

Executive Summary

Organizations are increasingly faced with challenges that are too complex to address alone. This is especially the case in sectors with high interdependence and infrastructure complexity, such as aviation. Addressing transitions such as digitization, sustainability, and data-driven operations requires collaboration between multiple organizations. Such collaboration is often organized through *innovation networks*, which bring together diverse actors to co-create innovation.

Although innovation networks offer significant opportunities, they are also difficult to manage. Diverse interests, power imbalances, and cultural differences can slow down innovation. Effective collaboration on shared innovation therefore depends on more than simply bringing organizations together. Collaboration in innovation networks requires active steering through formal governance structures and adaptive orchestration practices.

Academic literature offers useful frameworks to understand network governance and innovation orchestration. These concepts are both recognized as ways to steer multi-actor collaboration, but previous research often treats them separately. Governance studies have largely focused on public sector or health care networks, offering insights into coordination mechanisms but not addressing the dynamics of *innovation* settings. Empirical evidence on orchestration is even more scarce and has mostly focused on alliances rather than wider innovation networks. While these studies offer valuable insights, they rarely examine *innovation* networks, and tend to address either network governance or orchestration in isolation.

This research addresses that gap by exploring how innovation orchestrators facilitate collaboration in Schiphol Airport's innovation network in which Schiphol and its external innovation partner coordinate joint innovation initiatives. The main research question was:

How do innovation orchestrators facilitate collaboration in innovation networks within the Dutch aviation industry?

To address this question, this research adopted a qualitative case study approach. Data were collected through workshops to map the actors in the network, semi-structured interviews, and observations. Analysis was guided by three sub-questions concerning the network's structure and actors, the orchestration practices applied, and the main challenges encountered.

Key findings:

- The network operates under a hybrid governance structure in which Schiphol acts as the lead organization, complemented by an external innovation partner that has a supportive coordinating role.
- The Schiphol innovation network is layered and segmented, with core partners and peripheral actors engaging at different levels of formality across functional domains. Actors play different roles depending on their domain, proximity to Schiphol, and maturity of innovation projects.
- Six orchestration practices were identified: actor mobilization, agenda setting, knowledge sharing, stakeholder management, strategic guidance, and trust & commitment. The mix and emphasis of these practices vary by collaboration setting: innovation projects, innovation programs, technology scouting programs, or strategic coordination efforts.
- The network faces persistent challenges, including governance barriers, misaligned interests, inconsistent actor engagement, cultural resistance to change, and difficulties in capturing knowledge. Orchestration practices help mitigate these issues by aligning stakeholders, creating transparency, and fostering trust, though they cannot eliminate them entirely.

In conclusion, the orchestrators in the Schiphol innovation network use a dual approach: combining formal network governance structures with adaptive orchestration practices tailored to the specific collaboration setting. This combination enables the orchestrators to align actors, maintain trust, and accelerate shared innovation despite the structural complexity and diverse interests visible in the network.

Building on this, the following recommendations have been made on how collaboration could be enabled even more in Schiphol's network:

1. Develop a living actor map: maintain an up-to-date overview of all innovation partners, to ensure the right actors are engaged early in new projects.
2. Formalize roles and responsibilities: use collaboration arrangements such as manifestos, alliances, or programs to create shared vision, alignment and legitimacy for joint initiatives.
3. Strengthen the external innovation partner's role: increase their visibility and relationships across the wider ecosystem to unlock more collaboration potential.

As a single-case qualitative study, the findings are shaped by the Schiphol context and are based primarily on perspectives from Schiphol and its innovation partner. These limitations highlight future research opportunities to broaden the current sample size with various innovation partners, compare multiple cases across regulated and infrastructure-heavy sectors (such as rail or electricity transmission networks) and apply longitudinal approaches to observe how both governance and orchestration evolve over time and across collaboration settings.

Contents

Preface	i
Abstract	ii
Executive Summary	iii
1 Introduction	1
2 Theoretical Framework	3
2.1 Integrated Theoretical Framework	3
2.2 Innovation Networks	4
2.3 Governance and Collaborative Arrangements	5
2.4 Innovation Orchestration	6
3 Methodology	8
3.1 Research Design	8
3.2 Case Selection	8
3.3 Sampling Strategy	9
3.4 Data Collection	11
3.5 Data Analysis	12
4 Results	15
4.1 The Innovation Network of Schiphol	15
4.1.1 Innovation Network Actor Map	15
4.1.2 Structure and Governance of the Innovation Network	19
4.1.3 Sub-conclusion: Actors, Structure and Governance of the Schiphol Innovation Network	22
4.2 Enabling Network Collaboration through Orchestration Practices	23
4.2.1 Orchestration Practices	23
4.2.2 Adapting Orchestration to Collaborative Contexts	26
4.2.3 Sub-conclusion: How Orchestration Practices enable Network Collaboration	26
4.3 Navigating Collaboration Challenges	28
4.3.1 Collaboration Challenges and Possible Solutions	28
4.3.2 Sub-conclusion: Mitigating Challenges through Orchestration	32
5 Conclusion & Discussion	33
5.1 Conclusion	33
5.2 Discussion	34
5.2.1 Implications	35
5.2.2 Recommendations	35
5.2.3 Limitations	36
5.2.4 Future Research	36
References	37
A Interview Guides	40
B Code Book	43

List of Figures

2.1	Model of theoretical framework including all key concepts used for this research	4
4.1	Visual representation of the actors in Schiphol Airport's Innovation Network	16

List of Tables

3.1	Overview of interview participants	10
3.2	Interview themes and their theoretical grounding	12
3.3	Overview of code categories and descriptions	13
3.4	Overview of code groups and their underlying category codes	13
4.1	Orchestration practices promoting collaboration in the Schiphol innovation network. . .	23
4.2	Relevance of orchestration practices across collaborative settings	27
4.3	Overview of reported collaboration challenges and orchestration practices for mitigation	29
B.1	Code book for interview analysis	44

1

Introduction

Collaborative innovation has gained increased attention, as organizations face challenges that are too complicated to address alone. Systematic transitions such as digitization, sustainability, and growing data-driven operations require organizations to seek solutions beyond their organizational boundaries. This means that many firms have moved away from closed innovation models and instead adopted strategies of interorganizational collaboration to share knowledge and risks, ultimately accelerating innovation (Chesbrough, 2003). This is particularly relevant in sectors characterized by infrastructural complexity and high interdependence, such as energy, healthcare, logistics, and aviation (Dall-Orsoletta et al., 2022; Dias & Escoval, 2012; Yun et al., 2020). In such settings, innovation is not just a matter of developing new technologies but also aligning multiple actors to ensure coordinated implementation.

A key concept in this context is the innovation network: collaborative structures that connect a variety of actors who together work on joint innovation goals (Ritala & Hurmelinna-Laukkanen, 2013). Rather than relying on internal resources only, firms engage in inter-organizational collaborations to share knowledge, reduce risks, and accelerate innovation outcomes (Pittaway et al., 2004; Powell et al., 1996; Ritala & Hurmelinna-Laukkanen, 2013).

However, while networks offer significant opportunities, they also present challenges. Collaborating with multiple organizations means you have to deal with diverse interests, power asymmetries, and cultural differences, which can hinder decision-making and trust-building (Aarikka-Stenroos & Ritala, 2017; Pittaway et al., 2004). Cultural and operational differences can further complicate collaboration and social dilemmas may lead participants to disengage because of uncertainty about reciprocity or fear of free riding (Das & Teng, 2002; Mohr et al., 2016). These challenges become even more complicated in case of high interdependence between actors in the network (Ritala & Tidström, 2014).

These challenges show that simply bringing together various actors, does not automatically lead to effective collaboration. It raises the question of how such networks can be steered to overcome these challenges and unlock their innovation potential. This steering can be understood in two ways: by shaping the network's structure (e.g. governance or other formal structures) or by actively managing collaboration through orchestration. Together, these perspectives form the basis for understanding how innovation networks are managed in practice.

As networks become larger and more complex, informal coordination becomes insufficient. Without clear structures that guide decision-making and coordinate multi-actor innovation efforts, there is a risk of fragmentation or failure (Wang & Ran, 2023). Governance can help coordinate multi-actor networks. Provan and Kenis (2008) offer a framework to understand governance in networks, distinguishing between three modes of network governance: participant-governed networks, lead organization governance, and network administrative organizations (NAO). Each mode offers different approaches to coordinating networks, based on factors like trust, network size, and goal consensus.

Recent studies show that governance is more dynamic in practice than this governance framework suggests. Networks often adopt hybrid forms that do not typically fit in the network governance typology

(Clauss & Ritala, 2023; van den Oord et al., 2023). Besides governance, organizations also formalize collaborations through different collaborative arrangements, such as strategic alliances, joint ventures, or partnership manifestos (de Man & Duysters, 2005; Gomes-Casseres et al., 2006; Hagedoorn, 1993). These collaboration strategies must be carefully managed to prevent an overload of agreements (Hottenrott & Lopes-Bento, 2016).

In addition to governance, the concept of innovation orchestration introduces a more dynamic perspective on steering networks. While governance focuses on the formal structures that coordinate collaboration, orchestration refers to the actions and practices that enable actors within a network to collaborate (Hurmelinna-Laukkanen et al., 2022; Provan & Kenis, 2008). Orchestrators' core functions include enabling knowledge mobility, ensuring innovation appropriability, and maintaining network stability, to support shared innovation (Dhanaraj & Parkhe, 2006). Later work expanded this view, by exploring who can orchestrate, such as firms, intermediaries, or public organizations, each having different capabilities (Hurmelinna-Laukkanen & Nätti, 2018). Subsequent to this, Hurmelinna-Laukkanen et al. (2022) introduced orchestration profiles, showing that orchestration practices should adapt to the network's interdependence and determinacy. They distinguish between three profiles (translative, transformative, and transcending), each suited to different types of networks.

Although these governance and orchestration frameworks offer different but complementary perspectives on managing innovation networks, empirical research on this topic remains limited. Most studies on network governance are based on public sector or health domains (Klijn et al., 2025; Provan & Kenis, 2008; van den Oord et al., 2023), which provide information on coordination mechanisms, but rarely focus on *innovation* settings. Only a few market-driven examples study entrepreneurial ecosystems without applying the full network governance lens (Colombo et al., 2017). Empirical studies on orchestration are scarce and often even more fragmented across domains or sectors. Previous studies on this topic focus on alliances in high-tech, or pharmaceutical sectors, healthcare networks, or on orchestration at project level (Dhanaraj & Parkhe, 2006; Faccin et al., 2020; Pikkarainen et al., 2017; Roehrich et al., 2023). While these studies provide relevant insights, they are often sector-specific, and tend to focus on either network governance or orchestration, not both.

This study addresses that gap by exploring the structural and orchestration practices within the innovation network of Schiphol Airport, the largest Dutch commercial airport. The study explores how Schiphol and its external innovation partner coordinate and enable collaboration across the network. This research is guided by the following main research question:

How do innovation orchestrators facilitate collaboration in innovation networks within the Dutch aviation industry?

The main question is addressed through the following sub-questions:

1. What are the structural characteristics of the innovation network and who are the key actors involved?
2. What orchestration practices are applied to promote collaboration in the network?
3. What challenges arise while collaborating in innovation networks, and how does the orchestrator manage these?

To answer these questions, this research uses a qualitative case study approach, combining network mapping workshops, semi-structured interviews, and observations.

The next chapter describes the theoretical framework (Chapter 2), introducing the concepts of innovation networks, governance, and orchestration, which together form the basis for further analysis. The methodology (Chapter 3) explains the data collection methods (network mapping workshops, interviews, and observations), the analysis approach, and the rationale for choosing Schiphol as a case study. The results (Chapter 4) are structured based on the three sub-questions. It discusses the structure and dynamics of the Schiphol innovation network, the orchestration practices applied, and the main challenges related to this. The final chapter (Chapter 5) brings the results and theory together, by answering the main research question. It reflects on the theoretical and practical implications, while also addressing the limitations of the study and identifying future research opportunities.

2

Theoretical Framework

In this chapter, a theoretical framework has been developed to systematically study how innovation orchestrators steer innovation networks. These networks offer significant opportunities to solve complicated problems, share resources, and accelerate innovation. Yet the literature offers only a partial view of *how* such collaboration is structured and coordinated. To address this, the chapter draws on three complementary perspectives: the characteristics of innovation networks, the governance and formal structuring of collaboration, and the role of innovation orchestrators in enabling innovation.

These different perspectives together form the theoretical framework that helps analyze the empirical case of Schiphol Airport and its innovation network, the first section will explain how these concepts are combined (2.1) as an layered analytical lens. The following sections each explain one of the concepts: innovation networks (2.2), governance & collaborative arrangements (2.3), and innovation orchestration (2.4).

2.1. Integrated Theoretical Framework

Empirical studies rarely analyze *innovation* networks through a combined lens of network governance *and* innovation orchestration. Governance studies are focused on public-service or health-care networks, showing different coordination mechanisms, but not in an *innovation* setting (Klijn et al., 2025; Provan & Kenis, 2008; van den Oord et al., 2023). Orchestration research, in contrast, is scattered across high-tech and pharmaceutical R&D consortia or on project level and seldom considers a *wider* network structure (Dhanaraj & Parkhe, 2006; Faccin et al., 2020; Pikkariainen et al., 2017). In addition, the mutual influence of structural governance and dynamic orchestration practices remains poorly understood, especially in innovation contexts.

This study addresses that gap by examining the multi-actor innovation network of Schiphol Airport. To understand how innovation orchestrators steer collaboration, the research is guided by three sub-questions, that mirror the theoretical concepts as shown in the framework in Figure 2.1 on the next page:

1. **Network structure & actors** → What are the structural characteristics of the innovation network and who are the key actors involved?
2. **Orchestration practices** → What orchestration practices are applied to promote collaboration in the network?
3. **Challenges** → What challenges arise while collaborating in innovation networks, and how does the orchestrator manage these?

Together, the theoretical concepts shown in Figure 2.1 form the theoretical foundation to address the knowledge gap of how governance and orchestration interact within innovation networks.

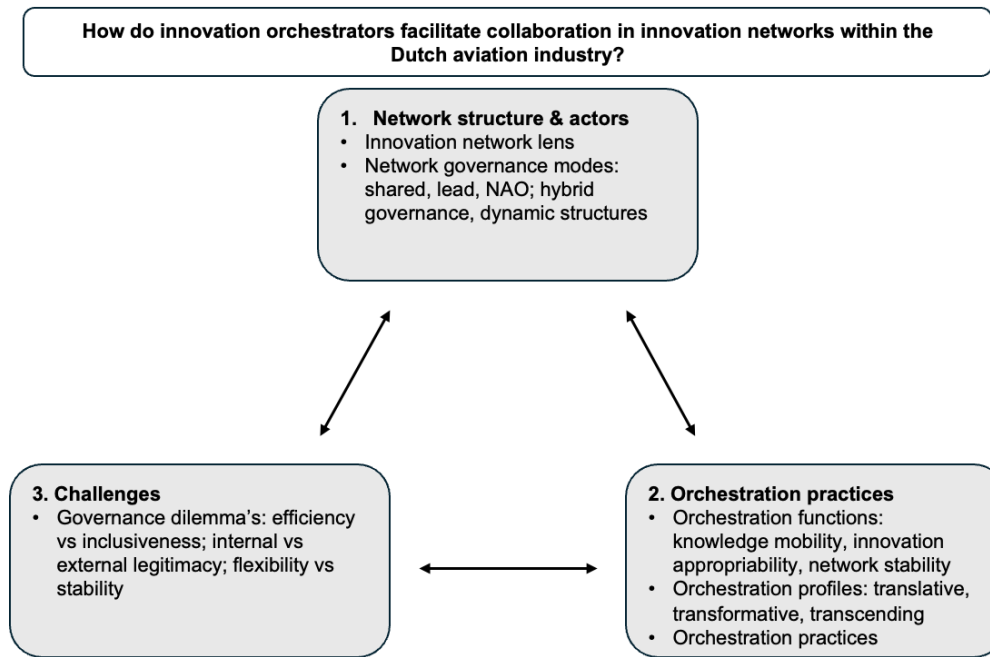


Figure 2.1: Model of theoretical framework including all key concepts used for this research

The figure above integrates the three lenses used in this study and links them to the sub-questions. SQ1 maps the Schiphol innovation network using the *innovation* network lens to explore the actors and how they collaborate on innovation (2.2), while it also explores how coordination is organized with insights from *network governance* theory (including the formal arrangements that come with this) (2.3). SQ2 then examines *orchestration* as a dynamic complement to structure (what do actors actually do to enable knowledge sharing, agenda setting etc.) (2.4). SQ3 identifies the collaboration challenges of innovation networks empirically, and interprets them in relation to the dilemmas presented in the network governance theory (2.3).

The arrows in Figure 2.1 indicate the interdependence of these concepts: network structure (1) shapes orchestration practices (2), which in turn affect how challenges emerge and are managed (3). The subsequent sections will explain each of the concepts described above in more detail.

2.2. Innovation Networks

Innovation in complex and interdependent industries such as the aviation sector cannot be understood by looking at individual firms. Each single change affects multiple actors, therefore close collaboration is required while innovating. This study therefore frames the Schiphol case as an innovation network, which is a deliberately formed constellation of actors who work on shared innovation goals (Pittaway et al., 2004; Powell et al., 1996). Adopting the network lens directly aligns with sub-question 1, which aims to reveal the structural characteristics and actors of the innovation network.

The lens helps to clarify which actors are present and how they collaborate on innovation in the network. It also sets a clear analytical boundary by focusing the analysis only on inter-organizational ties, that are actively engaged in conceiving, developing, and implementing shared innovations. Although this network is part of broader systems and ecosystems, such as policy frameworks, European or even worldwide aviation infrastructure, it focuses specifically on the collaboration between organizations involved within the Schiphol network itself. Broader ecosystem or linear supply-chain perspectives would blur these actor-specific pathways, whereas the network lens offers the level of detail required to answer the questions of this research (Aarikka-Stenroos & Ritala, 2017; Adner, 2016; Ahrweiler & Keane, 2013).

In literature, innovation networks are defined as intentionally created collaborations in which heterogeneous actors share knowledge and co-develop new technologies or processes, co-creating value in

the process (Hurmelinna-Laukkanen et al., 2022; Pittaway et al., 2004; Powell et al., 1996). Firms join such networks to spread risk, pool complementary resources, gain access to new markets or technologies and accelerate time-to-market (Pittaway et al., 2004). They also function as "networks of learning", where mutual capability building occurs (Powell et al., 1996).

While these benefits draw actors into innovation networks, sustaining them depends on the network's ability to adapt its structure and coordination to evolving roles, interests, and interdependencies between actors (Aarikka-Stenroos & Ritala, 2017). This is underscored by Hurmelinna-Laukkanen et al. (2022), who argue that networks built around shared goals must be actively managed to remain effective.

Together, the literature on innovation networks presents how networks are intentionally designed and dynamically evolving. Participating in networks has multiple benefits, as long as their structure and coordination are managed carefully. The network lens provides the starting point to analyze how organizations collaborate on shared innovation goals, from a governance and orchestration perspective.

2.3. Governance and Collaborative Arrangements

Innovation networks bring together actors with varying interests, resources, and responsibilities. Network governance provides the structural lens for analyzing how decision making, monitoring, and conflict resolution are organized in a network (Provan & Kenis, 2008). Previous empirical studies on network governance have mostly explored public-service or health-care collaboration networks, contexts where the focus is mainly on service delivery and social welfare instead of technological innovation. A recent review shows that more than two thirds of documented cases involve health, welfare or environmental collaborations, while business and technology oriented networks account for less than 10% (van den Oord et al., 2023). Foundational syntheses also focus on public interest, such as accountability and citizen legitimacy (Klijn et al., 2025; Provan & Kenis, 2008), and only a few market-driven examples study entrepreneurial ecosystems without applying the full network governance lens (Colombo et al., 2017). Analyzing Schiphol's innovation network therefore extends theory on network governance into innovation-oriented network settings, where empirical evidence is limited.

In this context, network governance helps explain the structural choices that enable collaboration in innovation networks. Provan and Kenis (2008) have defined the core construct, and present three governance modes:

- **Shared governance:** actors make joint decisions without a central coordinator. This governance mode relies strongly on trust and equality. It's often used in relatively small and tight networks with shared interests.
- **Lead organization model:** one dominant actor takes the lead within the network. The lead actor sets the direction, and s.
- **Network administrative organization (NAO):** a separate independent entity has been appointed to coordinate the network. This organization has the task to facilitate collaboration, share information, and structure the decision-making process.

Each of the governance modes is linked to contingencies such as trust density, network size, goal consensus, and the need for network-level competencies. The value of this typology is its analytical clarity, in systematically analyzing coordination within networks. Provan and Kenis (2008) also present governance dilemmas: efficiency versus inclusiveness, internal versus external legitimacy, and flexibility versus stability. The authors state that these dilemmas are not managed, it can affect the network's performance. This links back to the central question of this research, of how an innovation network can be steered for effective collaboration.

In this research, the governance dilemmas are only used to interpret the observed collaboration challenges, not to pre-structure the analysis, since the study also focuses on the orchestration perspective. To reflect both structural and dynamic coordination, the challenges in this research are empirically derived from the Schiphol case.

Other studies on network governance show that Provan & Kenis' model is not always sufficient to capture the dynamic nature of networks, as they rarely fit in one governance mode. As networks scale or become more complex, configurations evolve (e.g. from shared governance in early phases, toward

brokered forms such as lead organization or NAO modes), and hybrid forms become more common (van den Oord et al., 2023). Beyond these formal modes, informal norms and emergent routines are found to keep collaboration aligned (Clauss & Ritala, 2023). This reinforces that governance is also *dynamic* and shifts with its context.

In network governance, collaborative arrangements can add a formal layer that helps stabilize coordination, complementing the informal norms that shape collaboration in innovation networks. While governance specifies *who* participates, *who* holds authority, and *how* disagreements are handled, these collaborative arrangements formalize these choices into decision rights, resource commitments, and accountability. These arrangements range from light instruments (e.g. manifestos or strategic alliances) to more binding forms (e.g. joint ventures or licensing) (Bloomenthal, 2024; de Man & Duysters, 2005; Gomes-Casseres et al., 2006; Hagedoorn, 1993; Schilling, 2020). Such formalization coexists with informal norms and shared beliefs, so governance typically combines written agreements with enacted routines. Together, they determine how the network is steered.

The governance concepts above serve as the structural lens for interpreting coordination within the innovation network of Schiphol. What it does not explain is how this coordination is enacted from a dynamic perspective. The next section therefore turns to the role of innovation orchestrators in steering the network.

2.4. Innovation Orchestration

Where the previous section specified the structure of collaboration, *orchestration* captures the dynamic coordination aspect that makes this structure work and adapts it to changing conditions. In innovation networks, interdependencies and interests are not static, so structure alone is not sufficient. The concept of 'innovation orchestration' is the process through which network processes are purposefully shaped to keep actors aligned, and engaged around shared innovation goals (Dhanaraj & Parkhe, 2006; Hurmelinna-Laukkanen & Nätti, 2018). An 'orchestrator' can create the environment that enables this shared innovation.

Dhanaraj and Parkhe (2006) describe orchestration as a process that consists of three related orchestration processes:

- **Knowledge mobility:** includes the extent to which knowledge flows within the network. Orchestrators can reduce barriers to knowledge sharing and establish connections between different actors to create the environment where they share knowledge.
- **Innovation appropriability:** refers to the degree to which involved parties can capture value from innovation. This requires management on trust, ownership agreements (IP), and equal distribution of returns.
- **Network stability:** is required for a sustainable long-term collaboration, despite different interests or power asymmetries. Orchestrators can contribute to network stability by fostering relations, manage tensions, and set directions.

These elements reinforce each other and must be balanced contextually. Neglecting one of these processes can undermine the others. For example, knowledge mobility is less effective if there is no trust about the distribution of benefits, which is related to appropriability. The orchestrator must accurately respond to what is most needed to enable innovation in the network at that moment.

Other studies shift the attention of *what* an orchestration does, to *who* orchestrates, and *how*. Hurmelinna-Laukkanen and Nätti (2018) portray orchestration as a dynamic capability: actors adopt, switch, and combine roles so that practices can be adjusted to changing conditions. Later, Hurmelinna-Laukkanen et al. (2022) link orchestration practices to network context showing that effective approaches match a network's degree of interdependence and determinacy. The authors distinguish three profiles: *translative* (low alignment, fuzzy objectives), *transformative* (intermediate form, deepening existing collaboration), and *transcending* (high alignment, explicit goals, exploitation of knowledge).

Each of the profiles is associated with a characteristic set of orchestration practices. In translative settings, practices are centered around creating a shared vision and spanning boundaries between actors. As alignment grows, the practices within the transformative profile focus on specifying shared goals,

agreeing simple routines. In transcending contexts, practices shift toward clear role allocation and standardization, while clarifying IP and profit sharing. These 'practice families' informed the interview guide for this research. Respondents were asked about the activities that Schiphol does related to sharing knowledge, agenda setting et cetera.

These profiles are dynamic, when conditions change, orchestrators often switch roles and re-balance knowledge mobility, appropriability, and stability. In the Schiphol case, the profiles are used as an interpretive lens to identify which profile characteristics align with the innovation network.

Empirical orchestration research remains fragmented and often focuses on project-level alliances rather than wider multi-actor networks (Faccin et al., 2020; Pikkariainen et al., 2017; Roehrich et al., 2023). Therefore, this research uses the described orchestration constructs to explore how collaboration is facilitated across the Schiphol Innovation network. Orchestration adds a dynamic complement to the structural lens of network governance. These constructs informed the interview guide and the findings were interpreted in light of them. The next chapter will explain the design of this research and the methods used.

3

Methodology

This chapter outlines the methodology used to explore how innovation orchestrators facilitate effective collaboration in innovation network within the Dutch aviation industry. The study is based on a qualitative case study of Schiphol Airport's innovation network. The next section introduces the research design and explains why this approach is suitable. This is followed by a description of the selected case (3.2), the sampling strategy (3.3), and the methods used for data collection (3.4). The final section explains how the data has been analyzed to answer the research questions. (3.5).

3.1. Research Design

This study uses a *qualitative single-case study design* to explore how innovation orchestrators facilitate collaboration in innovation networks within the Dutch aviation industry. This design was chosen because collaborative innovation and its orchestration are complex, context-dependent processes that are strongly shaped by the environment in which they occur (Hurmelinna-Laukkanen et al., 2022; van den Oord et al., 2023). In the aviation industry, this complexity arises from the large number of actors involved, their interdependent relationships, and strict regulations. A case study design is suitable to investigate such dynamics, as it allows for a in-depth, context-specific analysis of how orchestration is performed in practice, which is relevant to the complex environment of innovation networks in the aviation industry.

To investigate orchestration, the research design integrates three complementary qualitative methods:

- **Actor mapping workshops**, to explore the structure and actor composition of the innovation network;
- **Semi-structured interviews**, to examine orchestration practices and governance structures in detail;
- **Observations**, to gain additional insights and support interpretation through contextual understanding.

This research design has been applied to the case of *Schiphol Airport's innovation network*. This network offers a relevant setting to explore how innovation orchestration unfolds in practice. The following section explains the rationale for selecting this case.

3.2. Case Selection

The selected case for this study is the innovation network of Schiphol Airport. This case was chosen because Schiphol plays a central role in coordinating innovation across a wide range of interdependent actors such as airlines, ground handlers, infrastructure partners etc. to enable progressive aviation in the Netherlands. This makes the case suitable and rich in information to study orchestration in practice.

Collaborative innovation between airports, airlines, and other partners is increasingly seen as the key to solving complex challenges, such as reducing environmental impact or improving labor conditions

with respect to baggage handling (Future Travel Experience, 2025; Pereira et al., 2021). Orchestrating the innovation network that results from this is therefore of high importance for Schiphol, also to achieve their goal to become the world's most sustainable airport by 2030 (Royal Schiphol Group, 2025b). This drives Schiphol to act as a central actor and initiator of innovation to achieve such goals.

From a scientific perspective, this case offers valuable insights into orchestration unfolds in a complex, multi-actor setting. In addition, the case offers the possibility to study network governance in an *innovation* network, complementing current empirical studies on governance in, for instance, public networks. Moreover, Schiphol's long-term partnership with their innovation partner and consultancy firm *nlmtd*, adds an extra dimension to the case by highlighting the role of an external orchestrator. This innovation partner helps organizations become future-proof by co-creating innovation initiatives, they have an extensive network and a lot of expertise related to start-ups, accelerators, and innovation strategy (Royal Schiphol Group, 2023). The presence of an external partner particularly in innovation orchestration has not been researched yet.

3.3. Sampling Strategy

This research uses a purposive sampling strategy, in which participants were selected based on their knowledge of Schiphol's innovation network and their involvement in relevant innovation activities. The sampling was guided by the need to collect different perspectives from both the central people within innovation at Schiphol and those involved in concrete innovation efforts. Two complementary data collection methods were used: actor network mapping workshops and semi-structured interviews.

Workshops

To understand the structure, dynamics, and actors involved in Schiphol's innovation network, workshops have been organized. Participants were selected based on their strategic position and involvement in the innovation ecosystem:

- **Schiphol's Innovation Hub representatives (3):** individuals who are exploring and shaping the future of aviation at Schiphol. They work on different innovation initiatives while also setting strategic direction. They have a broad view of innovation activities at Schiphol, and the (external) actors that are included with this. These representatives were selected because of their strategic role and knowledge of innovation within Schiphol. They provided insights into the network's composition, the actors with whom they collaborate, and how these relations are structured, which helped compile the initial network actor map.
- **Innovation partner representatives (4):** consultants from *nlmtd* who support Schiphol in orchestrating innovation programs and ecosystem activities. These people have been selected to add on the perspectives of the Schiphol Innovation Hub, by offering an external cross-organizational view on the network's structure, having supported multiple initiatives and partnerships within the network.
- **Procurement department staff Schiphol (4):** individuals that are involved when procuring new technologies at Schiphol. They know what kinds of contracts are in place with current innovation partners, and if they specify anything on innovation collaboration. They have been involved in adding a contract perspective, which is essential to understand how formal structures or collaboration agreements play a role in current innovation initiatives. These people have been involved later to validate the the network actor map.

This combination of participants ensured diversity of relevant perspectives on how the network is structured and who is included in the innovation network of Schiphol, to help answer the first sub-question of this research.

Interviews

For the semi-structured interviews, a more targeted approach has been used to gain deeper insight into the governance structure, orchestration practices, and collaboration challenges (sub-question 2 & 3).

This included the selection of the following interviewees:

- **Representatives of Schiphol's innovation partner (3):** consultants from nlmtl who support Schiphol in orchestrating innovation programs and ecosystem activities. They have been selected because their external position and involvement in innovation efforts allows them to reflect on orchestration practices and the challenges that come with this.
- **Participants in a specific innovation project (4):** the second group has been chosen for their direct involvement in a recent multi-actor innovation project. Their close collaboration around a shared innovation goal was expected to provide concrete practice-based insights into how Schiphol collaborates with external partners, and the orchestration practices included. Because they worked on the same project, they could offer consistent and detailed perspectives on orchestration at project level, complementing the broader view of the innovation partner representatives. The selected group includes employees of Schiphol involved with product and business development of the innovation, a consultant, and an airline representative that was included from an operational perspective.

The innovation partner representatives have been selected to provide a more general perspective on orchestration within the innovation network, whereas the project participants were selected to provide deeper insights in an actual multi-actor collaboration setting. Table 3.1 below provides an overview of the interview participants (anonymized), including their organization and function.

Table 3.1: Overview of interview participants

Participant	Organization	Role / Function
A	Innovation partner	Innovation Program Lead & strategic advisor to Schiphol
B	Schiphol	Go-to-market director responsible for commercializing Schiphol's internal innovations
C	Innovation partner	Business Developer & innovation project lead (Schiphol)
D	Innovation partner	Senior innovator at Schiphol Innovation hub, leading strategic projects
E	Airline X	Process coordinator, ground operations
F	Schiphol	Airside process manager
G	Consultancy firm Y	Business developer & consultant

Participants were identified through the network of the innovation partner and the Schiphol Innovation Hub. Two gatekeepers have provided access to the interview participants. One of them was connected to the innovation partner, and was part of the Schiphol Innovation Hub. The other gatekeeper was the head of innovation of Schiphol's Innovation Hub. The participant list evolved during the early research phase. The final sample reflected the most relevant and varied participants regarding the orchestration activities.

Reflection on sampling bias

Even though participants were purposefully selected for their relevance to the research questions, several potential biases should be acknowledged. The workshop participants came mainly from Schiphol's Innovation Hub and its innovation partner, which could lead to a more centralized view of the network. External or peripheral actors were not directly involved. To mitigate this, validation steps were included, such as a feedback session with the procurement department to refine the network representation. The interview sample was focused, prioritizing participants with direct experience in Schiphol's innovation initiatives. While this allowed for in-depth practice-based insights, it could lead to relatively coherent or aligned narratives. Also innovation partner representatives may have an interest in portraying their orchestration efforts in a favorable light. These risks were mitigated by including participants from different organizational positions and by triangulating interview data with the insights from workshops and

the researcher's own observation.

This research does not aim for broad generalization, but for a in-depth understanding of orchestration in a complex innovation network like Schiphol's. Given the time constraints of this study, a focused and logical sample was required to ensure depth while remaining feasible within the available time.

3.4. Data Collection

The data for this research have been collected through a combination of network mapping workshops, semi-structured interviews, and the researchers' observations. This mixed data collection method ensured a multi-layered understanding of the Schiphol Airport innovation network and the orchestration practices involved with it.

Workshops

Three network mapping workshops have been conducted, to explore the structure, context, and complexity of Schiphol's innovation network. All workshops have been held in person. The first one included with two people of Schiphol's innovation partner and three people of their Innovation Hub. This session was used to create a first version of the map. The second workshop included two additional people of the innovation partner with different aviation-related backgrounds to refine and expand the mapping. The final and third workshop was with people of the procurement department of Schiphol, to validate the map from a formal contracting perspective.

Each session lasted approximately 1.5 hours and was facilitated by the researcher. The sessions have been recorded but not transcribed. Through an open, interactive discussion, the participants suggested who was included in the network and explained what the collaboration with these partners entails. Through this iterative process, the group created a shared understanding of which actors played central roles in the innovation network. The outputs have been captured in Miro, an online collaborative whiteboard tool.

The workshops revealed that Schiphol's innovation network is not static, relatively large, and complex to study. Placing the actors in certain categories was challenging, as many roles were found to be dependent on specific innovation themes or collaboration settings. For this reason, the interview part of the research has been focused on a single innovation project. This allows for a more detailed examination of orchestration activities in practice.

Interviews

During the second phase of the research, seven semi-structured interviews were conducted. The interviews were held in person and online using Microsoft Teams. Each interview lasted between 45 to 60 minutes and was conducted in Dutch. Interviews were recorded and automatically transcribed using Teams.

Two interview guides have been developed (see Appendix A). One for the participants who were part of a specific innovation project, and another one for the innovation partner participants, to tailor the questions to the context. Both guides include five themes: network structure & dynamics, collaboration setup & governance, orchestration practices, and challenges. The guides have been created based on the theory as presented in the theoretical framework (Chapter 2) of this report. The questions have been compiled based on the following theoretical grounds. The order does not correspond exactly with the theoretical framework, this is to improve the flow of the interview (Table 3.2):

Table 3.2: Interview themes and their theoretical grounding

Interview theme	Theoretical ground
A. Introduction & background	–
B. Network	• Orchestration profiles (section 2.2 & 2.4)
C. Collaboration Setup & Governance	• Governance modes (section 2.3)
D. Orchestration Practices	• Orchestration processes • Orchestration practices per network type (section 2.4)
E. Challenges	• Governance challenges (section 2.3)
F. Reflection & evaluation	–

The interview guides have been reviewed and refined by the researcher's academic and company supervisors.

Observations

The researchers' observations were used as a complementary data source. As part of the case study, the researcher was part of the Schiphol account at their innovation partner for five months. The researcher was present during account meetings and has visited the Schiphol Innovation Hub several times. These observations helped gather contextual insight in the innovation network. Notes were taken throughout this time, to support data triangulation and improve interpretation of the other data sources.

Ethical considerations

All participants signed an informed consent form. The form outlined the goal of the research, how their data would be used, and measures about data confidentiality and storage. Names and roles of interviewees have been anonymized in all transcripts. The research received approval of the Human Research Ethics Committee (HREC) at TU Delft who evaluated the data management plan for this study.

3.5. Data Analysis

The data analysis of this study is a combination of an interpretive analysis of the workshop outcomes and a thematic analysis of the interview data. The analysis process followed an abductive logic, which means that the theoretical concepts informed the analysis, but were refined throughout the research process based on the gathered empirical insights.

The workshops and the researcher's observations resulted in the innovation network map, which ensured contextual knowledge to support the interpretation of the other data sources. The analysis was focused on capturing the collective insights and translating them into a visualization that represents the Schiphol Innovation Network. The network map has been refined iteratively based on the different workshops.

The interview data have been thematically coded using the coding software ATLAS.ti. This method has been selected because it helps identify patterns specific to certain themes across different perspectives. The initial codes were based on the key concepts as presented in the theoretical framework (Chapter 2). These codes provided a starting point, but changed significantly during the coding process. This coding method allowed the analysis to stay close to theory, while also being responsive to the context of the Schiphol case.

The interview data was automatically transcribed while being recorded with Microsoft Teams. Then the transcripts were summarized according to the main themes of the interview guide to get rid of any repetitive or useless information. The summarized transcripts were shared with the interviewees afterwards to validate if all information was interpreted the right way. The transcripts are not publicly available due to privacy reasons. The summarized transcripts were then uploaded to ATLAS.ti, where the coding analysis was done. This was an iterative process, starting with coding the transcript, then

reviewing it, comparing codes between other transcripts until sufficiently coded. There were predefined category codes, with subcodes underneath, which changed along the coding process. Table 3.3 shows an overview of the main category codes used for the analysis. In Appendix B, the full code book, including the subcodes, descriptions and groundedness is presented.

Table 3.3: Overview of code categories and descriptions

Category code	Description
Context	Background information on the innovation network and interviewee roles.
Governance formality	Degree to which coordination is organized through formal or informal structures.
Governance mode	Characteristics of governance mode applied in the network, such as lead organization or NAO.
Network	Characteristics of the innovation network, including actor composition and interdependence.
Orchestration practices	Actions taken to facilitate collaboration, such as actor mobilization, knowledge sharing, and stakeholder management.
Orchestrator role	Roles that orchestrators take within the network.
Reflection on involvement nlmt	Reflections on the impact and potential influence of Schiphol's innovation partner on the network.
Challenges	Barriers to collaboration within the network.

After all transcripts were coded, a thematic analysis followed to systematically address the research sub-questions. Each of the category codes has been assigned to broader code groups, which correspond directly to this research' sub-questions (see Table 3.4). For example, codes such as *governance formality*, *governance mode*, *network*, and *orchestrator role* were grouped under code group 1 "*network type & actors*" to support the first sub-question.

Table 3.4: Overview of code groups and their underlying category codes

Code group	Category code
1. <i>Network type & actors</i>	Governance formality Governance mode Network Orchestrator role
2. <i>Enablers of collaboration</i>	Governance formality Orchestration practices
3. <i>Challenges & how managed</i>	Challenges Reflection involvement nlmt

Then, the analysis proceeded by reviewing the coded data per code group. For each group, the coded segments were compared between the interview participants. This helped identify recurring themes, and key insights were noted for each underlying category code. For example, within code group 1 "*network type & actors*", the category *governance formality* included two subcodes: formal and informal governance. By comparing how different actors described coordination, patterns could be identified in how governance structures were perceived. In this case, the analysis of these subcodes led to insights on how coordination was structured and how this relates to the type of network being orchestrated.

This structured use of code groups ensured that the analysis was directly connected to the research sub-questions. In addition, the grouping guaranteed that not only isolated codes were analyzed, but also that patterns were interpreted throughout interviews and that the insights were connected with the theoretical lens as presented in Chapter 2. The results chapters were structured to reflect this, with each subsection organized around one of the sub-questions and its corresponding code group.

To ensure the validity and credibility of this qualitative analysis, several strategies have been applied. The analysis was based on theoretical grounds, and codes were refined iteratively through repeatedly evaluating the interview results. The data has been triangulated by combining the three data sources: workshop outputs, interview data, and the researcher's observations. In addition, the analysis has been validated with people of Schiphol and their innovation partner, to ensure that the data is interpreted correctly. This helped mitigate individual bias of the researcher.

4

Results

This chapter presents the empirical findings of this research, based on semi-structured interviews, workshops, and the researcher's observations on the Schiphol innovation network. The goal of this chapter is to answer the main research question: *How do innovation orchestrators facilitate collaboration in innovation networks within the Dutch aviation industry?*

To guide the analysis, three sub-questions will be answered in different sections of this chapter. The first section (4.1) explores the structure and dynamics of the Schiphol innovation network by describing who is involved, how the network is structured, and what governance mechanisms shape the network. This analysis shows what kind of innovation network is being orchestrated. The second section (4.2) focuses on how collaboration within the network is being facilitated by the orchestrators. Six orchestration practices have been identified that enable effective collaboration. The section shows how both Schiphol and their innovation partner execute these practices, depending on the collaborative setting. The final section (4.3) explores the challenges that occur while orchestrating collaboration in Schiphol's innovation network. The different challenges are grouped in five categories. The section concludes with a reflection on how orchestration practices and the involvement of an external innovation partner could strengthen network collaboration.

4.1. The Innovation Network of Schiphol

To explore the innovation network of Schiphol Airport, this section dives into its structure, who is involved, and its governance dynamics. It addresses the first sub-question of this research: *What are the structural characteristics of the innovation network and who are the key actors involved?* The analysis is based on network mapping workshops, semi-structured interviews, and the researcher's observations during the case study. The section is divided into two substantive parts. The first subsection presents a visual representation of the actors in the innovation network of Schiphol, explaining its composition and the proximity of actors (4.1.1). The second subsection explains the network characteristics and governance dynamics (4.1.2). The final part presents the conclusion to the first sub-question of this research (4.1.3).

4.1.1. Innovation Network Actor Map

To understand who are the actors involved in the innovation network of Schiphol Airport, an innovation actor map has been created (see next page, Figure 4.1). The map has been co-created through four workshops with both people of Schiphol's innovation partner, and their Innovation Hub, and the procurement department of Schiphol.

The design of the actor map will first be explained on the page following the map, followed by the main findings that resulted from this. After that, the map's content will be broken down further.

Actor Map of the Schiphol Innovation Network

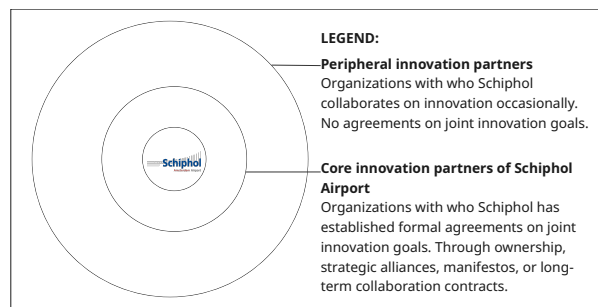
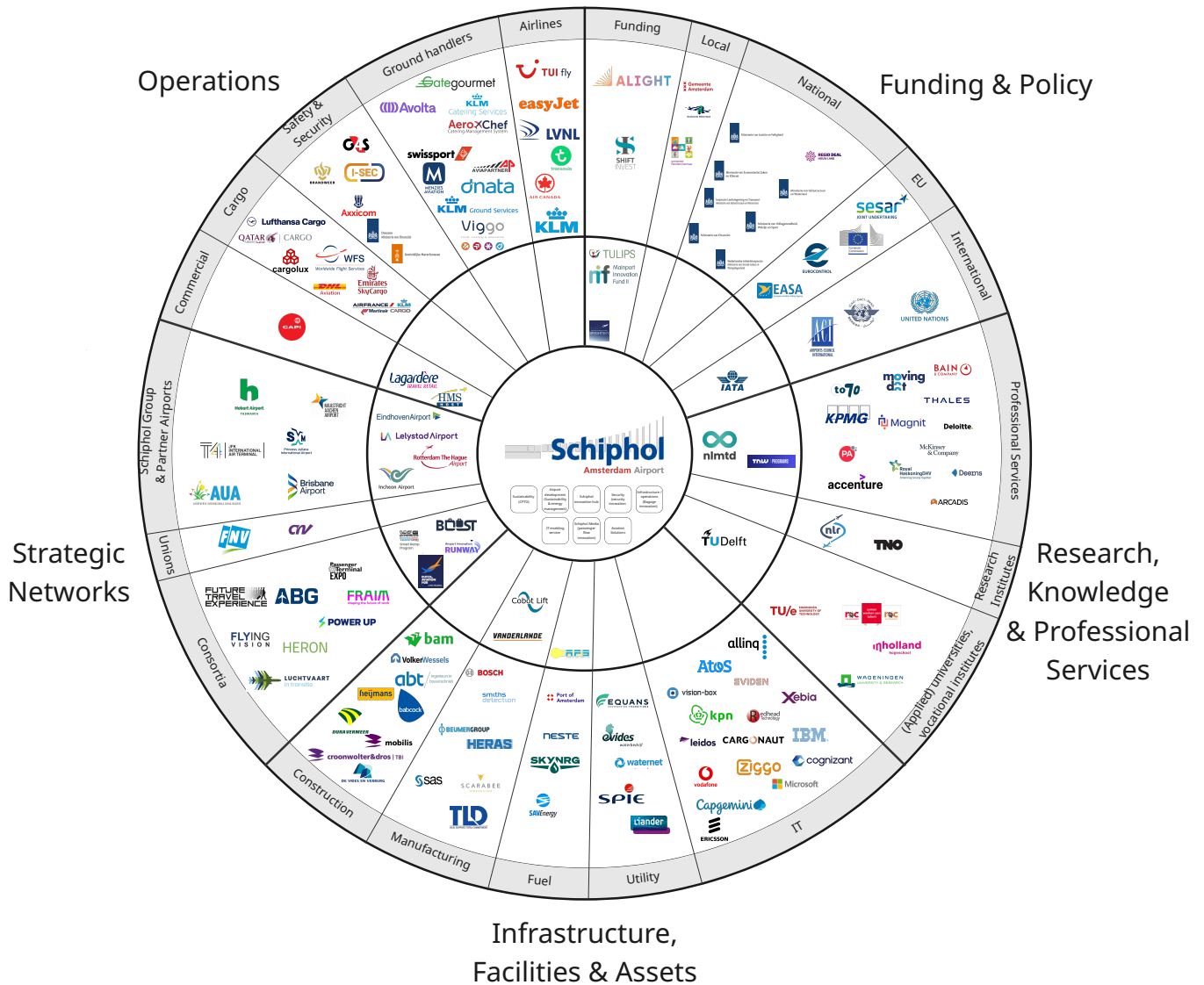


Figure 4.1: Visual representation of the actors in Schiphol Airport's Innovation Network

The innovation actor map is structured as a union model with different layers. The layers capture both the proximity as the formality of collaboration between Schiphol and its partners. The inner layer, closest to Schiphol are the actors with whom Schiphol maintains formal or semi-formal innovation arrangements (section 2.3). These can be arrangements on joint innovation goals, through ownership, strategic alliances, manifestos, or long-term collaboration contracts. An example of such collaborative arrangement is the BOOST program, which is a collaborative innovation program on the topic of baggage handling. Within this program, Schiphol and other airports have committed to work jointly on this topic to accelerate innovation in the baggage domain (BOOST Baggage, 2025). The outer layer includes actors with whom Schiphol collaborate on innovation without any formalized arrangement on further joint innovation goals. These actors may be engaged through innovation projects. It's important to note here that these partners could have 'regular' contracts with Schiphol on their assignment. However, for this actor map, there has been looked into contracts mentioning specific joint *innovation* goals.

Besides the layers, the actor map is further segmented into domains, each representing a functional area in the innovation network. Each domain consists of subdomains that are created to show a group of actors with similar roles. For example, the operations domain includes the sub domains of airlines, ground handlers and security related actors. The research and knowledge domain shows universities, research institutes and professional services companies. Each domain is a different area within the innovation network but also represents different contributions to innovation.

The actor map offers an understanding of how the innovation network of Schiphol is currently structured at Schiphol and to what extent collective innovation goals are defined. The layered model shows both existing formal innovation arrangements as unused opportunities for innovation. Within multiple domains it appeared that for some 'important actors' like large airlines and large construction companies, there were no innovation related collaborative arrangements in place. Despite their importance, some essential actors are not part of formal innovation arrangements with Schiphol. This might be showing a disconnection between operational relevance and innovation governance. By visualizing the gaps, the map helps identify where an orchestrator could build relationships or collaboration mechanisms to further strengthen the innovation network.

The map's high density of actors spread across the wide variety of (sub-)domains reflects the complexity and the scale on which Schiphol does innovation. The large number of organizations, each having different roles, interests, and proximity to Schiphol shows that innovation orchestration is not a static process, but dynamic and context dependent. In addition, the map shows that Schiphol engages in different types of collaborative frameworks, such as association or consortia memberships, letters of intent, and jointly developed sectoral agreements. Each of the domains will be further elaborated on in the remainder of this subchapter.

Operations

The operations domain includes actors that are related to the daily operations of the airport. These could be airlines, ground handling companies, safety & security, cargo or commercial retailers at the airport. Examples of innovation projects are related to improving ground handling activities like turnaround times, baggage logistics but also topics related to sustainability, like sustainable taxing or capturing ultra fine particles on the apron (Schiphol, 2025). For projects like these Schiphol needs to work together with multiple parties from every subdomain to innovate. During the network analysis it became clear that there were only formal innovation contracts with two commercial retailers. Although actors, like large airlines or ground handling companies seem important for these topics, formal innovation agreements are not in place.

Funding and Policy

The funding & policy domain includes funding actors, municipal, national, EU and international actors that have financial or regulatory roles related to innovation at the airport. These include funding mechanisms such as subsidies or innovation grants and policy regarding for instance climate change and energy transitions. In the outer layer of the funding subdomain, the actors are mostly investors. The inner layer shows innovation consortia funded by the EU, such as TULIPS. The fact that it is funded by the EU reflects a collaborative arrangement which is why it is shown in the inner layer. TULIPS is a consortium led by Schiphol, the goal of this consortium is to promote low carbon mobility and sustainability (TULIPS, 2025). The project has received funding from the EU's Horizon 2020 research and

innovation program. The initiative aligns with broader EU goals to lower carbon emissions.

Within the other subdomains, municipal, national, and EU the actors are more focused on policy. However, within this domain it's essential to note the layered nature of rules within aviation. The distinction is as follows:

- Formal legislation (governments)
- Sector-wide standards (such as baggage tag coding systems)
- Recommended practices (like data protection (AVG))
- Sectoral agreements (by organizations like IATA) (Mapping workshop 3, June 18, 2025)

Sectoral consortia are important in developing sectoral agreements and standards. For example, the International Air Transport Association (IATA) is an aviation trade association that organizes working groups where aviation stakeholders jointly develop recommended practices. This is also why IATA is in the inner layer because Schiphol is a member of this association, while the other actors impose rules on Schiphol (outer layer).

Research, Knowledge and Professional Services

This domain consists of universities, research institutes, and professional service providers like consultancy firms. This domain mainly serves as a way to explore emerging technologies and knowledge. Together with these research related actors, Schiphol works on diverse innovation topics like automatization and data driven solutions. For example, Schiphol works together with TU Delft on a living lab at Rotterdam The Hague Airport, which is part of Schiphol Group. This collaboration has been formalized by a Letter of Intent in 2019, which is why TU Delft is in the inner layer of the model (TU Delft, n.d.). Consultancy firms offer expert knowledge that Schiphol does not have internally, the innovation projects for which they are hired can be quite diverse. It can be providing (strategic) advice, developing IT solutions, coordinating projects et cetera. Within this subdomain, only the innovation partner is in the inner layer, as they are a contracted partner of Schiphol Airport.

Infrastructure, Facilities and Assets

Actors in this domain include construction companies, manufacturers, IT, fueling, and utility providers (e.g. energy, water). Innovation in this domain focuses mainly on airport development projects, improved infrastructure, and energy transitions. Collaboration is mainly structured through projects. There are two categories in which innovation collaboration arrangements are in place. The first one is within fuel, this is the company that is responsible for all fuel at Schiphol Airport. They collaborate on sustainable aviation fuel (SAF). Next to that, within the manufacturing domain there are several actors that are contracted due to a specific innovation topic such as baggage.

Strategic Networks

Within the last subdomain, the airports within Schiphol Group are shown, unions, and consortia. These are strategic networks in which actors collaborate on systematic innovation topics such as autonomous turnaround (innovation program Smart Ramp), baggage (BOOST), Single European Sky Air Traffic Management (HERON consortium), and climate neutral flying (Flying Vision initiative). These networks are important to map, because it shows what kind of topics Schiphol is already working on collectively. Within the Schiphol Group, not all airports are included in the inner circle of the network, because they do not yet work on innovation collectively throughout the group. Also, the airports within the Schiphol Group are operated through a variety of management contracts, strategic interests, partial or full ownership, and holding or exploiting real estate (Royal Schiphol Group, 2024).

Internal Innovation Structure

Within Schiphol, innovation follows a hub and spoke model, in which the Schiphol Innovation hub serves as a central coordinating entity of innovation. The hub is connected to different parts of the organizations that work on innovation efforts. The spokes are formed by departments such as sustainability, airport development (energy management), security, infrastructure operations (baggage innovation), IT enabling service, Schiphol Media (passenger flow innovation), and Aviation Solutions (selling proven innovations to other airports).

4.1.2. Structure and Governance of the Innovation Network

This section presents part of the semi-structured interview results with participants of the Schiphol innovation network. The actor map provided a visual overview of the network composition and the collaborative arrangements between Schiphol and its partners. The interviews offer a deeper insight in the network characteristics, what formal procedures (related to innovation) are in place, and what network governance mechanisms exist. The goal is to understand the structural characteristics of the innovation network, while focusing on formal innovation procedures and existing network governance mechanisms.

Network characteristics

The Schiphol innovation network is *diverse* and *layered*, including actors across various domains. It is also characterized by its *dynamic actor roles*, which change depending on the innovation stage and project focus. Finally the *interdependence* in the network is *high* and dependencies increase even more as is even more increased as innovations mature. These characteristics will be explained below.

The first characteristic is that Schiphol is part of a diverse and layered network. Interviewees describe Schiphol's innovation network as large, spanning different domains and including many different actors, such as academic institutions, corporates, government bodies, and sector-specific innovation partners. Depending on the topic or department, different subsets of actors within the network are included. This is also illustrated in section 4.1.1, that presents the network actor map, which visually reflects the domain-based segmentation as mentioned by the interviewees. One interviewee describes this as each domain having their own small networks:

Within each domain, teams often have their own networks. For example, Airside Operations has a network of people at other airports and with their direct stakeholders, handlers and airlines. Terminal or Passenger Operations teams will have their own networks. (C, interview, June 4 2025)

Another example, within the innovation project explored for this case study showed that operational departments, airlines, and ground handlers needed to be included, whereas energy-focused projects rely more on infrastructure partners and fuel providers (B, interview June 5, 2025). This aligns with what was found within the innovation actor map of the previous section. These insights confirm that the network is segmented based on functions but still is interconnected.

The roles of the different actors in the network of Schiphol are not fixed. Actor involvement shifts depending on the project stage or maturity and its substantive focus. Some stakeholders are brought in for early-stage experimentation, while others only become involved from scale-up. This dynamic is illustrated by the innovation project explored for this case study. In the early stages of the project, when Schiphol focused on developing a proof of concept and piloting the new tool, actors like ground handlers and airlines were mainly only consulted and informed in later stages of the innovation process. Their role in the developing process was limited.

[...] we [airline] looked at the data and gave feedback [to Schiphol] on whether it [the tool] was correct and useful for us [...] [b]ut beyond giving feedback, we didn't have an official role in the development itself. The scope and the design of the project had already largely been defined by Schiphol by the time we became involved. (E, interview, June 12, 2025)

However, as the project moved forward to implementation and operational integration, the same actors became central to adoption:

A turning point came when our tool started providing real value in daily operations. For example, a ground handler realized they could optimize equipment use. An airline was able to reduce the time spent in daily meetings about turnaround data. When partners started to depend on the tool, adoption really accelerated. (B, interview, June 5, 2025)

This turning point reflects how actors who were initially peripheral to the development phase, became essential during implementation and operational integration. This shows how the same actors may shift from peripheral to key roles, depending on the maturity of the project.

As the innovation network map already showed a lot of actors, many interviewees emphasized that these actors are highly interdependent. Many innovation projects or topics require coordination be-

tween multiple internal and external actors, especially if operational or infrastructure processes are involved. This interdependence increases as innovations mature and move toward operational integration. According to one participant, scaling technologies (for instance from pilot to implementation) often creates new dependencies, such as regulatory approval, operational alignment and funding:

But as you move toward higher TRL levels, shifting from proof of technology to proof of operations, more actors become involved. That's because the technology needs to function within a real operational environment. At that point, you start dealing with health and safety, security, legal regulations, various handlers, air traffic control, and so on. (A, interview, May 28, 2025)

Together, these characteristics show that the innovation network of Schiphol is complex, and highly interdependent, where actor roles vary by context and maturity of the innovation (project).

Formal procedures while innovating at Schiphol

In addition to the composition of the network, interviewees also provided insight into the (in-)formal structures used within Schiphol to systematically collaborate at Schiphol. Schiphol's innovation collaboration is characterized by a mix of formal, semi-formal and informal structures. The most prominent formal mechanism is the public procurement process, which is legally required for high cost innovation projects. In addition, Schiphol uses semi-formal processes such as airlines consultations for investment decisions. Despite these formal mechanisms, much of the collaboration in the network is based on trust. This mix of (in-)formal structures highlights both the constraints and flexibility in Schiphol's innovation governance. This will be further elaborated on below.

The procurement process and innovation investment decisions of Schiphol is the most mentioned formal aspect to collaboration while innovating at Schiphol. The airport is a public entity, a special sector company. Therefore, Schiphol is bound by Dutch and EU public procurement laws, to ensure transparency and fair competition for suppliers (Royal Schiphol Group, 2025c). Interviewees stated that projects that exceed a certain financial threshold require public tendering: "Everything is regulated by law when it comes to financial thresholds that require a tender. Schiphol must follow these legal requirements, like any public entity" (D, interview, June 11, 2025). The interviewees emphasize that innovation related tenders have to be organized very often due to two reasons. First, often the technology used for innovation projects at Schiphol, is already expensive on itself. Next to that, if the project is scaled up, higher budgets are involved which automatically require a tender process to be started. Even though the tender process ensures fair competition, interviewees also highlight that the process takes up a lot of time and can be cumbersome, not well designed for emerging technologies or innovation processes (D, interview, June 11, 2025). One of them shows the effect on established relationships: "If the project exceeds a certain financial threshold, Schiphol is required to go through a new procurement process. So even if they want to work with you, they may have to re-tender the project" (G, interview, June 17, 2025).

In addition to the formal process of tendering, interviewees highlight another semi-formal collaboration process: airline consultation on Schiphol's investment portfolio. This is an example of how Schiphol includes external actors in their decision-making process regarding high investments. In this case, airport operations are funded by the airport fees paid by airlines. The airlines are (formally) consulted when high-cost innovation projects are done at Schiphol (D, interview, June 11, 2025; F, interview, June 13, 2025). The innovation project explored for this case study, for instance, has first been reviewed by the airlines before it was continued: "[The innovation project] was presented to [the airlines] through this [consultation] process, and no objections were raised, which allowed us to proceed with a phased roll out over several years" (F, interview, June 13, 2025).

Despite the formal collaboration structures, collaboration on innovation within Schiphol often also relies on informal interaction and trust-based relationships. As one participant explained: "The procurement process is very formally structured. But in the projects themselves, it's more informal, more about seeing which projects are there and how you can get involved" (G, interview, June 17, 2025). Since the external innovation partner is included, they try to bring relevant actors together with a shared problem, on informal basis. They can help establish partnerships, but these are often not formal in legal terms (D, interview, June 11, 2025).

Governance Modes: Lead Organization and NAO elements

The innovation network of Schiphol is governed through a combination of centralized leadership complemented by external facilitating support to coordinate the network. This shows that there is a hybrid governance structure in place. From the actor mapping workshops and the interviews was found that Schiphol is the obvious leader within their innovation network. While Schiphol has a strong lead organization role, in defining direction and initiating innovation projects, the external innovation partner provides support as an independent stakeholder. This combination shows elements of both the *lead organization* and the *network administrative organization (NAO)* governance modes as described by Provan and Kenis (2008). There is no indication of shared governance in this innovation network, as the network has too many participants for that.

Interviewees consistently describe Schiphol as the main driver of the innovation network. They emphasize that Schiphol takes a clear and active leadership role. Several aspects of Schiphol's role in the network align closely with the features of the lead organization governance mode as defined by Provan and Kenis (2008). First, the strategic and operational decision-making is centralized, Schiphol defines the innovation agenda (roadmaps), sets priorities, and initiates projects based on these roadmaps. In terms of power, Schiphol has a unique and dominant position.

As the airport they are the controller of key aviation infrastructure and assets, and they have great access to funding by the EU. From this position, they have the ability to steer collaboration between actors using this infrastructure.

Also, Schiphol leads and maintains the network to align with core airport processes. The innovation project explored for this case study illustrates this, as Schiphol launched the initiative, selected actors to involve and managed the implementation of the tool.

In addition to this, these actors like airlines, suppliers, and research partners primarily interact with Schiphol being the central actor, rather than each other. Innovation efforts are generally coordinated through bilateral relationships, and not through collective mechanisms, which also became clear from the interviews:

About once a month, or every two months, there was an update session where Schiphol shared their development plan and timeline with us. They also communicated which feedback they had received from other partners, for example, from a ground handler [...] the meetings were just between us and Schiphol [...] we actually don't have much insight into how other airlines are using the system or what kind of feedback they are giving. (E, interview, June 12, 2025)

These combined features reflect the *lead organization governance structure* because this network is not distributed or co-managed like the shared model, but instead it is led and structured around a single actor.

While Schiphol leads, their innovation partner facilitates, coordinates and executes projects to support innovation at Schiphol. This resembles the characteristics of the *NAO governance mode*, however, in a limited and evolving form. Within the NAO model, a separate entity is established to coordinate the network on behalf of all the members. Schiphol's cooperation with their external innovation partner reflects this model partly. The innovation partner supports the innovation network by coordinating pilots, aligning stakeholders, tech scouting and managing innovation programs. These activities are related to orchestration practices and will be further elaborated on in the next subsection (4.2).

However, the innovation partner does not act as an independent entity orchestrating the network. Their role is currently mainly assignment-based initiated and scoped by Schiphol. They lack autonomy or mandate to govern the broader network or even ecosystem as illustrated by the following quotes:

We do not have the assignment to orchestrate the whole ecosystem of Schiphol. We don't do that yet (A, interview, May 28, 2025)

We [the innovation partner] have a partnership with the Schiphol Group. This allows us to also play a role in innovation across the various airports of the group. In practice, this is currently more of a facilitating role. (D, interview, June 11, 2025)

This is why the innovation partner does not meet all criteria of being a NAO, like that they are not central with a network-level governance function. Instead, the innovation partner functions more as an

embedded orchestration partner, offering network-level competencies on demand, but without formal authority or responsibility for the whole network.

The combination of Schiphol as a lead organization and the innovation partner complementing this with NAO elements, reflects a hybrid governance mode. The lead organization delegates some orchestration capacity to an external partner but remains in control regarding strategy and decision-making.

4.1.3. Sub-conclusion: Actors, Structure and Governance of the Schiphol Innovation Network

The innovation network of Schiphol is characterized by a layered and functionally segmented structure, governed through a hybrid model. Schiphol acts as the orchestrator of this innovation network, by taking a central position as lead organization. The airport defines the strategic direction and coordinates innovation activities across the network. This role is complemented by their external innovation partner, who support coordination, stakeholder alignment, and facilitates innovation partnerships. Including an external innovation partner reflects elements of a network administrative organization (NAO) governance mode. Together, both of their roles suggest a hybrid governance structure, combining centralized leadership with characteristics of an external orchestrating entity.

The network includes a mix of formally integrated core innovation partners, and a broader set of peripheral actors who collaborate with Schiphol more occasionally instead of structurally collaborating on joint innovation goals. The actors in the network span across different domains from operations to infrastructure, however, the analysis showed that not all strategically relevant actors (such as large airlines or infrastructure companies) belong to the group of core innovation partners.

The actors within the network take up different roles depending on the stage and focus of innovation projects. They are highly interdependent, which increases as innovation projects mature. Although formal procedures such as procurement and airline investment consultations processes structure collaboration, much of the interaction on innovation remains informal and trust-based, particularly in the early stages. This combination of formal and informal structures further reflects the network's hybrid governance character.

While the analysis showed what the network of this case looks like in terms of actors, governance structure, and the mix of formal and informal collaboration mechanisms, it also made clear that actors play different roles depending on their domain, their proximity to Schiphol and the maturity of innovation projects they're involved in. Understanding the network's actors, structure, and governance does not yet explain how Schiphol actively creates the conditions for innovation to occur together with these actors. What kind of practices or activities do they use to mobilize actors, align interests, and promote shared innovation? The next part of the results section (4.2) addresses this, by analyzing the orchestration practices applied in the Schiphol innovation network.

4.2. Enabling Network Collaboration through Orchestration Practices

The next section discusses how collaboration is actively facilitated by innovation orchestrators, to address the second sub-question: *What orchestration practices are applied to promote collaboration in the network?* Orchestration practices are concrete activities that facilitate and promote collaboration across the innovation network. In the previous section (4.1) the Schiphol innovation network has been identified as a hybrid network governance mode. From this point on, the analysis proceeds on the understanding that there are two orchestrating entities in the Schiphol innovation network:

- **Schiphol** itself, being the central lead organization, complemented by their
- **Innovation partner**, reflecting key elements of a network administrative organization (NAO).

The insights on orchestration practices are based on semi-structured interviews with actors from Schiphol, their innovation partner and network partners. The first subsection describes the orchestration practices that could be identified from the interviews (4.2.1). In addition, the analysis revealed that the exact use of these orchestration practices depends on the collaborative setting in the network (4.2.2). The section ends with a conclusion that shows how these orchestration practices enable network collaboration (4.2.3).

4.2.1. Orchestration Practices

From the interviews, six orchestration practices that promote network collaboration have been identified. These practices reflect how orchestrators create the conditions for actors to jointly work on common innovation goals. In Table 4.1, the practices are presented and defined. They are often used in combination and tailored to the collaboration context. The last column shows if interviewees attributed the orchestration practice mostly to Schiphol, or its innovation partner.

Table 4.1: Orchestration practices promoting collaboration in the Schiphol innovation network.

Orchestration Practice	Definition	Who?
<i>Actor mobilization</i>	Bringing relevant actors together around shared problems.	Both
<i>Agenda setting</i>	Setting innovation direction and goals.	Mainly Schiphol
<i>Knowledge sharing</i>	Facilitating exchange of ideas, insights and information across actors.	Both
<i>Stakeholder management</i>	Identifying and engaging key actors based on their role, power, and interest.	Both
<i>Strategic guidance</i>	Advising on innovation related topics.	Innovation partner
<i>Trust & commitment</i>	Building trust through transparency and shared value.	Both

Actor mobilization

Actor mobilization refers to the process of bringing relevant actors together around shared problems. In the Schiphol innovation network, both Schiphol and their innovation partner contribute to this process, but in different ways. Schiphol mainly mobilizes actors through structured programs, and innovation projects. These projects are sometimes tied to external funding. As example, the airport is involved in EU funded initiatives, such as the TULIPS program, where Schiphol is the lead. Actors are brought together to address topics like sustainability.

The innovation partner on the other hand, supports Schiphol with a more proactive approach. Within open innovation programs such as BOOST and Smartramp, the innovation partner actively helps identify and collaborate on shared problems, they select relevant actors for this. As one interviewee explained:

We also facilitate innovation partnerships. When we see a common problem appearing in different parts of the ecosystem, we actively bring the relevant actors together to collaborate on that issue. We sometimes formalize this collaboration through partnership agreements, ensuring that actors work together in a structured way to address shared challenges. (D, interview, June 11, 2025)

In these cases, Schiphol's innovation partner helps define the collaboration, sets up the approach to mobilize actors and ensures that progress is made with for instance the innovation program. In addition, the innovation partner does scouting and network brokering activities as part of actor mobilization. An example of a scouting program is Airport Innovation Runway (AIR). In this program the innovation partner searches for startups that match specific innovation challenges of Schiphol. As described by an interviewee: "We also support AIR, the open innovation program of Schiphol [...] we'll find one or two startups that can offer a solution, and then we move on to piloting" (A, interview, May 28, 2025). With network brokering, people of the innovation partner connect actors across the network by leveraging their presence in multiple organizations (also outside the aviation sector): "[...] I often spot opportunities to connect people or bring in external players" (C, interview, June 4, 2025). In addition to this, the innovation partner organizes events or conferences like The Next Web conference to bring together actors. These events could be seen as early moments of mobilization, of which formal partnerships can develop.

Agenda setting

Agenda setting involves defining and carrying out innovation goals. Schiphol sets the broad strategic innovation direction through long-term visions with across areas like airside, baggage, or sustainability. "Each of these teams has its own long-term vision for Schiphol [...] from that future vision, they work backwards to determine which innovations need to be initiated and tested and how to achieve that vision." (A, interview, May 28, 2025). This is then translated into a roadmap by internal departments related to these topics. The innovation partner supports Schiphol's strategic goals by helping them translate them into actions. For example, they use tools like InnovationCast software to keep track of innovation projects. In addition, they help with agenda setting through innovation programs, where the different interests and goals of actors are translated in a shared research agenda.

Knowledge sharing

The practice of knowledge sharing refers to how information and insights are exchanged within the innovation network. Both Schiphol and their innovation partner play an active role across different levels of collaboration. Knowledge sharing is particularly relevant in the context of innovation programs. In such contexts the success of the collaboration depends on transparent information flow between actors. The conditions should be just right to create a shared learning process. The innovation partner plays a key role in creating these conditions. They ensure transparent communication, trust and commitment across actors. This is why this orchestration practice has strong overlap with the 'trust and commitment' one. The innovation partner helps formalize the collaboration around a shared ambition so actors can share relevant knowledge.

Another important mechanism to get knowledge in, is technology scouting. The innovation partner monitors and searches for new technologies or startups. After that, these companies are brought in to use their knowledge within an innovation challenge at Schiphol. Similar happens with consultancy companies that have very specific knowledge that Schiphol does not possess. One of the interview participants stated that knowledge sharing already starts in the early tendering process:

You're [consultancy company] invited to give your vision, and they [Schiphol] provide a case to base it on. It's actually a good way for Schiphol to gather knowledge. Even if they don't choose your firm, they still learn a lot from the cases. (G, interview, June 17, 2025)

Finally, within innovation projects, knowledge is shared and captured through regular update sessions with external partners. Internally, Schiphol innovation teams meet regularly to exchange lessons across projects (A, interview, May 28, 2025; E, interview, June 12, 2025).

Stakeholder management

Stakeholder management involves identifying relevant actors, understanding their influence, and interests and engaging them to support collaboration. While stakeholder management is closely related to actor mobilization, it has a different function. Actor mobilization focuses on bringing the right actors

within the network, or in an innovation project, whereas stakeholder management is about maintaining engagement and alignment once these actors are involved. Within the Schiphol Innovation network, stakeholder management is especially done at project and program level. Interviewees reported mainly about stakeholder management mechanisms that the innovation partner uses. They apply structured methods like stakeholder matrices, responsibility matrices (RACI), and tracking sheets as highlighted by the interviewees:

I typically create a stakeholder tracking sheet where I list who is involved, what we need from them [...] that helps us stay aligned and maintain engagement. (C, interview, June 4, 2025)

This [stakeholder matrices] helps map out each stakeholder's involvement. Are they someone you need to inform, consult, involve in decision-making, or hold accountable? [...] There's a well-known principle: "keep your friends close and your enemies closer. (A, interview, May 28, 2025)

As interviewee A states, stakeholder management also addresses resistance. If someone opposes the project, you need to manage them closely. Interviewees also emphasize that the more mature a project becomes, the more (external) stakeholders are involved. In implementation phases, key partners such as large airlines are intentionally included in the project teams to ensure joint responsibility and structured alignment.

Strategic guidance

Strategic guidance refers to providing advice on innovation related topics. While referring to strategic guidance, interviewees mainly spoke about Schiphol's innovation partner. Within the context of the innovation network of Schiphol, interviewees stated that the innovation partner advises on project execution, strategic positioning and setting direction within innovation programs. They help Schiphol link innovation to departmental goals and get executive support. "We also advise on governance, for example, how Schiphol Innovation hub connects to the executive team to secure support and budgets. At that level, the innovation partner provides strategic input" (A, interview, May 28, 2025).

In addition, they support decision-making by combining scouting with innovation program design. "We scan the global market [...] then help with the program design to guide the process from point A to point B" (G, interview, June 17, 2025). Sometimes the innovation partner recommends structural changes like this interviewee states: "We [innovation partner] advised Schiphol they could manage parts of the process themselves [...] the feedback loop became much faster" (C, interview, June 4, 2025).

Trust & commitment

From previous orchestration already became clear that mobilizing and managing stakeholders are essential for joint collaboration. In the Schiphol innovation network, both Schiphol and their innovation partner actively work on building trust and secure long-term engagement from partners. There are several ways how they try to secure this.

The most critical parts of ensuring trust and commitment are transparency and creating shared value according to interviewees. Taking the the innovation project explored for this case study as an example, building trust began with clear communication. "We maintained open communication with them [external partners], emphasizing that the tool was intended to improve sector-wide efficiency and predictability, not to enforce penalties" (F, interview, June 13, 2025). Schiphol was transparent about the purpose of the tool and how data would be used. This helped reduce resistance and building credibility from the beginning.

However, what really drove commitment was the development of shared value. Partners became motivated as they started to see the operational benefits. "A turning point came when our tool started providing real value in daily operations [...] when partners started to depend on the tool, adoption really accelerated." (B, interview, June 5, 2025). Once the value became clear to the (external) actors, they moved from passive interest to more intrinsic motivation and active ownership. Finally, over time, a small governance structure had to be created to ensure alignment: "*At first, partners worked with us on goodwill, but over time you need clear agreements and formal structure to maintain alignment*" (B, interview, June 5, 2025). Governance was created to ensure everyone knows their role and responsibilities to improve collaboration.

4.2.2. Adapting Orchestration to Collaborative Contexts

Across the different orchestration practices described in this section, a recurring pattern becomes visible. The way the practices are applied depends on the collaborative setting. While every orchestration practice has its own purpose, such as mobilizing actors or building trust, they are rarely used on their own. Instead, the practices often overlap or reinforce each other, depending on how the collaboration is organized: as a project, partnership/program, scouting effort or overarching strategic coordination settings.

Orchestration practices are not fixed, but dynamic activities shaped by context. This is reflected in the interview results. For example, stakeholder management often builds on actor mobilization efforts, while trust and commitment are supported by transparent knowledge sharing. Agenda setting is supported by strategic guidance. This shows the interconnectedness of the orchestration practices.

From this interconnectedness appeared an empirical pattern: the form and intensity of orchestration practices vary for each collaborative setting, depending on the characteristics of the collaboration. The interview data showed that the goals, structure, and maturity of technology and collaboration influence which practices become more central or how they are performed. For example, innovation projects require more trust building, whereas programs rely more on agenda setting and knowledge sharing.

Based on these patterns, four innovation-related collaborative settings could be identified within the Schiphol innovation network:

1. **Innovation projects:** short to mid term temporary initiatives focused on developing, testing, and implementing innovation. (*case of innovation project*)
2. **Innovation partnerships and programs:** longer term collaborations around shared problems. (*BOOST, Smart Ramp, TULIPS*)
3. **Scouting and tech exploration activities:** initiatives focused on exploring new technologies and partners for specific innovation challenges. (*Airport Innovation Runway program*)
4. **Strategic coordination settings:** efforts to align innovation goals across ecosystem level, within network organizations or broader platforms (*Airports Council International (ACI)*)

These four collaboration settings show how collaboration within the Schiphol innovation network can take multiple forms, each requiring different orchestration practices.

4.2.3. Sub-conclusion: How Orchestration Practices enable Network Collaboration

The interview results show that collaboration in the Schiphol innovation network is actively facilitated through a set of six different orchestration practices that enable aspects such as alignment, commitment and knowledge sharing among the actors involved in the network. These practices, namely, actor mobilization, agenda setting, knowledge sharing, stakeholder management, strategic guidance and trust & commitment are not static but dynamic activities (4.2.1). While diving into the orchestration practices, the analysis revealed a pattern: orchestration practices are used differently depending on the collaborative setting in which they are used. The different collaboration settings identified from the interview results are: innovation projects, innovation programs, tech scouting, and strategic coordination (4.2.2) This section synthesizes these findings to show how orchestration practices enable network collaboration.

The analysis of the interviews showed that orchestration practices are interdependent and reinforce each other. Actor mobilization is often accompanied by stakeholder management, whereas knowledge sharing builds transparency related to maintain trust and commitment. Instead of being applied separately, these practices complement each other.

In addition, the collaborative setting actors are in, seems to determine the set of orchestration practices required. Table 4.2 on the next page shows how different orchestration practices are used across the four collaborative settings identified within the Schiphol innovation network. The table synthesizes insights from the interviews and the researcher's field observations, and reflects a qualitative interpretation of the relative importance of each orchestration practice per collaboration setting. The scores in the table (low, medium, high) indicate how strongly each practice appeared to shape collaboration in that context.

This interpretation is based on how frequently and in what detail interviewees discussed each practice in relation to specific collaboration settings, complemented by observations during the research period at Schiphol's innovation partner. The table does not rely on systematic code counts, as some interviewees naturally focused more on certain topics than others. Relying on frequency would have risked over representing specific practices. Instead, an interpretative approach was chosen to offer a more balanced and accurate reflection of how orchestration unfolds in the network. The content of the table is discussed below the table.

Table 4.2: Relevance of orchestration practices across collaborative settings

		Collaborative Setting			
		Innovation projects	Innovation programs	Tech scouting	Strategic coordination
Orchestration Practices	Actor mobilization	Medium	High	High	Low
	Agenda setting	Low	Medium	Low	High
	Knowledge sharing	Medium	High	High	Low
	Stakeholder management	High	High	Low	Low
	Strategic guidance	Medium	Medium	Medium	High
	Trust & commitment	High	High	Low	Low

In *innovation projects*, like the specific project studied for this research, collaboration is enabled through trust and commitment, built by managing the stakeholders and building trust among actors, to ensure key stakeholders like large airlines or ground handlers are committed to the solution. Here, practices like agenda setting is less important as this is a more practical collaboration setting. In contrast, *innovation programs or partnerships* (such as BOOST or Smartramp) rely heavily on agenda setting and trust & commitment. These type of collaborations actively address systematic or joint problems, requiring actors to align on a shared ambition. Actor mobilization is used to bring stakeholders together, but also to design and formalize partnerships. *Technology scouting* settings are obviously strongly enabled by knowledge sharing practices as they focus on translating external ideas into solutions within the Schiphol innovation network. Within this collaboration setting, startups are scouted which means actor mobilization practices are required from the orchestrator. Stakeholder management is less important here as this collaborative setting is a very exploratory stage of innovation. Finally, in *strategic coordination* settings (like ACI), collaboration is promoted by high-level agenda setting and strategic guidance practices. In these situations, orchestration helps align broader strategic innovation agendas, for instance across airport or international partners. Here Schiphol can act as a connector between different strategic interests to foster alignment and work on joint innovation goals on a higher network level.

These integrated findings show how (different sets) of orchestration practices enable network collaboration in the Schiphol innovation network. The practices create the conditions under which actors can come together, share knowledge and develop trust. However, the way these practices are applied is dependent on the collaborative setting the orchestrator is in. Each of the collaborative settings resemble a different level of formality, amount of stakeholders, and innovation maturity which requires Schiphol and their innovation partner as orchestrators to strategically adapt these practices to the collaboration setting.

The orchestration practices identified in this section show how Schiphol and their innovation partner promote and facilitate collaboration across different settings in the network. However, understanding orchestration also requires attention to the obstacles that it must overcome. The next section (4.3) therefore builds on this analysis, by examining the persistent challenges that influence collaboration in the network, and explores how orchestration practices interact with, respond to, or fail to address them.

4.3. Navigating Collaboration Challenges

Orchestrating the Schiphol innovation network is not an easy task. Collaborating with many different actors does not come without challenges and tensions. This section addresses the third and last sub-question of this research: *“What challenges arise while collaborating in innovation networks and how does the orchestrator manage these?”*

Based on the results of the semi-structured interviews with Schiphol, their innovation partner, and external partners from an innovation project, challenges have been identified thirteen challenges have been identified. These challenges have been grouped into five overarching categories. For each category, this section describes the challenges experienced by the interviewees per category, supported with examples. In addition to this, it will be explained how the earlier mentioned orchestration practices, help mitigate these challenges. In addition, interviewees highlighted the potential of including an external innovation orchestrator even more, to address some of these challenges. (4.3.1). The second section will briefly synthesize these findings (4.3.2).

4.3.1. Collaboration Challenges and Possible Solutions

The interviews revealed a variety of challenges that hinder collaboration within the Schiphol innovation network. These challenges range from organizational issues to external factors that put pressure on the collaboration within the network. Together these challenges illustrate the structural, relational and cultural barriers that make orchestrating collaboration across the network complicated. Table 4.3 on the next page shows the five overarching categories and the corresponding challenges. The challenges are further explained in detail below the table.

When the interviewees were asked how the challenges were addressed they mentioned activities that are alike to the earlier described orchestration practices. While some of these challenges are hard to solve, a few of them seem to be already mitigated by orchestration practices. For instance, setting clearer agendas could help with misalignment in strategic and operational teams. Knowledge sharing mechanisms on the other hand, could help with the problem of knowledge capture and no structured learning. The last column of Table 4.3, shows how other orchestration practices can be used to mitigate the challenges of collaborating in the Schiphol innovation network. While many of these orchestration practices are already applied in some parts of the network, the findings on the challenges within the network suggest that they could be used more to strengthen the collaboration.

Table 4.3: Overview of reported collaboration challenges and orchestration practices for mitigation

Challenge category	Challenges	Orchestration practice for mitigation
1. Governance & structural barriers	• Siloed structures • Bureaucratic decision-making • Regulatory and tendering constraints • Limited top-down support • Lack of formal mandate for ecosystem orchestration by external partner • Complexity due to large network size	• Agenda setting: formalized agenda setting to align efforts across actors and internal silos • Strategic guidance: provide structural advice and connect innovation goals with governance structure
2. Misalignment of goals, interests & trust	• Lack of alignment between actors • Lack of shared vision • Diverging innovation and operational goals • Trust issues between actors	• Agenda setting: align goals across actors by developing shared innovation agendas • Trust & commitment: build trust through transparency and shared value • Stakeholder management: keep actors engaged and manage conflicting interests
3. Network engagement	• Late or reactive engagement of actors • Lack of systematic communication	• Actor mobilization: actively bring relevant actors in early on • Stakeholder management: keep actors involved with structured communication
4. Cultural & sectoral resistance to change	• Risk-averse mindset rooted in safety culture • Innovation perceived as impractical	• Trust & commitment: ensure trust by being transparent about the process • Strategic guidance: build credibility and reduce resistance through low-risk pilots
5. Resource constraints & knowledge capture	• Scarcity of time, funding, and other resources • Weak knowledge transfer between actors • No structured learning	• Knowledge sharing: enable structured knowledge sharing and shared learning mechanisms • Strategic guidance: support departments in linking innovation to operational goals

Governance & structural barriers

Several interviewees described how the lack of network governance is sometimes limiting coordination and alignment across the Schiphol innovation network. Siloed structures within Schiphol internally were a recurring topic when asking about challenges regarding governance. The departments within Schiphol operate rather independently when it comes to innovation. In addition to this, interviewees state that innovation efforts are sometimes developed without operational teams: "It [implementation of a developed baggage solution] failed completely. Why? Because operations hadn't been involved, didn't recognize the problem, and saw no need for the solution. It was innovation in isolation, fundamentally flawed" (A, interview, May 28, 2025).

These silos are further reinforced by the bureaucratic decision-making within Schiphol. Interview participants emphasized how internal bureaucratic processes, like multiple layers of approvals and risk assessments slowed down innovation efforts: "Even small projects can take years when you include all the approvals and process steps" (C, interview, June 4, 2025). The bureaucratic decision-making can be attributed to the way Schiphol is organized, because they are used to traditional, large-scale infrastructure projects, making it difficult to apply any form of radical or disruptive innovation (D, interview, June 11, 2025).

Related to this are the strict regulations that Schiphol has to deal with. Regulations regarding aviation are very strict due to safety reasons, but next to that, public procurement rules limit fast innovation: "Standard tender processes are geared toward established technologies and straightforward replacements, not toward adopting new solutions" (D, interview, June 11, 2025). Interviewees describe the tender process as inflexible and time-consuming. In addition, one of them states that, for external partners, the tender process can be costly and time-consuming: "The total cost of participating in both rounds can be substantial, sometimes more than €100,000, without any guarantee of receiving the assignment" (G, interview, June 17, 2025).

Another limiting factor was the lack of top-down support for innovation orchestration. This is both mentioned by participants of Schiphol as well as their innovation partner. This resulted in lack of prioritization: "We were pushing from the bottom up, trying to create traction, but without clear leadership support, it was hard to scale the innovation fully across the organization" (B, interview, June 5, 2025). In the broader ecosystem, there is currently no formal mandate for the innovation partner to orchestrate the broader ecosystem. Some of the interviewee's state that this is because the innovation partner is not yet that long involved (2 years to date), others state that they don't do this kind of orchestration because they don't have that kind of autonomy (yet) (A, interview, May 28, 2025; C, interview, June 4, 2025; D, interview, June 11, 2025).

Finally, from a structural perspective, the overall size and complexity of the Schiphol innovation network were mentioned as a factors that further challenges joint collaboration as this comes with many different interests and more complex decision making (C, interview, June 4, 2025; D, interview, June 11, 2025).

Misalignment of goals, interests & trust

Misalignment occurs frequently between Schiphol and its innovation partners due to differences in priorities, interests, and resources. Lack of alignment and shared vision was mentioned as the number one challenge by all interviewees. One of the interviewees describes this with an example:

Every stakeholder tries to protect their own interests. For example, sustainable taxiing reduces fuel use for airlines but increases workload for handlers and requires new equipment. Then you also have to figure out how to fairly distribute costs and benefits, which is politically sensitive. (C, interview, June 4, 2025)

Strongly related to this are trust issues, which often come directly from misalignment. For instance, in the early stages of the innovation project explored for this case study, partners questioned whether Schiphol's innovation efforts were designed to have shared benefits or if it only served their needs: "Some stakeholders were skeptical at first, fearing Schiphol would use the data for enforcement" (F, interview, June 13, 2025).

Finally, some of the interviewees reported on misalignment not only with external partners, but also with Schiphol's operational teams. In several cases innovation teams, worked independently from operations, which lead to limited implementation of their innovation efforts. In addition, one of the

interviewees mentioned that Schiphol tends to focus on goals in the (far) future, instead of current problems:

Before we [the innovation partner] were brought in by Schiphol, the innovation team was primarily focused on Horizon 2 and 3, working on problems five years out, not the ones people are facing today. That caused them to lose connection with operations and with the day-to-day reality of the organization. As a result, innovation was sometimes seen as a group of people doing “fun projects,” but not solving real business problems. And that’s fatal for the branding and credibility of your innovation efforts. (A, interview, May 28, 2025)

Even though orchestrators try to address misalignment and trust issues, some of the interviewees emphasized that this will always be part of working with different stakeholders. They state that it is not always possible to get everyone on the same page.

Stakeholder engagement

Interviewees described issues with the timing and structure of how different actors are included in innovation projects. In some cases, they were only engaged a few times in innovation projects that were already getting more mature. As an external partner described, “We often hear about these kinds of projects too late or in an informal way” (E, interview, June 12, 2025). In addition, they reported on limited cross-network engagement, which means they are often not in contact with other network partners while collaborating on a Schiphol innovation topic. In addition, the same external partner reported on a missing systematic communication structure on innovation within Schiphol.

Cultural & resistance to change

The aviation sector strictly relies on the ‘safety first’ mindset, which ensures a deeply embedded safety culture. Interviewees frequently mentioned that this is, at the same time, also a burden to innovation. They stated that this mindset prioritizes control, predictability, and stability, which is in contrast with the uncertainty and experimental characteristics of innovation. As one of the interviewees explained: “The industry is highly regulated and extremely risk-averse [...] the primary task of an airport is to be safe and secure, and everything is organized around safety” (D, interview, June 11, 2025). In addition, the operational process is focused on time and efficiency, which results in reluctance to adopt new tools or methods because they are not used to it. This was also the case with the tool developed in the innovation project explored for this case study: “There was some resistance internally. Within Schiphol, some units were reluctant to adopt the tool because it wasn’t yet part of the official process” (B, interview, June 5, 2025).

One of the interviewees adds to this that innovation is sometimes perceived differently by people that are not involved with the concept: “Innovation, as a discipline, is still relatively unfamiliar to most people [...] because innovation is often mistakenly treated as a simplified version of project management” (A, interview, May 28, 2025).

Resource constraints & knowledge capture

Multiple interviewees reported that working jointly on innovation efforts is often constrained by resources such as limited time and people. “There’s always competition for resources, time, people, money. Priorities differ between stakeholders. Even if Schiphol sees something as urgent, that doesn’t mean airlines or handlers do” (C, interview, June 4, 2025).

In addition to this, one interviewee doubts if knowledge is captured well enough within Schiphol. “Structured learning, capturing insights and actively improving based on past experience, that’s often missing.” (A, interview, May 28, 2025).

Potential impact of integrating an external orchestrator

In addition, within the interviews, the impact and potential of an external Network administrative organization (NAO) to address these challenges was discussed. Although the innovation partner contributed to several innovation projects and programs up until now, interviewees stated that they are not yet addressing the broader ecosystem. Multiple interviewees described the current impact and future potential of having an external innovation partner within the network to promote collaboration and address current challenges. From the interviews, it became clear that the innovation partner has made the most impact in terms of structuring innovation and connecting initiatives across siloed departments. One of the interviewees states: “The feedback loop with customers became much faster, and Schiphol gained

better insight into what customers actually wanted. That kind of strategic advice is where I think we've really added value" (C, interview, June 4, 2025). Another one focuses on process maturity: "The way we scout, test, and implement projects, along with how we manage stakeholders and structure the innovation process, is much more mature now than it used to be" (A, interview, May 28, 2025). In addition, being a NAO-like neutral external orchestrator is something that interviewees value:

You also see this at other airports, places that work with external partners or venture builders often manage to scale innovations much more effectively. The external orchestrator brings discipline, focus, and a push towards real operational impact. That's exactly where I see the added value. (B, interview, June 5, 2025)

I think an external party could add a lot of value, especially in the early stages. Aviation is a conservative sector where processes have not changed fundamentally in decades. An external partner can bring in fresh perspectives, help translate ideas into concrete solutions, and connect innovations from other industries to the aviation context. (F, interview, June 13, 2025)

As for the potential impact, interviewees state that this would be greater if the innovation partner is more formally embedded in the network towards other actors so they can engage more in *ecosystem-wide orchestration activities*, to promote cross-organizational learning.

Having an external party who ensures that the project is progressing, that updates are shared regularly, and that actions are followed up [...] They could also help bring in perspectives from other stakeholders and encourage more collaboration across the ecosystem. (E, interview, June 12, 2025)

What I do think we could do more actively [as innovation partner] is to play an even stronger connecting role in the ecosystem [...] This would give us a broader presence and more opportunities to connect stakeholders. (D, interview, June 11, 2025)

4.3.2. Sub-conclusion: Mitigating Challenges through Orchestration

Collaboration within the Schiphol Innovation network is hindered by structural, relational and cultural challenges. From the interview results, 5 categories of challenges could be identified: governance & structural barriers, misalignment of goals, interest & trust, problems with network engagement, cultural & sectoral resistance to change, and resource constraints & knowledge capture challenges. Together, these challenges make orchestration of the Schiphol innovation Network more complicated and slow down innovation initiatives across the network.

To address these challenges, interviewees stated that Schiphol and its innovation partner apply a range of orchestration practices to approach them in a structured way. Practices like agenda setting and strategic guidance help overcome governance and structural barriers by aligning priorities across internal silos and connecting innovation initiatives to formal governance structures. In addition, challenges related to misalignment, trust and stakeholder engagement are managed through trust building efforts, stakeholder management, and actor mobilization. These practices help involve actors from early on, and keep them committed throughout the innovation process. Then, knowledge sharing practices are used to address problems with structured learning and improve the knowledge capture while innovating.

Beyond these practices, interviewees highlighted the potential of involving an external orchestrator even more in the current innovation network. The current innovation partner of Schiphol already acts in a network administrative organization (NAO)-like role, but interviewees stated that strengthening this role could benefit collaboration in the network. Up to now, the external innovation partner has contributed to structuring innovation, connecting initiatives across siloed departments. Several interviewees emphasized that the impact of including an external innovation partner could be increased if they could support more ecosystem wide collaboration. This suggests that combining the orchestration practices with a more integrative role of the innovation partner within the network, would improve the total network collaboration.

5

Conclusion & Discussion

5.1. Conclusion

This research aimed to provide empirical insight into how innovation orchestrators facilitate collaboration within complex, multi-actor innovation networks. The research focused on the interplay between governance structure and active orchestration within the Schiphol innovation network, guided by the question: *How do innovation orchestrators facilitate collaboration within innovation networks in the Dutch aviation industry?*

The findings reveal that orchestrators use an integrated approach that combines both formal structure and active management. In the Schiphol case, the innovation network is found to be layered and functionally segmented, with core partners and peripheral actors engaging on varying levels. Formal procedures and collaboration arrangements like procurement processes and innovation partnerships help structure the joint innovation process.

Collaboration is further structured by network governance. The Schiphol innovation network is steered through a hybrid governance structure, that combines Schiphol's central role as the lead organization with an external innovation partner who supports coordination, stakeholder alignment, and cross-organizational partnerships. The external innovation partner resembles a Network Administrative Organization (NAO). This combined governance model sets the conditions for collaboration by including strategic leadership with operational coordination.

Orchestration complements these formal structures, by managing the dynamics within the network. Orchestration practices are concrete tools to foster alignment, trust, and knowledge exchange among actors. Six of these practices have been identified for this case: actor mobilization, agenda setting, knowledge sharing, stakeholder management, strategic guidance, and trust & commitment. These practices are not applied in a fixed or rigid way. Instead, they are adapted to four distinct collaboration settings observed in the network: innovation projects, programs, technology scouting, and strategic coordination platforms. Each setting requires a different configuration of the practices, depending on the stage of innovation, the number of actors involved, and the level of formality. In addition, these practices reinforce each other, for example, knowledge sharing ensures transparency, which in turn fosters trust.

However, collaborating in a complex network like Schiphol's, remains challenging. Several persistent structural, relational, and cultural challenges could be identified. Orchestration helps navigate these challenges, but cannot overcome them completely. Multiple interviewees suggested that expanding and formalizing the role of the external innovation partner could improve network-wide collaboration.

In conclusion, this research shows how orchestrators facilitate collaboration by combining formal structures such as governance and collaboration arrangements with adaptive orchestration practices. This dual approach of combining structure with management allows orchestrators not only to steer the network, but to adapt it to collaborate on evolving innovation challenges.

5.2. Discussion

This research explored the question of how innovation orchestrators enable collaboration in innovation networks, using the Schiphol innovation network as a case study. Previous research has been conceptually addressing the orchestration of innovation networks. There was limited empirical understanding of how orchestrators steer these networks in practice, this research addressed that gap by diving into the Schiphol innovation network.

The findings reveal that orchestrating collaboration in the Schiphol innovation network requires an integrated approach that combines structure and orchestration. Structures set the conditions for collaboration by defining roles, responsibilities and setting shared agendas. These structures include the network's governance model, collaboration arrangements, and coordination mechanisms. Orchestration complements this by actively managing network dynamics through practices that align interests, build trust, and promote knowledge exchange. Together, structure and orchestration ensure that the network is steered to sustain collaboration on joint innovation topics over time.

The first key insight of this research is the presence of a hybrid network governance structure in the Schiphol innovation network. Schiphol acts as a lead organization, while the innovation partner adds NAO-like coordination. This finding shows not only the co-existence of governance modes, it also specifies the configuration. Schiphol retains agenda setting, priority decisions, control over key assets and funding, and steers the collaboration largely through bilateral ties, while the innovation partner supports this with NAO-like coordination. They facilitate pilots, align stakeholders, help with tech scouting, and facilitate innovation programs when broader network alignment is needed. The Schiphol case illustrates how a hybrid governance form can take shape in practice. This combination expands the network governance modes as described by Provan and Kenis (2008), who treat these modes as distinct forms, and supports the view of van den Oord et al. (2023) that governance is dynamic and can evolve to combine modes to fit a specific network.

The need for such a hybrid form of network governance can be explained by the structural complexity and interdependence of the Schiphol network, which is not homogeneous but structured in different layers of collaboration. The network is organized across various functional domains such as operations, infrastructure and research. In addition, actors differ in their proximity to Schiphol. Some of them are core partners through formal collaboration arrangements, while others engage more occasionally and on a less formal basis. The engagement of actors also varies in terms of intensity and frequency. Some of the actors are structurally embedded in the network through long-term programs, and others are involved less often and only through smaller initiatives like innovation projects of scouting.

The complexity and interdependence of the Schiphol innovation network makes that no single governance form suffices. Orchestration theory confirms that the coordination of the network should be fitted to the network's structure and degree of alignment (Hurmelinna-Laukkanen et al., 2022). In this case, that fit is realized structurally through a hybrid lead organization steering complemented by NAO-like support. It provides direction, while also ensuring alignment across the layered, diverse, and interdependent network and its collaboration settings.

The research also shows that orchestration in the Schiphol innovation network is an adaptive process, where practices are tailored to a specific collaboration setting. This complements the orchestration profiles by Hurmelinna-Laukkanen et al. (2022), who link orchestration practices to the overall alignment and structure of the network. While their profiles describe how orchestration can be adjusted to different types of networks, this study showed that within a complex network like Schiphol's, multiple collaboration settings exist. Each of these collaboration settings requires a different set of orchestration approaches.

This set of orchestration practices shifts with different triggers: (1) increasing interdependence, (2) growing actor diversity/power asymmetry, and (3) shifting from exploration to implementation phases. These triggers re-balance a set of orchestration practices by collaboration setting. When interdependence rises across domains (e.g. baggage or smart ramp programs), agenda setting and knowledge sharing become most important to create shared vision. By contrast, as projects move from exploration to implementation, practices to manage stakeholders and trust & commitment are important to secure adoption. Also, Schiphol cannot be assigned to one single orchestration profile, the network shows elements of each profile. For example, it's translatable in technology scouting, where interdependence is low, and determinancy is fuzzy; transformative in innovation programs, with moderate interdependence

and growing determinacy (e.g. shared roadmaps and simple routines); and transcending in projects where innovations are implemented (high interdependence and clear determinacy). Therefore, this research extends the theory of Hurmelinna-Laukkanen et al. (2022) by offering a "collaboration setting" lens for networks that cannot be clearly assigned to one of the orchestration profiles. This perspective does not treat orchestration through profiles, but as adjustable orchestration practice bundles based on the collaboration setting.

While the results show structures and orchestration practices that enable collaboration, the findings also show persistent challenges within the Schiphol innovation network. Structural, relational, and cultural barriers such as governance challenges, misalignment of interests, variable actor involvement, resistance to change, and difficulties with capturing knowledge, complicate the collaboration. These challenges are based on governance, orchestration practices, and context-specific grounds. The challenges found in this research add a practice-centric and dynamic perspective on innovation orchestration instead of only the structural governance dilemmas of Provan and Kenis (2008).

In addition, the research showed how a combination of orchestration practices and network governance could complement each other to overcome the collaboration challenges. For example, the hybrid governance structure provides direction and coordination, but does not resolve alignment issues among actors. Orchestration can add to this by performing practices related to agenda setting, and trust & commitment. However, the results also showed that some challenges are difficult to overcome. This also suggests one of the limitations of orchestrating an innovation network: while it steers and navigates challenges in a network, it cannot fully overcome them. Especially in regulated sectors like aviation, where formal structures limit innovation.

5.2.1. Implications

This research contributes to theory by providing empirical insight into how structure and active management can interact to facilitate collaboration in innovation networks. It adds to governance literature by showing how lead organizations and NAO-like entities can be combined in hybrid forms and complement each other to address structural complexities of interdependent networks. In addition, it extends the orchestration literature by showing that orchestration practices are interdependent and have to be adapted to different collaboration settings in the network.

In practice, the findings emphasize the importance of being able to adapt orchestration efforts to different collaboration settings within the same network. Instead of applying a uniform approach, orchestrators have to be adaptive and switch practices depending on the actors involved, the maturity of the collaboration, and the level of formality. In addition, the research shows that participants see the potential in expanding the role of an external innovation partner to improve network wide collaboration.

5.2.2. Recommendations

Based on the findings, several recommendations can be made on how Schiphol and their innovation partner can enable collaboration in their innovation network:

1. **Create an interactive actor map and identify collaboration opportunities**

The actor map and interviews showed a layered, heterogeneous network with various actors and collaboration opportunities with strategically important actors. Actor mobilization is currently ad-hoc and key stakeholders are not always included early on in innovation initiatives. Therefore, this research advises to create and maintain a 'living' actor map: a visual register of all actors that Schiphol collaborates with on innovation. For each actor, keep track of their domain, proximity, internal contact persons, shared innovation initiatives, and (innovation) contract status. The map should be owned and updated regularly (e.g. quarterly) to identify collaboration opportunities. The map could also be centered around different innovation domains such as "Baggage". When starting a project to automate the baggage process to reduce physical strain on employees, the map in the "Baggage" domain can help select the right actors. The map makes actor mobilization more deliberate and lets Schiphol and its innovation partner align agendas with the right parties when initiating a new innovation initiative.

2. **Clarify roles, responsibilities, and ownership through formal collaboration arrangements such as manifestos, alliances, or innovation programs**

The interview outcomes repeatedly highlighted misalignment, bilateral ties, and late engagement

of key actors. Therefore, clarify roles, responsibilities, and ownership through formal collaboration arrangements with key actors in the network. The obligations of the arrangements increase with interdependence and determinacy. An *innovation manifesto* is the lightest form, and something that is not done very often yet within Schiphol: it is a short, mostly non-binding statement of shared intent that often is pre-contractual. It sets shared goals, a few operating principles and basic commitments. The manifesto can provide a starting point for shared innovation, which can evolve into more binding arrangements (like alliances, programs, joint ventures). This formalization step moves expectations from implicit to shared commitment, and creates a common reference for alignment and a shared vision, while it also creates legitimacy for collaborations in the network, and finally accelerate complex innovation initiatives.

3. **Strengthen the position of the external innovation partner across the broader ecosystem to enable network-wide collaboration opportunities**

The interviews showed that the innovation partner currently works mainly based on assignments with limited network-wide visibility. However, some interviewees highlighted the potential of an external innovation partner. Although they are structurally well embedded in the network (long-term contract, formal roles), the relational embedding is still limited. To strengthen the innovation partner's role, it is essential to be more present in the informal part of the network. The partner can participate in community events, set up workshops or sessions with Schiphol's key partners, and engage in initiatives led by other core network members, such as KLM, to broaden their presence beyond Schiphol itself. In doing so, they can actively showcase themselves and promote the ecosystem story.

5.2.3. Limitations

This single-case study was designed for depth and theory building, and not for statistical generalization. Therefore, the empirical setting shapes the patterns that are identified, but does not restrict them. The Schiphol case being in the aviation industry sets specific conditions under which the patterns are most likely to hold (high regulation, strong central actor, high interdependence among actors). In this light, three limits apply to this study.

First, the sample was weighted towards interviews with Schiphol and the innovation partner. Perspectives from other network actors were limited to only one airline and one consultancy partner. Although this research focuses on how orchestrators operate, it shows only a limited view of external stakeholders that are subject to the orchestration.

In addition to this, this research risks a social desirability bias, where participants, especially innovation partners, could present their roles or organizations in a more favorable light. Finally, the researchers' close collaboration with the innovation partner raises issues of their positionality. This may introduce interpretation bias in the qualitative analysis of this research. To mitigate this, the data (workshop/interviews) have been triangulated, preliminary findings have been validated with people of Schiphol and the innovation partner itself.

5.2.4. Future Research

Building on these limitations, future research can broaden the perspectives on how orchestrators can facilitate collaboration in innovation networks. The first future research option is selecting a wider actor set beyond the orchestrators. In the event of an aviation-related case, airlines, handlers, infrastructure firms and regulators should be included in a comparative multiple-case design across similar highly regulated networks. This could be another airport, rail network, health care system, or electricity transmission network. Using structured interviews or surveys to capture collaboration settings, governance modes, orchestration practice use, and formal alignment.

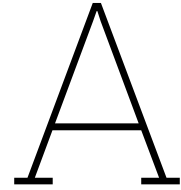
Another option is a longitudinal study to observe how orchestrators steer a network over time with evolving conditions. This gives the possibility to capture how orchestrators operate within a network governance structure and navigate orchestration practices in relation to changing conditions in the network. This also allows to examine the "collaboration setting" lens over time, to see how the sets of orchestration practices evolve in light of this.

References

- Aarikka-Stenroos, L., & Ritala, P. (2017). Network management in the era of ecosystems: Systematic review and management framework. *Industrial Marketing Management*, 67, 23–36. <https://doi.org/10.1016/j.indmarman.2017.08.010>
- Adner, R. (2016). Ecosystem as structure: An actionable construct for strategy. *Journal of Management*, 43(1), 39–58. <https://doi.org/10.1177/0149206316678451>
- Ahrweiler, P., & Keane, M. T. (2013). Innovation networks. *Mind Society*, 12(1), 73–90. <https://doi.org/10.1007/s11299-013-0123-7>
- Bloomenthal, A. (2024, October). Letter of intent (loi): Definition, uses, and example. <https://www.investopedia.com/terms/l/letterofintent.asp>
- BOOST Baggage. (2025). Boost baggage: Innovating baggage handling together. *BOOST Baggage*. <https://www.boostbaggage.com/>
- Chesbrough, H. (2003). *Open innovation: The new imperative for creating and profiting from technology*. Harvard Business School Press.
- Clauss, T., & Ritala, P. (2023). Network governance institutionalization: Creating mutual value by harnessing and avoiding conflicts in interorganizational networks. *Journal of Business Research*, 163, 113880. <https://doi.org/https://doi.org/10.1016/j.jbusres.2023.113880>
- Colombo, M. G., Dagnino, G. B., Lehmann, E., Erik, & Salmador, M. (2017). The governance of entrepreneurial ecosystems. *Small Business Economics*, 52(2), 419–428. <https://doi.org/10.1007/s11187-017-9952-9>
- Dall-Orsoletta, A., Romero, F., & Ferreira, P. (2022). Open and collaborative innovation for the energy transition: An exploratory study. *Technology in Society*, 69, 101955. <https://doi.org/https://doi.org/10.1016/j.techsoc.2022.101955>
- Das, T. K., & Teng, B.-S. (2002). Alliance constellations: A social exchange perspective. *The Academy of Management Review*, 27(3), 445–456. <https://doi.org/10.2307/4134389>
- de Man, A.-P., & Duysters, G. (2005). Collaboration and innovation: A review of the effects of mergers, acquisitions and alliances on innovation. *Technovation*, 25(12), 1377–1387. <https://doi.org/https://doi.org/10.1016/j.technovation.2004.07.021>
- Dhanaraj, C., & Parkhe, A. (2006). Orchestrating innovation networks. *The Academy of Management Review*, 31(3), 659–669. <http://www.jstor.org/stable/20159234>
- Dias, C., & Escoval, A. (2012). The open nature of innovation in the hospital sector: The role of external collaboration networks. *Health Policy and Technology*, 1(4), 181–186. <https://doi.org/https://doi.org/10.1016/j.hlpt.2012.10.002>
- Faccin, K., Wegner, D., & Balestrin, A. (2020). How to orchestrate r&d networks? the role of orchestration subprocesses and collaborative practices over time [Analysing collaborative practices in long-lasting R&D networks; published January 2020 issue]. *Creativity and Innovation Management*, 29(1), 161–177. <https://doi.org/10.1111/caim.12355>
- Future Travel Experience. (2025). 12 technology and cx trends that can enhance airline and airport operations in 2025. *Future Travel Experience*. <https://www.futuretravelexperience.com/2025/01/12-technology-and-cx-trends-that-can-enhance-airline-and-airport-operations-in-2025/>
- Gomes-Casseres, B., Hagedoorn, J., & Jaffe, A. B. (2006). Do alliances promote knowledge flows? *Journal of Financial Economics*, 80(1), 5–33. <https://doi.org/https://doi.org/10.1016/j.jfineco.2004.08.011>
- Hagedoorn, J. (1993). Understanding the rationale of strategic technology partnering: Interorganizational modes of cooperation and sectoral differences. *Strategic Management Journal*, 14(5), 371–385. <https://doi.org/https://doi.org/10.1002/smj.4250140505>
- Hottenrott, H., & Lopes-Bento, C. (2016). R&d partnerships and innovation performance: Can there be too much of a good thing? *Journal of Product Innovation Management*, 33(6), 773–794. <https://doi.org/https://doi.org/10.1111/jpim.12311>

- Hurmelinna-Laukkanen, P., Möller, K., & Nätti, S. (2022). Orchestrating innovation networks: Alignment and orchestration profile approach. *Journal of Business Research*, 140, 170–188. <https://doi.org/10.1016/j.jbusres.2021.11.084>
- Hurmelinna-Laukkanen, P., & Nätti, S. (2018). Orchestrator types, roles and capabilities – a framework for innovation networks. *Industrial Marketing Management*, 74, 65–78. <https://doi.org/10.1016/j.indmarman.2017.09.020>
- Klijin, E.-H., Koppenjan, J. F. M., Spekkink, W., & Warsen, R. (2025). *Governance networks in the public sector* (2nd ed.) [Second edition, fully revised and updated]. Routledge. <https://doi.org/10.4324/9781003402138>
- Mohr, A., Wang, C., & Goerzen, A. (2016). The impact of partner diversity within multiparty international joint ventures. *International Business Review*, 25(4), 883–894. <https://doi.org/10.1016/j.ibusrev.2015.11.001>
- Pereira, B., Lohmann, G., & Houghton, L. (2021). The role of collaboration in innovation and value creation in the aviation industry. *Journal of Creating Value*, 7(1), 44–59. <https://doi.org/10.1177/23949643211010588>
- Pikkarainen, M., Ervasti, M., Hurmelinna-Laukkanen, P., & Nätti, S. (2017). Orchestration roles to facilitate networked innovation in a healthcare ecosystem [Open access; published under CC BY licence]. *Technology Innovation Management Review*, 7(9), 30–43. <https://doi.org/10.22215/timreview/1104>
- Pittaway, L., Robertson, M., Munir, K., Denyer, D., & Neely, A. (2004). Networking and innovation: A systematic review of the evidence. *International Journal of Management Reviews*, 5-6(3-4), 137–168. <https://doi.org/10.1111/j.1460-8545.2004.00101.x>
- Powell, W. W., Koput, K. W., & Smith-Doerr, L. (1996). Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. *Administrative Science Quarterly*, 41(1), 116–145. <https://doi.org/10.2307/2393988>
- Provan, K. G., & Kenis, P. (2008). Modes of network governance: Structure, management, and effectiveness. *Journal of Public Administration Research and Theory: J-PART*, 18(2), 229–252. <http://www.jstor.org/stable/25096364>
- Ritala, P., & Hurmelinna-Laukkanen, P. (2013). Incremental and radical innovation in coopetition—the role of absorptive capacity and appropriability. *Journal of Product Innovation Management*, 30(1), 154–169. <https://doi.org/10.1111/j.1540-5885.2012.00956.x>
- Ritala, P., & Tidström, A. (2014). Untangling the value-creation and value-appropriation elements of coopetition strategy: A longitudinal analysis on the firm and relational levels. *Scandinavian Journal of Management*, 30(4), 498–515. <https://doi.org/10.1016/j.scaman.2014.05.002>
- Roehrich, J. K., Kalra, J., Squire, B., & Davies, A. (2023). Network orchestration in a large inter-organizational project [Open access; Roehrich and Kalra contributed equally]. *Journal of Operations Management*, 69(7), 1078–1099. <https://doi.org/10.1002/joom.1237>
- Royal Schiphol Group. (2023, April). Schiphol, nlmted en tnw bundelen innovatiekracht voor luchthaven van de toekomst. <https://nieuws.schiphol.nl/schiphol-nlmted-en-tnw-the-next-web-bundelen-innovatiekracht-voor-luchthaven-van-de-toekomst/>
- Royal Schiphol Group. (2024, November). *Annex 1: List of group companies of royal schiphol group n.v. as at 31 december 2023* (Report). https://assets.ctfassets.net/biom0eqyyi6b/10G1NeUY6TwShKTpGg1glR/8d725d7b348f0d71b6fba2f407bbc/ANNEX_1_List_of_group_companies_of_Royal_Schiphol_Group_NV_as_at_31_December_2023-FINAL21112024.pdf
- Royal Schiphol Group. (2025a). Schiphol beeldbank [Accessed July 9, 2025].
- Royal Schiphol Group. (2025b). Sustainable airport. *Schiphol as a Neighbour*. <https://www.schiphol.nl/en/schiphol-as-a-neighbour/sustainable-airport/>
- Royal Schiphol Group. (2025c). Tenders – royal schiphol group. *Schiphol Group*. <https://www.schiphol.nl/en/schiphol-group/tenders/>
- Schilling, M. A. (2020). *Strategic management of technological innovation*. McGraw-Hill Education.
- Schiphol. (2025). Innovating together – schiphol innovation. *Schiphol*. <https://www.schiphol.nl/en/innovation/innovating-together/>
- TU Delft. (n.d.). Innovation airport – tu delft infrastructures onderzoek. *TU Delft Infrastructures*. <https://www.tudelft.nl/infrastructures/onderzoek/innovation-airport-1>
- TULIPS. (2025). Tulips green airports. *Tulips Green Airports*. <https://tulips-greenairports.eu/>

- van den Oord, S., Kenis, P., Raab, J., & Cambré, B. (2023). Modes of network governance revisited: Assessing their prevalence, promises, and limitations in the literature. *Public Administration Review*, 83(6), 1564–1598. <https://doi.org/https://doi.org/10.1111/puar.13736>
- Wang, H., & Ran, B. (2023). Network governance and collaborative governance: A thematic analysis on their similarities, differences, and entanglements. *Public Management Review*, 25(6), 1187–1211. <https://doi.org/10.1080/14719037.2021.2011389>
- Yun, J. J., Zhao, X., Park, K., & Shi, L. (2020). Sustainability condition of open innovation: Dynamic growth of alibaba from sme to large enterprise. <https://doi.org/10.3390/su12114379>



Interview Guides

In this appendix, the interview guides for this research are presented. The first guide has been used for the innovation partner participants, the second one has been used for participants involved in the innovation project on making the turnaround process more data-driven.

Interview Guide – innovation partner participants

A. Introduction & Background

1. Can you briefly describe your role and how you were/are involved in orchestrating innovation at Schiphol?
 - Which domains or stakeholders do you mostly work with?
 - What are your main responsibilities in this orchestration role?
2. How does the innovation partner approach its orchestration role in the innovation network of Schiphol?
 - Is your role focused on leading, facilitating or coordinating the network?
 - How would you describe the relationship with Schiphol and other actors?

B. Network

3. How would you describe the type of innovation network of Schiphol?
 - Is the network structured, or emergent in terms of how projects take place?
 - Are goals clearly defined or do they evolve over time?
 - How interdependent are actors that are involved in your current projects?

C. Collaboration Setup & Governance

4. How is the collaboration between parties organized?
 - Is it structured formally (e.g. contracts) or more informally?
 - Does the innovation partner have a coordinating role, or is it more of a shared process?
5. What is innovation partners' role in innovation projects?
 - Do you set the direction, coordinate, or mainly support others?
 - Would you describe the innovation partner more as a leader or facilitator?

D. Orchestration Practices

6. What orchestration practices do you apply to support collaboration within the network?
 - How do you set shared goals or agendas?

- How do you mobilize actors and maintain engagement?
 - How do you facilitate coordination and knowledge sharing?
 - What do you do to foster trust and commitment across parties?
7. Which orchestration activities are most challenging in this context?
- What makes it difficult to 'orchestrate'?
 - Are there any specific dynamics that make orchestration more complicated?

E. Challenges

8. What kind of tensions or collaboration challenges have you experienced while orchestrating Schiphol's innovation network?
- Tensions regarding fast decision-making? Is everyone included or only Schiphol?
 - Are there often conflicting interests or legitimacy issues?
9. How do you manage these tensions in practice?
- Formally or informally?

F. Reflection & Evaluation

10. What do you think has changed the most since Schiphol has included their innovation partner?
11. What do you think the innovation partner should do (more) to improve orchestration at Schiphol?

Interview Guide – Innovation Project participants

A. Introduction & Background

1. Can you briefly describe your role and how you were involved in the turnaround project?
- What was your organization's contribution to the project?
 - Were you involved from the beginning or brought in later?
2. Who else was involved in the project from your perspective?
- What types of organizations or roles?
 - Did you interact directly with them?

B. Network

3. How would you describe the kind of collaboration in the turnaround project?
- Was there a clear and shared goal from the beginning or did it evolve over time?
 - Were roles and tasks clearly defined, or did people figure it out as they went?
 - Was the collaboration mostly about improving existing operations, or creating something new?
 - Did everyone know each other beforehand, or were new connections formed?

C. Collaboration Setup & Governance

4. How was the collaboration between parties organized?
- Was it structured formally (e.g. contracts) or more informally?
 - Was Schiphol coordinating, or was it more of a shared process?
5. What was Schiphol's role in this collaboration?
- Did they set the direction, coordinate, or mainly support others?
 - Would you describe them more as a leader or facilitator?

D. Orchestration Practices

6. What ensured that the collaboration worked well in this project?
 - Was there a clear vision or shared agenda from the beginning?
 - How were people brought in or mobilized (to share knowledge)?
7. How did the coordination of collaboration between different actors happen in practice?
 - Were tasks clearly divided or more flexible?
 - Was knowledge actively shared?
8. Was trust or motivation something that played a role (positive/negative) during the project?
 - How was commitment ensured?
 - Did Schiphol do anything to build trust?

E. Challenges

9. Were there any tensions or challenges in the collaboration?
 - Decision making: were decisions made quickly? Or did involved actors slow the project down?
 - Did everyone agree on goals, or were there conflicting interests?
 - Were roles clearly defined? Or was there a shift during the project?
10. How were these tensions handled?
 - Formally or informally?

F. Reflection & Evaluation

11. What was most challenging for you during this project regarding orchestration?
12. What would help you to collaborate more effectively in future innovation projects?
13. How would you look at working in a project like this with an external orchestrator?
 - Easier/harder to collaborate?
 - What would you expect from such a partner?
 - How do you see Schiphol's role if an external partner helps leading the process?

B

Code Book

Below the code book for the coding analysis in ATLAS.ti is presented. Table (B.1) shows the category codes, sub codes, together with the related definition and groundedness in the analysis.

Table B.1: Code book for interview analysis

Category code	Sub code	Description	Ground- edness
Context	Case context	Background information about the Schiphol innovation network.	6
	Interviewee role	Descriptive information about the interviewee's position within or relation with Schiphol.	9
Governance formality	Formal governance	Coordination and decision-making are organized through formal structures or processes.	18
	Informal governance	Coordination is based on more informal base through trust, personal relations, shared norms.	9
Governance mode	Lead organization	A single central actor that takes the lead in the network.	6
	Network Administrative Organization (NAO)	A separate, neutral entity that facilitates the network on behalf of the other members.	10
Network	Composition	The mix of actors involved within the innovation network.	7
	Interdependence	The extent to which actors in the network rely on each other.	4
Orchestration practices	Actor mobilization	Practices aimed at engaging, involving and activating relevant actors on shared innovation topics.	25
	Agenda setting	Defining shared priorities, focus areas and setting direction.	9
	External partnerships	Relations or collaborations with partners outside the organization of Schiphol.	4
	Knowledge sharing	Facilitating the exchange of information, expertise, lessons learned between actors.	16
	Role switching capability	The ability of an actor to adapt roles depending on the context or collaboration setting.	12
	Stakeholder management	Coordinating the power and interests of different stakeholders in the network.	21
	Standardized tools/methods	Tools or methods that help facilitate or structure collaboration or innovation.	13
	Strategic guidance	Strategic advice provided on governance, innovation or network positioning.	6
	Trust & commitment	Building trust and dedication among actors to ensure collaboration between partners.	21
Orchestrator role	Assignment-based	Orchestrator acts based on ad hoc projects or pre-defined assignments with clearly defined boundaries.	10
	Facilitator	Orchestrator supports collaboration by guiding and facilitating rather than taking a leading role.	13

Category code	Sub code	Description	Ground- edness
<i>Reflection on involvement nlmt</i>	Impact	Descriptions of impact that nlmt has had on the network in the past.	6
	Possible impact	Descriptions of how nlmt could make more impact in the future.	15
<i>Challenges</i>	Alignment/shared vision	Lack of alignment or joint view due to conflicting interests, priorities or goals.	17
	Aviation cultural resistance to change	Cultural resistance within the aviation sector to deviate from established norms or risk-aversion due to safety.	6
	External factors	Influences from outside the network that impact the collaboration.	4
	Governance	Challenges related to structures, decision-making and coordination of the network.	14
	Knowledge/information flow	Barriers to the exchange of information, expertise, lessons learned between actors.	5
	Network engagement	Difficulties with getting and keeping partners in the network engaged in joint collaboration.	7
	Network size	Issues due to the number of actors involved in the network.	5
	Regulations	Legal or policy constraints that influence innovation efforts.	8
	Resources	Lack of time, funding or people to support joint collaboration.	5
	Support of higher management	Insufficient support of senior leadership.	3
	Trust	Lack of confidence among other partners on innovation efforts.	9