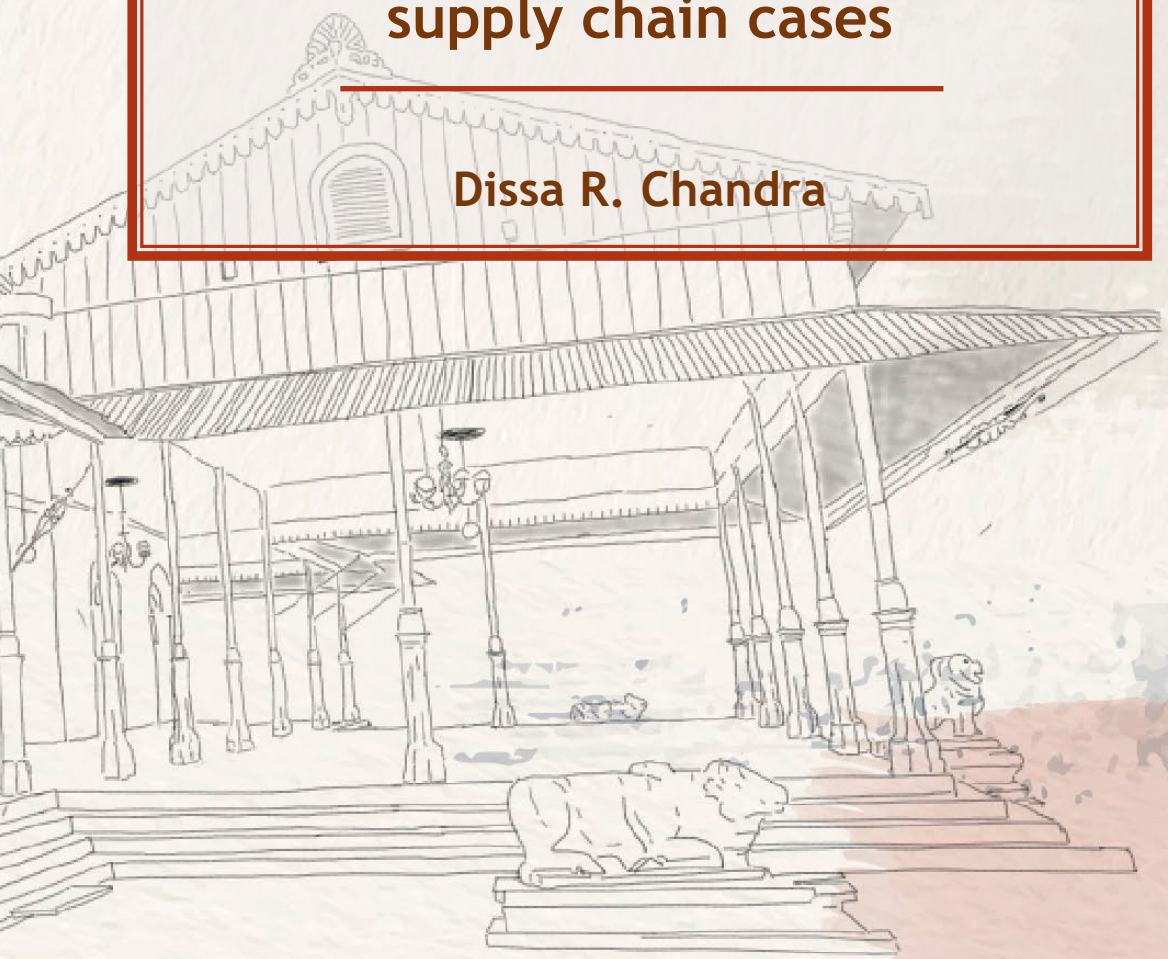
Governance of Inter-organizational System based Collaboration

supply chain cases

Dissa R. Chandra



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GOVERNANCE OF
INTER-ORGANIZATIONAL SYSTEM BASED COLLABORATION

SUPPLY CHAIN CASES

DISSERTATION

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Chapter 1
Introduction

1.1 Background

Nowadays, competition in the industrial sector has become harsher due to globalization and rapid technological development. Establishing inter-organizational collaboration is an increasingly important strategy to gain competitive advantages. The potential benefits of joining collaboration are tremendous, such as resource and risk sharing, efficiency in executing business processes and learning, as well as innovation and agility (Barringer & Harrison, 2000; Popp, Milward, MacKean, Casebeer, & Lindstrom, 2014). A business is no longer a self-contained organization working with closely coupled partners; it participates in several networks where it may lead or act together. Thus, "collaboration" is a pervasive discussion topic among practitioners and academics (Alonso, MartÃnez de Soria, Orue-Echevarria, & Vergara, 2010).

Collaboration is one of the most engaging topics in organizational studies. The study of collaboration is flourishing in diverse fields, such as the supply chain management field, the humanitarian sector (Mutebi, Muhwezi, Ntayi, & Munene, 2020), the public sector (Isett, Mergel, Leroux, Mischen, & Rethemeyer, 2011; Popp et al., 2014) and the health care field (Palumbo, Manesh, Pellegrini, & Flamini, 2020; Provan, Beagles, & Leischow, 2011). Initially, the discussion focuses on the collaboration's formation process and its benefits and challenges, e.g., C. Jones, Hesterly, and Borgatti (1997). The studies in inter-organizational collaboration expanded their focus to the collaborations' development and other related phenomena, e.g., collaborations' maturity by Alonso et al. (2010).

Inter-organizational systems (IOS) support collaborations to address operational and technical challenges. An IOS connects companies in collaboration and enables data sharing between their information systems. Inter-organizational coordination hubs are employed to facilitate interoperability for organization transactions. The technological capabilities, such as modularization (Gopalakrishnan, Matta, & Cavusoglu, 2022) and easy configuration for a flexible and scalable system (Hjartar, Krishnakanthan, Prieto-Muñoz, Shenai, & Kuiken, 2019), accelerate the IOS implementation. Services can be configured on the fly to add value to the network. An IOS is developed based on standardized business processes and generates confidential and shared information. However, technology can be both an enabler and a challenge for establishing and maintaining agile collaborations. The IOS's control and ownership are critical;

Disagreement and power struggles induce failures in many IOS-based collaborations (Chatterjee & Ravichandran, 2013).

“Both academia and industry observers have long been concerned about the continued slow, painful process and many cases of failure to realize the performance value of IOS” (C. Zhang, Xue, & Dhaliwal, 2016). Studies on technological challenges in IOS implementation, such as Gopalakrishnan et al. (2022) and Shao, Liu, Li, Chaudhry, and Yue (2021), discuss governance as one of the exigent issues in managing collaborations. IOS-based collaborations are more complex than traditional collaborations due to the nature of IOS implementation. Collaboration structures and procedures will gain success if they fit their environments and are appropriate for their missions or adapted to their contexts (Alexander, 1995). Therefore, a proper understanding of governing company relationships in an IOS-based inter-organizational context is needed to achieve a sustainable collaboration.

Inter-organizational governance is the act of coordinating a collaboration of multiple companies (Markus & Bui, 2012; Provan & Kenis, 2008). A recent literature study by Roehrich, Selviaridis, Kalra, Van der Valk, and Fang (2020) finds that there has been a massive growth in the inter-organizational governance field over the last decade, but less than 2% of the articles discuss network governance. Most studies in this field are still limited to the individual or organizational level of analysis. Some studies are limited to a single organization level of analysis using sets of constructs or classifications with different viewpoints, disregarding the network’s governance (Chatterjee & Ravichandran, 2013). To further examine this gap, we collected studies on network governance and did a preliminary literature collection. The detail is presented in Sub-Chapter 2.1.

Even though there is quite a consensus in the definition of governance of inter-organizational collaborations, prior studies have been using the term “governance” too loosely. Some studies do not declare a precise conceptualization, and other researchers define governance using sets of constructs or classifications with different points of view, such as governance lifecycles, governance modes, and governance mechanisms. Moreover, their points of view are segregated. This segregation is apparent in the state of the art in Sub Chapter 2.2. The studies mainly focus on one specific point of view and ignore the others.

However, there is a consensus that inter-organizational governance is dynamic and context-dependent. Over time, there are changes in the collaborations' context and environment (Whitelock, 2015). Consequently, the collaborations adapt, and their governance evolves accordingly (Alvarez, Pilbeam, & Wilding, 2010; De Pourcq & Verleye, 2022; Lowndes & Skelcher, 1998; Popp et al., 2014; Srour, Oosterhout, Baalen, & Zuidwijk, 2008). This principle is a dynamic context-dependent perspective for analyzing collaborations. Despite this consensus, the segregation of governance definition is prevalent. For example, Markus and Bui (2012) analyze five governance aspects that changed dynamically over time, but the study does not describe the

collaborations' lifecycle in systematic phases. Meanwhile, empirical studies (Provan et al., 2011) try to explain the governance evolution in collaborations, yet there is a lack of governance framework and mainly explore only the formation and consolidation process.

Despite advancements in the inter-organizational governance literature (Baudry & Chassagnon, 2012; Lowndes & Skelcher, 1998; Provan & Kenis, 2008), the interplay of IOS and inter-organizational governance is still limited (Markus & Bui, 2012). This fact is also apparent in the recent literature study on inter-organizational governance, such as Roehrich et al. (2020), that overlooks the interaction between technology and governance. Based on the dynamic and context-dependent perspective, we should not diminish the IOS-based collaborations' governance transformation. The first step to understanding the evolution of IOS-based collaborations' governance during their lifetime is to be precise on the conceptualization of the governance itself. According to Gregor (2006), a theory that analyzes and describes a concept is a foundation for other studies in explaining, predicting, designing, and implementing the concept. A good definition helps avoid ambiguous measures and a vague theory (Wacker, 2004). Thus, there is a solid need to define the abstract concept of governance in IOS-based inter-organizational collaborations.

Markus and Bui (2012) propose that the governance of an IOS-based collaboration is not one specific type of governance but is a hybrid arrangement – such as stakeholders' membership, stakeholders' involvement in decision making, and the legal status of the collaboration and its members. Those governance aspects are identified based on the relationships between the stakeholders – inside and outside – of the collaboration. However, few studies focus on the stakeholders and their dynamic relationships in IOS-based collaboration governance. In a recent literature study by Roehrich et al. (2020), it is apparent that the Transaction Cost Economy (TCE) theory application on dyadic relationships dominates the studies on inter-organizational governance. Other popular theories in this field, such as agent and social exchange theories, are also limited to analyzing dyadic relationships (Wang, Müller, & Zhu, 2022).

Researchers and practitioners need a conceptualization of inter-organizational governance for IOS-based collaborations that explain the stakeholders' dynamic relationships beyond the dyadic level. We propose the use of stakeholder theory to fill this research gap. Stakeholder theory emerged from strategic business management (South, Eriksson, & Levitt, 2018) and analyzed the multiorganization relationship. Freeman (1984) defines stakeholders as "any group or individual who can affect or is affected by the achievement of the firm's objectives." In information systems and technology, the stakeholder concept is shifting from individual perspectives (developer and user) to IOS problems (Mishra & Mishra, 2013). The key stakeholders and their influence or involvement in a collaboration can be identified using this theoretical perspective (Mishra & Mishra, 2013). For example, external consultants or managers may affect the choice of governance structure (Vélez, Sánchez, & Araújo, 2022). The number

and variety of stakeholders are closely related to the complexity of trust building and shared goals development (Kapucu & Hu, 2020c). Mishra and Mishra (2013) emphasize the dynamics of critical stakeholders in a collaboration. Thus, this theoretical framework can help us define the influential organization groups in the evolution of IOS-based collaboration governance and complement the definition of inter-organizational governance.

1.2 Research Question

Many studies explored inter-organizational governance from different perspectives. Our study fills the gap in the state of the art: the segregated points of view and the limited focus on the interplay of IOS and inter-organizational governance. The first research question aims to explain inter-organizational governance for IOS-based collaborations in a structured framework. The proposed framework will provide conceptual consistency in analyzing and describing.

RQ1: *How can inter-organizational governance for IOS-based collaboration be explained using a dynamic perspective?*

The dynamic perspective explores the collaborations' governance adaptation to its context and environment. To explain inter-organizational governance for IOS-based collaboration, we utilize stakeholder theory to identify the key stakeholders and connect the segregated points of view. The following detailed questions are formulated:

- RQ1-1: What is the state of the art in the research on inter-organizational governance for IOS-based collaborations? (Chapter 2)
- RQ1-2: Who are the stakeholders in IOS-based collaborations? (Chapter 3)
- RQ1-3: What framework is effective in analyzing and describing inter-organizational governance for IOS-based collaborations? (Chapter 4 and the second part of Chapter 9)

Next, we strive to understand how the framework can describe collaborations' evolution. Empirical studies on inter-organizational systems, such as Rodon, Pastor, and Sesé (2007) and Popp et al. (2014), have emphasized the importance of an in-depth longitudinal study. Surprisingly, this recognition is in contrast with the recent studies' approach. A literature review by Roehrich et al. (2020) finds that longitudinal research on inter-organizational governance is still limited. The second research question addresses this concern. The dynamic and context-dependent perspective leads us to investigate IOS-based collaborations throughout their lifetime and compare different points in time. The cases in practice provide us with means to evaluate the framework proposed in this study.

RQ2: *How does the governance of IOS-based collaborations evolve in practice?*

To demonstrate the governance transformation, we focus on an empirical study and use the framework to address the following:

- RQ2-1: How does governance for IOS-based collaborations evolve? (Chapter 5 until Chapter 8)
- RQ2-2: How to compare different governance arrangements for a specific collaboration and study various collaborations? (The first part of Chapter 9)

"Both academia and industry observers have long been concerned about the continued slow, painful process and many cases of failure to realize the performance value of IOS" (C. Zhang et al., 2016). Looking into the past and the current practice, many lessons can be learned from mistakes and success stories. These lessons will benefit IOS-based collaborations and contribute to the literature on designing inter-organizational governance. Thus, we aim to gather knowledge from the description of governance evolution. We address this in the third research question. The last part of Chapter 9 comprises the lessons learned.

RQ3: *What can we learn from the governance lifecycles to achieve a successful IOS-based collaboration?*

1.3 Research Context: Supply Chain Collaboration

According to our preliminary literature study (see Sub Chapter 2.1 Step 3: Full Paper Collection), the Supply Chain (SC) field is one of the popular fields for studying inter-organizational collaboration governance. Without a specific context, an inter-organizational collaboration study may flounder in the diversity of collaborations' characteristics. For example, collaborations in the SC industry have different features compared to networks of governmental organizations in the public policy field. Thus, in this study, we focus on the SC field.

Supply Chain Collaboration (SCC) is vital for an agile industry. Moreover, current SCCs are aware of the benefits of IOS implementation in supporting their information sharing. The leading firms in SC are conscious of digital transformation to boost their overall performance. For example, Johnson & Johnson's digital SC control tower provides real-time data to optimize their decision making (Gartner Inc., 2023). Digital transformation is inseparable from innovation and collaboration. Sharing data in logistics is crucial to ensure that the increasingly complex supply chains (or networks) are well managed. Without the support of an information system, it is not easy to achieve successful SC operations (Gunasekaran & Ngai, 2004).

SC is "all the activities involved in delivering a product from raw material through to the customer including sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, delivery to the customer, and the information systems necessary to monitor all of these activities" (Lummus & Vokurka, 1999). SC discussions go beyond

intra-organizational and dyadic relationships toward inter-organizational collaborations perspective (Dissa R Chandra & van Hillegersberg, 2015). Various terms – SCCs, SC coordination, and supply network – have been used to define things closely related and simultaneously substitute each other in publications. This study follows Simatupang and Sridharan (2002) in Arshinder, Kanda, and Deshmukh (2008), that define SCC as "two or more independent companies that work jointly to plan and execute SC operations with greater success than when acting in isolation."

Traditional SCCs concepts started from the vertical integration of SC within a company and moved towards a dyadic relationship between supplier and manufacturer by introducing horizontal integration and outsourcing. Then, it expands to vertical SCCs between companies, horizontal SCCs with multiple logistic providers, and recently, SCCs that crossed the boundary of one specific chain and shifted towards cross-chain SCCs (G. R. Janssen, Man, & Quak, 2015). Figure 1 visualizes this shifting of the SCCs concept with five echelons of roles in SC. At the same time, the SC concept has evolved from the linear (top-down) SC to the non-linear SC (Ismail & Alina, 2008). Vertical and horizontal SCCs will be seen as a specific structure of cross-chain SCCs in which only particular stakeholders are involved. We limited our research to B2B SCCs.

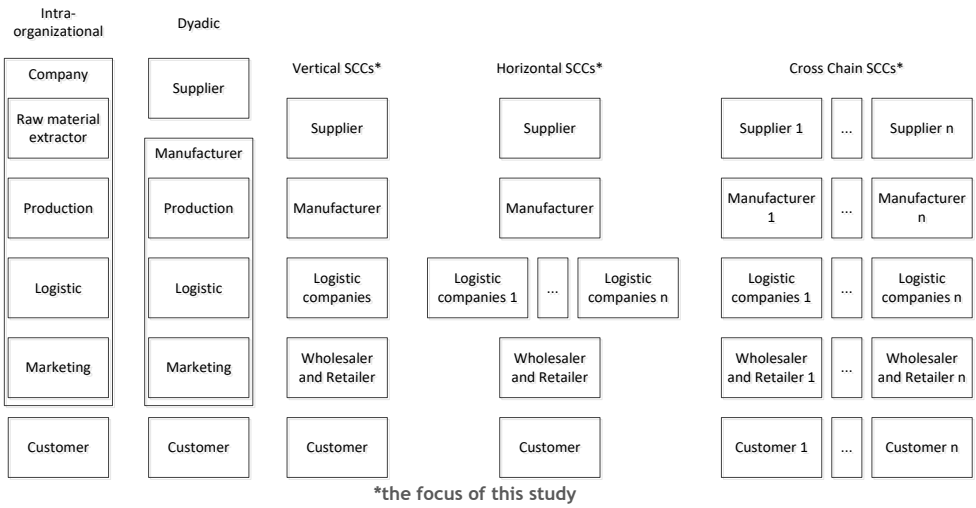


Figure 1. Supply Chain Collaborations Concept Development

SCCs will have to cope with several challenges when dealing with network coordination. In inter-organizational SCC, an IOS transforms the competitive relationship into a heterogeneous coopetition (Burström, Kock, & Wincent, 2022). Some potential issues are membership selection, linking, goal setting, risk and reward management, continual improvement, and fault tolerance (Van Heck & Vervest, 2007). In general, SCCs require careful governance. Conceptual and empirical studies support links between governance instruments and SCCs' outcomes (Pilbeam, Alvarez, & Wilson, 2012). Cross-chain collaboration is popular in SCCs, yet Popp et al. (2014) remind us that interconnectivity

is a remedy and, at the same time, is a source of problems. With limited studies in this field, there is a demand for future research on inter-organizational governance (Kohlborn, Korthaus, Riedl, & Krcmar, 2009).

1.4 Methodology

This study uses the typology research design (Jaakkola, 2020) and the case studies approach (Eisenhardt, 1989; Robert K Yin, 1994). We combine both methods to develop a conceptual framework based on state of the art and current practice to address RQ1 (*How can inter-organizational governance for IOS-based collaboration be explained using a dynamic perspective?*). Based on the taxonomy of theory by Gregor (2006), this framework is classified as a theory for analyzing.

Typology research design aims to systematically differentiate constructs for a complex concept (Jaakkola, 2020). This approach is suitable for inter-organizational governance for IOS-based collaborations. The fuzzy use of the term "inter-organizational governance" and the fragmented observations of IOS-based collaborations are pervasive in literature. Consequently, organizing the concept of inter-organizational governance will benefit us in observing the governance evolution phenomenon. The result of this approach is a structured framework to describe and analyze the governance.

When this study was started, the solution – a structured framework – was not obvious. This project was initiated to describe and analyze the practices of complex phenomena - inter-organizational governance. During the research journey, the existing concepts' shortcomings led us to design the governance framework. Besides typology research design, another method that is popular for developing a conceptual artifact is design science research (vom Brocke, Hevner, & Maedche, 2020). Nevertheless, we decided to use the case studies approach and preserved the typology research design.

According to Jaakkola (2020), the typology research design is not limited to classifying; Its main contribution is the explanatory nature using the defined types and constructs. The governance framework should be able to explain how evolution happens in a particular context where an act of collaboration exists (RQ2: *How does the governance of IOS-based collaborations evolve in practice?*). Thus, the case studies approach is adopted. These cases demonstrate the usage of our framework, which defines types and constructs in inter-organizational governance.

We have set a boundary about what is expected from the conceptual framework in the previous paragraph. Moreover, this framework is not aimed to explain: why a specific governance arrangement is adopted (reason), why a particular arrangement is successfully implemented (implementation), and how a collaboration – supported by a specific arrangement – performs (performance). We believe these questions should be explored after the governance concept is structured. According to Gregor (2006), future

studies to answer these questions are research for explaining, predicting, and designing inter-organizational governance.

RQ1-1: *What is the state of the art in the research on inter-organizational governance for IOS-based collaborations?*

RQ1-1 states the importance of knowledge about previous academic development before diving into empirical studies. We consolidate literature in the domain of inter-organizational governance to build the conceptualization of inter-organizational governance for IOS-based collaborations. This approach results in formal and conceptual definitions. "Formal and conceptual definitions exist at the abstract level and do not contain measurable attributes" (Wacker, 2004). Later, we use the conceptualization to analyze existing collaborations and describe their evolution.

RQ1-2: *Who are the stakeholders in IOS-based collaborations?*

First, we do an initial scan of the existing cloud-based SCCs. The data collection period for exploring cloud-based SCCs was from April 2014 until June 2015. The exploration of cloud-based SCCs aims to get a glance at the concept of inter-organizational governance (the governance modes and the stakeholders) in the context of SCCs. The study is not a longitudinal study. In this step, we explored the concept at a specific time and ignored the governance evolution. We argue that the description of a static state of governance should be clear first before we analyze the description using a dynamic perspective. Due to its visual power, we use stakeholder theory to describe governance for IOS-based inter-organizational collaborations and answer RQ1-2. Studies were conducted on seven companies claiming to be third-party SCCs cloud integrators and one SCC control tower project. Cases were selected through online market research or suggestions in interviews.

When we started the exploration, there was extensive publicity about cloud technology for SCCs. The technology is vital for SC agility and IOS flexibility. By 2016, more than 40% of new logistics applications were predicted to be cloud-based (Gartner Inc., 2012). Thus, we decided to investigate cloud IOS and explore the influence of cloud characteristics on inter-organizational governance. Regrettably, our study in 2013-2014 was conducted in the early stage of cloud adoption in this field. Cloud terminology was everywhere, yet the SCCs' claims about cloud adoption were equivocal. IOS-based collaborations adopted cloud technology in different layers (infrastructure, platform, or software). During the adoption process, it is not easy to be sure about the success of the technology adoption itself.

On the other side, we realized that the problem regarding the ambiguity of the inter-organizational governance concept is not limited to cloud-based collaborations. This ambiguity is a common problem in the studies and practices of IOS-based collaborations. We decided to drop the cloud technology focus and broaden our research.

RQ1-3: *What framework is effective in analyzing and describing inter-organizational governance for IOS-based collaborations?*

The exploration gives insight into developing a stakeholder perspective for IOS-based inter-organizational collaborations. This perspective is intertwined with other perspectives in the state of the art. Thus, we combine the perspectives and propose a framework – the governance building blocks. The structured concept is our framework to address RQ1-3. Later, this framework is evaluated in the case studies and adjusted according to the cross-case analysis.

RQ2-1: *How does governance for IOS-based collaborations evolve?*

The case study method is implemented in the longitudinal case studies. The method is selected because we believe inter-organizational governance is dynamic and context-dependent. Each IOS implementation in an SCC is a unique case that is dependent on the collaboration's characteristics and environment. Thus, each case of inter-organizational collaboration should be analyzed in a unique context. For the longitudinal study, we collected data from 2014 until 2023. The data collection period is varied in all cases.

Later, in the longitudinal case studies, we observe selected cases and explain the phenomenon using the structured concept. Our longitudinal case studies are examples of observation using structured conceptualization. This approach fills in the gap of limited longitudinal studies that is reflected in RQ2 (*How does the governance of IOS-based collaborations evolve in practice?*), especially RQ2-1. The structured constructs help us to identify the governance arrangement and the changing elements. The longitudinal approach in the case study also allows us to observe SCCs in different situations. This approach reduces momentary emotional or political bias because talking about a specific event at other times brings different perspectives from our interviewees.

The IOS in the longitudinal studies was not limited to cloud technology. We limited our cases to collaborations with a legal governance entity. A legal governance entity means a specific entity (a private company, an association, or other forms of organization) established legally to govern the collaboration. This limitation is needed because of the ambiguity of market collaborations. Some SCCs are B2C markets in which companies come and sell their products or services to customers. In this kind of collaboration, the B2B relationships are limited. Moreover, the sustainability of collaborations with a legal entity in our exploration study was proven. The SCCs' years-long experience aids our observation of the governance transformation over time.

We selected the Rotterdam Port Collaboration, Schiphol Air Freight, Dutch Energy Market, and Dutch Floriculture Supply Chain for the observation. Data collections are limited to Dutch SCCs. The Netherlands is one of the leading countries in SC. It is reflected in the FM Global Resilience Index, which measures 130 countries and regions'

business resilience to SC disruption. In 2016, the Netherlands ranked eighth globally, and its SC driver factors – e.g., SC timeliness and SC visibility) – ranked 3rd (FM Global & Oxford Metrica, 2016). The country's SC strength has been steady. In 2023, the Netherlands remains in the first quartile on top of other countries (FM Global, 2023). The practitioners in Dutch SC also work hand in hand with the academics. A study by Amirbagheri, Merigó, and Yang (2020) identified the Netherlands as one of the leading countries in SC management research from 1990 to 2017. Moreover, even though the SCCs' bases are in the Netherlands, the collaborations connect multinational companies. This multinational membership and Dutch democratic culture affect the SCCs to behave accordingly.

These collaborations are selected because:

- The collaborations size and significance in the related industry:
    - The port of Rotterdam is the largest in Europe. It is one of the leading ports in the world (Port of Rotterdam Authority, 2017b) with four different containerized on- and pre-carriage transport modalities – road, rail, inland shipping, and short sea shipping (van Baalen, Zuidwijk, & van Nunen, 2009).
    - In 2021, Schiphol was the fourth-largest cargo airport in Europe (Royal Schiphol Group, 2022b). The collaboration information system in Schiphol is a pioneering system recommended by AACI/IATA (Airport Associations Coordinating Council/International Air Transport Association) as a paradigm for other airports (Dac, 1996).
    - EDSN's IOS is the sole IOS that connects the Dutch electricity market (CGI, 2021). Its predecessor – ECH – was one of the first successful IOS-based collaboration cases in the electricity market.
    - HubWays NV tried to connect all stakeholders in the Dutch floriculture supply chain. Although the implementation failed, the IOS was half-finished, and the pilot project was conducted. Moreover, this case also reduces a survivor bias risk in our analysis.
- Many studies on these collaborations have been published for reference, which enriches the analysis in this study.
- The sample SCCs are spread across several sectors to ensure the results' generalizability to the SC context.

We use several sources to collect case information: interviews, academic articles, company reports, and news. Before interviews, data was collected through the companies' or projects' websites and documents. Concerning the interviews' focus on governance, persons with strategic positions in the companies or projects were selected as interviewees. Individual experiences of key players in collaborations are rich resources for learning about the collaborations' transformation (Popp et al., 2014). Interviews were recorded and transcribed, and notes were taken during the interviews. The interviews were semi-structured. It comprised open discussion and questions about their companies or projects and the associated SCCs' governance.

Later, additional documentation was collected to fill in the missing details and confirm the information. Documentation can verify and provide specific details from direct quotes or information inference (R.K. Yin, 2018). Some documents, reports, and web pages were in Dutch. In this case, Google Translate is used to translate the data sources. The examples of our analysis based on multiple sources are presented in Appendix D.

Validity and reliability are fundamental to be addressed by the case study design to warrant the research's quality (G. Robbert Janssen, Man, & Quak, 2016; R.K. Yin, 2018). Our research design is presented in Table 1.

Table 1. Longitudinal Case Study Design (adapted from G. Robbert Janssen, Man, & Quak (2016) and Yin (1994))

Case study design	Implementation in this study
Construct validity	
Unambiguous construct definition	The constructs observed in this study are the building block elements. These constructs have been defined since the beginning of the study and are evaluated to ensure unambiguous conceptualizations. Our interview questions and other data collections utilize this conceptualization as the framework.
Multiple sources of evidence	We did interviews and attended presentations for each case study to evoke personal knowledge and experience. The interviews lasted between 60 to 120 minutes. The interviews were recorded and transcribed afterward. Additional resources (slide presentations, website pages, news, company database, and reports) were analyzed for data triangulation. The use of data triangulation supports qualitative research to warrant the study's validity (Robert K Yin, 1994).
Allowing respondents to review case study reports	Participants were asked to review the written reports and give input or corrections. The written reports already apply our research constructs in analyzing the cases' governance. Thus, we confirm the interviewees' understanding of the constructs in their collaborations' context.
Internal validity	
A clear research framework	The conceptual constructs that are used in this study have been defined. The framework combined our findings from the exploration study and other literature (e.g., Markus and Bui (2012), Alvarez et al. (2010))
Pattern matching	We analyze multiple case studies and multiple points of time in a single case study. The patterns are identified across different situations and timelines.
External validity	
Establishing the domain to which the study's finding can be generalized	Data collections are limited to industry-specific and culture-specific, which are Dutch SCCs. This domain is reflected in our case selection. The cases are spread across several sectors in SC. The observed phenomenon can be generalized to the domain of inter-organizational collaborations, specifically in the SC context with a similar situation with the Netherlands. We do not recommend

Case study design	Implementation in this study
	generalizing this study's results to settings that are poles apart from our research scope.
Reliability	
Replicability and transfer potential is ensured by using a consistent typology	Using structured building blocks as the research framework ensures that other researchers can systematically revisit the collaborations' data and infer the governance information.

RQ2-2: *How to compare different governance arrangements for a specific collaboration and study various collaborations?*

Next, we use logical and comparative analysis for the cross-case discussion to address RQ2-2. This analysis uses the building blocks to identify the similarities and dissimilarities between all longitudinal cases' lifecycles. Using the cross-case comparison, we evaluate the constructs' definitions according to the empirical evidence. This evaluation results in adjustments to our building blocks' illustration and conceptualization that aim to sharpen our answer for RQ1-3.

RQ3: *What can we learn from the governance lifecycles to achieve a successful IOS-based collaboration?*

The case studies and cross-case analysis lead us to lessons learned for achieving success in operating IOS-based collaborations, specifically for SCCs. During this cross-case analysis, we identified intriguing topics. These topics address our concern in RQ3.

1.5 Structure of the Thesis

This thesis consists of 10 chapters and appendixes – including a list of abbreviations in Appendix A. Most chapters (whole or part) are based on previously published conference or academic journal articles. We have permission from co-authors/publishers to use the works listed below in this dissertation. This dissertation is based on:

- Chandra, D. R. and van Hillegersberg, J. (2019). Creating Competitive Advantage for Air Freight Communities Using a Cargo Community System: A Case Study in Amsterdam Schiphol Airport. *25th Americas Conference on Information Systems, AMCIS 2019*. Cancun (Chapter 6)
- Chandra, D. R. and van Hillegersberg, J. (2018). "Governance of Inter-Organizational Systems: A Longitudinal Case Study of Rotterdam's Port Community System." *International Journal of Information Systems and Project Management,* 6(2), 47 - 68 (a part of Subchapter 2.2, Chapter 4, and Chapter 5)
- Chandra, D. R. and van Hillegersberg, J. (2017). "Governance Lifecycles of Inter-Organizational Collaboration: A Case Study of the Port of Rotterdam." *Procedia Computer Science,* 121, 656-663 (Extended to the previous journal article for the *International Journal of Information Systems and Project Management*)

- Chandra, D. R. and van Hillegersberg, J. (2015). The Governance of Cloud-based Supply Chain Collaborations. *International Conference on Industrial Engineering and Engineering Management (IEEM)*. Singapore (a part of Subchapter 2.2 and Chapter 3)

Some adjustments have been made to eliminate redundant information and improve this thesis's consistency. Chapter 1 and Chapter 10 encapsulate this thesis's introduction and conclusion, respectively. Chapter 2 until Chapter 9 are dedicated to answering our research questions. Our research questions and this thesis' chapters are presented in Figure 2.

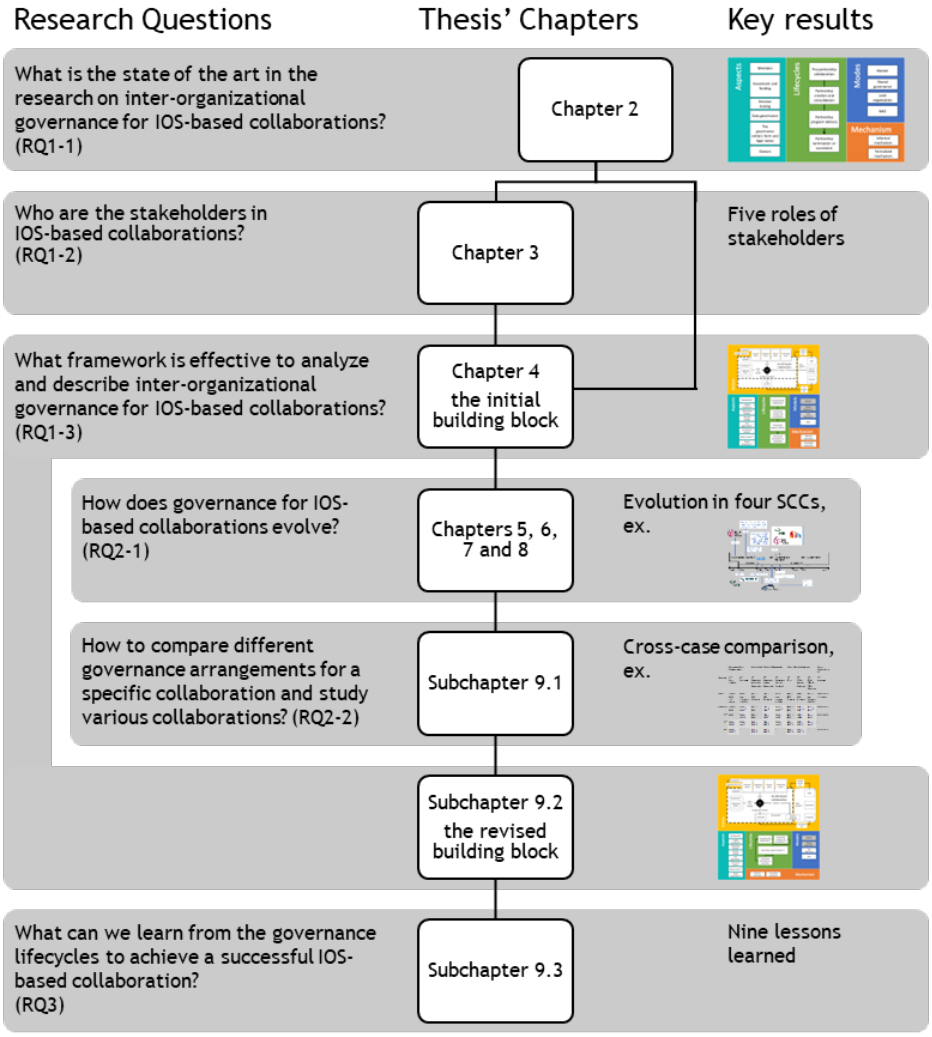


Figure 2. Research questions and chapters

Chapter 2 presents our literature study. Our preliminary literature collection found a problem in the fuzzy definition of governance for inter-organizational collaboration. Another insight from this preliminary study is the dominance of SC in the articles' keywords. This finding means that collaboration is a topic that is surging in the SC industry. Consequently, problems in SCC deserve our attention. The state of the art of inter-organizational governance presented in this chapter consists of (1) the concept of governance lifecycle, (2) 3 points of view for inter-organizational governance, and (3) the theoretical frameworks that are used in literature. From the state of the art, we found a gap in the literature and proposed a study based on stakeholder theory to fill in this gap. The last part of this chapter discusses the stakeholder theory and its use in inter-organizational governance literature.

Chapter 3 explores the current application of inter-organizational governance in 8 SCCs. We concentrate on cloud-based SCCs due to the early cloud computing trend in the SC industry. Using stakeholder theory, we propose roles of organizations that are constructed and closely related to cloud-based SCCs. Moreover, the governance aspects and modes in the SCCs are identified. In this chapter, we find that it is essential to define the companies' roles to understand the SCCs' boundaries.

Chapter 4 compiles our findings from the literature (Chapter 2) and our exploration (Chapter 3). This chapter will broaden our research context to IOS-based SCCs and drop cloud computing from our research boundary. This chapter proposes building blocks of inter-organizational governance for IOS-based SCCs. The building blocks define the dynamic of governance that is arranged by and for the stakeholders across governance lifecycles by describing three governance points of view.

Our longitudinal case studies are presented in Chapter 5 until Chapter 8. Each chapter is dedicated to a case. The cases are Rotterdam Port Collaboration, Schiphol Air Freight, Dutch Energy Market, and Dutch Floriculture Supply Chain. These IOS-based SCCs are described and analyzed based on the initial building blocks from Chapter 4. In addition, we also discuss current and future issues in those SCCs.

Cross-case discussion in Chapter 9 comprises our reflection on the initial building block from Chapter 4. We analyze the results from longitudinal case studies. From our contemplation, we propose some improvements for the building block. The improvements are used to re-analyze the cases. This chapter produces revised building blocks of inter-organizational governance for IOS-based collaborations in the SC industry. In addition, we also review some lessons learned that we find in the cases for achieving success in operating IOS-based collaborations, specifically for SCCs.

Chapter 2
Literature Review

Abstract – The preliminary literature collection was conducted in 2013. There are three steps in this preliminary study: (1) keyword searches and duplication elimination, (2) selection based on abstract and title, and (3) full paper collection. This preliminary study aimed to get an initial understanding of studies on inter-organizational network governance. We found a gap in the definition of inter-organizational collaboration governance and that studies in the SC industry dominate the literature on the governance of inter-organizational collaborations. Later on, state of the art literature until 2022 was collected. We discussed studies on inter-organizational governance for IOS-based SCCs and theoretical frameworks that are relevant to this topic. Most literature has a broad and fuzzy scope on inter-organizational governance, does not study IOS-based collaboration, and their points of view are segregated. Stakeholder theory emerged as a promising framework for conceptualizing inter-organizational governance.

2.1 Preliminary Literature Collection

Step 1: Keywords Searching

Keyword searches were done in Scopus and Web of Knowledge (WoK) to access peer-reviewed scientific literature. The list of keywords is presented in Table 2. It was used in a search criteria template: ([1st keyword] OR [synonyms]) AND ([2nd keyword] OR [synonyms]) AND ([3rd keyword] OR [synonyms]).

Table 2. Keywords and Synonyms in Systematic Literature Review

3rd Keyword	1st Keyword	2nd Keyword
Govern	Interorganizational	Collaboration
Governance	Inter-organizational	Coordination
Governing	Network	Orchestration
Gain sharing		

In addition, there were rules related to the citation and year of publication: (1) papers from 2001 - July 2013 that have been cited more than five times are included, and (2) papers from 1990 - 2000 cited more than fifty times are included. The preliminary literature collection was conducted in 2013. The rules assure the inclusion of influential articles, such as older articles that were widely cited. The search process resulted in 679 papers and 555 papers in Scopus and WoK, respectively. Afterward, duplicate papers

are identified and eliminated from the list. The result from the first step was 1045 papers. An example of the search criteria in WoK is:

Topic=(("govern" OR "governance" OR "governing" OR "gain sharing") AND ("interorganizational" OR "inter-organizational" OR "network") AND ("collaboration" OR "coordination" OR "orchestration")) OR Title=(("govern" OR "governance" OR "governing" OR "gain sharing") AND ("interorganizational" OR "inter-organizational" OR "network") AND ("collaboration" OR "coordination" OR "orchestration")) Timespan=1990-2013. Databases=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH]

Step 2: Abstract Selection

Two researchers with information system management backgrounds were involved in the second stage to reduce subjectivity bias. First, literature selection was done separately. Acting as standard guidance in this process were inclusion and exclusion criteria, which helped to make sure that both researchers had the same perspective. The inclusion criteria were research on the governance of inter-organizational enterprise collaboration. The exclusion criteria were:

- Research that is not in the field of governance study.
- Research on inter-organizational collaboration focuses on a specific aspect besides governance, such as trust and performance measurement.
- Governance study that is not in the field of enterprise governance; For example, research on public governance or public service, teamwork governance, project or temporary governance, and information technology governance.
- Research on a single organization or intra-organization governance and dyadic relationship governance.

In the second step, the percentage of different abstract selection decisions given by the researchers was 11.29%. Each paper with different decisions was discussed to achieve a final decision. In the end, this step resulted in 241 articles.

Step 3: Full Paper Collection

The full paper selection starts with collecting full papers for each list of literature groups. Some documents not available via Scopus and Web of Knowledge directly were collected with the support of Google Scholars and the social research network. In this process, some papers whose full texts were not in English were identified and were not included. The number of documents with available full text was 127 papers.

Using the keywords, we could determine topics that are related closely to the papers' focus. The keywords are used because there is a strong link between the papers' keywords and their entire content (Jede & Teuteberg, 2015). The keywords are inductively categorized based on the words' basic form. For example, the keyword "public-private academic partnerships" are organized into "public", "private", "academic", and "partnership" categories. Twenty papers do not have any keywords. From the remaining 107 papers, the keywords range from 5 to 16 words in each article.

After the categorization, 198 categories are extracted. The categories are ranked based on the frequency of their occurrence. The ten most frequent keyword categories are presented in Table 3.

Table 3. Keyword categories

Keyword categories	Rank
Network	1
Governance	2
Collaboration	3
Management	4
Organization	5
Inter-organizational	6
Supply chain	7
Alliance	8
Coordination	8
Health	9

Keyword categories	Rank
Social	9
Innovation	9
Relationship	9
Transaction cost	9
Information	10
Global	10
System	10
Cooperation	10
Strategic	10
Partnership	10

Most of the keyword categories are the keywords that were used for the first step in this literature review and their synonyms. The keywords are "network", "governance", "collaboration", "inter-organizational", and "coordination". The synonyms are "alliance", "relationship", "cooperation", and "partnership". The occurrence of these categories proved that the keywords were chosen adequately in this literature review. Some categories describe the field of collaborations; those are "supply chain", "health", and "innovation". One of the categories is a "transaction cost" theory. There are also categories that describe the level of collaborations; those are "management", "global", and "strategic". These categories indicate that the studies of inter-organizational collaborations' governance are mostly done at the level of "management", "global", or "strategic" in the fields of "supply chain", "health", or "innovation" using the "transaction cost" theory (transaction cost economic theory/TCE). The "supply chain" category amplifies our research context in SC collaboration. Collaboration is a topic that is surging in the SC industry, and studies in this industry dominate the literature on the governance of inter-organizational collaborations.

2.2 State of The Art: Inter-Organizational Governance[1]

Inter-organizational governance is an act of coordinating a collaboration of multiple companies (Markus & Bui, 2012; Provan & Kenis, 2008). In a collaboration, coordination consists of (1) between the individual companies and the collaboration, (2) within the collaboration itself, and (3) between the non-collaboration activities of partners (Aggarwal, Siggelkow, & Singh, 2011). In a collaboration with an IOS, all coordination activities need to consider the interaction between the companies and the IOS. For example, an IOS and data ownership could give a company power over other companies

[1] This subchapter is based on a paper published in the *International Journal of Information Systems and Project Management* and a paper presented and published in the proceedings of the International Conference on Industrial Engineering and Engineering Management (IEEM) 2015

within the collaboration. On the other hand, an IOS is a supporting tool in implementing formalized business rules by embedding the regulations in the processes. Studies on the governance of IOS-based collaboration emerge to address organizational challenges in IOS adoption.

While analyzing the articles in the preliminary literature study, we found difficulties in understanding the definition of governance of inter-organizational collaborations. Researchers use diverse terms and partial definitions for network governance (C. Jones et al., 1997). By common consent, studies use "governance" to express coordination means, styles, or procedures. In literature, several points of view are used to describe inter-organizational governance. These are the governance mechanism, the governance aspects, and the governance modes. However, most studies do not specify their points of view on inter-organizational governance and often jump on the trend of "governance" as a buzzword.

In the information system field, theory for analyzing a concept is fundamental (Gregor, 2006). This kind of theory provides descriptions that enrich other studies for explaining, predicting, designing, and implementing the idea. Thus, there is a solid need to define the abstract concept of governance in IOS-based inter-organizational collaborations. Figure 3 is the state of the art in inter-organizational governance for IOS-based collaboration literature. Most literature has a broad and fuzzy scope on inter-organizational governance and does not focus on IOS-based collaboration. Moreover, their points of view are segregated.

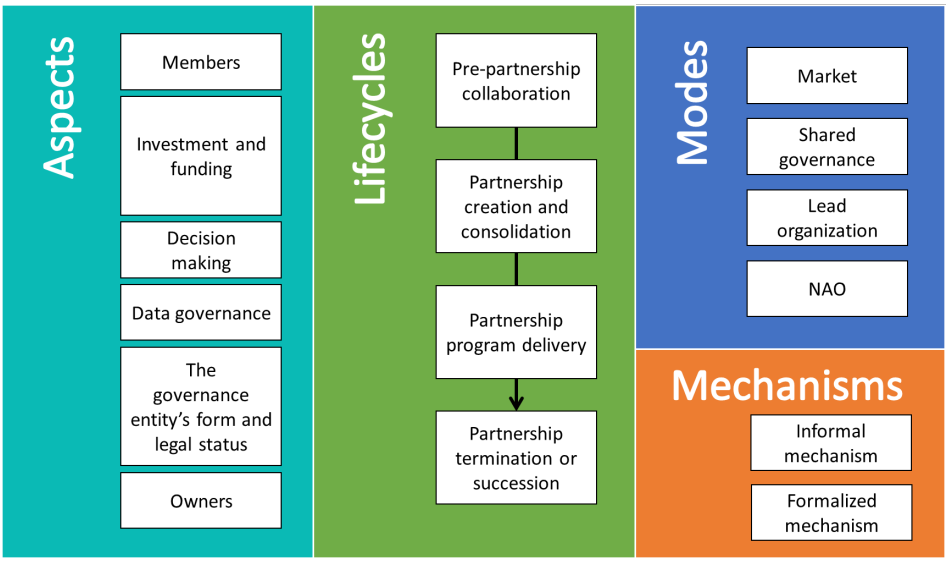


Figure 3. The state of the art in inter-organizational governance for IOS-based collaboration literature

2.2.1 Governance Lifecycles

Because a collaboration may undergo changes, governance is not a static coordination choice. A collaboration needs to adjust its governance to survive. Governance is a dynamic and context-dependent phenomenon that introduces the concept of governance lifecycles (Alvarez et al., 2010; Srour et al., 2008). Empirical studies (Provan et al., 2011) try to explain the governance evolution in collaborations, yet there is a lack of governance framework and mainly explore only the formation and consolidation process. Studies divide collaboration's evolution process into phases (see

Table 4). Popp et al. (2014) diminish the pre-partnership collaboration phase defined by Lowndes and Skelcher (1998) and jump to the formation stage. Skipping the preparation period means that the study of Popp et al. (2014) determines that a collaboration's lifecycle is started after it is established. On the other hand, it is common to find that a collaboration is initiated and fails to be formed. In addition, Popp et al. (2014) break down the collaboration's operational period into two phases – the development and growth stage and the maturity, sustainability, and resilience stage. Currently, there is no standard measurement to determine a collaboration's maturity. This lack of measurement tools could lead us to a debatable timeline for each collaboration.

Table 4. Studies on collaboration lifecycles

Lowndes and Skelcher (1998)	Popp et al. (2014)
Pre-partnership collaboration	-
Partnership creation and consolidation	Formation
Partnership program delivery	Development and growth
	Maturity, sustainability, and resilience
Partnership termination or succession	Death and transformation

2.2.2 Governance Modes

Some studies (e.g., Lowndes and Skelcher (1998)) associate governance modes with governance mechanisms. Even though there is a correlation between those concepts, the distinction is observed in the elements. Governance mechanisms are means of coordination. Meanwhile, governance modes are categorizations of the governance that are executed using the mechanisms. Several modes of inter-organizational governance have been proposed in academic articles (see Table 5).

The integrated firm mode is excluded from this classification because it is a new legal entity established through a merger or a joint venture of companies. After the organizational restructuring, previous inter-organization collaborations are replaced by

Table 5. Literature on inter-organizational governance modes

Governance Modes	Lowndes and Skelcher (1998)	Baudry and Chassagnon (2012)	Provan and Kenis (2008)	Markus and Bui (2012)	Kohlborn et al. (2009)
Market	✓	✓			✓
Shared governance	Network		✓		✓
Lead organization	Network	✓	✓		✓
NAO	Network		✓	✓	
Firms	✓	✓			

intra-organizational interactions under a legal authority (Baudry & Chassagnon, 2012). Thus, it is not a governance mode for a network of organizations but a new organization.

Even though differences in naming and classification are present, we conclude that there are four basic modes of inter-organizational governance:

- *Market*, is formed by contractual relationships between suppliers and buyers (Lowndes & Skelcher, 1998).
- *Shared governance*, in which members participate in network governance without a separate and unique governance entity (Provan & Kenis, 2008).
- *Lead organization*, in which a particular member coordinates major network-level activities and decision making in a network (Provan & Kenis, 2008).
- *Network Administrative Organization* (*NAO)* is a separate entity established to govern the network (Provan & Kenis, 2008).

2.2.3 Governance Mechanism

The inter-organizational governance can be done through members' role definition (Anderson, Michael, & Peirce, 2012), a formal mechanism (Cristofoli, Markovic, & Meneguzzo, 2012) for decision making (Alvarez et al., 2010), an informal and communication mechanism (Borch, 1992; Chapman & Corso, 2005), or performance measurements and incentives (Aggarwal et al., 2011; Alvarez et al., 2010; Anderson et al., 2012; Bryson, Crosby, & Stone, 2006).

The role definition needs to be clearly designated from the start of the collaboration. Each company has responsibilities and rights to be claimed based on its contribution. Further, the role definition implies the power distribution within the collaboration (Kampstra, Ashayeri, & Gattorna, 2006) and the degree of autonomy held by the individual companies (Alvarez et al., 2010).

Governance can be formalized in an organizational structure or contracts between companies. In the case of an unforeseen dispute, informal communication between the companies is more effective than a formal mechanism (Arranz & de Arroyabe, 2012; Arranz & Fdez. de Arroyabe, 2007). The performance of each company and the collaboration needs to be measured. Thus, the collaboration coordinator has a method to measure the contribution and is able to distribute the resources and incentives to promote better performance from every company (Kampstra et al., 2006).

No single coordination choice would apply equally effectively across all circumstances (Aggarwal et al., 2011). The coordination mechanisms help a collaboration to achieve solid outcomes by interacting with governance antecedents (Roehrich et al., 2020). In a collaboration with a high trust between the companies, an informal arrangement – such as norms that are developed during the interactions over time (Aulakh & Gençtürk, 2008) - could achieve a better result than formal coordination.

2.2.4 Governance for IOS-based SCCs

The impact of information systems on a tendency towards hierarchical or formalized governance has been proposed and confirmed by several studies (Gulati & Singh, 1998; Markus & Bui, 2012). In addition, these governance modes will not only fit for coordinating the complexity of the information systems but also for supporting the SCC itself. Referring to SC and SCC definitions, it is clear that the interdependence between companies in SCCs and their goal consensus is high; both factors have been identified as critical predictors of hierarchical governance modes (Gulati & Singh, 1998; Provan & Kenis, 2008). Accordingly, lead organization and NAO are predicted to suit IOS-based SCCs better than the market and shared governance. There is an opinion that an IOS is selected by a dominant organization in a collaboration (Gopalakrishnan et al., 2022). However, it is suggested that lead organization governance is not a likely fit with IOS-based collaboration, mainly because members may fear that the dominant company uses other members' data to gain a competitive advantage (Markus & Bui, 2012). Thus, researchers and practitioners suggest that IOS-based SCCs are ideal bases for establishing NAO governance mode.

Some studies propose a classification of governance modes. Nevertheless, hybrid governance arrangements in decision making, ownership, or legal status are observed in collaborations (Markus & Bui, 2012). For example, collaborations with NAO governance mode typically have board structures that include all or a subset of network members (Provan & Kenis, 2008). Markus and Bui (2012) define six characteristics for mapping governance for IOS-based inter-organizational collaborations. Fundamentally, the characteristics are governance aspects of inter-organizational collaborations.

Table 6 demonstrates how these characteristics correlate with the corporate governance assets identified by Weill and Ross (2004). Weill and Ross (2004) distinguish companies' six key assets that need to be governed to accomplish their strategies.

Table 6. Comparison between corporate and inter-organizational governance aspects

	Weill and Ross (2004)					
Markus and Bui (2012)	Human	Financial	Physical	Intellectual Property	IT	Relationship
Organizational form and legal status	--	--	--	--	--	--
Who can be members?	--	--	--	--	--	X
Who can be equity owners?	--	X	--	--	--	X
Capital investment and operational funding	--	X	X	--	--	--
Board composition and decision making	X	--	--	--	--	--
Data governance	--	--	--	X	X	--

This comparison justifies that Markus and Bui's (2012) characteristics are basically key aspects of collaborations. Some of the connections are loosely defined, but those are not imprudent. The gap is explained by the nature of collaborations. First, collaborations mainly concern members' coordination, so the human assets are not strongly reflected in the collaborations' governance. Second, because collaborations involve multiple companies, the legal forms are not always carved in stone and require careful planning and coordination.

2.2.5 Theoretical Framework

Many studies discuss a network of collaboration using different theories or perspectives. Barringer and Harrison (2000) identify six popular theories in studies on the formation of inter-organizational relationships: TCE, resource dependency, strategic choice, stakeholder theory, organizational learning, and institutional theory. A study by Wang et al. (2022) classifies the theories in inter-organizational governance literature for temporary projects into:

- dyadic level (i.e., TCE, agency theory, stewardship theory, and social exchange theory),
- multiple organizations level (i.e., contingency theory, stakeholder theory, network embeddedness, social capital theory),
- inter-network level (i.e., social network theory)

Our preliminary literature collection finds that TCE (Transaction Cost Economy) is one of the most frequent keyword categories. A similar finding is also observed in a literature review on inter-organizational governance by Roehrich et al. (2020). This study finds that 47% of 1,415 articles from 1990 to 2018 use TCE as the main theory. The rest of the articles also use alternative theoretical perspectives, i.e., agency theory, contact theory and control, relational contracting, and relational exchange theory. Other theories account for not more than 9% of the articles. The notoriety of TCE is related to its usage in explaining why companies collaborate and create a market or a hierarchical structure to coordinate the collaboration. The focus is on companies' decision to organize inter-organizational relationships to minimize the sum of companies' production and transaction costs (Barringer & Harrison, 2000). TCE is also frequently used in the early stages of SC collaboration literature (Cannavale, Esempio, & Ferretti, 2021).

Our study's goal is to define the concept of inter-organizational governance in IOS-based SCCs. The unit of analysis in this study is a collaboration of organizations. Consequently, TCE and other dyadic level theories are not applicable because our level of analysis is the multiple organization level. Inter-network level perspective is also not suited due to our focus on the governance of one specific collaboration. Thus, we will discuss the theoretical framework for the multiple organization levels (see Table 7).

Table 7. Theoretical framework in inter-organizational governance literature (multiple organizations level)

Theoretical Framework	Short Description
Contingency theory	"Classical contingency theory asserts that different external conditions might require different organizational characteristics, and that the effectiveness of the organization is contingent upon the amount of congruence or goodness of fit between structural and environmental variables." (Shenhar, 2001) "Contingency theory contains the concept of a fit that affects performance, which, in turn, impels adaptive organizational change. Some of the more important contingency theories of organizational structure involve the three contingencies of the environment, organizational size, and strategy." (L. Donaldson, 2001)
Stakeholder theory	"Organizations are at the center of an interdependent web of stakeholders and have a responsibility to consider the legitimate claims of their stakeholder when making decisions and carrying out business transactions." (Barringer & Harrison, 2000) "Stakeholder theory suggests that if we adopt as a unit of analysis the relationship between a business and the groups and individuals who can affect or are affected by it, then we have a better chance to deal with: (1) the problem of value creation and trade; (2) the problem of the ethics of capitalism; and (3) the problem of the managerial mindset." (Freeman, Harrison, Wicks, Parmar, & De Colle, 2010)

Theoretical Framework	Short Description
Network embeddedness	"Most behavior (including economic behavior) is closely embedded in networks of interpersonal relations. The use of embeddedness analysis in explicating proximate causes of patterns of macro-level interest is well illustrated by the markets and hierarchies question. The extent of vertical integration and the reasons for the persistence of small firms operating through the market are not only narrow concerns of industrial organization. I suggest here that small firms in a market setting may persist instead because a dense network of social relations is overlaid on the business relations connecting such firms and reduces pressures for integration." (Granovetter, 1985) "In the broadest sense, the concept of embeddedness is used simply as indicating the state of dependence on the context (organizational, institutional, social, or other). The concept of embeddedness has become a popular tool for the analysis of the impact of social context, social capital, and personal relationships, interorganizational relationships as well as spatial scope of specific relationships on companies' behavior and activity." (Ratajczak-Mrozek, 2017)
Social capital theory	"Social capital is a resource embedded in social relationships. Social capital emerges in the structure of relations or networks among individuals or collectives (e.g., organizations, nation-states). The structures or networks can be open (bridging) or closed (bonding). Generally, the networks consist of formal or informal and institutionalized or non-institutionalized relationships." (Häuberer, 2011) "There is an impressive diversity of empirical evidence showing that social capital is more a function of brokerage across structural holes than closure within a network, but there are contingency factors. The weaker connections between groups are holes in the social structure of the market. These holes in social structure – or more simply, structural holes – create a competitive advantage for an individual whose relationships span the holes. The network structure of social capital boils down to the three kinds of networks: entrepreneurial network (sparse, flat structure), clique network (dense, flat structure), and hierarchical network (sparse, center-periphery structure)." (Burt, 2000)

In inter-organizational governance literature, contingency theory, network embeddedness, and social capital theory are mainly used to explain the process of choosing and the factors that are important for organizations in designing their governance. For example, Lin, Huang, Lin, and Hsu (2012) investigate network embeddedness as a factor influencing formal governance mechanism implementation. Liu and Wei (2021) combine the contingency perspective and TCE to examine the moderating effect of cultural distance on the relationship between governance mechanisms and a firm's bridging responses to SC disruptions. Carey, Lawson, and Krause

(2011) explore the relations between social capital dimensions, legal bonds – as a means of governance – and performance in a buyer-supplier relationship.

A network comprises various stakeholders tied together by various relationships (Kapucu & Hu, 2020c). The relationships are constructed by formal and informal agreements (Barringer & Harrison, 2000). This perspective is aligned with stakeholder theory. In a network model of stakeholder theory, a firm is linked with other firms that are its stakeholders, and these linkages exist across a network of firms (Fassin, 2008; Rowley, 1997). Identifying the timeline and each stakeholder's contribution or activities in inter-organizational projects is essential because the key stakeholders may change (South, Eriksson, & Levitt, 2018). Mishra and Mishra (2013) emphasize the dynamics of key stakeholders in a collaboration. The stakeholders may join or affect the collaboration in different timelines. The stakeholders' power and the relationships' legitimacy and urgency are not steady (Mitchell, Agle, & Wood, 1997). Consequently, labeling the stakeholders in a longitudinal study will be difficult without differentiating the time points. The stakeholder concept is favored because of its simplicity and visual power (Fassin, 2008). Therefore, we argue that the visualization of IOS-based inter-organizational collaborations' stakeholders and their relationships in a longitudinal study will complement the current literature on the collaborations' governance.

Another theory that focuses on the stakeholders of a dynamic network is the Actor Network Theory (ANT). Hald and Spring (2023) suggest that ANT will complement current theoretical perspectives of SC management due to its nature and assumptions that match the dynamic nature of SC. Rodon, Pastor, Sesé, and Christiaanse (2008) use ANT in a longitudinal study on IOS implementation in the seaport of Barcelona. This study describes the dynamic of IOS implementation by using four phases - problematization, interessement, enrolment, and mobilization (Callon, 1986) – and identifying human and non-human actors that construct the network. The study's focus is the IOS implementation in general. While this focus selection gives the readers a broader view, the study's complexity is massive. Technical problems (e.g., IOS performance) intertwine with social (e.g., trust), managerial (e.g., IOS provider's management process), and governance problems (e.g., membership selection).

ANT theoretical framework has several limitations for studying inter-organizational governance. First, the staging (lifecycle) definition in ANT studies is unclear. Second, the actors identified are scattered due to the "flatness" nature of social networks in ANT (Latour, 2007). The managers are described at the same level as the organizations (e.g., the Port Authority, Banks, and Customs). Third, ANT-specific terms, such as translation, mobilization, and inscription, are not familiar to researchers and practitioners. Consequently, other researchers will have difficulty in using the theory to explore other hypotheses about inter-organizational collaboration, design an IOS-based collaboration, or develop a prediction for an existing collaboration. Due to this

limitation, we suggest that stakeholder theory will give us more insight than ANT in constructing the concept of inter-organizational governance.

2.3 Stakeholder Theory

The stakeholder theory originates from strategic business management literature (South et al., 2018). The original goal of this theoretical framework is to understand how a firm could meet the expectations of the stakeholder groups (Freeman et al., 2010). Freeman (1984) recommends that firms' stakeholders are beyond a simple managerial perspective. Stakeholders are "any group or individual who can affect or is affected by the achievement of the firm's objectives" (Freeman, 1984). T. Donaldson and Preston (1995) discuss three aspects of stakeholder theory:

- Descriptive: "It (stakeholder theory) presents a model describing what the corporation is."
- Instrumental: "It (stakeholder theory) establishes a framework for examining the connections, if any, between the practice of stakeholder management and the achievement of various corporate performance goals."
- Normative: "It (stakeholder theory) involves acceptance of the following ideas… Stakeholders are identified by their interests in the corporation and whether the corporation has any corresponding functional interest in them. The interests of all stakeholders are of intrinsic value."

It is important to be precise about the inclusion criteria that differentiate the stakeholders from non-stakeholders and differentiate key stakeholders from minor stakeholders. Mitchell et al. (1997) define the rationale for stakeholder identification:

- A relationship exists between the firm and the stakeholder.
- Power dependence
    - The stakeholder is dominant.
    - The firm is dominant.
    - Mutual power-dependence relationship.
- There is a contractual or claim basis for the legitimacy of the relationship.
- The stakeholder has an interest in the firm.

There is a common misconception in studies using stakeholder theory that all stakeholders are equally important or influential (Barringer & Harrison, 2000; Freeman et al., 2010). Freeman (1984) divides the stakeholder groups into internal and external groups and introduces eleven examples of stakeholder groups (i.e., customers, employees, suppliers, owners, governments, competitors, special interest groups, media, environmentalists, and customer advocates). Freeman, Harrison, and Wicks (2007) differentiate stakeholders into primary (parts of the firm's value chain) and secondary stakeholders. The categorization is presented in Figure 4.

Using the descriptive characteristic of stakeholder theory, we would like to show how a collaboration governance can be described through stakeholders' relationships. "Organizations are not necessarily at the center of the stakeholder set" (Rowley, 1997). Some studies discuss a network model of stakeholder theory (see Figure 5). In this network model, stakeholder theory is not limited by a firm's perspective. "A stakeholder of one firm can also be a stakeholder of other firms, with its own stakeholder network" (Fassin, 2008). Based on this theoretical perspective, a collaboration is constructed by organizations that are related to each other. In a collaboration, the stakeholder organizations are the nodes, and the collaboration's governance can be described by the stakeholders' relationship in coordinating their activities.

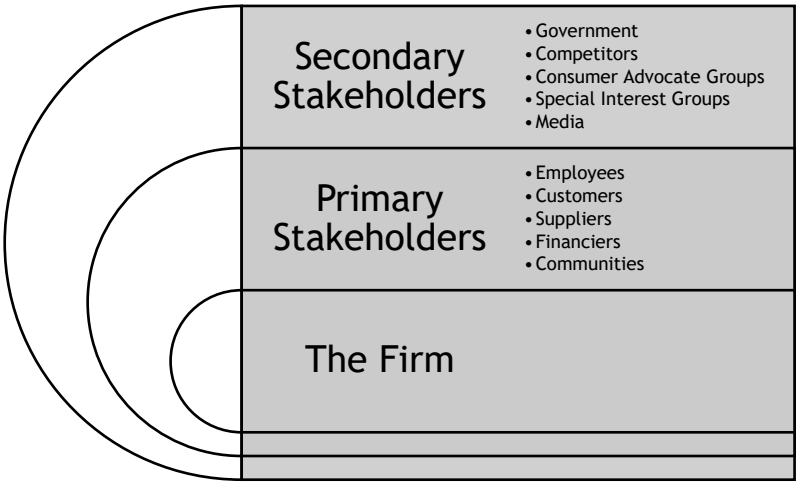


Figure 4. Basic two tiers stakeholder classification (Freeman et al., 2007)

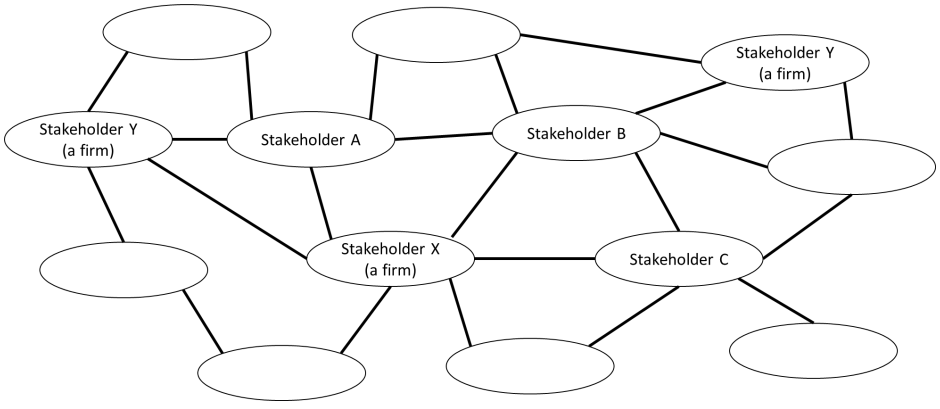


Figure 5. The network model of stakeholder theory (Fassin, 2008; Rowley, 1997)

We can observe this inter-organizational relationship of stakeholders in the IOS implementation. Many early studies define stakeholders as individuals or groups within the organization (i.e., end-users and managers) that are important to successfully implement a system (Barringer & Harrison, 2000). Later, the stakeholder theory in the information system field shifted from individual perspectives in a firm to IOS problems in networks (Flak & Rose, 2005; Mishra & Mishra, 2013). For example, Fedorowicz, Gogan, and Culnan (2010) use this theory to study the barrier to inter-organizational information sharing in e-government.

In addition, the relationship between stakeholders and collaboration governance is apparent. A study by Vélez et al. (2022) finds that the existence of external consultants or managers may affect the choice of governance structure. Beach (2008) discusses the justification for using stakeholder theory to identify public organizations' interdependence that affects the network's governance. The number and variety of stakeholders are closely related to the complexity of trust building and shared goals development (Kapucu & Hu, 2020c). The network structure is the relations between nodes, which can be described by the nodes' characteristics and relationship patterns (Kapucu & Hu, 2020b), so a collaboration's governance structure can be described by its member organizations and the organizations' relationship patterns.

A study by South et al. (2018) studies a collaboration of public and private firms in projects and describes the partnership as a stakeholders' network of different actors. This study shows that stakeholders' emergence and involvement fluctuate across a project's timeline and discusses the change of the means of interactions from informal to formal. This dynamic phenomenon is also presented as one source of graphical limitations of the stakeholder theory (Fassin, 2008). Thus, we propose to combine the visual representation of stakeholder theory with other theoretical frameworks in inter-organizational governance to overcome this limitation.

Studies that use stakeholder theory to explore inter-organizational collaboration governance are limited. We searched in Scopus and found eight articles from 1990 until March 2023. Our search algorithm was:

TITLE-ABS-KEY((“govern” OR "governance” OR “governing” OR "gain sharing" OR "gain-sharing") AND ("interorganizational" OR "inter-organizational" OR "network") AND ("collaboration" OR "coordination" OR "orchestration") AND ("stakeholder theory")) AND SUBJAREA(mult OR ceng OR CHEM OR comp OR eart OR ener OR engi OR envi OR mate OR math OR phys OR mult OR arts OR busi OR deci OR econ OR psyc OR soci) AND PUBYEAR > 1989

Three of the articles are not closely related to our study's focus on the governance of inter-organizational collaboration. Williams (2015) is a literature review on typology and

dimensions of collaboration that refer to governance in the public administration and public policy field. Other articles, Whitelock (2015) and Baddache and Nicolai (2013), use a firm's perspective in their research. Both studies' units of analysis are a single organization. The remaining articles are presented in Table 8.

Table 8. Studies that use stakeholder theory to explore inter-organizational collaboration governance

No	Authors	Title	Year	Source Title
1	Rompoti, K., Madas, M., Kitsios, F.	A conceptual framework for effective contracting in construction supply chains	2020	International Journal of Construction Supply Chain Management
2	Morales, M.E., Diemer, A.	Industrial symbiosis dynamics, a strategy to accomplish complex analysis: The Dunkirk case study	2019	Sustainability (Switzerland)
3	Pankowska, M.	Information technology outsourcing chain: Literature review and implications for development of distributed coordination	2019	Sustainability (Switzerland)
4	Power, D., Singh, P.	The e-integration dilemma: The linkages between Internet technology application, trading partner relationships and structural change	2007	Journal of Operations Management
5	Clegg, S.R., Pitsis, T.S., Rura-Polley, T., Marosszeky, M.	Governmentality Matters: Designing an Alliance Culture of Inter-organizational Collaboration for Managing Projects	2002	Organization Studies

Rompoti, Madas, and Kitsios (2020) identify the general structure of construction SC networks and only focus on stakeholder analysis to support the contractual relationship. Clegg, Pitsis, Rura-Polley, and Marosszeky (2002) discuss governmentality (a contemporary neo-liberal form of governance) in construction projects. Both studies' focal point is a temporary partnership in an inter-organizational project. Pankowska (2019) identifies the individual-level stakeholders in information technology outsourcing chains and the elements of contracts as a formal control mechanism that connects these stakeholders. Power and Singh (2007) test three hypotheses about the relationship between internet technology applications for integrated SC activities, trading partner relationships, and an organization's structural change. Morales and Diemer (2019) combine stakeholder theory with complexity theory and ecosystems theory to analyze the drivers and barriers of industrial symbiosis's sustainability and suggest governance as one of the proposed interventions.

These articles are scattered in the construction, information technology (IT), trading SC, and general industries. Some articles – for example, Morales and Diemer (2019) – do not precisely describe inter-organizational governance. Meanwhile, other articles – for example, Rompoti et al. (2020) – fixate on the formalized mechanism of governance, which is a legal contract. Thus, these articles do not provide us with a comprehensive understanding of the concept of inter-organizational governance and its dynamic and context-dependent changes. It is a gap that will be addressed in this study.

2.4 Conclusion

The initial literature gathering in 2013 comprised three stages: keyword searches and deduplication, selection based on abstract and title, and full paper collection. This study employed keyword searches in Scopus and Web of Knowledge. Specific citation and publication year criteria were applied to include relevant papers. Two hundred forty-one articles were selected after reviewing by researchers with backgrounds in information system management.

The chosen keywords (network, governance, collaboration, inter-organizational, and coordination) were effective in identifying suitable literature. These terms were aptly matched by synonym terms like "alliance", "relationship", "cooperation", and "partnership". Certain keywords reflected collaboration fields like "supply chain," "health", and "innovation." Another keyword encompassed the "transaction cost" theory, and distinctions were drawn among levels of collaboration such as "management", "global", and "strategic". These findings underscored the prevalence of TCE as a prominent keyword category, consistent with previous research.

The dominant theory in the state of the art – TCE – was used extensively in explaining companies' collaborative motivations and their decisions to establish market-based or hierarchical structures for managing inter-organizational relationships. However, during the examination of articles, we encountered challenges in comprehending the definition of inter-organizational collaboration governance. This research aims to bridge that gap and offer insights into the evolving landscape of inter-organizational governance. The keyword category "supply chain" enhances the scope of our research within the context of SCC.

The literature study was expanded to cover state of the art literature on inter-organizational governance in the context of IOS-based collaborations until 2022. Inter-organizational governance's dynamic and context-dependent nature was highlighted, necessitating adjustments for a collaboration's survival. Lifecycles of governance emerged as a relevant concept. The literature revealed diverse viewpoints, including governance mechanisms, aspects, and modes. These viewpoints are segregated from

each other. Nevertheless, the interplays between these viewpoints are observed, such as in Markus and Bui (2012).

Stakeholder theory emerged as a promising framework for conceptualizing inter-organizational governance and connecting the state of the art viewpoints. Stakeholder theory was proposed as a more comprehensive lens than theories like ANT, contingency theory, network embeddedness, and social capital theory in shaping the concept of inter-organizational governance. It illuminates the network-like relationships among firms and stakeholders, with formal and informal agreements evolving over time. Stakeholder theory's shift from individual firm perspectives to addressing network contexts in the field of information systems was observed. However, limited studies employed stakeholder theory to explore inter-organizational collaboration governance, revealing a gap in understanding the concept's dynamic and context-dependent changes.

Chapter 3
Exploration of Cloud-based SCCs[2]

Abstract - Despite the promising benefits of cloud computing in enabling efficient, sustainable, and agile SCCs, this service does not eliminate governance challenges in SCCs. Cloud-based SCCs may flounder without a proper understanding of how to govern inter-organizational relations and insight into how the cloud service will affect them. This study aims to: (1) observe cloud-based SCCs in practice and develop a classification of stakeholders and (2) get an overview of current governance modes that exist for cloud-based SCCs. Five types of company roles (members, SC partners, cloud providers, other partners, and orchestrators) in cloud-based SCCs are proposed to reduce ambiguity in inter-organizational communication. This study identifies market and shared governance for cloud-based SCCs besides the hierarchical governance, Network Administrative Organization (NAO). This study's contribution is to describe how the cloud is currently used to enable a diversity of the SCCs' governance modes.

3.1 Introduction

Evolving over time, SC competition nowadays is not only between companies but also between entire value chains (Horvath, 2001). SC discussions went beyond intra-organizational and dyadic relationships towards inter-organizational SCCs perspective. SCCs emphasize the importance of information sharing among companies in SC to gain competitive advantages by reducing costs and increasing service quality. However, SCCs are often problematic and face several challenges (Arshinder et al., 2008; Christiaanse, 2005; J. Van Hillegersberg, Tseng, Zuidwijk, Van Oosterhout, & Van Nunen, 2003): 1) information system challenges, such as incompatible infrastructure and legacy systems, a lack of standardized Service Level Agreements (SLAs), and limited scalability; 2) operations challenges, such as a mismatch of execution parameters and missing cost-benefit evaluations; and 3) organizational challenges, such as a lack of trust, power imbalance, conflicting goals, and a lack of a coordination mechanism. Failure to address these challenges could lead companies to havoc.

Without the support of an information system, it is not easy to achieve successful SC operations (Gunasekaran & Ngai, 2004). Succeeding prior innovations, such as the internet and RFID, the trend of cloud computing promises to enable efficient,

2 This chapter is based on a paper presented and published in the proceedings of the International Conference on Industrial Engineering and Engineering Management (IEEM) 2015

sustainable, and agile SCCs by overcoming information system and operational challenges. The cloud potentially enables data exchange and further collaboration in SCCs with lower capital investment and higher flexibility compared to on-premise systems (COIN Team, 2011).

Still, cloud-based SCCs have to address the organizational challenges. SCCs may flounder without a proper understanding of how to govern the relationships between companies in an inter-organizational context. Conceptual and empirical supports exist for links between the use of governance instruments and supply network outcomes (2012). In the case of cloud-based SCCs, the cloud service and the SC activities become closely intertwined. Despite advancements in the inter-organizational governance mode literature, there is little literature on IOS-based inter-organizational collaboration (Markus & Bui, 2012). This study specifically focuses on the governance of cloud-based SCCs to complement the state of the art.

Many theoretical frameworks have been applied to analyze collaboration networks and their governance, such as group theory, sociometry, transaction cost economic theory, and game theory (Kapucu & Hu, 2020a). We argue that stakeholder theory is suitable for visualizing the governance of cloud-based inter-organizational collaborations. Stakeholder theory does not emerge in the top five theories of inter-organizational governance (Roehrich et al., 2020). The term “Stakeholder” was first used in an internal memorandum at the Stanford Research Institute and was defined as “those groups without whose support the organization would cease to exist” (Freeman et al., 2010). In inter-organizational governance, this theoretical framework can help us define the organization groups that are influential. There is enormous attention in this stakeholder field. Stakeholder theories are expected to provide a concise, structured, and comprehensive framework to explain the governance of SCCs and help identify the governance modes.

This study aims to: (1) observe cloud-based SCCs in practice and develop a classification of stakeholders – actors that support the collaborations, (2) explore governance modes that exist for cloud-based SCCs in practice. Our main contribution to the SC management field is the presentation and analysis of cloud-based SCC cases using this stakeholder and governance perspective.

3.2 Governance of Cloud-based SCCs

We define SCCs as the act of two or more independent companies working together to execute a part or all of their SC activities. Among all types of cloud services, there is an emerging concept of Coordination as a Service (CaaS). CaaS is a set of coordination services cloud that can be rented from the cloud for the purpose of achieving agile service integration (J. Van Hillegersberg, Moonen, & Dalmolen, 2012). It enables data exchange and further collaboration across companies in SCCs by providing a platform connecting multiple Software as a Service (SaaS). In CaaS-enabled SCCs, SC

orchestrators, CaaS providers, and SaaS providers come together to support SCCs. Figure 6 represents a CaaS-enabled SSC's structure, which includes an SC orchestrator, a CaaS provider, and multiple SaaS providers. Depending on its legal form and its offered business value, each entity in the structure might work as an independent company or as a business unit that establishes a company with other entities.

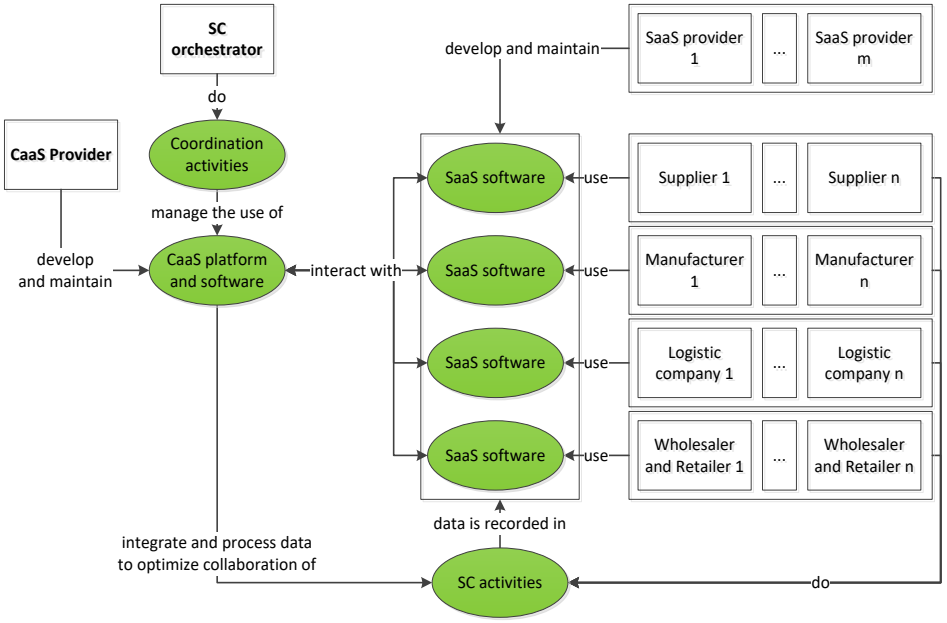


Figure 6. An illustration of CaaS-enabled SCC

We expect that cloud-based SCCs (SaaS-based or CaaS-based) can be configured to be compatible with other types of governance modes, primarily market and shared governance. This conjecture is built based on the main feature of cloud computing. Cloud computing provides the services of infrastructure, platforms, and software over the internet. Giving the benefits of no up-front investment, being highly scalable, easy access, and reducing business risks (Q. Zhang, Cheng, & Boutaba, 2010), cloud technology provides SCCs and their members with the flexibility to choose their system providers. The cloud can reduce barriers for companies to enter and exit SCCs. Consequently, hierarchical structures may become less critical in cloud-based SCCs compared to traditional SCCs. Meanwhile, contracts together with SLAs, as governance mechanisms, maintain legal protection for property rights, data ownership, security, and promised system performance.

3.3 Data Collection

We conducted semi-structured interviews based on a protocol. The protocol comprises: (1) the introduction to our research, (2) informed consent form signing, and (3) open

discussion and questions about their companies or projects and associated SCCs' business and governance. The topics and questions in our discussion are presented in Appendix B. The first part of our discussion highlights the cloud-based SCCs' business context elements: its value proposition, information technology, and partners. The second part of the discussion is based on inter-organizational collaboration governance aspects: the governance entity's form and legal status, members, owners, investment and funding, decision making, and data governance (Markus & Bui, 2012). In addition, we asked other questions related to the companies' competitors to identify other potential cases.

The data was collected from 2014 until 2015. There are 8 cases. The information on each case was collected from a sample company (Companies A-H). Cases were selected through online market research or suggestions in interviews, in which the interviewees were asked to mention their SCCs' rivals. Seven companies (Companies A-G) claimed to be third-party SCC integrators, and 1 (Company H) claimed to be an initiator of an SCC control tower project. These companies' roles in their SCCs will be discussed later. The companies' establishment years show that most SCCs were not more than a decade old in 2015 – when this analysis was conducted. Most companies were established in the Netherlands – except company B, which was based in Belgium. The data collected is summarized in Appendix C.

3.4 Discussion

We analyze the SCCs using stakeholder theory to develop a classification of stakeholders in cloud-based SCCs and explore their governance. These SCC are:

- SCC A is a logistic cross-SCC that offers SC orchestration and consultation services by Company A.
- SCC B is a logistic horizontal cross-SCC that offers SC orchestration services by Company B.
- SCC C is an omnichannel logistic SCC. Company C's IOS connects the companies and enables the SCC.
- SCC D is an SCC for companies in a specific location and transportation channel that Company D's IOS connects.
- SCC E is a transportation service marketplace built on Company E's IOS.
- SCC F is an SCC for companies in a specific location and transportation channel offering SC orchestration services by Company F.
- SCC G is an industry-specific SCC that Company G orchestrates.
- SCC H is a logistic distribution collaboration that Company H initiated.

First, we identify the positions of sample companies (companies A-H) in SCCs based on their value propositions and critical resources. Companies A, B, C, D, E, and F provide their customers with IOSs that support data sharing in their SC activities. These IOSs connect to the customers' systems or can be used directly using web-based services. Meanwhile, companies G and H work together with cloud providers and software developers to arrange IOSs for their SCCs. Company G offers SC orchestration services

to optimize the SC activities in its SCC. This kind of orchestration service is also provided by companies A, B, D, and F. Company H is a logistic service provider that initiated an IOS implementation project for an SCC. This IOS connects companies that have partnerships with a supermarket chain. All interviewees claimed that their IOSs use cloud technology. However, we could not gather technical data and confirm whether the IOSs are SaaS or CaaS.

Next, we identify the sample companies' partners in SCCs besides the companies' customers (see Table 9). We observe the inter-organizational relationship of stakeholders in the SCCs and categorize the companies based on the stakeholder classification proposed by Freeman et al. (2007). All partners that were stated in interviews are primary stakeholders: customers, suppliers, financiers, and communities. Primary stakeholders define most businesses and have a high legitimacy for their relationship (Freeman et al., 2007). To visualize the SCCs, the classical classification of stakeholders is not adequate.

Table 9. Sample companies' partners

Partners	**Companies**								**Classical stakeholder classification (Freeman et al., 2007)**
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	
Logistic agents	✓								Customers (non-paying IOS users)
Logistic service providers	✓						✓		
Customs	✓								
Cloud providers and system developers	✓	✓	✓	✓	✓	✓	✓	✓	Suppliers
Members' IS providers	✓	✓	✓	✓		✓	✓	✓	
Universities and research institutes	✓	✓	✓	✓	✓		✓		
Legal advisors		✓							
Financial auditor					✓				
Associations				✓		✓	✓		Communities
Business Angels					✓				Financiers

A collaboration needs coordination: (1) between the individual companies and the collaboration; (2) within the collaboration itself; and (3) between the non-collaboration activities of partners (Aggarwal et al., 2011). Thus, we need to identify the boundary of an SCC and differentiate the companies inside the collaboration's boundary from the companies outside the boundary.

The classical classification is limited to a firm as a central node. This limitation leads to several consequences. First, the theory does not define the observed firm's position in a collaboration. Companies A, B, C, D, E, and F own the SCCs' systems. The same companies may offer orchestration services. However, this role is not observed in companies G and H. Company G orchestrates SC activities without owning the IOS.

Company H is one of the logistic service providers that use IOS in its SCC. Second, there is only one customer category. In cloud-based SCCs, there are users who pay to use the systems (inside the SCCs) and users who use the systems for free (outside the SCCs). The identified customers in Table 9 are different from the companies' customers that have contracts with the IOS providers and pay to use the IOSs. These companies are connected to the IOSs because of interconnectivity in their SC activities. Data are sent and received from these companies for the customers' needs.

In addition, we also need to consider the specific characteristics of a cloud-based SCC. In an SCC, a cloud-based IOS should be present to define the collaboration as cloud-based. However, the supplier category in the classical classification does not differentiate cloud providers and system developers from other stakeholders that supply optional services. Other partners' services are non-compulsory to define a cloud-based SCC. For example, a cloud-based SCC can operate without a partnership with legal advisors, but the cloud providers and system developers are the key stakeholders that provide the SCC's IOS.

We use the classical stakeholder classification to identify some roles that exist in cloud-based SCCs. Based on the SCCs' partners in Table 9 and the sample company's value proposition, we conclude that companies may have different roles in cloud-based SCCs:

- *Members* are companies that do SC activities and could be involved in the SCCs. By being members, companies are expected to gain benefits and pay costs for using the shared cloud system. This category may include manufacturers, warehouses, retailers, logistic service providers, and other parties in SC. Company H is included in this category.
- *SC partners* are companies that are not a member of SCCs but do SC activities to support the SCCs. Examples of this type are logistic providers in case A and G; company A's and G's goals are to maximize their members' benefits by minimizing the transportation cost, which might reduce the logistic providers' revenue. Being outside of SCCs means that the companies may get access to the shared cloud system, but their benefits will not be a priority for the SCCs. Consequently, these companies will not be expected to pay a fee for the cloud system.
- *Cloud providers* are companies that deliver cloud-based information systems, either software or platform as a service, for supporting the coordinated SC activities of SCCs' members and enabling SCCs. It includes companies A, B, C, D, E, F, and platform providers in cases G and H.
- *Other partners* are other companies that support SCCs besides the SC partners and cloud providers. Examples of companies with this role are internet providers, IS developers to whom cloud providers outsource a part or all of their software or platform development, universities, research institutes, and employee organizations.
- *Orchestrators* are control-tower-like companies that coordinate the SC activities of other companies. Companies A, B, D, F, and G belong to this category.

The stakeholders and their roles in the SCCs are presented in Table 10. These roles can be classified into:

- *essential roles* – members and cloud providers
- *potential roles* – SC partners, other partners, and orchestrators

Table 10. SCCs' stakeholders

Companies	SCCs							
Roles	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
Members	Private companies (Company A's customers)	Private companies (Company B's customers)	Private companies (Company C's customers)	Private companies (Company D's customers)	Private companies (Company E's customers)	Private companies (Company F's customers)	Private companies (Company G's customers)	Private companies (including Company H)
Cloud providers	Company A	Company B	Company C	Company D	Company E	Company F	A platform provider	A platform provider
SC partners	• Logistic agents • Logistic service providers • Customs	-	-	-	-	-	Logistic service providers	-
Other partners	• Cloud providers and system developers • Members' IS providers • Universities and research institutes	• Cloud providers and system developers • Members' IS providers • Universities and research institutes • Legal advisors	• Cloud providers and system developers • Members' IS providers • Universities and research institutes	• Cloud providers and system developers • Members' IS providers • Universities and research institutes • Associations	• Cloud providers and system developers • Universities and research institutes • Financial auditors • Business angels	• Cloud providers and system developers • Members' IS providers • Associations	• Cloud providers and system developers • Members' IS providers • Universities and research institutes • Associations	• Cloud providers and system developers • Members' IS providers
Orchestrators	Company A	Company B	-	Company D	-	Company F	Company G	-

The existence of companies with essential roles in collaborations defines that the collaborations are cloud-based SCCs. On the other hand, cloud-based SCCs do not necessarily have any SC partners, other partners, or orchestrators. The existence or absence of companies with potential roles does not indicate the quality of governance. The presence is neither good nor wrong because the role definition aims to analyze the governance of SCCs and help identify the governance modes. Among all case studies, case A and case G are the only ones with SC partners: logistic agents, logistic service providers, and customs. In addition, cases C and H present the absence of other partners and orchestrators. Furthermore, one company could have more than one role. These coexisting roles are present in companies A, B, D, and F. These companies are cloud providers for their SCCs and orchestrators.

Using the proposed stakeholders' roles, we can visualize the cloud-based SCCs. Many of the most popular management models are expressed or supported using a visual format (Fassin, 2008). An example of company A is presented in Figure 7. Company A is a cloud provider and an orchestrator. This company owns an IOS connected to a logistic data center for its customers. Its customers are private companies with contracts with company A, but they do not necessarily come from the same vertical SCC.

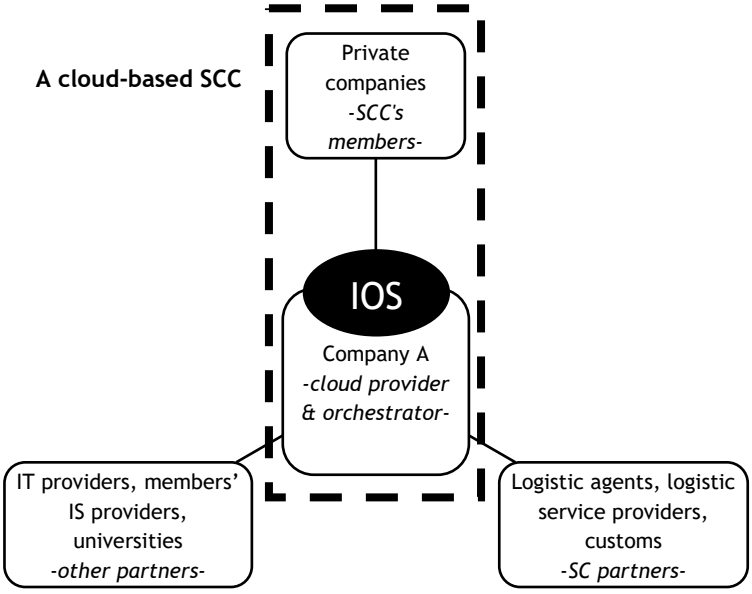


Figure 7. Stakeholders' roles in the case of company A

Company A orchestrates the customers' transport flow and SC activities, such as combining shipments and proposing multimodal transports based on the available services from its partners. Thus, the customers are members of an SCC as long as they are connected to company A's cloud-based IOS and are free to stop the contract – disconnected from the SCC. Because of this freedom, company A does not decide on the

SCC's arrangement and policies. Company A's and the customers' influence on each other is limited by the contracts and NDAs (Non-Disclosure Agreements) between companies. In providing its services, company A has to work together with some SC partners – i.e., logistic agents, logistic service providers, and customs. These SC partners do SC activities that are related to the members' SC activities and connect to the IOS. Moreover, company A is also supported by other partners – i.e., IT providers, members' IS providers, and universities.

By analyzing the companies' roles, the cloud-based SCCs structures, and their governance aspects, the governance modes of the SCCs can be determined. From the case studies conducted, three governance modes emerge:

- NAO, which is represented in cases D, F, and G. Its main characteristic is the establishment of legal companies to be the orchestrators. These companies are not always owned by all members. However, the members have their representatives in the NAO organization structure to ensure their influence in decision making. In the case studies, the separate entities in NAO mode are usually non-profit organizations, which means that profits are not divided between shareholders but used for the SCCs' development. This is an important attribute for NAO because it increases the members' trust.
- Market, which is represented in cases A and B. This kind of SCCs is formed by contractual relationships between the orchestrators – which also have roles as cloud providers – and the members. In this governance mode, a company does not necessarily have partnerships with other members to enter the SCCs.
- Shared governance, which is represented in cases C and H. Orchestrators do not exist, and all members share almost equal responsibilities regarding coordination activities.

The collaboration in case E does not fit in any mode. The SCCs have not been well planned yet because company E is still in an early stage of development. Lastly, all cases portray a certain degree of data governance formality in the form of a Non-Disclosure Agreement (NDA). NDA gives all of the companies legal power to ensure their data security and increase their trust towards other companies in the SCCs.

3.5 Conclusion

Increasingly, companies are jumping on the bandwagon of cloud-based SCCs. Most of them use similar words − such as control tower, integrator, and collaborator − to describe their role, even though they offer different services in SCCs, which also have different proposed governance modes. This creates ambiguity as to how the planned SCCs should work. If this is not addressed, ambiguity could drive potential members away from their rivals. Thus, a structured way to communicate a company's role in cloud-based SCCs to their potential members or other parties is needed.

This study proposes the categories of roles in a cloud-based inter-organizational collaboration. These categories of roles can be used in other cases to analyze and identify the key stakeholders – that have essential roles – and the other stakeholders – that have potential roles. Moreover, the proposed categories can also be used to identify company relationships. The categorization and these relationships identification will help future research set a collaboration boundary as the research's scope. Thus, future research will have a clear unit of analysis. We proposed a classification for companies' roles in cloud-based SCCs: members, SC partners, cloud providers, other partners, and orchestrators. This classification and the governance mode explanation will help to describe the phenomenon of cloud-based SCCs.

The introduction of cloud technology in SCCs breaks down the old paradigm of SCCs governance. Several studies (Gulati & Singh, 1998; Markus & Bui, 2012) have proposed and confirmed the impact of information systems on a tendency towards hierarchical or formalized governance. Studies based on the old paradigm, such as a study by Markus and Bui (2012), endorse NAO governance mode. Benefiting from the flexibility of the cloud and the legal strength of contracts, SCCs nowadays could adopt market and shared governance. The cases in this study have portrayed that a diverse SCCs' governance modes supports the cloud-based SCCs. This study is limited to the cross-sectional situation of the cloud-based SCCs to present the existing governance. Longitudinal case studies will be needed to explore stakeholders' roles and inter-organizational governance dynamics.

Chapter 4
IOS-based Inter-Organizational Collaboration's Governance[3]

Abstract – This chapter proposes a framework to analyze and describe inter-organizational governance for IOS-based collaborations. The framework consists of 5 building blocks of inter-organizational governance: stakeholders, lifecycles, aspects, mechanisms, and modes. The stakeholders' roles are suitable for analyzing the collaboration context and systematically communicating the collaboration's boundary design and governance to potential members or other parties. Two points of view are used to address dynamic and context-dependent inter-organizational governance – i.e., the governance mechanisms and the governance aspects. These points of view are interrelated in each stage of a collaboration's lifecycle. Lastly, the governance modes categorize collaboration governance based on the governance mechanisms observed for the governance aspects.

4.1 Building Blocks

Researchers and practitioners need a conceptualization of inter-organizational governance for IOS-based collaborations that explain the stakeholders' dynamic relationships beyond the dyadic level. We propose a framework that is presented in Figure 8. We combine the result from Chapter 3 with the synthesis from the state of the art. Specifically, we added the stakeholders building block and revised the constructs' conceptualization. For example, we separate the 'capital investment' and 'operational funding' constructs in governance. The framework consists of 5 building blocks of inter-organizational governance: stakeholders, lifecycles, aspects, mechanisms, and modes.

This visual representation defines inter-organizational governance for IOS-based collaborations. *The italic* format is used to identify the building blocks' elements in this chapter. In each description of components, other governance components may be mentioned and referred to. The understanding of a collaboration's governance using one point of view cannot be independent of the knowledge of the same governance using other points of view. For example, Wang et al. (2022) stated that collaborations are not

[3] This chapter is based on a paper published in the *International Journal of Information Systems and Project Management*

limited to one style of governance mechanisms, and there is an interplay between these mechanisms and the collaborations' governance structure.

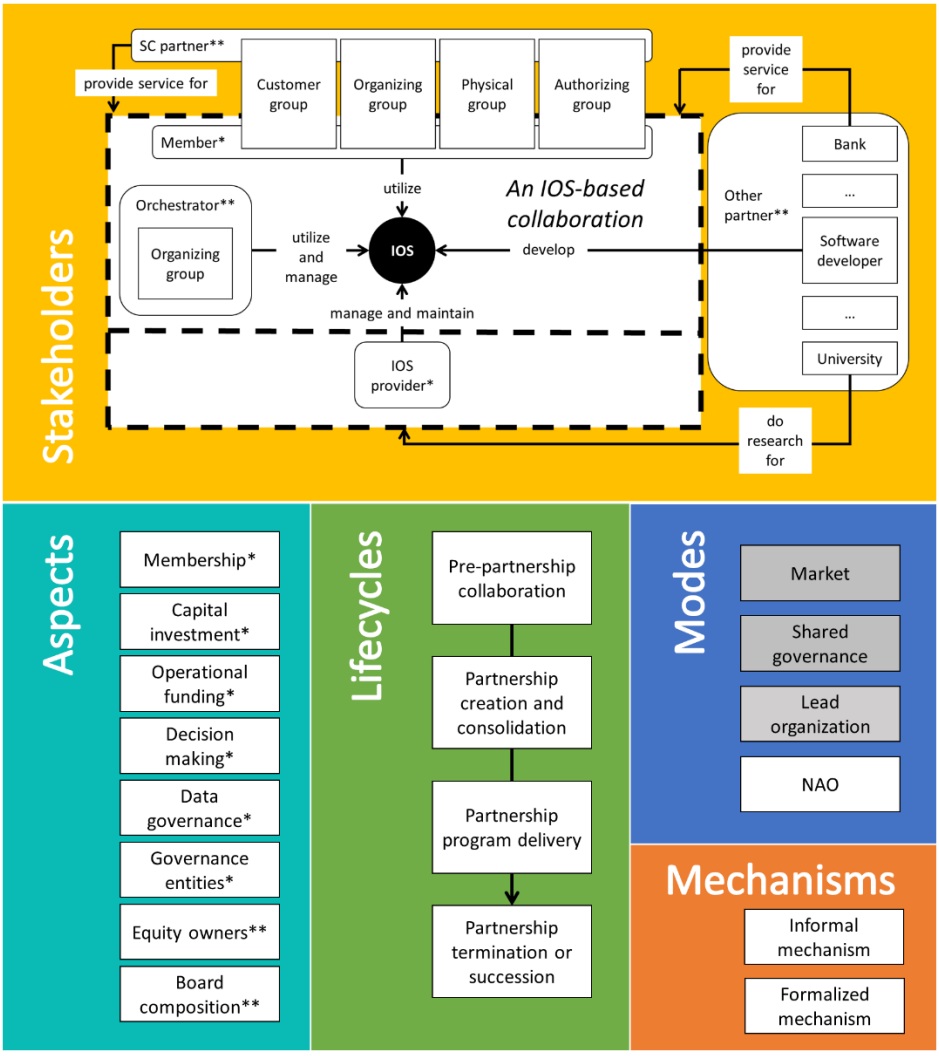


Figure 8. Building blocks of IOS-based inter-organizational collaborations' governance

4.2 Stakeholders (Who)

In explaining inter-organizational collaborations, it is important to understand the roles of each organization related to the collaborations, which are the stakeholders. Wagenaar (1992) in van Baalen et al. (2009) categorizes organizations in container

transport into five groups based on the organizations' activities in the SC arrangement: customer group, organizing group, physical group, authorizing group, and financial group. However, this categorization has not taken the adoption of a shared IOS into consideration. Further, Chandra and Hillegersberg (2015) proposed five general roles of organizations based on the analysis of several cloud-based SCCs:

- *Members*. Entities that are members of a collaboration can be involved in the collaboration's operational, tactical, or strategic activities. The members adopt the shared services to support their SC activities. In order to maintain their access to these services, the members can invest in the IOS or/and pay access fees per transaction. Any organizations directly involved in the SC activities can become members of a collaboration – the collaboration's business model determines the arrangement. The examples of potential members are presented in Table 11.

Table 11. Examples of potential members for collaborations

Group (van Baalen et al., 2009)	**Examples of Organizations in Seacargo SC** (van Baalen et al., 2009)	**Examples in Aircargo SC** (Christiaanse, Been, van Diepen, & O'Callaghan, 1995)
Customer group	Shipper; Consignee	Passenger, shipper
Organizing group	Forwarder (merchant haulage); Shipping line agent (carrier haulage); Logistics service provider (4PL)	Freight agents/forwarder; Integrator (e.g., Federal Express, DHL)
Physical group	Sea terminal operator; Shipping line/sea carrier; Pre- or On-carrier: carrier inland transport, i.e., barge operator, rail operator, road carrier (truck); Inland terminal operator; Logistics service provider (3PL); Empty container depot operator	Airlines, i.e., passengers or cargo and cargo-only carriers; Ground transport companies or handlers, i.e., road carrier (truck) and rail operator
Authorizing group	Customs; Port authorities; Seaport police; River police; Inspection authorities	Customs; Airport authorities

- *IOS providers/operators* is a provider who delivers the IOS to support the coordinated SC activities of members. The IOS operator manages and maintains the IOS according to Service Level Agreements (SLA) with the members (The International Port Community Systems Association, 2015).
- *SC partners*. Outside collaborations, some organizations perform SC activities related to the collaborations. These organizations are not members of collaborations but may get access to the shared system. However, their benefits are not a priority for the collaborations. Consequently, these organizations may not be expected to pay fees for using the system.
- *Other partners* are organizations that support collaborations besides the SC partners and the IOS providers. Examples of organizations with this role are banks, insurance companies, internet providers, software developers to whom

IOS operators outsource a part or all of their software and platform development, universities, research institutes, associations, and labor organizations.

- *Orchestrator* is a company that coordinates the SC activities inside the collaboration.

A stakeholder can have one or more types of roles in a collaboration. The roles can be assigned to separate organizations, or multiple roles could be performed by a single organizational unit (Jos van Hillegersberg & Chandra, 2020). These roles can be classified into essential roles – member and IOS provider – and potential roles – SC partners, other partners, and orchestrators. The existence of IOS and companies with essential roles indicates that the collaboration is an IOS-enabled inter-organizational collaboration. On the other hand, a collaboration does not necessarily have any SC partners, other partners, or orchestrators. The boundary of a collaboration is determined by who can be the collaboration's members (customers). The IOS operator may be related to the collaboration as an internal entity – which has power over the SCC's arrangement or the IOS' development and management – or as an external entity – which is interchangeable. The examples of organizations with their roles are presented in Figure 9.

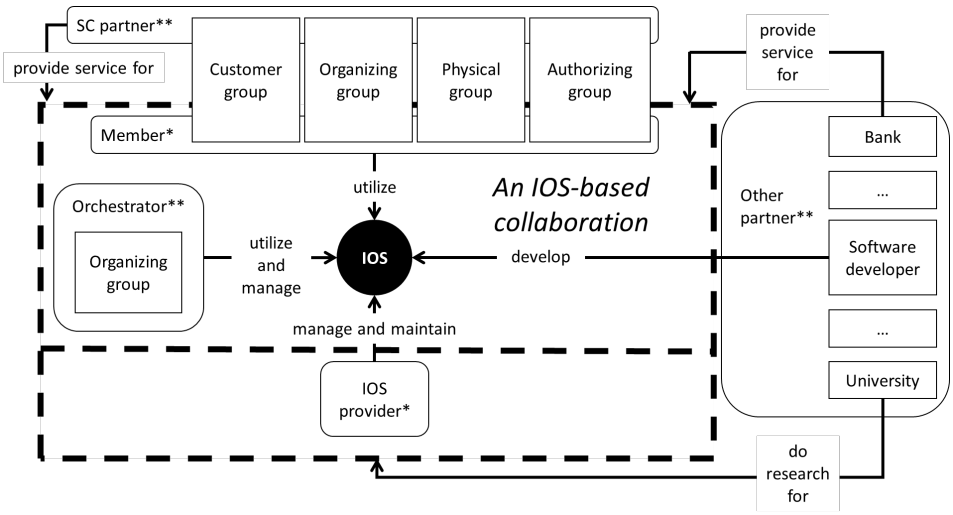


Figure 9. Roles and examples of organizations in an IOS-based collaboration[4]

The dashed lines in Figure 9 show the boundary of the collaboration. This boundary defines the context of an IOS-based collaboration. As the complexity of the collaboration

[4]Examples of organizations with other partner role are banks, insurance companies, internet providers, software developers, universities, research institutes, associations, and labor organizations. For examples of organizations in customer, organizing, physical, and authorising groups, please refer to Table 11.

quickly grows as the collaboration members and activities expand in breadth and depth, applying some form of inter-organizational governance on different aspects is advisable. Governance can be executed by combining formal and informal mechanisms.

4.3 Aspects (What)

We define governance aspects as domains that need to be governed by inter-organizational collaborations to achieve their strategic goals. The Markus and Bui (2012) study is used as a foundation to explore the governance aspects of inter-organizational collaborations, as follows:

- *Membership*. The members determine the values of collaborations. Thus, membership governance in a collaboration is intensely concerned with member selection. A more significant number of members usually results in a higher organizing cost. Collaborations have to decide the number of members based on the added value of additional members and the balance between coordination costs and the networks' complexity (Van Heck & Vervest, 2007). After being selected, the members must be able to interoperate swiftly. This interoperability includes the capability to connect quickly and their compatibility to enable a superior response speed. Decision rules and logic concerning connection and disconnection will be crucial components for the success of the collaboration (Van Heck & Vervest, 2007). After selecting the members, collaborations need to ensure members' participation. The members may be required to participate by making investments and sharing information. Success, as well as the effectiveness of collaborations, depends on the ability to encourage and sustain participation. Collaborations need to attract their member' participation by ensuring membership benefits. Markus and Bui (2012) observe three ways to attract the participation of members:
    - ensuring that owners do not profit financially at the members' expense,
    - drawing owners from all major segments of the community, and
    - providing for participants to have a say in decision making.
- *Capital investment*. The purpose of a collaboration would be defeated by excluding members who do not contribute to building the collaboration. Consequently, *organizations* may not be willing to fund the development of collaborations, and organizations may wait to join a collaboration until their partners join (Markus & Bui, 2012). Adopting cloud services, instead of on-premise systems, by inter-organizational collaborations could reduce the significant investment needed. However, collaborations still need capital to provide services with a specific quality standard. Collaborations need formalized governance mechanisms – to provide the legal authority required to amass and disburse funds and to protect the physical and intellectual properties involved in the information system and standards. Collaborations need to

attract capital to fund their technological and organizational requirements and would need to find a way to overcome their shareholders' reluctance.

- *Operational funding*. Collaborations have non-trivial ongoing operating and maintenance costs, which may involve the employees' salaries, rents, and multiyear contracts with the system providers. Inter-organizational collaborations could use mixed revenue streams to fund these costs – composed by (The International Port Community Systems Association, 2015): (1) annual or monthly subscription fee by services *or* for all services; (2) fee per unit charge specific for the collaborations' fields (tons, watts, km), per service charge, or per EDI transaction charge; and (3) fixed fee per stakeholder.
- *Decision making*. In a decision making process, several plans are created, evaluated, and ranked by an objective function to identify the best one (Stadtler, 2015). The investors naturally gain decision making capabilities, which might be unattractive to some members due to limitations in resources, geographical locations, or experiences.
- *Data governance*. Inter-organizational collaborations amass substantial data resources from interactions between members. The system provider or the leading members could potentially use this data to gain a competitive edge over the other members. Therefore, collaborations need formal governance to address members' concerns about who owns the data, how the data is protected, and who can access the data.
- *Governance entities* are responsible for coordinating the members' activities. In collaboration, these entities also engage in contracts with IOS operators to acquire the required IOS. Governance entities could be all the members, a particular leading member, or a separate legal form; the selection depends on the governance modes of a specific collaboration. Essential factors for the choice of organizational structure could be taxation (Markus & Bui, 2012), field-specific law, and the members' past experience.

Markus and Bui (2012) suggest that IOS-based collaboration will lean toward establishing a separate governance entity to maintain the neutrality of IOS development and data usage. Consequently, the study discusses the legal governance entity's equity owner and board composition. However, these aspects do not exist before a legal entity is established. Thus, we identify both aspects as additional aspects that emerge if a collaboration has a separate governance entity:

- *Equity owners*. Suppose a specific governance entity is established in a collaboration. In that case, there are three alternative ownership models for the entity: member-owned (Hart & Moore, 1996), investor-owned (Hart & Moore, 1996), and a hybrid combination of both (Markus & Bui, 2012). The two factors that are most influential in the choice are diversity among the member organizations and competition with other stock exchanges (Hart & Moore, 1996). Member-owned stock markets are limited in terms of available capital. According to Hart and Moore (1996), this problem is compounded by the slow and possibly contentious process of collective decision making in member-

owned cooperatives. In investor-owned companies (such as publicly listed stock corporations), there is greater availability of capital for investment, whether it comes from issuing equity or undertaking debt. Moreover, ownership plays a vital role because it goes hand in hand with decision making capabilities (Markus & Bui, 2012). The authoritative style of decision making associated with investor-owned companies promotes a speedy decision process. One significant advantage of member-owned is that it is more responsive to the members' preferences. Although authoritative decision making in investor-owned may be faster than collaborative decision making in member-owned, the latter may be preferred by members. In fact, democratic governance structures may actually help motivate potential members to join and participate in a collective undertaking like open-source software development (Markus, 2007).

- *Board composition.* In a separate governance entity, the board composition determines how decision making capabilities are divided among owners and members. If the governance entity has many owners, exercising control on a day-to-day basis would be ineffective. In that case, owners of a governance entity might be unfit to take on decision making responsibilities and represent members.

4.4 Mechanisms (How)

As stated by Ebers (1997) in Cropper, Huxham, Ebers, and Ring (2008), governance mechanisms are the means (instruments) through which entities manage the content flows and coordinate their relationships. Governance mechanisms are classified into formal and informal mechanisms of coordination (Alvarez et al., 2010). These mechanisms complement each other in the governance of inter-organizational collaborations (Arranz & de Arroyabe, 2012).

Formalized mechanisms can take the form of monitoring, control, and reporting systems through which organizations structure their interaction in an explicit way (Alvarez et al., 2010; Arranz & de Arroyabe, 2012). Formalized mechanisms have been advocated in conditions of high asset specificity (Alvarez et al., 2010) to reduce risk and uncertainty (Aulakh & Gençtürk, 2008) and prevent the dissolution of inter-organizational collaborations (Markus & Bui, 2012). Thus, formalized mechanisms become the foundation for the collaborations' stability.

The most common formalized mechanism in inter-organizational collaborations is a *contract*. Contracts entail anticipation to make explicit both payoffs and task coordination (Arranz & de Arroyabe, 2012; Aulakh & Gençtürk, 2008). Other mechanisms that collaborations could use are *regulations, policies, and procedural approaches* in: decision making (Arranz & de Arroyabe, 2012; Cristofoli et al., 2012), partner selection (Arranz & de Arroyabe, 2012), joint information and communication systems (Cristofoli et al., 2012), shared marketing, planning or implementation of services (Arranz & de Arroyabe, 2012; Cristofoli et al., 2012), joint activities (Arranz & de Arroyabe, 2012;

Cristofoli et al., 2012), integrated service capacities (e.g., a one-stop entity at the service of network clients) (Cristofoli et al., 2012), organization of meetings (Cristofoli et al., 2012), incentive structures (Alvarez et al., 2010; Cropper et al., 2008), and administrative controls (Alvarez et al., 2010; Cropper et al., 2008). In addition to contracts, the *documented formalized mechanism* could also exist in the form of Service Level Agreements (Grant & Tan, 2013), costs and benefits analyzes (Carlan, Sys, & Vanelslander, 2016), the definition of the network agenda (Cristofoli et al., 2012), documented dispute resolution procedures (Alvarez et al., 2010), and standard operating procedures (Alvarez et al., 2010).

Informal mechanisms are characterized by relationships rather than bureaucratic structures (Alvarez et al., 2010). Consequently, the mechanisms are not legally enforced in inter-organizational collaborations. The moderating effect of informal mechanisms on the need for formal contractual mechanisms (Alvarez et al., 2010) is evident in the inception of a collaboration. Later, these effects become more inconspicuous in collaborations with hierarchical governance but never entirely disappear. A comprehensive contract may not be possible because of bounded rationality and the cost of writing, negotiating, and implementing such a contract (Aulakh & Gençtürk, 2008). Consequently, informal mechanisms provide flexible adjustment procedures to handle future contingencies in the collaborations (Aulakh & Gençtürk, 2008), especially when monitoring and formal controls are difficult and costly (Alvarez et al., 2010).

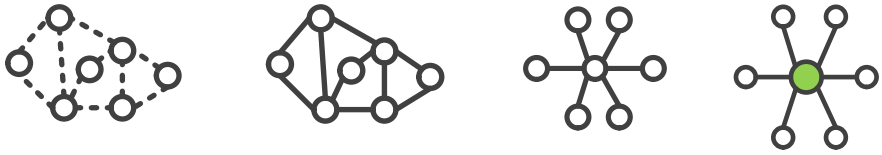
Some forms of the informal mechanism are personal and informal contact between collaborations members (Cristofoli et al., 2012), reciprocity and equity, as well as other norms (Alvarez et al., 2010; Cropper et al., 2008) that are developed through a social exchange in the past and based on future expectation (Aulakh & Gençtürk, 2008), commitment (Alvarez et al., 2010; Aulakh & Gençtürk, 2008), flexibility (Aulakh & Gençtürk, 2008), information exchange (Aulakh & Gençtürk, 2008), and trust (Alvarez et al., 2010; Aulakh & Gençtürk, 2008; Cropper et al., 2008). According to Zaheer (1998), *trust* is the expectation that the counterpart will behave in a reliable, predictable, and fair manner (Alvarez et al., 2010). Along the phases in the governance lifecycles, trust between members of inter-organizational collaborations could be established and nurtured.

4.5 Modes (Classification)

Governance modes classify inter-organizational governance into categories. This classification is based on:

- the existence of a separate governance entity, and
- the dominance of a particular governance mechanism, such as contracts or a member assembly, in coordinating the governance aspects.

Even though differences in naming and classification exist, there are four basic governance modes for inter-organizational collaborations (Dissa R Chandra & van Hillegersberg, 2015). These modes are illustrated in Figure 10.



Market Shared governance Lead organization NAO

Figure 10. Governance modes

Market, is formed by contractual relationships between suppliers and buyers (Lowndes & Skelcher, 1998). A market has certain features, such as multiple suppliers of the same product or service (Grant & Tan, 2013) and short-term partnerships mainly occurring during the transaction. In this governance mode, inter-organizational system providers can be seen as suppliers of a coordinating service, and members can be seen as customers.

Shared governance, in which members participate in network governance without a separate and unique governance entity (Provan & Kenis, 2008). Members' regular meetings govern collaborations applying this governance mode. In these collaborations, the members are collectively responsible for making decisions.

Lead organization, in which a particular member coordinates major network-level activities and decision making in a network (Provan & Kenis, 2008). This member takes sole responsibility for its inter-organizational collaboration. In a collaboration applying a lead organization governance mode, the leading member should have adequate power over the remaining members, which could be acquired through market domination, law enactment, or buyer-supplier relationship dependencies. The leading member could use centralized data in the inter-organizational system to gain a competitive advantage. For this reason, a study by Markus and Bui predicts that inter-organizational collaborations will most likely be governed by organizations that are not one of the members (Markus & Bui, 2012).

Network Administrative Organization (*NAO)* is a separate entity established to govern the network (Provan & Kenis, 2008). “Capturing and leveraging a position in a business network does not mean one must own or control the platform on which those networks run” (Markus, 2007). The NAO mode provides inter-organizational collaborations with the benefits of having a neutral governance entity.

4.6 Lifecycles (When)

We adopt the phases defined by Lowndes and Skelcher (1998) because of the completeness and clarity of every phase. We describe 4 phases in the lifecycles of inter-organizational collaborations, adapted from Lowndes and Skelcher (1998):

- *Pre-partnership collaboration*. A collaboration's lifecycle begins when an initiator dedicates its resources – e.g., finance, human resources, and network – to develop a collaboration. In this initial phase, the scope of the collaboration is defined by assigning roles to each company involved, inviting potential organizations, and defining the business requirements. Next, how to govern the collaboration is discussed. During these activities, collaborations initially rely mostly on informal governance mechanisms (Alvarez et al., 2010), supported by trust and a common purpose (Lowndes & Skelcher, 1998). This is against the common view that collaborations start with formalized governance and proceed to cycles reinforcing stakeholder trust (Alvarez et al., 2010).
- *Partnership creation and consolidation*. After the partnerships are established, collaborations that decided on hierarchical governance design an assertion of status and authority differentials and the formalization of procedures (Lowndes & Skelcher, 1998). Formalized governance mechanisms can also be designed in other collaborations that aim at less hierarchical governance. However, the less hierarchical collaborations will focus on intensifying the partnership between the companies to prepare for the program delivery. During this phase, alternative services are assessed. At the end of this phase, the selected service should be implemented and made ready to be used. The success of collaborations in this phase depends on the members' willingness to contribute financially to the setup and exchange their information with other partners (Srour et al., 2008).
- *Partnership program delivery*. In this phase, the partners' business processes are executed after connecting the collaboration's members using inter-organizational services. The market (or quasi-market) mechanisms of tendering and contract, with low levels of cooperation between providers, dominate collaboration in this phase (Lowndes & Skelcher, 1998). These mechanisms can be reinforced by informal governance, depending on the collaboration design. During this phase, the system providers, such as an IOS operator, can request members to pay fees for accessing the system. Usually, this fee is mainly meant to cover the development and maintenance expenses (Carlan et al., 2016).
- *Partnership termination or succession* is characterized by re-asserting an inter-organizational governance mechanism to maintain the stakeholder's commitment, community involvement, and staff employment (Lowndes & Skelcher, 1998). This phase can be triggered by any changes inside or around the collaboration.

4.7 Conclusion

A framework for IOS-based inter-organizational governance is proposed in this chapter. The framework consists of 5 building blocks of inter-organizational governance: stakeholders, lifecycles, aspects, mechanisms, and modes. The stakeholders' classification is based on their roles in IOS-based SCCs, i.e., *members, IOS providers, orchestrators, SC partners, and other partners*. *Formalized* and *informal mechanisms* are utilized to coordinate the collaboration activities in 8 aspects: *membership, capital investment, operational funding, decision making, data governance, governance entities, equity owners,* and *board composition*. These points of view are interrelated in each stage of a collaboration's lifecycle. The stages are *pre-partnership collaboration, partnership creation and consolidation, partnership program delivery, and partnership termination or succession.* During the lifecycles, collaborations may adopt different governance modes - *market, shared governance, lead organization*, or *NAO*.

These building blocks are tools to analyze and describe inter-organizational governance. The stakeholder roles are suitable for analyzing the collaboration context and systematically communicating the collaboration's boundary design and governance to potential members or other parties. The dynamic of governance is decomposed into different phases in collaborations' lifecycles. Two points of view are used to address dynamic and context-dependent inter-organizational governance – i.e., the governance mechanisms and the governance aspects. Lastly, the governance modes categorize collaboration governance based on the governance mechanisms observed for the governance aspects.

According to Gregor (2006), a theory that analyzes and describes a concept is a foundation for other studies in explaining, predicting, designing, and implementing the concept. This framework fills in the research gaps: the dynamic and context-dependent characteristics of inter-organizational governance and the effect of IOS on the collaborations' governance. Researchers can use the proposed building blocks as an inter-organizational governance framework in future studies. In addition, the building blocks are also useful for practitioners in analyzing their collaborations' governance state. The practitioners may concentrate on each element from these building blocks in designing a collaboration. The framework is also convenient for communicating the big picture of their collaborations to potential members.

Chapter 5
Rotterdam Port Collaboration[5]

Abstract – As part **of** an increasing use of inter-organizational systems, the Port Community System (PCS) can be observed in port collaborations. As multiple organizations often rely on PCS, even for business-critical processes, proper governance of these systems is crucial. This study aims to explain the governance of inter-organizational port collaborations using a lifecycles paradigm. Governance is explored using three points of view – i.e., governance mechanisms, governance aspects, and governance modes – and the stakeholders' roles in collaborations. A case study in the port of Rotterdam is analyzed. The port collaboration in Rotterdam has gone through three governance lifecycles and has entered the fourth iteration after the set-up of Portbase. The collaboration has maintained its NAO governance mode during the last two cycles.

5.1 Introduction

In maritime port collaborations, ports are critical hubs in which Supply Chain (SC) activities are drawn together. The performance of the port authorities, companies, government, and other entities in carrying out their SC activities depends on the effectiveness of their process. A port collaboration's physical, information, and financial flows are interdependent, thus causing many coordination challenges for parties in the port (van Baalen et al., 2009). To address these challenges, a port collaboration is commonly supported by a Port Community System (PCS), which is state of the art in information systems and connects SC stakeholders in port environments using inter-organizational services.

A port collaboration is the act of independent organizations working together to execute their SC activities related to one or multiple ports. Port collaborations can adopt a PCS to coordinate this cooperation. "A PCS is an electronic platform that connects the multiple systems operated by various organizations that make up a seaport, airport, or inland port community. It is shared in the sense that it is set up, organized, and used by firms in the same sector – in this case, a port community" (The International Port Community Systems Association, 2015). Going beyond the traditional function of PCS to share information, nowadays, PCS offers modules to support a variety of SC activities (van Baalen et al., 2009). The recent development of PCS includes cloud services, which

[5] This chapter is based on a paper published in the International Journal of Information Systems and Project Management

may become the most significant factor in the historical development of information technology outsourcing (Johansson & Muhic, 2017).

Designing governance is viewed as a crucial step in developing a PCS (The International Port Community Systems Association, 2015). Thus, to design effective PCSs, an understanding of inter-organizational governance is needed. A study by De Langen (2004) has focused on the governance of port collaboration, but this study only addresses governance as a coordination mechanism. Another study by Srour et al. (2008) discusses the lifecycles of port collaborations. However, this study has not shown how the theory of dynamic governance could be used in analyzing the evolution of governance in depth. Other empirical studies on inter-organizational systems, such as Rodon, Pastor, and Sesé (Rodon et al., 2007), have emphasized the importance of an in-depth longitudinal study. This study aims to fill this gap by demonstrating the use of the perspective of dynamics governance. The case study presented gives an understanding of port collaborations' changing governance arrangements and how all stakeholders involved shape dynamic mechanisms to govern collaborations.

The port of Rotterdam and the community around it have been selected as a case study for this research. The port is located in the Netherlands. It was the biggest port in the world in 1962 (Otten, 1988) and has been the biggest logistic hub of Europe ever since. The port of Rotterdam is also one of the leading ports in the world (Port of Rotterdam Authority, 2017b).

5.2 The Governance of Rotterdam Port Collaboration

Data used in this study combines an interview and correspondence with the Managing Director at Portbase (the PCS of the port of Rotterdam) in 2014 and 2017 and secondary data collected by reviewing reports, studies, and industry magazines and journals. After collecting and analyzing the data, we describe the Rotterdam Port Collaboration case according to its timeline in this section. The data sources that are used in describing this case are presented in Appendix E. Table 12 shows the summary.

The PCS-enabled Rotterdam Port Collaboration has been through three lifecycles of inter-organizational governance and is now in the fourth lifecycle, as illustrated in Figure 11. The history of the PCS is divided into three periods: (1) pre-PCS, (2) Port Infolink, and (3) Portbase. The pre-PCS period is the era of the initiative and consists of two lifecycles. During this time, the port community collaborated to establish an inter-organizational system. As a result of the port community's collaboration, the first PCS in the Rotterdam port community – which was developed and maintained by Port Infolink – was established in the second period (3rd lifecycle). Later, this PCS was replaced by Portbase's PCS in the fourth lifecycle.

Table 12. The data sources used in describing the Rotterdam Port Collaboration case

Data Source Types		Number of Data Sources
Primary Data	Interview (transcript & note)	1
	Correspondence & confirmation	✓
Secondary Data	Academic Article	7
	Book Section	3
	Company's report	1
	Magazine article	2
	Webpage	5
	Presentation Material	1

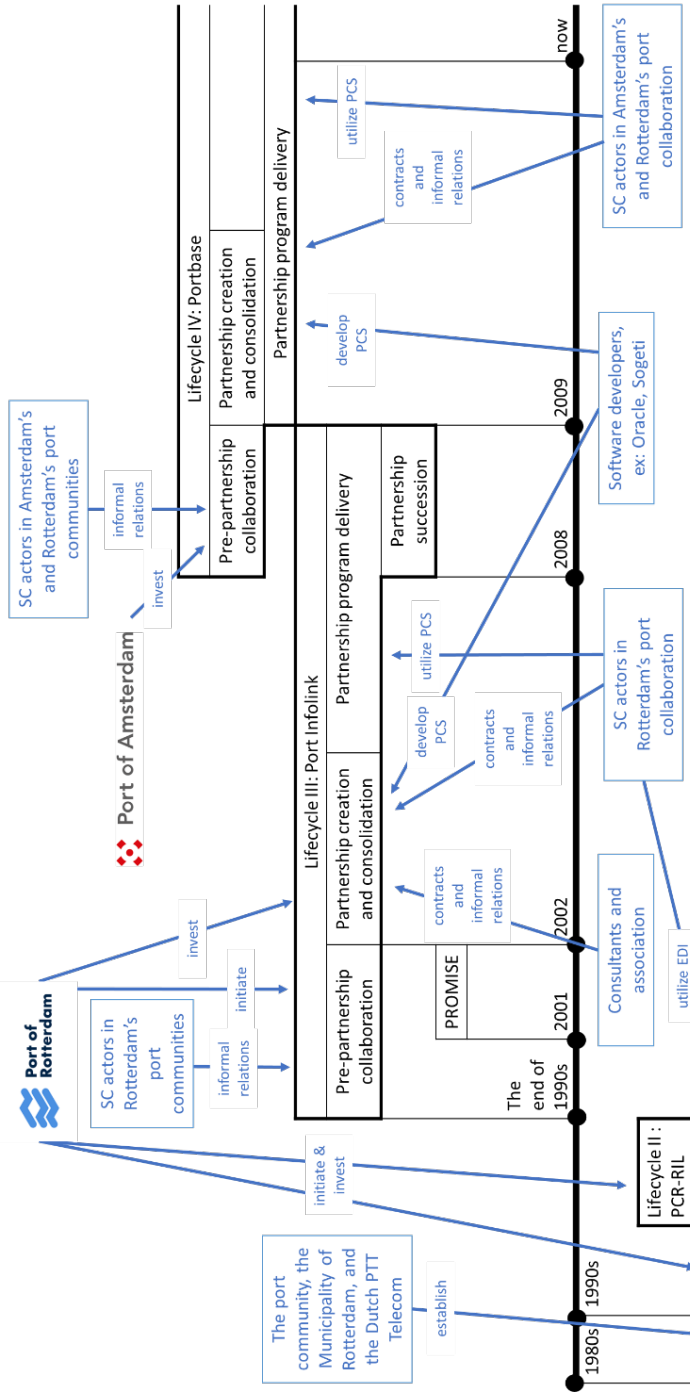


Figure 11. The governance lifecycles of Rotterdam Port Collaboration

5.2.1 Pre-PCS

The port of Rotterdam's infrastructure is owned by the municipality of Rotterdam and managed by the Port of Rotterdam Authority (Koeman, 1992). The Port Authority – a joint venture between the Municipality of Rotterdam and the Dutch government – is responsible for developing, managing, and exploiting the port sustainably and rendering speedy and safe shipping services (Port of Rotterdam Authority, 2017a). In 1989, the port and companies in its community employed about 70,000 people who handled 291.8 million tons of cargo that came from and distributed to 31,343 sea-going vessels and 120,000 inland vessels; This throughput positioned the port of Rotterdam in the highest position among the world's other major ports (Koeman, 1992).

In the 1980s, a system of Electronic Data Interchange (EDI) – consisting of a network, standard messages, and software – was developed in the Netherlands for the port of Rotterdam (Koeman, 1992; Otten, 1988). The INTIS (International Transport Information System) project was established in 1985 by the port community, the Municipality of Rotterdam, and the Dutch PTT Telecom (Koeman, 1992). The system aimed to handle the information flows between all the parties involved in transportation and shipping in the port community using standardized messages following EDIFACT (Otten, 1988; van Baalen et al., 2009). In 1989, more than 80 companies were connected to the INTIS network (Koeman, 1992). This number increased to 120 companies in 1992 (Porter, 1992). Despite the positive results generated, INTIS floundered. The main problem was not technical but organizational. INTIS' most significant challenge was to convince potential users of the short-term benefits of automated business systems (Porter, 1992). Ultimately, the project did not result in a PCS (van Baalen et al., 2009).

After INTIS ended, the port of Rotterdam's community focused on a bilateral data transfer on a lower scale than INTIS (van Baalen et al., 2009). Before the PCS implementation, data was managed bilaterally via an assortment of EDI tools, faxes, emails, or by making telephone calls (Lewandowski, 2005). Information systems development resulted in disconnected systems, many bilateral exchange systems, and a low rate of data reuse (van Baalen et al., 2009).

In the 1990s, the port of Rotterdam and its community established the Port Community Rotterdam (PCR) project (Lakshmanan, 2001). As the Rotterdam Municipal Port Management in Lakshmanan (2001) stated, PCR aimed to "create a faster, smarter design for a container transport logistical chain by developing, simulating, implementing, and managing port-wide information technology applications." This attempt and a later attempt called PCR-RIL to develop a PCS failed because there was not enough enthusiasm and support from the port community (van Baalen et al., 2009).

By the end of the 1990s, there was general discontent with the state of the port of Rotterdam's information system (Srour et al., 2008). In 2001, the port of Rotterdam decided to analyze the scope and potential solutions for a PCS in the Port of Rotterdam

Main Information Services (PROMISE) project. This project concluded that the PCS for the port of Rotterdam should be explicitly developed (tailor-made) for the port of Rotterdam with the latest proven technology (van Baalen et al., 2009).

5.2.2 Port Infolink

The pre-partnership collaboration phase

This phase was initiated by the Port of Rotterdam Authority (Lewandowski, 2005). The Port Authority began by identifying the most critical problem hampering the efficient flow of goods through the port: import processes (Srour et al., 2008).

The partnership creation and consolidation phase

Port Infolink BV was set up in 2002 as a separate *governance entity*. The Customs Department and the Association of Rotterdam Shipbrokers and Agents, Deltalinqs, joined the initiative *informally* in the *partnership creation and consolidation phase* (Hong Kong Shippers' Council, 2008). It was decided that the Port Authority would be the one and only *owner* of Port Infolink (Hong Kong Shippers' Council, 2008). This ownership means that the Port Authority will bear the initial *investments* to develop the information system (Srour et al., 2008). Port Infolink had a *Supervisory Board* – consisting of representatives of the Port of Rotterdam Authority, Dutch Customs, Deltalinqs, and the companies in the port collaboration – which decided on the strategy and set the priorities for the collaboration (van Baalen et al., 2009). The existence of these representatives enabled Port Infolink to gain a neutral position in the port collaboration (van Baalen et al., 2009).

The partnership program delivery phase

This project involved other stakeholders in the *partnership program delivery phase*, such as software development firms based in Rotterdam (Srour et al., 2008) working with Port Infolink based on *contracts*. The import SC, which was the focus of the Dutch government at that time, was supported by communication modules connecting the Harbourmaster and the Dutch Customs (van Baalen et al., 2009). The developed PCS succeeded in leveraging the existing dissatisfaction of the Port Authority and Customs in order to promote a paperless import process (Srour et al., 2008). As the two main parties agreed on the urgency of the problem, the first services of the new PCS were developed and implemented successfully (Srour et al., 2008). This system implementation was easily accepted because the Dutch Customs already had planned to automate the import SC (van Baalen et al., 2009). The organizations' roles in the collaboration are illustrated in Figure 12.

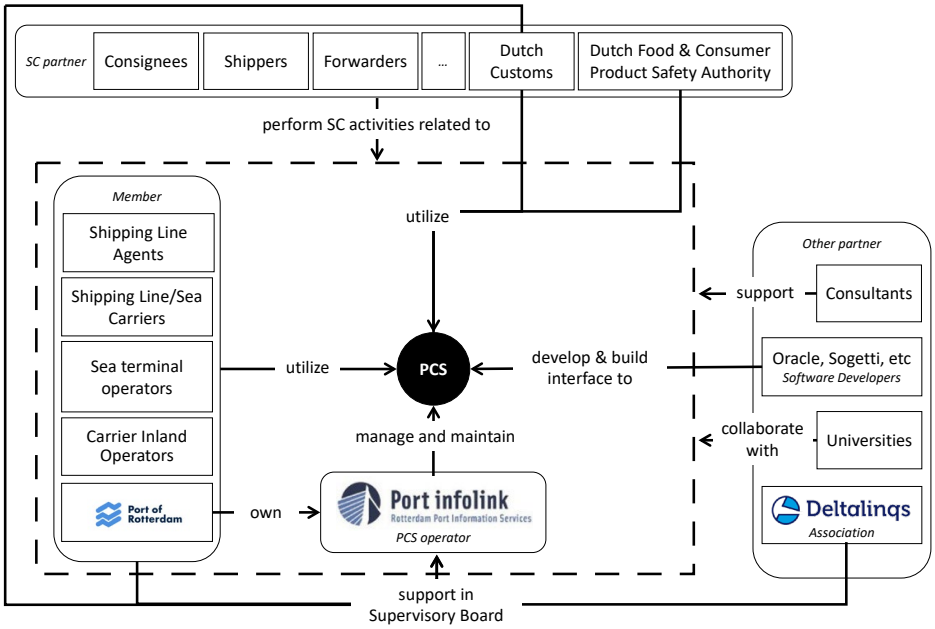


Figure 12. 3rd Lifecycle of Rotterdam Port Collaboration: Port Infolink

In 2005, Port Infolink was in the middle of developing a single PCS. The challenge was to transform a wide range of message formats to a single, common XML format, which is enabled by Xenos terminalONE solutions (Lewandowski, 2005). There were two designs of connectivity to the PCS (van Baalen et al., 2009):

- Users sent data in EDI or XML format, which would be converted to the internal XML format for the PCS and stored in the PCS database; later, these data could be sent and reused by any party in the collaboration.
- By utilizing Web-based applications, users could see, enter, or adjust the information on their Web screen.

The PCS was connected to OTP (Overheidstransactiepoort / The Public Transaction Gateway) to send and retrieve information on behalf of the companies in the port collaboration to and from Customs, Food & Consumer Product Safety Authority, and Plant Health Department. The PCS was designed to (Lewandowski, 2005):

- Provide any-to-any data exchange connectivity between any disparate platforms, which is the foundation of the PCS' service.
- Provide *regulations*, *policies*, and *procedural approaches* for *data governance* by: (1) authenticating every data exchange, in every protocol and format, to ensure that no data is sent or received unless both the recipient and the data type for that recipient have been pre-approved; (2) determining the communications *protocols and business rules* required for each specific data exchange between a shipper and the port and ensures that communications are sent using those same protocols and rules; (3) storing the data centrally (Oosterhout, Veenstra,

Meijer, Popal, & Berg, 2007); (4) making the data available to all parties who have access to the information (Oosterhout et al., 2007); (5) securing all data exchanges with standard, key-based security; (6) manipulating and delivering data to appropriate back office systems, based on *business rules;* and (7) re-sending data when acknowledgement is not received in defined intervals until such acknowledgement is received, or a timeout period has been reached.

The PCS provided by Port Infolink was developed using a modular implementation approach, which is referred to as the next generation of PCS that was getting implemented (Carlan et al., 2016). In 2006, the PCS consisted of 15 services (including import, export, communication between organizations in the community, communication with governmental organizations, carrier haulage, and merchant haulage), which were available for 1,000 companies with 2,500 users who exchanged about 1 million transactions each month (van Baalen et al., 2009). According to Port Infolink, the modular architecture had three advantages (van Baalen et al., 2009):

- Relatively low development costs. The development cost of this system was estimated to be roughly 35 million euros, which were divided into two categories, i.e., the central platform development and modules developments. The platform provided standard functionalities – messaging, authorization, and authentication – so its development cost was high. On the contrary, the modules were built relying on these standard functionalities. Thus, the development costs were relatively low.
- Stable maintenance cost of the PCS. The maintenance cost was not sensitive to the change in the number of modules and transactions.
- Possibilities to reuse the existing functionalities in new services. Consequently, the cost and time to develop new modules were cut to a minimum amount.

Later, Port Infolink adopted an architecture that provides mechanisms for *data governance*. With the new system, the SC activities in the port of Rotterdam were getting faster and more efficient. The Port Authority could pass along the significant cost reductions to other entities in the port environment (Lewandowski, 2005). The *benefit sharing* was controlled by Port Infolink. Lower costs increased traffic, and additional savings were realized when the electronic transaction systems were integrated with e-Government systems for Customs (Lewandowski, 2005). “At that time, we stepped in the middle, [we do] not only automate and optimize the business-to-government flow but also make it more attractive to reuse the information,” Portbase Managing Director. Only three years after the establishment, the enthusiasm for Port-Infolink was mutual between the port of Rotterdam and Deltalinqs. “At the most recent consultation, Deltalinqs, the Association of Rotterdam Shipbrokers and Agents, quite unequivocally called Port Infolink a great success” Pieter Struijs, Rotterdam's director of infrastructure and maritime (2005).

Next, Port Infolink changed its’ *revenue stream*. The Port Authority believed that the market needed to invest (Lewandowski, 2005). Thus, Port Infolink started to charge

members for accessing the services in 2007. "In the beginning, there were some resistances, but we were strict on what we were going to charge and how we were going to charge, so no companies left us" (Portbase Managing Director). During this *partnership program delivery phase*, Port Infolink also maintained close formal and informal relationships with other stakeholders in Dutch SCs.

During this *partnership program delivery phase*, Port Infolink also maintained *close formal and informal relationships* with other stakeholders in the Dutch SC field. For example, Port Infolink participated in PROTECT (2005-2008), a research project funded by the Dutch transport research fund Transumo together with Dutch Customs, the shippers' branch organization (EVO), Transport and Logistics Netherlands, Holland Distribution Council, Det Norske Veritas, RSM Erasmus University, TNO, Technical University Delft and Buck Consultants (Oosterhout et al., 2007). This project aimed to increase the security of the global supply chain – which included information system security, supply chain structure, and strategies – to address the threat of criminality and terrorism.

The partnership succession phase

At the end of Port Infolink's lifecycle, the collaboration entered the *partnership succession phase*. This succession was incited by the thriving Dutch maritime SC activities and the growing concern to preserve the competitive position of Dutch ports. By this point in time, Port Infolink had already offered 24 different services, with around 4500 users who sent more than 20 million electronic messages a year (Hong Kong Shippers' Council, 2008).

5.2.3 Portbase

The partnership creation and consolidation phase

As of early 2009, the next governance lifecycle's *partnership creation and consolidation phase* was marked by the merger of Port Infolink in Rotterdam and PortNET in Amsterdam, which provided the Ports of Rotterdam and Amsterdam with one joint PCS (Hong Kong Shippers' Council, 2008). This merger aimed to actualize a vision of a single national PCS in Dutch ports (van Baalen et al., 2009).

PortNET's history started eight years before the merger – in 2000. PortNET was a public-private partnership organization that successfully encouraged the development and use of ICT in the ports of the Amsterdam North Sea Canal area (Hong Kong Shippers' Council, 2008). Even though Port Infolink was younger than PortNET, Port Infolink had developed more functions in its PCS, which were logistic and navigation functions (Carlan et al., 2016). The merger *contract* guaranteed that the PortNET *members* would be able to use the services of Port Infolink for the exchange of data in mid-2009 (The Journal of Commerce Online, 2008). Even though PortNET had maintained a centralized governmental PCS for businesses and various government agencies for six years (Carlan

et al., 2016), it was decided that Port Infolink's PCS would be the foundation for their future service.

In the beginning, Portbase's *board of management* consisted of a director from Port Infolink and another director from PortNET (Maritime Information Services Ltd., 2009). It was after the Portbase BV was established that the "neutral" notion began to be used in describing the company. Portbase has roles as a neutral *PCS operator* and *orchestrator* for Dutch port communities. At its launch, Portbase offered 25 different information services and had approximately 1300 clients in all port sectors (Maritime Information Services Ltd., 2009). "Portbase's main objective is to create a competitive edge for Dutch ports by reducing SC costs and increasing the quality. We provide better information in [an] easier way for all its users" (Portbase Managing Director).

The partnership program delivery phase

Portbase is in the *partnership program delivery phase*. The *ownership* is shared between the Port of Rotterdam Authority (75%) and the Port of Amsterdam Authority (25%). The governance mode and the organizations' roles in the collaboration are presented in Figure 13.

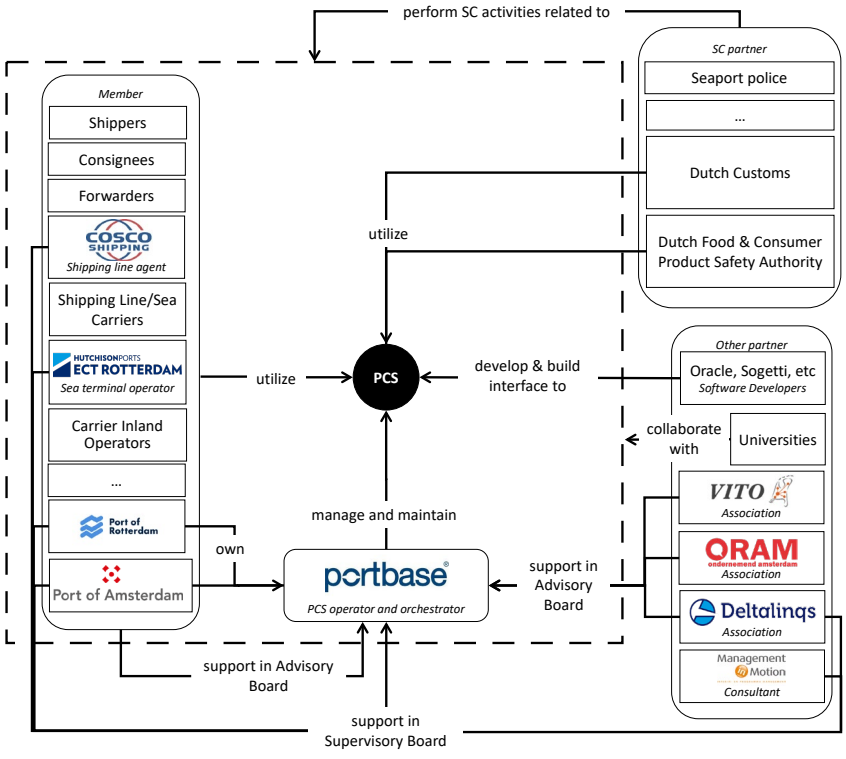


Figure 13. 4th Lifecycle of Rotterdam Port Collaboration: Portbase

Portbase's *Management Board* and its team are supported by a *Supervisory Board* and an *Advisory Board*. Both Port Authorities are represented on the *Supervisory Board*, together with Portbase's other main business partners. The *Supervisory Board* is responsible for evaluating Portbase's performance and deciding on its PCS development strategy (Portbase, 2017c). This responsibility regarding the development of Portbase's PCS is shared with the *Advisory Board*, which is initiated by Deltalinqs. The *Advisory Board* gives advice, proactively or reactively, on Portbase's PCS and the services that are to be developed in the PCS (Portbase, 2017c).

Portbase's PCS has four PCS functions: dangerous goods declaration, customs, logistics, and navigation (Carlan et al., 2016). The major development in the PCS is the digitalization of export processes. The services provided through each function are available by using several application modules (Carlan et al., 2016). Thus, Portbase's PCS retains Port Infolink's PCS modular architecture approach. These services are built on top of a platform provided by Oracle. Besides the main services, *members* also have access to build their own services on top of Portbase's platform – e.g., ProRail's Wagonload Information System. In order to develop these services, Portbase collaborates with IT companies and service providers that support its *members*. The services are used in all Dutch ports to guarantee synchronized data between its *members*. Nowadays Portbase offers around 40 services to support its community. By offering these services, Portbase provides a standardization of information that is being exchanged in the port community.

To support these services, Portbase emphasizes the importance of system and data security. According to Portbase's website, "information is visible only to those in certain roles (need-to-know basis)" (Portbase, 2017b). This statement proves that Portbase implements strict *data governance*, which had been practiced by Port Infolink. Moreover, Portbase offers data encryption for Web interface connections and a free User Management service to the *members* to help the organizations enforce the *data governance* procedure (Portbase, 2017b).

The generic infrastructure and services are developed in-house by Portbase in project working groups. The infrastructure and platform are *supported financially* by its *owners* – i.e., the Port Authorities. Meanwhile, the *members* pay Portbase *access fees* based on their transaction for exploitation and development of the services on the Portbase's platform, based on two packages (Yip, Wang, Haider, & Velde, 2016):

- Portbase Basis Plus. The members can decide to pay subscription fees for the services for lower transaction fees.
- Portbase Basis. Members who do not subscribe will pay higher transaction fees for using the services.

Portbase issues monthly invoices for the *members*; the settlement takes place once a year (Yip et al., 2016). With this *revenue flow*, Portbase's balance sheet reaches break even and proves its standing as a *not-for-profit* company.

Nowadays, Portbase's community has expanded – i.e., agents, barge operators, shipbrokers, Customs, empty depots, exporters, importers, forwarders, Food & Consumer Product Safety Authority, inspection stations, Port Authorities, selection points, companies, rail infrastructure managers, rail infrastructure operators, traction suppliers, road haulers, and terminals. The port of Rotterdam still maintains its influence in the import and export SCs that pass through the port. The Port Authority is one of the founding members of the cooperation, which aimed to reduce traffic on the main road leading to the port during rush hours (van der Horst & van der Lugt, 2011). By the end of 2016, Portbase had 3900 companies as members and 14000 users that were involved in 82 million transactions within the system (Portbase, 2017a). Today, Portbase's PCS has been implemented in The Rijkswaterstaat Maritime Navy and several Dutch ports: Rotterdam, Amsterdam, Harlingen, Zeeland Seaports (Vlissingen and Terneuzen), Dordrecht, Scheveningen, Den Helder, Groningen Seaports (Delfzijl and Eemshaven), and Moerdijk.

Portbase continues to develop its PCS. In 2018, Portbase released a cloud-based SaaS using the AWS platform (Gardeitchik, 2020). Moreover, they keep pursuing the latest trends in information technology, such as blockchain, big data, and AI.

5.3 Discussion

The PCS-enabled Rotterdam Port Collaboration had been through the first and second lifecycles that occurred in the 1990s, which was indicated by the establishment of PCR and PCR-RIL projects. Following the failed attempts to develop a PCS, the Port of Rotterdam Authority initiated the third lifecycle by the end of the 1990s. Thus, the third lifecycle was started and resulted in the establishment of Port Infolink in 2002. This lifecycle lasted until Port Infolink was merged with PortNET in 2009. The last phase of Port Infolink overlapped the *pre-partnership phase* of its successor, Portbase. The collaboration's timeline is presented in Figure 11.

PCR and PCR-RIL projects did not scale because the Port of Rotterdam Authority did not manage to gather support from the port community. At that time, this challenge was not a novel issue. The INTIS project, which was initiated a decade earlier, was also terminated due to the organizational failure in convincing potential users to join the project. The lifecycles of PCR and PCR-RIL projects were terminated prematurely before the project entered the *partnership program delivery* phase. Both project did not develop a PCS and a solid port collaboration. Because there is limited information regarding the governance of both projects, the discussion in this study will focus on the third and fourth lifecycles.

At the beginning of the third lifecycle, the Port of Rotterdam Authority was the sole initiator and powerhouse of the collaboration. *Formal governance mechanisms* had not been enforced yet in the *pre-partnership collaboration* phase. Consequently, the Port Authority depended on *informal governance mechanisms*, such as *contacts* between the

Port Authority's employees and the Dutch Customs' employees and *trust* in the Port Authority. In the second phase, the establishment of Port Infolink was an indicator that the Rotterdam Port Collaboration adopted the *NAO governance mode*.

In this cycle, Port Infolink adopted an EDI-based PCS and later a web-based PCS. The collaboration made *data governance* their priority in the *partnership program delivery* by establishing strict *documented rules, procedures, and policies*. Port Infolink connected the Port of Rotterdam Authority, shipping lines, agents, carrier inland operators, and the port terminal, mainly throughout the import processes. During this lifecycle, the port collaboration exercised *formalized and informal governance mechanisms* to govern the governance aspects, which successfully led the collaboration to the *succession phase*.

In the fourth lifecycle, the *pre-partnership collaboration* phase was started and ended together with the third lifecycle's *partnership succession* phase. During this period, Port Infolink's PCS continued functioning for the Rotterdam's port collaboration. In addition to the usual day-to-day activities, the port collaboration was also engaged in the discussion and preparation for the merger. The collaboration depended on the *informal mechanism* before the *formal mechanism* was enforced through the merger. In the next phase, Portbase was established to substitute Port Infolink and PortNET. Portbase maintains the governance best practices from Port Infolink, preserving the *NAO governance mode* and exercising *formalized and informal mechanisms*.

The differences between the governance modes in the third lifecycle (Port Infolink - Figure 12) and fourth lifecycle (Portbase - Figure 13) are (1) the addition of the Port of Amsterdam Authority, which together with the Port of Rotterdam Authority owns and invests in Portbase, (2) Portbase claims to be an orchestrator, which is a development from Port Infolink's role that is limited to PCS operator, (3) Portbase manages to include the shippers, consignees, and forwarders in the PCS-enabled port collaboration, and (4) Portbase has an Advisory Board, and the arrangement of representatives in Portbase' Supervisory Board is different from Port Infolink's Supervisory Board.

Furthermore, stark distinctness (highlighted by the words in bold format) can be observed in Table 13. Table 13 compares the arrangements of governance aspects in the third and the fourth lifecycles, in which port collaborations are governed by Port Infolink and Portbase, respectively. First, Portbase enlarged its collaboration. The collaboration *membership* is not limited to Rotterdam's port community anymore. The data sources – the shippers, consignees, and forwarders in import and export SC – are included in the current Portbase collaboration. Second, the *investment* for Portbase comes from two port authorities, which are the *equity owners* – the Port of Rotterdam Authority and the Port of Amsterdam Authority. Third, Portbase offers two financial plans for funding the *operational cost*. These plans give the *members* flexibility in deciding on the plan that fits their needs. Fourth, Portbase's organizational structure consists of a *Management Board* and its team, a *Supervisory Board*, as well as an *Advisory Board*. There is a clear distinction between the *documented responsibility* of the *Supervisory Board* and the

Advisory Board. This distinction helps both Boards to focus on the issues at the respective levels of *decision making*.

Table 13. The governance aspects in the 3rd and 4th lifecycles of the Rotterdam Port Collaboration[6]

Governance Aspect	3rd Lifecycle (Port Infolink)	4th Lifecycle (Portbase)
Membership	• The membership was limited to organizations that conducted SC activities in or related to the Port of Rotterdam (location-based membership). • Port Infolink's PCS managed to connect shipping line agents, sea carriers, sea terminal operators, carrier inland operators, and the Port of Rotterdam Authority to each other and with the Dutch Customs and Dutch Food & Consumer Product Safety Authority.	• In the beginning, the membership was limited to organizations that conducted SC activities in or related to the Port of Rotterdam and **Port of Amsterdam** (location-based membership). Now, **other Dutch ports** are also included. • Portbase's PCS connects **the shippers, consignees, and forwarders**, which were not connected by Port Infolink's PCS.
Capital investment	The Port of Rotterdam Authority was the sole investor.	The Port of Rotterdam Authority and **the Port of Amsterdam Authority** share the investment for Portbase.
Operational funding	• 2002 – 2007: The Port of Rotterdam Authority paid the operational cost. • 2007 – 2009: Members paid access fees	Members pay Portbase access fees based on their transactions and can opt to pay **subscription fees**.
Decision making	• The benefit and cost-sharing were decided by Port Infolink's Management Board and Team. • The Supervisory Board decided on the strategy and set the priorities for the collaboration.	• The Management Board and Team decide on the operational, tactical, and strategical decisions, such as benefit and cost-sharing (via access fees and subscription fees), infrastructure maintenance and development, as well as the selection of software developers and other partners. • The Supervisory Board is responsible for evaluating Portbase's performance and deciding on its PCS development strategy. • **The Advisory Board** gives advice, proactively or reactively, on the Portbase's PCS and the services that are to be developed in the PCS.

[6] The bold words in a lifecycle indicate significant differences from the previous lifecycle.

Governance Aspect	3rd Lifecycle (Port Infolink)	4th Lifecycle (Portbase)
Data governance	Regulations, policies, and procedural approaches were enforced.	Regulations, policies, and procedural approaches are enforced.
Governance entities	Port Infolink BV coordinates the PCS-enabled information-sharing collaboration in the Port of Rotterdam.	**Portbase BV** coordinates the PCS-enabled information-sharing collaboration in several Dutch ports.
Equity owners	Port Infolink's shareholder is the Port of Rotterdam Authority.	Portbase's shareholders are: • The Port of Rotterdam Authority (75%) • **The Port of Amsterdam Authority** (25%).
Board composition	Port Infolink had a Supervisory Board: Port of Rotterdam Authority, Dutch Customs, Deltalinqs, and the major companies in the port collaboration.	In the beginning, Portbase was supported by the board of directors from both prior companies. Later in 2018, Portbase was supported by: • A Supervisory Board: Port Authorities, Deltalinqs, Cosco, ECT, and Management in Motion. • **An Advisory Board**: Port Authorities, Deltalinqs, ORAM, and the major companies in the port collaboration.

Portbase has become a successful *PCS operator* and *orchestrator* in European maritime port collaboration. The success can be observed from the increase in the number of Portbase's *members* from 3700 to 3900 companies (Portbase, 2017a) and the financial stability of the port of Rotterdam (Port of Rotterdam Authority, 2017b), which is the central hub of the port community. This success is related to the ability of Portbase to attract potential members and engage its members. This ability was a trait that was inherited by Portbase from its predecessor, Port Infolink. Moreover, the Port of Rotterdam declares that there is room for improvement in terms of the *members'* ease of doing business (Port of Rotterdam Authority, 2017b). Thus, this is an opportunity for Portbase to develop its support for Rotterdam's port community.

At the beginning of Port Infolink's establishment, Port Infolink chose an ideal process – the import process – to be automated by the first version of PCS. This choice was proven to be an excellent decision. The import process is favorable to Dutch customs. Therefore, Port Infolink had support from the Dutch government. This support helped Port Infolink attract the port community, establishing trust and contacts in the *pre-partnership collaboration* phase, as well as gaining data and information regarding the process for the PCS development. Later, Port Infolink managed to save time and decrease the cost of the import process. This benefits realization was a concrete example for other potential members who had not joined the collaboration at that time.

Port Infolink addressed the recurrent organizational issues in previous projects by establishing the *NAO governance mode*. Thus, Port Infolink inaugurated a neutral position in the collaboration. Port Infolink, as a separate governance entity, maintained its neutrality through the following:

- giving equal opportunity to join the *membership* to all potential eligible members,
- being open about the non-for-profit status in publishing the *investment* and the *operational funding,*
- implementing a strict and transparent *data governance,*
- communicating clear *rules, policies, and procedures* regarding the collaboration's operation, for example, the access fees,
- involving the members and Deltalinqs in a *Supervisory Board, and*
- having the Port of Rotterdam Authority, a public limited company, as the single *equity owner*.

Retaining the governance mode and most of the governance aspects' arrangements, Portbase evolved and developed more sophisticated details. Portbase identified the best practices for maintaining the governance entity's neutrality. Furthermore, Portbase uses the "neutral" word in communicating its value to its members, potential members, and partners. This wording emphasizes the importance of Portbase's neutrality to preserve the collaboration's performance.

However, the use of Portbase's PCS does not mean that Rotterdam's port community is problem-free. The port of Rotterdam has been struggling for years with delays in the container on barges, and the problem was persistent in 2017 (Dijkhuizen, 2017). Another challenge that needs to be addressed is the zero-emission issue. The port of Rotterdam has announced its vision to be a zero-emission port by 2050 (Port of Rotterdam Authority, 2017c, 2023). This vision is in line with the European Green Deal. European Green Deal policies aim to make Europe the first climate-neutral continent by 2025 (European Commission, 2023). In addition, the global supply chain is also leading the port of Rotterdam into a greater inter-organizational collaboration that involves other ports around the world. All of these problems and challenges have to be addressed by the port community as an integrated collaboration, and Portbase should participate in the process as well.

5.4 Conclusion

The PCS-enabled Rotterdam Port Collaboration has been through three full lifecycles of inter-organizational governance and is now in the fourth lifecycle. The first two lifecycles were terminated prematurely before a PCS developed. The last two lifecycles were successful in implementing a PCS in the port collaboration. The NAO governance mode was established in the third lifecycle and sustained throughout the fourth lifecycle to coordinate the governance aspects using the formal and informal governance mechanisms. In the third lifecycle, the governance entity was Port Infolink. Later, Port

Infolink merged with PortNET to establish Portbase, which is the governance entity in the fourth lifecycle. Portbase flourishes to be a successful neutral PCS operator and orchestrator in European maritime port collaborations. Nowadays, Portbase supports not only Rotterdam Port Collaboration but also several other Dutch port collaborations.

The case study analysis of Rotterdam's port collaboration gives an example of how a systematic approach could help to communicate and give a comprehensive overview of the governance of inter-organizational collaboration. This analysis can also serve to discuss future adaptations to the governance mode and as an inspiration to other inter-organizational governance designs. The systematic approach proposed in this study could be beneficial for researchers, consultants, and companies that are working on establishing an inter-organizational collaboration to identify the important roles of each party involved in both pre-partnership collaboration as well as partnership creation and consolidation phases. Having the roles defined, all parties can decide on the suitable governance mode for the collaboration. In the subsequent phases, the approach can be beneficial to explain the dynamic governance within the collaboration.

Chapter 6
Schiphol Air Freight Collaboration[7]

Abstract – Airports have become the center hubs of supply chain collaborations. A Cargo Community System (CCS) has been developed to support air freight collaborations in airports. A CCS is not only an enabler but also a challenge for establishing and maintaining collaborations. A proper understanding of how to govern the relationships between companies in the community is needed to achieve a sustainable collaboration. This study presents the development of Amsterdam Schiphol Airport's CCS – Cargonaut. The air freight community in Schiphol Airport has been through three lifecycles of governance. The main differences between the first lifecycle (1981-1996) and the second lifecycle (1995-2019) are (1) Cargonaut's ownership, (2) the cost-sharing structure, and (3) the member's power in decision making. Later in the third lifecycle, the ownership and the decision making processes mostly reverted to the previous arrangement. From Cargonaut's development, we observe that the governance of inter-organizational collaboration over time is dynamic.

6.1 Introduction

Players in air freight collaborations – e.g., freight agents/forwarders, airlines, ground transport companies, customs, and integrators – need to coordinate their SC activities to achieve their best performance. Air freight is preferable for goods that have a high value-to-weight ratio and cannot survive a long ocean trip (Christiaanse et al., 1995), as well as are needed in a short time frame. Airports' position in air freight – sometimes referred to as air cargo – collaborations go beyond their basic roles in the physical flow of goods. They have become the center hub of the Supply Chain (SC) collaboration. Cargo Community Systems (CCSs) have been developed to support air freight collaborations in airports. A CCS is an information system that connects the SC stakeholders in air freight communities; thus, it integrates the stakeholders' administrative systems and supports inter-organizational SC activities. IATA in Alt (1997) declared that generally, a CCS has three basic characteristics: (1) an open and neutral system to support, (2) automatic forwarding and conversion of standardized airfreight-related information, and (3) between a large number of participants.

In the studies on inter-organizational collaboration, technology is identified as not only an enabler (Oguz, Xie, Palvia, & Amoako-Gyampah, 2018) but also a challenge for

[7] This chapter is based on a paper presented and published in the proceedings of the Americas Conference on Information Systems (AMCIS) 2019

establishing and maintaining collaborations. A proper understanding of how to govern the relationships between companies in an inter-organizational context is needed to achieve a sustainable collaboration. Pilbeam et al. (2012) showed that there is conceptual and empirical support for links between governance instruments and supply network outcomes. The more effective collaboration structures succeeded because they fitted their environments and were appropriate for their missions, or they adopted themselves to their contexts (Alexander, 1995). Despite advancements in inter-organizational governance mode literature (Baudry & Chassagnon, 2012; Lowndes & Skelcher, 1998; Provan & Kenis, 2008), there is a limited number of studies on information-system-enabled inter-organizational collaborations (Markus & Bui, 2012).

An air freight collaboration's governance is an urgent factor for every CCS implementation. In order to explore the air freight communities, this study will focus on a specific community that is built around an airport. This study aims to present the history and evolution of the governance of the Amsterdam Schiphol Airport community and its CCS – Cargonaut. In this study, we will present that the Schiphol Air Freight Collaboration's governance has led this collaboration to achieve its competitive advantage as one of the largest airports in Europe.

6.2 Cargonaut

In 1920, Schiphol was transformed into a civil airport (Royal Schiphol Group, 2019). Schiphol Airport is located in the Netherlands and is owned and operated by Royal Schiphol Group (NV Luchthaven Schiphol), which was established in 1958 (Bloomberg, 2019). The majority stakeholder of Schiphol Group is the Dutch government, while the rest of the ownership is shared by the municipality of Amsterdam and the municipality of Rotterdam; In 2008, Groupe ADP (Aéroports de Paris) - Air France's hub operator – invested and joined the ownership (Royal Schiphol Group, 2018a).

Data used in this study combines an interview with the Chief Executive Officer (CEO) at Cargonaut in 2014, the Cargo Strategy Director at Royal Schiphol Group in 2023, and secondary data collected by reviewing reports, studies, and industry magazines and journals. We describe the Schiphol Air Freight Collaboration case according to its timeline in this section. The data sources that are used in describing this case are presented in Appendix E. Table 14 shows the summary.

Cargonaut's history and evolution are divided into three lifecycles (see Figure 14). In the first period of Cargonaut, Cargonaut Holding BV was fully owned by the Schiphol Airport Authority. Later, this ownership became shared with other companies in Schiphol's community. In the latest lifecycle, Cargonaut is a part of the Schiphol Group.

Table 14. The data sources used in describing the Schiphol Air Freight Collaboration case

Data Source Types		Number of Data Sources
Primary Data	Interview (transcript & note)	2
	Correspondence & confirmation	✓
	Archival Record	1
Secondary Data	Academic Article	1
	Thesis	2
	Company's report	3
	Magazine article	4
	Webpage	34

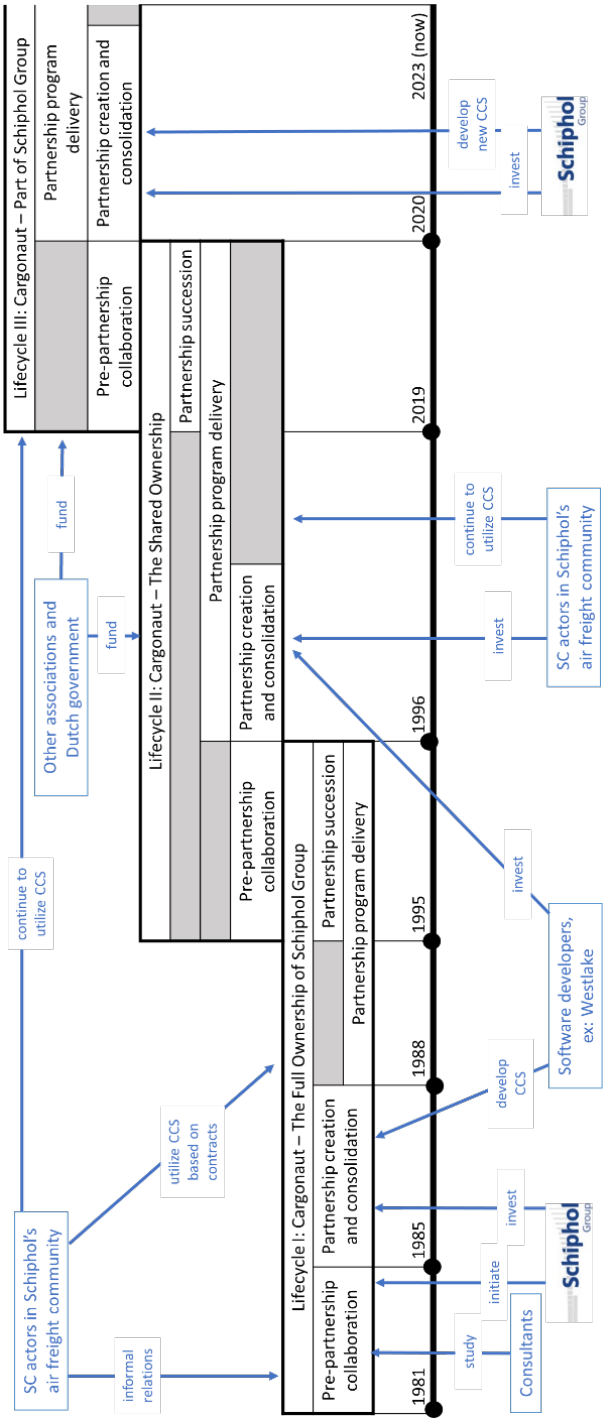


Figure 14. Governance lifecycle of Schiphol Airport Air Cargo Community

6.2.1 Full Ownership of Schiphol Group

The pre-partnership collaboration phase

A collaboration was prepared between the Schiphol Group (the Schiphol Airport Authority), the Dutch national airline (KLM), the freight forwarders, and the professional association of freight forwarders (Dac, 1996). The preparation studies dated back to 1981, and feasibility studies were executed between 1983 and 1985 (Dac, 1996).

The partnership creation and consolidation phase

Cargonaut Holding BV was established on the 31st of December 1985 in the Netherlands (LexisNexis, 2019) as an *independent CCS operator*. Despite Schiphol Group's intention to maintain its neutrality, the authority was the most important initiator, and later on, it became the sole *owner* of the company (Dac, 1996; Nieuwsblad Transport, 1995c). The main purpose of Cargonaut was to provide an EDI infrastructure and automation of some of their activities and information exchange (Dac, 1996) in order to speed up the ground handling process, lower the number of documents in the international transport, and improve the communication and the quality of information between all parties involved (Christiaanse et al., 1995).

The partnership program delivery phase

In the 1980s, Cargonaut 1.0 was released. When Cargonaut's first software, Piconaut, came into operation in 1988, 15 companies participated as members (Dac, 1996). The stakeholders' roles are illustrated in Figure 15.

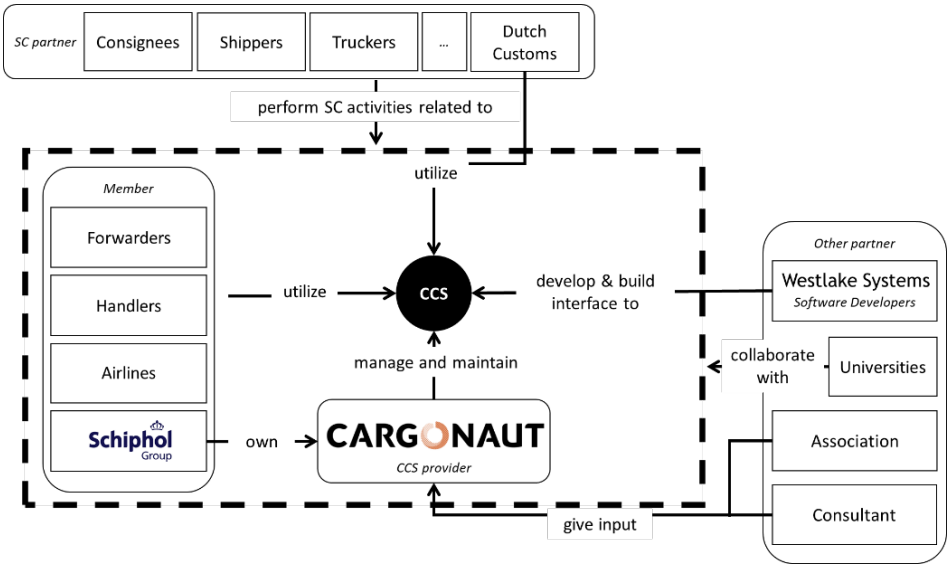


Figure 15. 1st Lifecycle of Schiphol Air Freight Collaboration: Cargonaut - full ownership of Schiphol Group

In the beginning, Piconaut only supported the airlines' reservations and status information (Rouss, 2016). Due to this limited service, the adoption of Cargonaut 1.0 was relatively slow. The adoption improved when Piconaut connected to Sagitta – the automated Dutch customs system – for import declaration in 1989 (Dac, 1996). Later in the 1990s, Cargonaut accounted for several successful developments, such as extended services for the air freight community in Schiphol Airport, as well as the connections to other CCSs, Traxon, and Sagitta-Export.

The introduction of Sagitta-Export in 1994 (Nieuwsblad Transport, 1993, 1994) increased the importance of the customs process in Cargonaut. In June 1995, Piconaut was replaced by an integrated package for import and export – CargoMate, developed by Westlake Systems (Cargonaut, 2016c; Nieuwsblad Transport, 1994).

Cargonaut's *operational funding* was generated from the *members*, including (1) one-time payment: communication module and adapter, air transport messages, customs messages, an (optional) module for printing the Single Administrative Document; (2) pay-per-use payment: renting an electronic mailbox per month, transmission cost per message (Dac, 1996). Besides, Cargonaut was also commissioned to provide tailor-made solutions for the members of the Schiphol Air Freight Community (Nieuwsblad Transport, 1996).

In 1995, the number of *members* increased to 120 companies; They produced more than 1.3 million electronic transactions – an increase of 21% from 1994 (Nieuwsblad Transport, 1995a). However, Cargonaut had not been as successful as expected to be (Christiaanse et al., 1995). Cargonaut's finance was in the red for the first time in 1995 (Nieuwsblad Transport, 1996).

The partnership succession phase

In 1995, Cargonaut entered *the partnership succession phase* of the first lifecycle initiated by the Schiphol Group. During this phase, Cargonaut had been developing and delivering its services as per usual. In 1995, the first air freight trucker – Jan de Rijk – connected to Cargonaut through e-mail services (Nieuwsblad Transport, 1995b).

6.2.2 Shared Ownership

The pre-partnership collaboration phase

This phase was indicated by the negotiation on the transfer of shares. The negotiation had taken less than a year, and by the end of 1995, a transfer agreement of 58% of the shares was reached (Nieuwsblad Transport, 1995a).

The partnership creation and consolidation phase

60% of Cargonaut's *shares* were in the hands of nineteen companies by the 1st of January 1996; Those companies are KLM and Martinair (12.5%), three handlers (19%), thirteen air freight forwarders (28.5%) and Westlake Systems BV (Nieuwsblad Transport, 1996).

Westlake later became Cargomate BV (Riege Software, 2021). After the transfer agreement, Cargonaut recorded a modest profit (Nieuwsblad Transport, 1996). The structure is presented in Figure 16.

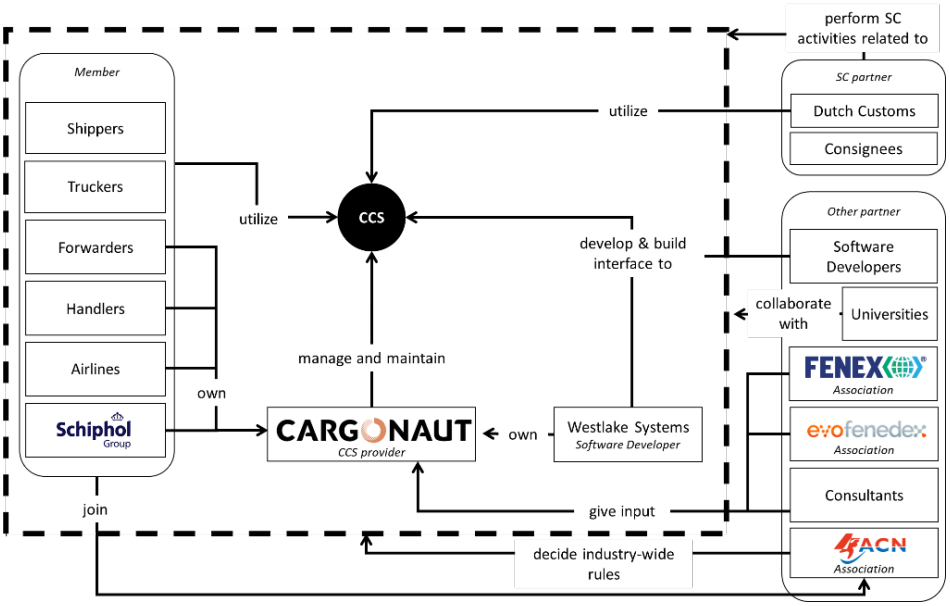


Figure 16. 2nd Lifecycle of Schiphol Air Freight Collaboration: Cargonaut – shared ownership

"The decisions for participation, however, are not based on the dividends, but the fact that everyone agrees that Cargonaut supports the Schiphol airfreight sector," Cargonaut's Director (Nieuwsblad Transport, 1996). This commitment based on the value that Cargonaut delivers was emphasized by the CEO during our interview, "We have never paid dividends to our shareholders in our history. It has always been re-invest to the market." Thus, Cargonaut is a non-profit organization. Later, the *shareholders' composition* slightly changed over time. Some benefits for the community to be involved as the *shareholders* are: the Cargonaut system's value in supporting their SC activities, the opportunity to be the first to make use of a certain innovation, and the influence in the *decision making* processes.

The partnership program delivery phase

In 1996, the system was updated to Cargonaut 2.0. In the same year, the Cargonaut system was linked to the Internet (Nieuwsblad Transport, 1996). During the second governance lifecycle, the challenge was shifted from technology to commerce in order to capture clients and prospects (Rouss, 2016). The opinions regarding Cargonaut's success were mixed between players who were pleased and unsatisfied (Nieuwsblad Transport, 1997). In the beginning, the international connection of the CCSs and the attempts to get more shippers on Cargonaut were not a great success (Nieuwsblad Transport, 1996). The main problem of Cargonaut and almost all CCSs was the structure

of and trends in the air freight sector (Nieuwsblad Transport, 1997); e.g., complex information flows, benefits from a lack of information (for example, was a benefit for freight forwarders), and the adoption of the Internet that could disturb Cargonaut's main service as an intermediary between incompatible systems (Nieuwsblad Transport, 1997).

To support its activities, Cargonaut established several *legal entities*. In September 1996, Cargonaut BV was established as a subsidiary of Cargonaut Holding BV (LexisNexis, 2019). In addition, there are other companies of which Cargonaut Holding BV is the owner: Cargonaut Nederland BV, Cargonaut IP BV, and Cargonaut International BV (LexisNexis, 2019). "Although we have three legal entities, we operate as one organization," Cargonaut's CEO said. In 2011, a European community trademark registration was filed for Cargonaut by Cargonaut Holding BV (Trademarkia, 2019), and Cargonaut BV officially became Cargonaut Holding BV (Drimble, 2022).

According to Cargonaut's CEO, by the end of the 1990s, Cargonaut evolved from processing EDI transactions to providing a critically integrated system, "We went from EDI messaging from A to B to more and more integrated message brokering, and we have been more and more a logistic solution provider for the industry chain." During this phase, Cargonaut also worked together with other *software developers and IT providers*, such as Traxon Europe (which was owned by Lufthansa Cargo and Air France, and later joined CHAMP Cargosystems) in 2010 (Air Cargo News, 2010) and ADF Performance Monitor in 2016 (Brinkmann, 2016). In 2014, Cargonaut 4.0 was introduced based on input from its users and stakeholders (CargoHub Magazine, 2014). Cargonaut has been greatly expanded to manage and speed up all the processes involved in the import and export of goods through Schiphol (Air Cargo World, 2016). This development was the result of Cargonaut's innovations and was influenced by the trend in the Schiphol Air Freight Community.

In 2016, approximately US$2.17 (€2) million was invested in the Cargonaut platform; Half of *the funding* came from TopSector Logistics – a government-and-industry-funded organization that seeks to promote advanced logistics practices in the Netherlands – while the remainder was provided by Dutch customs, Logius, ACN (Air Cargo Nederlands - industry association), Schiphol Group and Cargonaut (Air Cargo News, 2016a; Air Cargo World, 2016; Buxbaum, 2016). In 2016, Cargonaut's services for the air freight community were categorized into six groups: Customs Compliance, eFreight, Ready for Carriage, Security Compliance, Connectivity, and Track and Trace (Cargonaut, 2016b).

In 2016, The Smart Cargo Mainport Program (SCMP) was started. SCMP was initiated by Royal Schiphol, Dutch customs, KLM, ACN, and Cargonaut (Nederlands Genootschap van Bedrijfsjuristen, 2021) to find innovative schemes to improve cargo flow through Amsterdam, underpinned by transparent data exchange. Other significant developments of Cargonaut – European Green Fast Lane – were also initiated in 2016 (Dijkhuizen, 2018). The project aimed to improve KLM Cargo's truck supply lanes and is part of the SCMP (Air Cargo News, 2017a). The project succeeded. Philip Roodenburg at Swissport said,

“The key to success lies in a different way of working together: instead of telling each other ‘you have to do this, and you have to do that,’ we have looked with a helicopter view of how we can jointly organize the process efficiently and predictably“ (Royal Schiphol Group, 2018b).

In 2016, the Maritime Single Window had already been started and was the first step in the Single Window Trade and Transport (SWHT); The SWHT aimed to be the digital government window for data exchange in the commerce and transport sector in 2020 (Cargonaut, 2016a). In 2016, Cargonaut introduced a new timetable as the first step in setting up a cloud platform that makes the re-use of data between the cooperating parties possible (Cargonaut, 2016d). In 2017, Cargonaut developed an early warning system for pharma shippers; The fund came from the Netherlands Organization for Scientific Research and TKI Dinalog – the Dutch Institute for Advanced Logistics (Air Cargo News, 2017b). In 2018, Cargonaut supported Schiphol Airport in linking the airport’s CCS with Mumbai Airport’s CCS (Air Cargo News, 2018).

During Cargonaut’s second lifecycle, its *shareholders* and *members* had always been involved in the *decision making* to decide on the direction of Cargonaut’s development. “Ideas may come from individual customers or the airport operators. Then we have the rules and regulation changes. We come up with suggested solutions. Depending on the subjects, forwarder chambers, airlines chambers, are involved,” Cargonaut’s CEO. “Because we didn’t just want to implement changes to the system, we chose to consult a cross-section of our client list in combination with internal deliberation. Furthermore, we have met with external parties like ACN, FENEX, and EVO (Evofenedex)”, Cargonaut’s General Manager (Cargonaut, 2014). The role of ACN – which was established in 2003 (Buijze, 2013) – was also emphasized by Cargonaut’s CEO, “ACN played an important role because they are in which players negotiate of what the local rules should be. So, once they sign it off, then we know what solution to make. They are decision making role playing. We make the solution. Together, we come up with industry solutions.” ACN members represented Cargonaut’s customers. For every solution, Cargonaut always focused on developing an industry-wide solution. “For solutions we can think of, we always look if they are feasible, scalable, and if they can be of general use to the community,” Cargonaut’s CEO.

Since Cargonaut’s early development, the system has implemented detailed *data governance* using *contracts* and *NDAs* (Non-Disclosure Agreements). “Data ownership is a big thing. We have your information, but we will never abuse it, and you are in full control of your information.”, (Cargonaut’s CEO). The Cargonaut system made sure that the access to members’ data was under the control of each member. "We register each participant and agree on what can and cannot be requested. That is also checked," Cargonaut’s Director (Nieuwsblad Transport, 1996). Every member was clearly informed that the Dutch customs had access to all information in Schiphol’s CCS (Meijer, 2007). The *data governance* was also implemented in Cargonaut’s connection with other CCSs. For example, in the shared interface between Cargonaut’s and Kale Logistics Solutions’

CCSs to support Schiphol Airport's link to Mumbai Airport, India, participants of the network were in full control of their data at any time (Air Cargo News, 2018).

Cargonaut supported operational cargo processes, as well as provided knowledge, intelligence, and analytics capability to management and decision makers based on the industry benchmark. Cargonaut charged a certain amount of fees to its members. In 2013, research into the use of eLink at Schiphol concluded that the costs and requisites for implementing the system need to be communicated more clearly by Cargonaut to potential users (Douven, 2013). In 2014, based on a 'fair use policy,' Cargonaut offered different bundles for its various customer groups (Cargonaut, 2014). "We are going to do bundles that consist of subscriptions and based on the number of messages. The subscription becomes much easier.", said Cargonaut's CEO.

The new *cost structure* consisted of (Cargonaut, 2014, 2016b):

- basic infrastructure, i.e., connection and use of the CCS platform,
- community applications, i.e., ECS, eCargo Receipt, eAWB, eLink Basic,
- specific players' applications, e.g., forwarders will get Declarations Import, Export, Transit, NVWA, and Submission House Airwaybill information,
- data transfer (per month), and
- customized applications – the 'add-ons.'

The billing was done per month, but each *member* signed a contract with Cargonaut for a longer period. In addition, Cargonaut also charges the customers fees for advising/consultancy, training, and implementation services. Another possible revenue stream was from the information, e.g., big data processing in supporting the companies' management to get an insight into the air freight community.

The revenue paid for operational activities and Cargonaut's development. According to Cargonaut's CEO, Cargonaut's expenditure was focused on investment and research cost, "Three types of investments: IT quality investment, market investment, organizational development investment. And there is research cost." *Rules and procedures* were enforced. "It has been a very informal organization. And we do not need to be formal all of a sudden, but we need to be able to work according to certain procedures to be able to deal with the growth", Cargonaut's CEO.

Cargonaut offered solutions for all SC players. Concurrently, Cargonaut was also orchestrating the *information standard* in the Schiphol air freight community. "Our core processes are twofold. First is solution development, more of an innovation and initiator role. We (also) have our role in orchestrating the information components. We don't own the processes and infrastructure", said Cargonaut's CEO. Aiming to support the competitive advantages of the Schiphol air freight community, the Cargonaut system has been intertwined with various SC activities and has become a critical system for its members. "If Cargonaut stops, the cargo handling here stops. We have become a critical part of other companies", said Cargonaut's CEO.

The success of Cargonaut has been proven since its shift from focusing on EDI messages to developing an integrated system. Cargonaut took care of handling 98% of logistics information flows at Schiphol Airport and was the largest provider of messages to Customs in the Netherlands (Arendsen, Bisterbosch, & Oskam, 2004). In 2016, Amsterdam Airport Schiphol received awards from IATA - Air Cargo Excellence Award: 'Best Major European Airport' (Royal Schiphol Group, 2019). In 2017, Amsterdam Airport Schiphol served 1.75 million tonnes of cargo (Royal Schiphol Group, 2018a). These achievements proved that Cargonaut had delivered Schiphol to be a major port in the air freight industry. “It is not our role to improve someone’s company. It is our role to improve Schiphol as the main port.”, said Cargonaut’s CEO.

The partnership succession phase

SCMP has been Royal Schiphol Group’s strategic program since 2016. The collaboration came to the conclusion that a new CCS built from scratch is needed to achieve the target. ACN’s Chief explained in Schoeters (2020) that the Dutch Ministry of Infrastructure and Water Management prefers to make sure that the Authorities own Schiphol’s data exchange platform. The government refers to Portbase’s ownership arrangement as a role model for Cargonaut. Thus, Royal Schiphol Group decided that outsourcing the CCS to a private company did not give the Authorities sufficient control over the critical system.

6.2.3 Part of the Schiphol Group

The pre-partnership collaboration phase

Royal Schiphol Group owned 38.84 % of the shares from 1996 until 2019 and conducted due diligence on Cargonaut Holding BV in 2019 (Royal Schiphol Group, 2020). The plan was to increase the Schiphol Group’s *ownership*.

The partnership creation and consolidation phase

In 2020, Cargonaut reverted to its first ownership arrangement (see Figure 17), which was *full ownership* by the Royal Schiphol Group (Cargonaut, 2020b). In the same year, the company started a big project to modernize its CCS (Cargonaut, 2020a). The *fund* needed came from the Royal Schiphol Group and the Dutch government. The overhaul was an effort to address recent needs in the community and optimize their technology use. The plan was to finish the project in 2 years (Cargonaut, 2020a), and in January 2022, the system integration in Schiphol was completed (Royal Schiphol Group, 2022a). Thus, in 2020, Cargonaut shifted to their new partnership collaboration in the third lifecycle.

According to the Cargo Strategy Director, Cargonaut is under the Cargo Department at Royal Schiphol Group. The *decision making* is done by the department. Cargonauts’ current Supervisory Board and Steering Committee are simpler and connected to SCMP because there is only one stakeholder. A new board is arranged – the *Strategic Advisory Board*. The members are people with a background in the air cargo industry who are

managing the member companies. The Director mentioned, “They are not really representatives because they don’t have a formal mandate from their companies, but they have experiences and give very important advice.” The Advisory Board, together with ACN, is responsible for giving inputs to the Cargo Department. Moreover, the integration of Cargonaut's expertise into the Royal Schiphol Group was conducted by relocating Cargonaut’s former employees to Schiphol’s various departments (Royal Schiphol Group, 2022c).

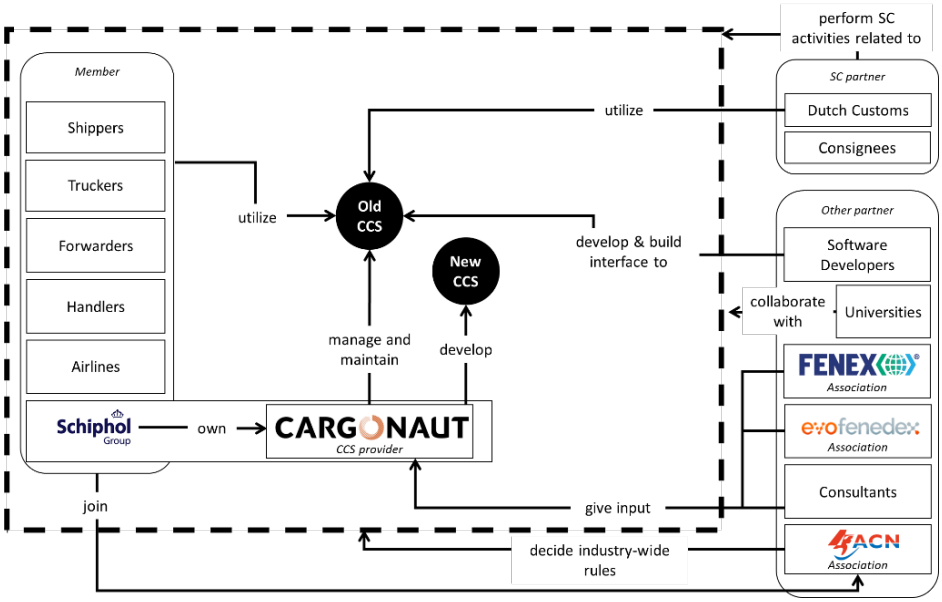


Figure 17. 3rd Lifecycle of Schiphol Air Freight Collaboration: Cargonaut - part of Schiphol Group

The partnership program delivery phase

Until now, Cargonaut has been serving the Schiphol Air Freight Community with the integrated system and its innovation. Cargonaut is currently developing its new CCS with an in-house project team and collaborating with IT providers. While preparing the new system, Cargonaut’s CCS is running and normally maintained (Cargo Forwarder Global, 2020). Several improvements are implemented with regard to future needs. For example, a 'compliance checker' service went live at the end of 2019 (Nederlands Genootschap van Bedrijfsjuristen, 2021), and a new digital pre-announcement of local export freight was introduced in 2021 (Limburg, 2020).

6.3 Discussion

The air freight community in Schiphol Airport has been through three lifecycles of governance (see Figure 14). During these periods, the old CCS developed and evolved. Nowadays, a new CCS is prepared as a part of the SCMP program.

The first lifecycle started as early as 1981 when the preparation study to implement CCS was executed in Schiphol. In the first lifecycle, Schiphol Group was the only *owner* of Cargonaut. It means that the Schiphol Group maintained Cargonaut's neutrality. This neutrality was mainly supported by the *ownership* of the Schiphol Group, which was owned by the state (Dutch government and two other municipalities). However, this governance arrangement (see Figure 15) was terminated in 1995 when Cargonaut was in red. The community decided that the loss was due to the lack of *members'* participation. Thus, *the partnership succession phase* in this lifecycle led Cargonaut to the following cycle.

In the second lifecycle, the governance arrangement was changed (see Figure 16). Cargonaut's *ownership* was shared between the Royal Schiphol Group and other private companies in the Schiphol community. In addition, all customers of Cargonaut were *sharing the cost* of developing and maintaining the CCS platform. The customers also had the power to *decide* on Cargonaut's development through ACN as their representatives.

Later, consensus and study in 2019 led the Schiphol Air Freight Collaboration to sell the Cargonaut's shares to the Schiphol Group. Consequently, today, Cargonaut is a part of the Cargo Department in Schiphol Group. The Schiphol Authority makes decisions about and funds the new CCS development. The current stakeholders are presented in Figure 17. Meanwhile, the old CCS is operating normally.

The changes of governance in the second and third lifecycles were established without affecting the CCS service. Cargonaut was delivering its services continuously. In the first lifecycle, the partnership succession phase occurred at the same time as the first partnership program delivery phase, and in the second lifecycle, the second partnership program delivery phase occurred at the same time as the partnership creation and consolidation phase. The same pattern is also observed in the transition from the second to the third lifecycle in Figure 14.

The ownership structure and the established governance mechanisms of Cargonaut in the first, second, and third lifecycles show that the Schiphol Air Freight Community adopts a *formalized governance*. This finding supports the previous studies (Gulati & Singh, 1998; Markus & Bui, 2012), which argue that the complexity of the information system, the high interdependence between companies, and the high goal consensus are key predictors for *formalized governance*.

It was apparent that the formalized *ownership* structure in the first lifecycle was not suitable for the Schiphol community later on. In the first lifecycle, the collaboration established a top-down governance approach. The collaboration hub, Schiphol Group, invested in Cargonaut because the collaboration did not have any experience with a CCS beforehand. In this lifecycle, Schiphol Group took the risk to introduce the concept of CCS and its benefits to the community. After the community got used to the Cargonaut system and the collaboration was built on top of the CCS in the second lifecycle, a

bottom-up governance approach was established. The privatization of Cargonaut gave the members more power in decision making in exchange for financial *investment* and participation. This governance arrangement (see Table 15) improved the members' involvement. However, private ownership was an issue for collecting funding and deciding the CCS' overhaul. In the current lifecycle, Schiphol Group is the sole *owner* of Cargonaut and dominates the *capital investment* and *decision making*.

Table 15. The governance aspects in the 1st, 2nd, and 3rd lifecycles of Schiphol Air Freight Collaboration[8]

Governance Aspect	1st Lifecycle: Cargonaut (Full Ownership of Schiphol Group)	2nd Lifecycle: Cargonaut (Shared Ownership)	3rd Lifecycle: Cargonaut (Part of Schiphol Group)
Membership	The membership was limited to organizations that conducted SC activities in or related to the Schiphol Airport (location-based membership).		
Capital investment	Royal Schiphol Group (the Schiphol Airport Authority) was the main investor.	The shares were transferred from the Schiphol group to **other shareholders**. There were additional investments or funding by TopSector Logistics, Dutch customs, Logius, ACN (Air cargo industry association), the Netherlands Organization for Scientific Research, and TKI Dinalog.	**Schiphol Group** (the Schiphol Airport Authority) bought the whole shares of Cargonaut. The Dutch Government gave some funds.
Operational funding	Cargonaut's operational funding was generated from the members, including: (1) one-time payment (2) pay-per-use payment (3) optional fee for tailor-made solutions	Cargonaut's operational funding was generated from the members based on different bundles for its various customer groups.	Cargonaut is preparing new cost-sharing cases for every development project to ensure the members' commitment.
Decision making	The Supervisory Board decided on the strategy and set the priorities	The members have the power to decide on Cargonaut's development through **ACN** as their representative.	• The decision making is done by the Cargo Department in Schiphol Group.

[8] The bold words in a lifecycle indicate significant differences from the previous lifecycle.

Governance Aspect	1st Lifecycle: Cargonaut (Full Ownership of Schiphol Group)	2nd Lifecycle: Cargonaut (Shared Ownership)	3rd Lifecycle: Cargonaut (Part of Schiphol Group)
	for the collaboration.		• The Advisory Board, together with ACN, is responsible for giving inputs to the Cargo Department.
Data governance	Regulations, policies, and procedural approaches are enforced.	Regulations, policies, and procedural approaches are enforced. The system has implemented detailed data governance using contracts and NDAs (Non-Disclosure Agreements).	
Governance entities	Cargonaut BV	Cargonaut Holding BV, which owns: • Cargonaut Nederland BV • Cargonaut IP BV • Cargonaut International BV	Cargonaut Holding BV, which is operated **under the Cargo Department** of Schiphol Group.
Equity owners	Investor-owned: Schiphol Group (100%)	Investor-owned. In 1995, the stakeholders were: • Schiphol Group (40%) • KLM and Martinair (12.5%) • Three handlers (19%) • 13 air freight forwarders (28.5%) • Westlake Systems BV (an IT provider) later became Cargomate BV. Later, the shareholders' composition slightly changed over time.	Investor-owned: Schiphol Group (100%)
Board composition	The members of the Cargonaut Holding BV Supervisory Board were people in the logistics, air cargo, and aviation industries. The chairman was elected for a 4-years term.		The Strategic Advisory Board's members are experts in the air cargo industries.

Nowadays, the Schiphol Air Freight Community has turned into a successful collaboration. Using Cargonaut's CCS to support its SC activities, Schiphol has become one of the best air cargo airports in Europe. An important advantage of Cargonaut compared to other CCSs is Cargonaut's focus on both B2B and B2G communication instead of on only one of these two types of communication (Meijer, 2007). According to many forwarders, the biggest advantage is the insight into the SC processes based on

transparent, fast, secure, and quality-guaranteed information; This benefit is more valuable than the 20-25% reduction in lead time and the paperless approach (Douven, 2013). One of Schiphol's competitive advantages is the transparent and fast information flow between the air freight players in the Cargonaut system. It is represented in the three pillars of Cargonaut's values, which are 'doorzien' (transparent), 'doordacht' (thought out), and 'door data' (by data) (Reggs, 2018). This success was greatly affected by the governance of the collaboration.

Cargonaut development is still ongoing. The air freight industry is affected by the changes in the global supply chain. For example, there is a shift from bigger imports to smaller imports, which is part of a wider trend – e-commerce is growing at the expense of traditional commerce, with small shops and businesses growing while large ones struggle. "There are more small packages, but also smaller players," said the Cargo Director of Amsterdam Airport Schiphol (Air Cargo News, 2016b). Schiphol's Cargo Partnerships Director in Royal Schiphol Group (2022c) mentioned, "The success of the SCMP depends entirely on the Cargo community. We need full acceptance and adoption of the digital services already in place as well as input and testing of the solutions to come." Thus, we are also expecting continuous improvement in the Schiphol collaboration's governance.

6.4 Conclusion

The case of the Amsterdam Schiphol Air Freight Community shows that the established inter-organizational governance is dynamic. The community has been through three lifecycles of governance. The main differences between the first lifecycle (1981-1995) and the second lifecycle (1996-2020) are (1) Cargonaut's ownership, (2) the cost-sharing structure, and (3) the member's power in decision making. Basically, the second lifecycle is the privatization of Cargonaut to its constituent participants. Later in the third lifecycle, the ownership reverted to the previous arrangement, and the decision making process was adapted to this change. Cargonaut is currently a part of the Cargo Department in Schiphol Group. The changes in the governance arrangement indicate that implementing Cargonaut's CCS was only the first step in creating a competitive advantage for the community. Later on, the implementation needs to be supported by a set of governance mechanisms and structure that is suitable for the relevant situation.

This study presents a CCS implementation case, which is popular in the air freight industry but still few in numbers. Our main contribution will be in supporting the supply chain management field – especially air freight management – which has been acknowledged in business practices and the academic world (Ellram & Cooper, 2014).

The managerial implication of this study is eloquently summarized by Cargonaut's CEO during our interview, "You can buy the technology, but it will be of no use. Because first, you have to have a good collaboration, and then you can apply the technology. If you don't have the collaboration mode and you don't have the ability to act and decide

as a community, technology is worthless." Moreover, this study will benefit large companies in the air freight industry and SMEs and start-ups in joining or establishing supply chain collaborations by giving access to inter-organizational governance state-of-the-art knowledge.

Chapter 7
Dutch Energy Market

Abstract – The current business process of the Dutch energy sector consists of the supply chain and the free market arrangement. Liberalization of the energy market in the Netherlands led to market players' need to arrange an information hub. Nevertheless, establishing inter-organizational collaboration for the Dutch Energy Market collaboration has been a long journey since its first IOS implementation in 2001. ECH, which later evolved into EDSN, is one of the first successful IOS-based collaboration cases in the energy market. This study discusses the development of the Dutch energy market's governance that intertwines with the market's evolution. The inter-organizational governance development in Dutch Energy Market collaboration consists of 3 lifecycles: ECH, EDSN with shared governance, and EDSN with DSOs and TSOs governance. By October 2020, EDSN's IOS already supported 100% network connections in The Netherlands. The most notable factors for the Dutch Energy Market's success are (1) the support from the Dutch Government and the major players in the sector, (2) the gradual change, (3) the clear separation of roles between EDSN and NEDU (later was changed to MFF), and (4) the strategic relationship between the IOS orchestrators and the system integrators.

7.1 Introduction

Electricity is one of the basic needs in modern society. The history of the electricity energy sector in the Netherlands started in 1886, when the country's first power station was built (TenneT Holding BV, 2020b). The current business process of the Dutch energy sector consists of the supply chain and the free market arrangement. The supply chain is electricity transport and distribution from the producers to industries and consumers, which consume energy. In this supply chain, the grid operators (Transmission System Operator / TSO and Distribution System Operator / DSO) own the infrastructure, i.e., cable and pipeline networks and electricity meters. On the other side, the electricity market arrangement is the management of suppliers' contracts with the producers and the customers.

The Dutch energy market liberalization preparation started in the 1990s (Epexspot, 2020) as a part of EU market liberalization. EU electricity market directive was enacted in 1996 and 2003 to achieve full liberalization in 2007 (Jamasb & Pollitt, 2005). In 1996, the Third Energy Note of the Ministry of Economic Affairs set a direction for a new structure of the Dutch energy market (Batenburg, 2016). The Electricity Law and the

Gas Law were enacted in 1998 and 2000, respectively (Cace & Zijlstra, 2003). Liberalization was completed for the Dutch electricity and gas market on 1 July 2004 (DeEnergieGids.nl, 2019); Specifically, the electricity market was fully liberated in 2003. Before the liberalization, large energy companies were responsible for supplying electricity in a particular area (DeEnergieGids.nl, 2019). The liberalization focused on the consumers' freedom in establishing and terminating contracts (Rukanova, 2005). Consequently, consumers have the freedom to choose their electricity supplier. According to Jamasb and Pollitt (2005), transforming a vertically integrated energy market into a competitive industry consists of several steps: industry restructuring, competition and market introduction, regulation arrangement, and privatization.

This liberalization led to market players' need to arrange an information hub. Electricity is a unique energy commodity because electricity cannot be stored, and the supply mechanism has to be stable in real-time (Epexspot, 2020). Thus, the information flows between the parties in this sector are enormous and sensitive to fluctuations in production and consumption. Energie Data Services Nederland BV (EDSN) is filling the Hub role in the Dutch market. EDSN offers digital services enabled by an IOS for the energy market. The IOS enabled inter-organizational collaboration in the Dutch energy market (electricity and gas) to flourish.

Nevertheless, establishing inter-organizational collaboration in the Dutch energy market has been a long journey since its first IOS. The IOS is continuously improving, and the collaboration's structure has changed. The form of inter-organizational collaborations may vary between two extremes: an informal network of contacts and a complex legal organization. Nevertheless, coordinating the collaborations – the governance – is fundamental to success. In establishing a centralized partnership using IOS, sufficient resources (such as financial capital, workforce, and information system) may not be enough; clear governance is essential.

The Dutch Energy Market is a noteworthy case study. Energie Clearing House (ECH), which was the predecessor of EDSN, is one of the first successful IOS-based collaboration cases in the energy market. Many other European countries follow the Netherlands in developing central data hubs. Estonia and Denmark developed their systems in 2012 and 2013, respectively (EDSN, 2015). The Finnish centralized information exchange system for the retail electricity market, Datahub, went live in February 2022 (Fingrid, 2022). Poland and Swiss are following.

This study will discuss the development of the Dutch electricity free-trade market's governance that intertwines with the market's evolution. The IOS in this case study, i.e., ECH's and EDSN's systems, were developed to support the Dutch Energy Market. The liberalization is not possible without data exchange through the IOS. The rules and laws in the collaboration direct the IOS' development. As the vital IOS orchestrators in this collaboration, ECH's and EDSN's organization arrangements represent the governance lifecycle of the collaboration.

7.2 Bilateral Communication Before IOS Implementation

The starting point of Dutch liberalization was in 1998, and it was marked by the enforcement of the Dutch Electricity Law regarding market liberalization (Cace & Zijlstra, 2003). The first phase of liberalization focused on heavy industry and wholesale (Fokkema, 2021). During this period, the Dutch energy market established a new structure. One of the major milestones was the foundation of TenneT BV. TenneT was established in 1998 and formally appointed by the Government as a TSO, which operated the Dutch high-voltage transmission grid (TenneT Holding BV, 2020b).

During this era, several standardization projects were initiated. SPOED (Support Programma Opening Energiemarkt Derde fase) was a project commissioned by Energie-Nederland, which was the association of energy companies, for running tests on the message exchanges via an IT system (van Rooy, Franken, Keuzekamp, & de Boer, 2003). SPOED developed a reference model (Rukanova, 2005). Unfortunately, SPOED hardly tested the model at the end of the project. The reference model was maintained by an organization called B'con (Rukanova, 2005). Another project – Platform for Energy Liberalization Acceleration (Platform Versnelling Energieliberalisering / PVE) – started in 1999. On 22 June 2000, the Dutch Ministry of Economic Affairs formally established PVE (Bakas & Gastel, 2002). PVE's primary responsibility was developing codes, rules and procedures, and standard messages for information exchange (Rukanova, 2005). The representatives of the Dutch Government, the energy industries, businesses, and other parties related to energy liberalization joined this platform (Bakas & Gastel, 2002).

The new structure of the Dutch energy market allowed new companies to enter the market. Most of the latest companies were suppliers that traded electricity and served the customers. Because electricity cannot be stored, a balance between supply and demand is crucial. In 2000, a single-buyer market was set up between TenneT and the producers to coordinate the supply of balancing power at the national level to address the suppliers' imbalances (Niesten & Jolink, 2014). The idea was to let the producers bid, and the winner established a tender for regulating and reserving power supply to TenneT. However, this attempt failed in mid-2000 because the producers were unwilling to join (Niesten & Jolink, 2014). Thus, the regulator solved the problem by enforcing long-term contracts on the big producers with a capacity larger than 60 MW while maintaining the voluntary bidding system for other producers (Niesten & Jolink, 2014). This rule was stipulated in Grid Codes.

At that time, the data within the electricity energy sector was interchanged using the EDINE standard (Electronic Data Interchange in the Dutch Energy Market) (DeEnergieGids.nl, 2018a), which was based on the EDIFACT standard (Lamont, 2021). The DSOs maintained the Dutch energy sector's data. Since it is not possible to have many parties install their cables and pipelines in the same area, there is a responsible DSO in a particular region (DeEnergieGids.nl, 2019). At that time, bilateral

communication between parties was outdated, had limitations, and was hardly ever used (DeEnergieGids.nl, 2018a).

7.3 Dutch Energy Market After IOS Implementation

Data used in this study is a combination of interviews and discussions with EDSN's Innovation Manager and Quality Assurance Manager in 2016 and EDSN's Senior Consultant – who was ECH's Director and has been working in EDSN since its establishment – in 2022 and 2023. We also use secondary data collected by reviewing reports, studies, and industry magazines and journals. We describe the Dutch Energy Market case according to its timeline in this section. The data sources that are used in describing this case are presented in Appendix E. Table 16 shows the summary.

Table 16. The data sources used in describing the Dutch Energy Market case

Data Source Types		Number of Data Sources
Primary Data	**Interview (transcript & note)**	2
	Correspondence & confirmation	✓
	Presentation Material	2
	Archival Record	1
Secondary Data	**Academic Article**	1
	Book Section	1
	Thesis	1
	Company's report	8
	Magazine article	3
	Webpage	18

As shown in Figure 18, the inter-organizational governance development of the Dutch Energy Market, which is an IOS-based collaboration, consists of 3 lifecycles: ECH, EDSN with shared governance, and EDSN with DSOs and TSOs governance.

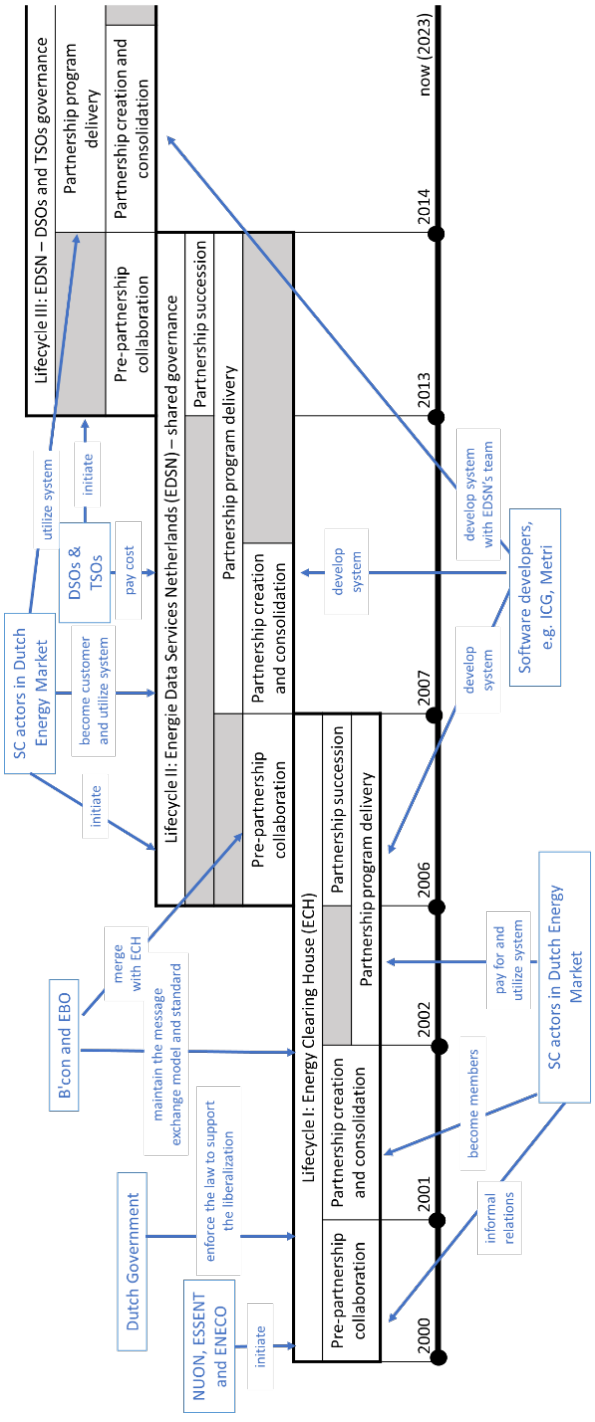


Figure 18. The Dutch Energy Market governance lifecycle

7.3.1 ECH

The pre-partnership collaboration phase

In 2001, TenneT was bought and wholly owned by the national Government (Cace & Zijlstra, 2003; Guayo, Kuhne, & Roggenkamp, 2010). The next phase in the liberalization focused on developing a centralized approach. After the new market structure was settled, contract management and data exchange were still the focus. Thus, the information exchange in the sector needed to be standardized and simplified (DeEnergieGids.nl, 2018a). "In February 2001, Tennet demanded the data exchange in EDI standard", EDSN's Senior Consultant. PVE adopted this EDI standard. Meanwhile, the incumbent firms came together to initiate a working IOS.

The partnership creation and consolidation phase

The Energie Clearing House (ECH) was founded on 6 July 2001 by three big incumbent firms– NUON, ESSENT, and ENECO – that owned seventy percent of the infrastructure in the Netherlands (DeEnergieGids.nl, 2018a; Hofman, 2005). ECH was established as a *neutral and independent foundation* (Stichting). The three firms invested and became the foundation's *owners*. Later, ECH also got loans from banks to *fund* its operation. To ensure its neutrality, ECH led by *a general board* (algemeen bestuur / bestuur op afstand), *a management team, and a customer council* (Hofman, 2005). The general board consisted of the owners' representatives. The general board was responsible for the investment and strategic decisions. Based on the ECH's legal standing as a foundation, *member* companies in the Dutch Energy Market joined the ECH as members. The customer council consisted of representatives of all ECH's members – such as suppliers and DSOs operating in the Netherlands. The council's decision making rule was one-man, one-vote. The board decided on new functionality, the release moment, and the exchange platform. "It was ECH that managed the members. We ensured all the members were involved," EDSN's Senior Manager.

The role of ECH was to facilitate the message exchange between the members and between member and non-member organizations (Rukanova, 2005). According to EDSN's Senior Consultant, understanding the facilitation process was challenging because Dutch liberalization had just started. Thus, ECH decided to prioritize the supplier-switching process by consumers as a foundation of liberalization. Before ECH implemented its IOS, this switching process was done manually, included many documents, and consumed many working hours.

The partnership program delivery phase

ECH's IOS went live on 20 December 2001. In 2002, ECH was the first Hub in the collaboration that delivered a working IOS; An IT provider – Logica – developed and hosted the software (CGI, 2021). The stakeholders are presented in Figure 19. The liberalization officially started at the beginning of 2002. While accommodating the switching process, ECH also supported the balance check process. At the end of the year, 15% of household customers had used the new system. The success was mainly because

of the national incentive strategy under the condition that the household used 'green electricity.'

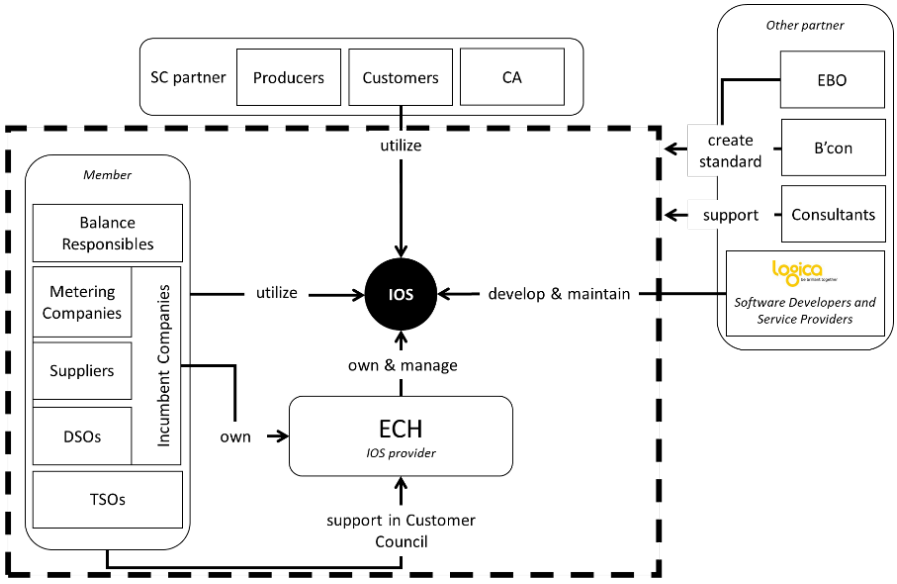


Figure 19. 1st Lifecycle of Dutch Energy Market: ECH

In 2002, the second liberalization was focused on the B2B (Business to Business) and green electricity B2C (Business to Consumer) business (Fokkema, 2021). In July 2004, the third liberalization phase of the Dutch energy (electricity and gas) market was executed (Rukanova, 2005) for B2C (Business to Consumer) and SME (Small and Medium Enterprises) (Fokkema, 2021). At the beginning of the liberalization, PVE accelerated market liberalization, but problems were pervasive. Clear rules and procedures were lacking; switching suppliers was difficult; invoices were incorrect and late; automatic payments were not completed (DeEnergieGids.nl, 2019). The situation in 2005 was chaotic. Some network operators and their once-related suppliers took advantage to prevent customers from switching suppliers using their previous status as one company (DeEnergieGids.nl, 2019).

Laws and rules were created, revised, and enacted to address the problems. Some of the notable-to-mention laws by the Dutch Government Authority (such as the Netherlands Consumer Authority or CA) were:

- The suppliers and the DSOs should formally be unbundled. A supplier charges customers, pays the fees – for example, transport cost and tax – to other market parties, and records the meter readings (DeEnergieGids.nl, 2018c). Meanwhile, DSOs own the electricity and gas network. Some large energy companies split into specified companies – i.e., suppliers, DSO, and producers (DeEnergieGids.nl, 2019).

- Legally enforced timelines were introduced within which the energy company needs to fulfill its obligations to the customers (Rukanova, 2005).
- The maximum rates DSOs and TSOs charged were determined (DeEnergieGids.nl, 2019).

Simultaneously, ECH improved its system. ECH used fixed format file messages and provided GUI for members. The GUI's primary users were small companies. Meanwhile, communication with non-member organizations was conducted using the EDINE protocol. By 2005, ECH served more than 98% of the Dutch energy sector (Hofman, 2005). EDSN's Senior Consultant emphasized the critical role of user training in the success of this IOS adoption. Moreover, during this time, ECH had studied the idea of a centralized registry for the IOS.

The members of ECH paid ECH's *operational cost* according to a transparent fee scheme. Each member rate was calculated based on the number of customers (for suppliers) or the number of connections (for DSOs) (DeEnergieGids.nl, 2018a). The members signed a contract and agreed upon a mutual *Service Level Agreement (SLA)* with ECH. The members were responsible for providing *data* related to the switching process according to the *specified timeline*. During its service, ECH provided *monthly operation reports*.

The partnership succession phase

Even though ECH's *members* successfully used the IOS, there was a severe problem regarding *data standardization*. EDSN's Innovation Manager mentioned, "There was no (national) standard notation (in the industry), so you get different interpretations, which makes it tricky." According to EDSN's Senior Consultant, at the start of the IOS development, there were 15 systems with different language standards. He recalled ECH's conflict with PVE in 2001 because of the various standards. Later, PVE stopped its operation in 2003. Other organizations – EDINE Beheerorganisatie (EBO) and B'con – maintained standards and models regarding data exchange. B'con was an organization that kept the reference model developed by SPOED (Rukanova, 2005). The TSO and DSOs established EBO in 2002 to coordinate the standard of the EDINE message traffic (kWh People, 2020).

7.3.2 EDSN – Market Oriented

The pre-partnership collaboration phase

During this period, the companies in the Dutch Energy Market started Programma Stroomopwaarts to improve the processes in the market. According to EDSN's Senior Consultant, the initiation was started in 2006 and was expected to yield a result in 2009. The project leaders were from TSOs (TenneT), DSOs (Enexis, Stedin, Alliander, Delta, Westland, Cogas, Rendo, and ObN-NetH/Endinet), an IT provider (Logica, later joined CGI in 2012 (Gorber, 2012)) and EDSN (EDSN, 2009b). The problem of having two standards (ECH's standard and EDINE) in the market became evident. This concern led to the merging of organizations that managed the standards. According to EDSN's Senior Consultant, in 2007, EBO was a virtual organization without permanent workers, and

B'con only had five employees. Meanwhile, most of the companies in the market have become ECH *members*. Thus, the merger was planned to promote the ECH's IOS.

The partnership creation and consolidation phase

In 2007, ECH merged with B'con and EBO; The name was changed to Energie Data Services Netherlands (EDSN) (DeEnergieGids.nl, 2018a). EDSN BV was founded as an *independent private company* on 18 April 2007 and employed 20 people (Bloomberg L.P., 2020; EDSN, 2015). The formal owners of EDSN were DSOs and TSOs. "EDSN's *capital* was borrowed from the market, banks, and other institutions," EDSN's Senior Consultant. EDSN was different from ECH regarding legal standing, so the company no longer had any *members*. The companies used EDSN's IOS – the system was inherited from ECH – and became EDSN's customers. Thus, EDSN's customers are *members* of the Dutch Energy Market IOS-based collaboration. Figure 20 presents the stakeholders' roles.

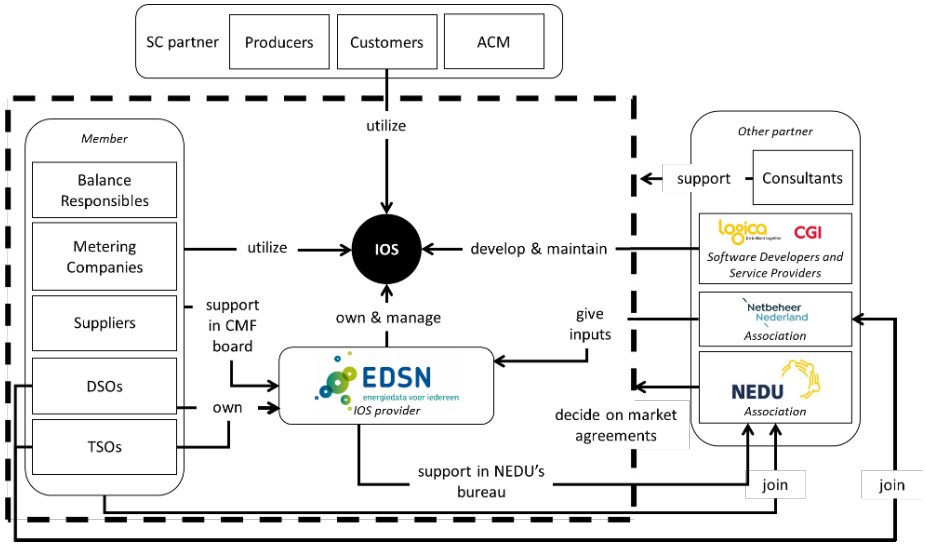


Figure 20. 2nd Lifecycle of Dutch Energy Market: EDSN – market oriented

Meanwhile, the Association of Dutch Energy Data Exchange (Vereniging Nederlandse Energie Data Uitwisseling or NEDU) was established in conjunction with EDSN to develop and maintain the market model. All roles (Supplier, Balance Responsible, DSOs, TSOs, and Metering companies) were represented in NEDU (Fokkema, 2021; NEDU, 2022). Creating consensus in the Dutch electricity market setting was a complex process due to the nature of the energy sector. NEDU was a collaboration platform for decision-makers in the energy market to propose regulations (Fokkema, 2021). NEDU studied every improvement project for EDSN in its bureau.

Besides NEDU, TenneT and Netbeheer Nederland – an association for DSOs – also contributed to the regulation consideration. TenneT proposes clear *rules and procedures* to ensure the electricity supply's security (DeEnergieGids.nl, 2018b; TenneT Holding BV,

2020a). NEDU, TenneT, and Netbeheer Nederland propose regulations to the Netherlands Authority for Consumers and Markets (ACM) (Fokkema, 2021). The energy market and EDSN followed the law passed by ACM. ACM is an independent regulator that was established and funded as a part of the Dutch Ministry of Economic Affairs in 2013 as a result of a merger of several predecessors: CA, the Netherlands Competition Authority (NMa), and the Netherlands Independent Post and Telecommunications Authority (OPTA) (ACM, 2014).

The *Central Market Facilitation (CMF) board* was formed as a Steering Committee for EDSN in 2011. CMF board consisted of the representatives of DSOs (Fokkema, 2016). As confirmed by the Innovation Manager, CMF meetings discussed EDSN boundaries and what needs to be done within the boundaries. CMF addressed the request from stakeholders and NEDU. Next, *the Supervisory Board* interprets the information into EDSN's vision, mission, strategies, and programs for the CEO and CFO. "The board of NEDU was the same as the board of EDSN (which were the market's representatives)," EDSN's Senior Consultant. For example, the same representative from Alliander was a member of EDSN's Supervisory Board and a member of NEDU's Board (Alliander NV, 2013). The representatives met in *regular yearly and quarterly meetings*.

The companies in the Dutch Energy Market had gradually unbundled since 2009, and this rule caused the incumbent firms to split. For example, Liander split off from NUON, and Enexis split off from Essent. Some of the suppliers were acquired by prominent foreign players. For example, the Swedish Vattenfall took over NUON, the supply side of Rendo and Cogas was taken over by Electrabel, and RWE from Germany took over ESSENT (DeEnergieGids.nl, 2019).

The partnership program delivery phase

In 2009, the energy sector and the Dutch Government executed a coordinated improvement effort (Programma Stroomopwaarts), which led to centralizing market facilitation (Fokkema, 2021). During the process, the collaboration worked on dividing the responsibilities between TSOs, DSOs, and EDSN; the project established *rules, communication protocols, and management procedures* (EDSN, 2009a) supported by consultant companies (Consultancy.nl, 2012). Using the new market model, consumers accepted only one invoice – for energy and delivery costs – from suppliers, which collected the fee on behalf of the DSOs (Computable, 2012).

Simultaneously, EDSN successfully developed an IOS – Central Connection Register (C-AR) – together with Logica (later joined CGI in 2012) in 2009. "We had a new tender again, but we wanted to be sure that we had a partner that understood the market and what we wanted. Logica was better because they had grown along with us", EDSN's Senior Consultant explained the selection of their long-time IT partner. C-AR is a central register for the metering administration. Other IT providers (e.g., Oracle and Tibco) also provided services for the IOS platform (Computable, 2012). In 2011, Liander was the first DSO to be included in C-AR (Alliander NV, 2012). All DSOs adopted the IOS in 2013 (CGI,

2021). This IOS used an XML-based data exchange standard. EDSN built a middleware (bridge) application during this time to connect C-AR and the predecessor IOS.

The improved processes' implementation was postponed while the market was waiting for a law enactment. Later, the Dutch Government dictated that the implementation date for the new market model was in 2013 (Enexis Holding NV, 2014). After 2013, the whole market adopted C-AR. Using the IOS, clear *data governance procedures* were adopted. This fact was explained by the EDSN's Senior Consultant, "One sector is the grid technical information. It is done by the grid (DSOs), and the market parties can not change it. Another sector is all the switch and market processes. The grid can not change it anymore." EDSN serves the Dutch energy sector by providing hub and register services (Fokkema, 2021). Thus, data exchange and validation of customer switches can be done quickly. "The purpose of EDSN is to ensure optimal functioning of the Dutch energy market in transition through uniform communication methods, transparent market processes, and secure data access" (EDSN, 2015).

EDSN is a non-profit, neutral party that offers energy companies in the Netherlands equal access to the same up-to-date and unambiguous market information (EDSN, 2016). EDSN enables the centralization of the grid management of the energy sector, which consists of allocation, reconciliation, and measurement (EDSN, 2016). Since the beginning, DSOs and TSOs have paid *the operational costs* of EDSN. Based on Dutch law, DSOs and TSOs were not allowed to do commercial activities. Consequently, EDSN's IOS cannot give services to suppliers and make a profit from the services. Later, a law was enacted. According to the law, the grid operators have to support the suppliers in the Dutch Energy Market with the CCP (Contract Control Protocol) that prevents double contracting. Thus, DSOs incorporated a component of market facilitation in their tariffs for other companies.

The partnership succession phase

In 2013, DSOs and TSOs realized that EDSN's IOS mainly supported their business. The C-AR implementation pushed the grid operators to take over the governance control.

7.3.3 EDSN – DSOs and TSOs Oriented

The pre-partnership collaboration phase

The *pre-partnership collaboration phase* in this lifecycle overlaps with *the partnership succession phase* from the previous lifecycle. The adjustment to the governance body was made from 2013 until 2014. "Over time, CMF board had become the governance body," EDSN's Senior Consultant.

The partnership creation and consolidation phase

The administrative model was finally stabilized in 2014 (Fokkema, 2021); EDSN established a new organizational structure on 1 January 2014 (EDSN, 2014). The *share composition* slightly changed over time, but DSOs and TSOs are still the legal *owners* of

EDSN (see Figure 21). For example, Alliander's ownership was 15% in 2012 (Alliander NV, 2013), and it increased to 26% in 2020 (Alliander NV, 2021).

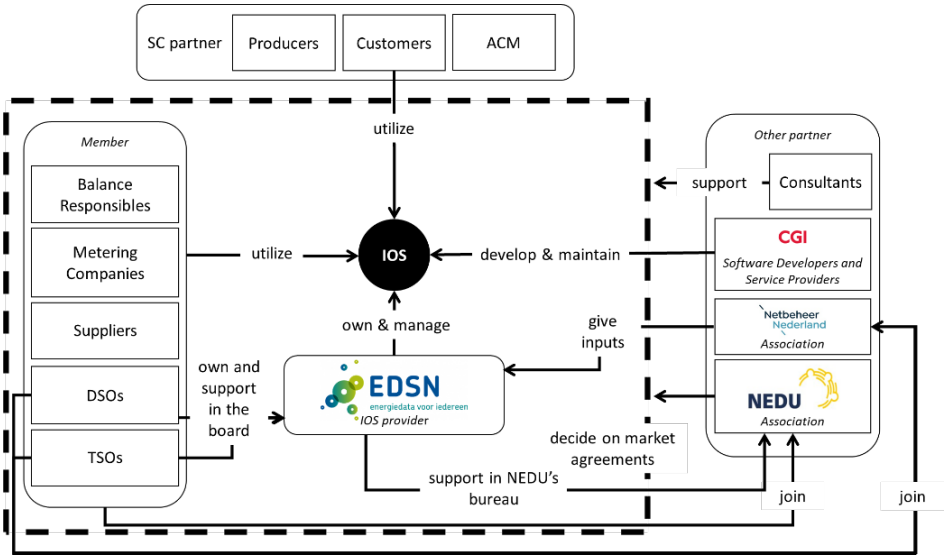


Figure 21. 3rd Lifecycle of Dutch Energy Market: EDSN - DSOs and TSOs oriented (2014 - 2021)

The partnership program delivery phase

In 2016, the data was managed in seven regions using different systems and particular languages (EDSN, 2016). Later, the operators started working with EDSN to gradually unify the market data in one location, in one language, and within one central ICT infrastructure (EDSN, 2016). In 2018, the Dutch energy sector agreed on uniform allocation and reconciliation services based on smart meter data (Fokkema, 2021). By October 2020, 100% of network connections in The Netherlands were serviced by EDSN's IOS (CGI, 2021).

EDSN's board representatives still meet in *regular yearly and quarterly meetings*. EDSN also gets inputs from Netbeheer Nederland (an association of Dutch DSOs and TSOs). The Innovation Manager is actively keeping track of the market's needs, "We usually go to events where we get to meet other people in the industry to get a more *informal talk* about their needs, to know what's going on." The *Supervisory Board* of EDSN and the board of NEDU maintain a very close relationship, which is reflected in the delegation. For example, Stedin's CFO was a member of the Supervisory Board of EDSN and also was a board member of NEDU in 2021 (Stedin Group, 2022).

After almost a decade of focusing on stabilizing the IOS, EDSN continues to develop its system. "The focus is shifting from doing things right into doing more things," the Innovation Manager. DSOs and TSOs *invested* in all of EDSN's projects. A recent development plan is to incorporate the management of electricity congestion by DSOs

and TSOs, which previously was maintained by a different IOS – i.e., GOPACS (Letschert, 2022). EDSN works with consultants and IT providers to develop their IOS. For example: (1) In 2016, EDSN worked with three system integrators at the same time for different functions in the IOS; (2) In 2018, EDSN established a 4-years contract with Technolution (Technolution, 2008); And later (3) EDSN developed an applications and IT infrastructure sourcing strategy solution with Metri (Metri, 2020). Even though the system integrators host and provide the IOS in their private cloud environment, EDSN is responsible for delivering the IOS as a service to its users. Thus, EDSN is managing the IOS on a day-to-day basis too. EDSN's innovation manager mentioned, "We have a monitoring screen to see how the systems are performing, showing whether the services are performing according to the SLA." The strategy is changing over time. EDSN's Senior Consultant mentioned that the IOS developments are shifting into an in-house strategy.

EDSN's data governance ensures that the central Hub does not monopolize the *data ownership* (EDSN, 2019). DSOs, suppliers, TSOs, and other parties are responsible for the data in the IOS by storing and keeping them updated. EDSN's Innovation Manager emphasized, "We (EDSN and its users) have a set of *agreements* on how to show (the data) and how we should do that to be consistent with the privacy laws as well." The database is stored in a private cloud and only accessible via electronic messages. EDSN monitors whether the users do not make incorrect requests in the systems. (DeEnergieGids.nl, 2018a). Therefore, the users of EDSN cannot access the data forcefully or decide to steer the development of EDSN merely for their benefit (DeEnergieGids.nl, 2018a). DSOs are actively involved in the Privacy and Security Policy and Expertise Group and use the Privacy Assurance Statement to ensure that the data and processes are managed based on the law (Alliander NV, 2021)

In 2021, 7 DSOs (e.g., Liander, Enexis, Stedin, etc.) and a TSO owned EDSN (Siöstedt & Wang-Hansen, 2021). On 1 April 2022, NEDU was replaced by the Market Facilitation Forum (MFF) and the Administrator of the Agreement System (BAS) (NEDU, 2022). Both organizations adopted one name – MFF/BAS. This change is presented in Figure 22.

MFF's members are TSOs, DSOs, the Dutch energy market participants, non-market parties, representative businesses, and consumer groups (MFFBAS, 2022). Thus, its membership scheme is broader than NEDU. The general assembly of MFF decides on system processes and data-sharing strategies using a specific voting rule (MFFBAS, 2022). Even though the parties outside the Dutch market can join MFF, they may not vote on system-process decisions. Working closely with MFF, BAS implements the agreements made in MFF and supervises the coordination, facilitation, and financing activities (MFFBAS, 2022). EDSN's Senior Consultant, "EDSN supported NEDU in NEDU's bureau, and now BAS is supporting MFF."

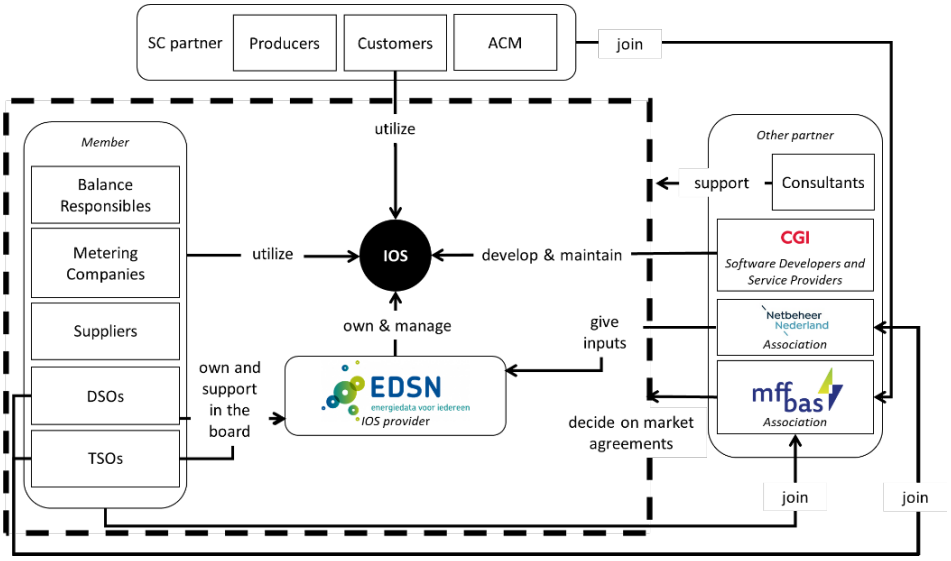


Figure 22. 3rd Lifecycle of Dutch Energy Market: EDSN - DSOs and TSOs governance (2022 - now)

7.4 Discussion

Before the IOS was implemented, energy liberalization had already started in 1998. In this era, ECH was not yet established formally because the Dutch energy sector relied heavily on bilateral communication between parties. During the first liberalization phase, the IOS-based collaboration was prepared. ECH became a *legal communication Hub*. ECH delivered the first IOS that was adopted by the energy market. Next, EDSN succeeded ECH. The lifecycles and phases of this collaboration are illustrated in Figure 18.

The phases of liberalization and the lifecycles of IOS collaboration show that the change was gradual. The Dutch energy market initiated the first liberation movement for large consumers (big industry), such as heavy industries and wholesalers, between 1999 and 2001 (DeEnergieGids.nl, 2019; Fokkema, 2021). Before ECH, the PVE project already connected parties in the Dutch Energy Market. Afterward, ECH was established when the Government arranged the free market of energy for small and medium industries and consumers from 2001 to 2002 (DeEnergieGids.nl, 2019; Fokkema, 2021). These steps helped the collaboration to first adapt to the process change and next to the system change. The IOS was also developed in gradual steps. In the beginning, ECH's IOS was only a communication Hub that connected its *members*. Later, the problem with the process and message standards emerged, and the problem was solved by forming EDSN for all market participants. In parallel, EDSN developed the centralized register in EDSN's IOS.

The Dutch energy market is a top-down collaboration. The governance structure of the first lifecycles is shown in Figure 19. The Dutch Government and the major players in the sector are the initiators. The liberalization project in the Netherlands was initiated by the Ministry of Economic Affairs (Rukanova, 2005). European Parliament and Council issued electricity directives (Niesten & Jolink, 2014), and later, the law in 1998 pushed the collaboration to commence. Later, the law dictates the IOS' functions and rules. For example, one of the IOS' performance indicators is the legal timeline for information delivery to customers. The players must abide by the law to continue their services.

The major incumbent firms founded the first IOS orchestrator, ECH. In the second lifecycle (see Figure 20), the EDSN owners are DSOs and TSOs, and one of the TSOs is TenneT, which the Dutch Government owns. These legal arrangements provide the IOS orchestrators with stable financial resources throughout the first and second lifecycles. Consequently, the supply chain stakeholders in the Dutch energy sector follow the lead to collaborate and use the EDSN's system.

In this collaboration, national standards and laws are heavily used to streamline the data exchange. The members and consumers have different concerns about the data. The Dutch energy sector's data was maintained in multiple systems and standards. Some foreign players have acquired several Dutch suppliers since 2005, and these foreign players probably had various procedures before joining the Dutch market. As a preparation for the liberalization and Hub establishment, several organizations and projects (e.g., PVE, SPOED, and EBO) worked on standards and models for the electricity market collaboration. In the following years, we also found a lot of troubleshooting that needed the stakeholders to adopt an agreement or standard — for example, the regulations issued by ACM and the legal segregation of suppliers and DSOs.

Since the second lifecycle, EDSN has been governing the IOS usage until now, and NEDU has governed the market model until 2021. Even though the governance of the IOS-based Dutch Energy Market changed in the third lifecycle due to the power takeover by DSOs and TSOs (see Figure 21), NEDU's role was the same. The existence of NEDU changed in 2022.

The current governance stakeholders are displayed in Figure 22. ECH and EDSN are the information Hubs for the SC stakeholders. Meanwhile, the same stakeholders also joined NEDU and MFFBAS to discuss and suggest regulations for ACM. In other collaborations, these roles are incorporated into one legal organization. The Innovation Manager stated, "This (the separation of EDSN and NEDU) is in place because of the way we are financed and owned. DSOs, as owners, want to have influence."

The existence of NEDU and MFF supports the Dutch energy market as a platform to self-regulate and gain consensus on market development. EDSN is the IOS provider. The majority ownership of EDSN by DSOs and TSOs gives those grid operators significant influence in deciding the process in EDSN's IOS than other market players.

Figure 19 until Figure 22 show that the ECH's IOS and EDSN's IOS are developed and hosted by other system integrators based on their *contracts* with ECH and EDSN. By separating IT solution development and IOS management, EDSN ensures flexibility in switching IT providers. The Innovation Manager emphasized that multiple outsourcing is the strategic decision of EDSN. He mentioned, "If we have a function generated by one system integrator, we should have the possibility to take it somewhere else if we are not pleased with the results that we achieve." However, this strategy must be executed by using standardized software packages with a well-documented configuration and customization. On the other hand, EDSN is one of the first IOS orchestrators in the energy market, and it is not always easy to find an available standard package that fits EDSN's requirements. Consequently, EDSN is working closely with one of the system integrators due to the long-term strategic relationship. Later, after the IOS is stable, EDSN develops its internal team to make improvements to the IOS.

The governance aspect differences between the lifecycles of the Dutch Energy Market are presented in Table 17. Since the beginning of ECH, the IOS-based collaboration in the Dutch Energy Market only connects the IOS to the stakeholders conducting market activities. Over time, EDSN has achieved success and connects all network connections in the Netherlands. The significant changes in the second lifecycle were *governance entity*, *data governance*, and *operational funding* scheme. EDSN was *established legally* as a private company (BV) rather than following ECH's legal form as an association (Stichting). The establishment's primary purpose was to *standardize the data* in the Dutch Energy Market and simplify *data governance*. Following this arrangement, DSOs and TSOs became the *legal owners* of EDSN. Thus, they *invested* and paid for the *operational cost*. In the third lifecycle, changes were related to the *decision making* and *board composition* because DSOs and TSOs took control of EDSN.

Table 17. The governance aspects in the 1st, 2nd, and 3rd lifecycles of Dutch Energy Market[9]

Lifecycle	1st Lifecycle: ECH	2nd Lifecycle: EDSN – shared power	3rd Lifecycle: EDSN – DSOs and TSOs governance
Membership	The membership is limited to organizations that conduct free trade market activities in the Dutch energy (gas and electricity) network (location-based membership).		
Capital investment	Three big incumbent firms (producers and suppliers) – NUON, ESSENT, and ENECO – invested capital in establishing ECH. ECH got loans from banks.	The capital was pooled from the **market** (mostly **DSOs and TSOs**) and loans from banks.	The capital was pooled from the **DSOs and TSOs**.

[9] The bold words in a lifecycle indicate significant differences from the previous lifecycle.

Lifecycle	1st Lifecycle: ECH	2nd Lifecycle: EDSN – shared power	3rd Lifecycle: EDSN – DSOs and TSOs governance
Operational funding	All parties paid for the cost. The *members* pay ECH's operational cost based on the number of customers (for suppliers) or the number of connections (for DSOs).	**DSOs and TSOs** pay the market facilitation cost.	
Decision making	ECH had: • a general board, • a management board, and • a customer council. The council was responsible for deciding on new functionality, the release moment, and the exchange platform. The general board was responsible for the investment and strategic decisions.	• The **Central Market Facilitation (CMF)** Board (Steering Committee) discussed EDSN boundaries and what needs to be done within the boundaries. • The **Supervisory Board** interprets the information into EDSN's vision, mission, strategies, and programs for the CEO and CFO.	EDSN's board addressed the request from stakeholders (DSOs and TSOs).
Data governance	There was a severe problem regarding data standardization.	EDSN's data governance ensures that the data is **standardized** and the central Hub does not monopolize the ownership. The data is maintained by the grid operators (DSOs and TSOs), suppliers, and metering companies. EDSN monitors the use of data and the data structure.	
Governance entities	Energie Clearing House (ECH) was a neutral and independent foundation (Stichting).	Energie Data Services Netherlands (**EDSN**) BV.	
Equity owners	Investor-owned: Three big incumbent firms – NUON, ESSENT, and ENECO – owned 70% of the infrastructure in the Netherlands.	Investor-owned: **DSOs and TSOs** legally own EDSN BV.	
Board composition	• The customer council consists of representatives of	• CMF board (Steering Committee) consisted	• The board members **are DSOs and TSOs**.

Lifecycle	1st Lifecycle: ECH	2nd Lifecycle: EDSN – shared power	3rd Lifecycle: EDSN – DSOs and TSOs governance
	ECH's members – all energy suppliers and network operators operating in the Netherlands who are affiliated with the ECH. • The general board consists of representatives of the three big incumbent firms.	of the representatives of **DSOs**. • The Supervisory Board members were all **market parties**.	• The Supervisory Board of EDSN and the board of NEDU maintain a close relationship.

Collaboration must govern different types of *members* and non-member parties using appropriate governance mechanisms. As stipulated in the Grid Code, *long-term contracts* coordinate the big producers and companies. The Grid Code is the code of conduct for the operators and the other parties in the electricity concerning the operation of the network and the transportation of electricity (Niesten & Jolink, 2014). *Long-term contracts* are also used to govern the relationship between EDSN and the software developers. One of the system integrators has been working with EDSN since the first ECH lifecycle (CGI, 2021). On the other extreme, the customers only need to abide by *short-notice contracts* to decide on their suppliers.

7.5 Future Challenges

In the Netherlands, a new energy market is emerging because of renewable energy sources (solar, wind, water). The target was to achieve a 50% CO2 emissions reduction by 2030 and a 100% elimination in the energy supply by 2050 (Energie-Nederland, 2022). Moreover, the electricity sector landscape is also evolving. In the Dutch energy market, an energy generator is acknowledged as a producer if the company owns more than 5 MW in production capacity (Cace & Zijlstra, 2003). With solar panels and other small-scale energy generators, energy consumers can also sell their electricity. This movement requires complex coordination between the stakeholders.

Electricity consumption is also increasing with the adoption of technological innovations for households and industries (e.g., electric cars supported by public charging pools). The energy grid fluctuates and must be organized smarter (EDSN, 2016). The law enforcers that the customers own the energy consumption data. The data, managed by EDSN, is the key to getting insight into the energy market. Thus, data governance and analysis are significant issues for the sector.

Moreover, globalization in the energy market is vital for the IOS development and governance arrangement. In 2010, TenneT acquired the German high-voltage grid from E.ON and became Europe's first cross-border transmission system operator (TenneT Holding BV, 2020b). International players also own a part of suppliers in the Netherlands. These multinational companies' strategic movements will affect inter-organizational collaborations in the energy market. Furthermore, the companies are also subject to different laws in their market countries. Energy policy harmonization and cross-border energy transmission are challenges for achieving an integrated European electricity market (Pepermans, 2018). With the new Energy Act (expected in 2025), new entrants can offer data-processing services for their end customers (EDSN, 2022).

7.6 Conclusion

Dutch Energy Market is an IOS-based collaboration currently connected by EDSN's IOS. This collaboration has gone through three lifecycles of inter-organizational governance. The lifecycles are ECH (1998-2006), EDSN with shared governance (2006 – 2014), and EDSN with DSOs and TSOs governance (2014 – now). During these lifecycles, the stakeholders have evolved. The unbundling of incumbent firms resulted in independent companies (suppliers, DSOs, metering companies). NEDU was established together with EDSN and later replaced by MFF/BAS. The inter-organizational governance aspects also changed from one lifecycle to the next. Nowadays, EDSN's IOS successfully registers all of the energy connections in the Netherlands.

Overall, the success of the Dutch Energy Market is a combination of some factors. The most notable ones are (1) the support from the Dutch Government and the major players in the sector, (2) the strategic relationship between the IOS providers and the system integrators, (3) the gradual change, and (4) the clear separation roles between EDSN and NEDU (or MFF). Energy is a vital sector for a nation. Consequently, the Government heavily controls this sector, and the national law is fundamental for the market transactions. Moreover, this sector's infrastructure is massive and managed by large TSOs and DSOs. Dutch Government and these prominent players have supported the IOS since its early development until now. This support helps ECH and EDSN solidify strategic partnerships with its IT developers, such as Logica, in developing the IOS. The IOS development was a gradual change for the market. ECH's IOS was replaced by C-AR, and Programma Stroomopwaarts' new market model was implemented after DSOs joined C-AR. The market's problems regarding data standards in the first lifecycle are helpful to experience for the second lifecycle. EDSN and NEDU (or MFF/BAS) have worked together during these lifecycles. An IOS-based collaboration might need different legal assemblies to incorporate the service into the collaboration’s business processes. A legal organization is required to govern the IOS-based collaboration because the information exchange is complex, and the risks (such as information misuse) are high.

Chapter 8
Dutch Floriculture Supply Chain

Abstract – Under the influence of information technology, the Dutch floriculture network has been undergoing a long journey of digital transformation. This study focuses on the longitudinal transformation of inter-organizational governance during a digital transformation initiative – HubWays. HubWays was selected as a case study in this study because HubWays' history in the Dutch floriculture collaboration expanded from the idea generation in 2008 until its dissolution in 2019. During the transformation, the governance was designed, established, and dissolved. However, until now, an ideal industry-wide collaboration has not yet been created in the network. Formal interviews with the key persons and several informal meetings were done to collect data and opinions from 2014 until 2020. This study confirms that the governance was designed according to the needs of the collaboration over time. Yet, the design may be late or unsuitable for collaboration. Our longitudinal analysis shows that the problems in the governance design – i.e., the lack of resources, the politics, the complex structure, the issues in change management, the conflict management, and the involvement of the IT provider on the Board – contributed to the collaboration failure.

8.1 Introduction

The Netherlands is one of the main hubs of the floriculture sector in Europe. This sector has made a huge contribution to the Dutch economy, trade balance, and employment (van Veen & van der Vorst, 2011). The Netherlands is the largest exporter of fresh products in Europe and the third-largest exporter in the world (van der Vorst et al., 2016). After the flowers and plants are bought from the auction in the Netherlands, around eighty percent of them are exported to other countries, such as Germany, England, Belgium, and France (Royal FloraHolland, 2019). The floriculture supply chain network consists of growers, auctions, traders (importers, exporters, and wholesalers), Logistics Service Providers (LSPs), and outlets/buyers (van der Vorst et al., 2016).

In 2011, Dutch floriculture gained a market share of sixty percent in Europe (Veen Streek, 2011). This market share has been kept up until now; around sixty percent of the global trade in flowers and plants passes through Dutch auctions (Royal FloraHolland, 2019). In the Netherlands, Royal FloraHolland organizes the international floriculture marketplace, with its annual turnover reaching 4.6 billion euros in 2019 (Royal FloraHolland, 2020a). FloraHolland is a primary cooperative that has a total of 6,000 members of growers both in the Netherlands and overseas (Royal FloraHolland, 2019). FloraHolland coordinates six marketplaces all around the Netherlands, namely Aalsmeer,

Naaldwijk, Rijnsburg, Bleiswijk, Eelde, and Herongen. These marketplaces are called Greenports (Hubways, 2010a).

To serve the floriculture supply chain, LSPs are collaborating in providing road and air cargo movements. Imported flowers and plants enter the Netherlands via air cargo and are loaded onto trucks for distribution to marketplaces and buyers (Kort-Boreas, 2014). The introduction of virtualization in the floriculture auction brought concern about logistic efficiency. All auction clocks from FloraHolland can be connected via a KOA (remote purchase) connection, and the goods can be purchased without being physically present at the marketplace (van Veen & van der Vorst, 2011). Digitalization was expected to reduce unnecessary movements and costs because the buyers do not need to physically buy the flowers and plants in the marketplaces (Veen Streek, 2011). Thus, the perishable products could be delivered faster from the grower to the end buyer location.

There were many attempts to introduce an IOS promoting integrated information sharing in this network. The floriculture industry will benefit tremendously from the IOS implementation. Some foreseen direct benefits include reducing the logistic cost, reducing the carbon print, and fast shipment. In addition, the IOS implementation will also increase the agility of the whole network in terms of agile partnership relations, event-driven fast responses, real-time data-driven learning, and automation to reduce administration time (J. Van Hillegersberg et al., 2012).

Technology gives an opportunity to the Duch floriculture network to integrate their information into a shared platform. On the other hand, technology is also a threat to the hub. Even though the Netherlands is one of the main floriculture hubs nowadays, there is a possibility that the Dutch and overseas growers will be involved in a direct transaction with the buyers. In this case, the Dutch Greenports needed to ensure that their value offered to the growers and the buyers still outnumbered the cost of trading via the auction. The floriculture supply chain network was expanding, and the Netherlands was conscious of maintaining its role as the central hub. Thus, there is a need to create added value for the whole supply chain network. To create value, a neutral Inter-Organizational System (IOS) – an information system to connect the stakeholders in the network platform to support communication and coordination – is needed in this network.

Under the influence of information technology, the Dutch floriculture network is transforming from traditional competition and cooperation to digital coopetition. Digital transformation in floriculture is beyond the implementation of IOS. The introduction of IOS brings benefits by changing the information sharing and coordination mechanism. Digital coopetition enables SC stakeholders in the floriculture industry to integrate information flow horizontally and vertically. IOS enables the network to be agile in adapting to the fluctuation of demand and supply and create sustainable supply chain activities. In consequence, IOS changes the power distribution of stakeholders and brings

forth resistance from some of the stakeholders. Hence, IOS implementation is an ongoing movement in the digital floriculture network.

In implementing IOS, the Dutch floriculture network went through several attempts. At this point, organizational issues have overcome technical issues. The network's governance changed over time and transformed to support digital transformation. One of the promising IOS initiations that were quite recent was HubWays. Hubways was started as a project and later transformed into a legal entity – HubWays NV. However, HubWays NV was dissolved, and the IOS was not implemented. Until now, an ideal industry-wide collaboration has not yet been created in the network. This unsuccessful story of the governance transformation is a great opportunity to learn from failure. This study aims to explore the governance transformation of the Dutch floriculture network in the pursuit of digital transformation.

8.2 HubWays – A Dutch Floriculture Network

We have been in touch with the Director of HubWays NV since 2014 and collected data from secondary documents, such as the company's presentation and reports, magazines, as well as other sources on the internet. Four formal interviews and several informal meetings were done to collect data and opinions from 2014 until 2020. Our interviewees are (1) the Director of HubWays NV (2013-2015), (2) FloraHolland's Supply Chain Development Manager (2008-2013), which was promoted to be the Supply Chain Manager (2014-2015), (3) HubWays' Project Manager (2010-2013), and (4) the Managing Director and Founder of Eyefreight (2008 – 2020). We describe the Dutch Floriculture Supply Chain case according to its timeline in this section. The data sources that are used in describing this case are presented in Appendix E. Table 18 shows the summary.

Table 18. The data sources used in describing the Dutch Floriculture Supply Chain case

Data Source Types		Number of Data Sources
Primary Data	**Interview (transcript & note)**	3 (4 interviewees)
	Correspondence & confirmation	✓
Secondary Data	**Academic Article**	1
	Book Section	1
	Company's report	1
	Magazine article	1
	Webpage	11
	Presentation Material	1

The governance cycle is presented in Figure 23. In the first phase, HubWays was initiated as a temporary project aimed at establishing a legal collaboration. The project was successful in establishing HubWays NV. However, HubWays NV failed to develop an IOS for the Dutch floriculture network.

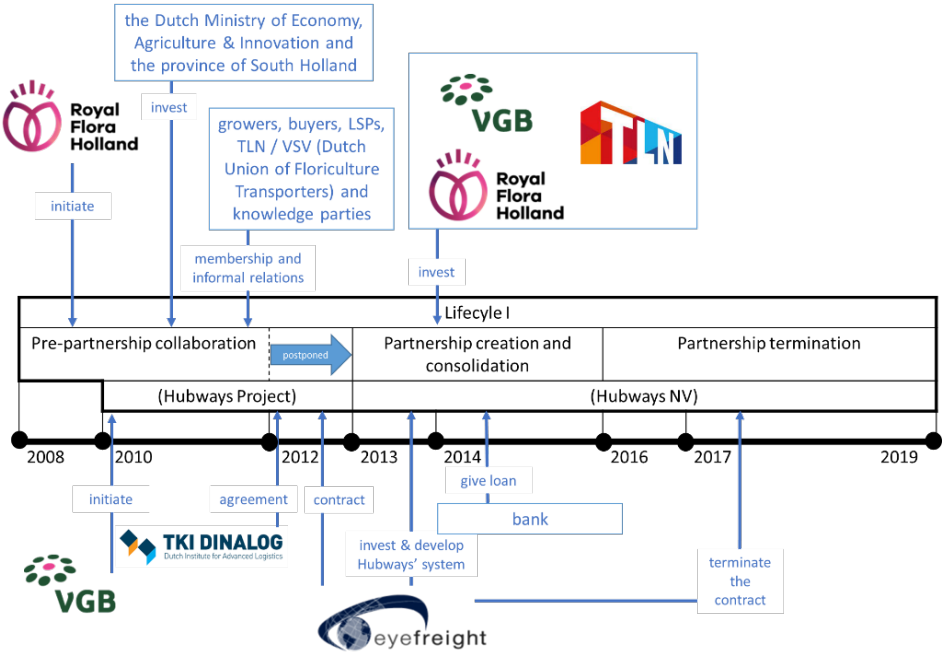


Figure 23. The governance lifecycle of the Dutch Floriculture Supply Chain

The pre-partnership collaboration phase: HubWays Project

Royal FloraHolland was the initiator of the HubWays Project. In this phase, FloraHolland noticed the supply chain bottleneck problem at the beginning and the end of the auction. FloraHolland's Manager recalled that the idea of a centralized platform had been discussed since 2008. The platform was envisioned to manage the data transfer between stakeholders in this industry. HubWays initiative was established as a *neutral project entity* to promote collaboration between different stakeholders. "Basically, since day one, I have made the project manager independent and neutral," FloraHolland's Manager. HubWays' research and development project was started in January 2010 and later ended in October 2013 (HubWays NV, 2020). This project was *funded* by the Dutch Ministry of Economy, Agriculture, and Innovation together with the province of South Holland via the Pieken in de delta (PID) program (van Veen & van der Vorst, 2011; Veen Streek, 2011).

HubWays' *Steering Committee* is led by an academician from Wageningen University & Research. "The reason behind this is that I want to have a neutral chairman who is not from the (floriculture) industry," FloraHolland's Manager. Figure 24 is the complete

HubWays project structure. In this structure, the project manager coordinates the project group – which consists of the stakeholders in the floriculture industries – and *the sounding Board* – which consists of the organizations that represent those stakeholders. This project is mainly supported by *informal coordination and networking*. "There is *no legal binding* in that (project) structure," FloraHolland's Manager.

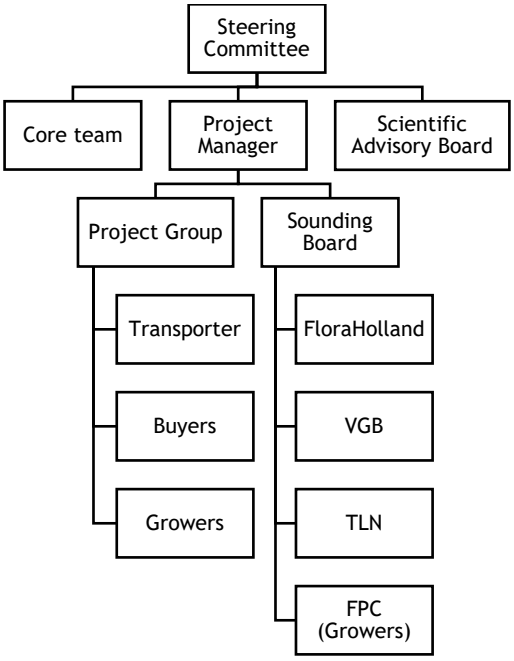


Figure 24. The initial HubWays project's structure (van Veen & van der Vorst, 2011)

In September 2010, the first official *meeting* took place with 24 existing partners from growers, buyers, LSPs, auctions, and knowledge parties (van Veen & van der Vorst, 2011). This meeting formulated two main objectives for the project:

- Build a neutral collaboration of companies: "HubWays wants to develop and realize a neutral coordination platform," HubWays' Project Manager (Veen Streek, 2011). FloraHolland's Manager stated this objective, "In the end, we wanted to set up a company. We wanted to have a platform that is actually owned by all the parties involved."
- Realize the concept in collaboration with various growers, auctions, traders, and traders transport companies on or affiliated with the various Greenports in the Netherlands: The HubWays project focuses on improving current logistics between stakeholders in the floriculture sector (Veen Streek, 2011), especially the current transport flows between the six Greenports in the Netherlands (Hubways, 2010a). Conceptually, HubWays aimed to (Hubways, 2010b; Redactie TTM.nl, 2011):
    - reduce the number of transport movements between the Greenports,

- reduce costs through logistical efficiency,
- increase the service level through innovative logistics solutions,
- improve the accessibility of the Greenports,
- improve the liveability in the urban area, and
- become a central independent platform for administration and transport.

In the beginning, FloraHolland and VGB (Vereniging van Groothandelaren - Dutch Association of Wholesalers in Floriculture) led over fifty knowledge institutions, growers, trade, and transport companies to join HubWays (Veen Streek, 2011). Later, TLN / VSV (Dutch Union of Floriculture Transporters) joined the collaboration (HubWays NV, 2020).

One of HubWays' issues was to convey the platform's benefit to the stakeholders in the Floriculture industry. HubWays' Project Manager stated, "In principle, this industry (consists of) a lot of enemies, a lot of entrepreneurial directors. And they only will step into something if it has a direct advantage for themselves." Since the beginning, LSPs have been reluctant to join the collaboration because efficient logistics could reduce their revenue. HubWays identified this problem quite early on. It was reflected in HubWays's revised purposes on its website. HubWays aimed to "reduce the chain costs with at least the same return for logistics service providers" and "increase the quality (flexibility, speed, reliability) of logistics services" (Hubways, 2012). Through these purposes, HubWays tried to convince LSPs that they would gain benefits by joining the platform. Thus, one of the Project Manager's main jobs was to convince the *SC stakeholders* about the necessity and the values of cooperation.

This HubWays project collected data through extensive desk research and 42 in-depth interviews with transporters, buyers, growers, and importers (Redactie TTM.nl, 2011). HubWays was designed to "provide a digital platform which enables logistical collaboration between supply chain partners for exchanging capacity, load, and information" (van Veen & van der Vorst, 2011). In the design, this platform consisted of (1) HubWays single registration, (2) Communication about congestion, weather forecasting, and roadblocks, (3) Transport order management using ETO (Electronic Transport Order), (4) My Hub, which is a physical holding at every marketplace for exchanging HubWays volume, (5) Online customer service, and (6) Report.

The conceptual model of HubWays' platform mentioned 11 extra services and four main concepts (Redactie TTM.nl, 2011; van Veen & van der Vorst, 2011); the main concepts were:

- HubWays as a digital marketplace. Growers, buyers, auction, importers, and logistics service providers could use HubWays to offer transport demands and transport capacity supplies.
- HubWays as a platform for LSPs. LSPs could combine their supply and demand at a fixed price to utilize their capacity.
- HubWays as a guarantor. HubWays guaranteed that the transport orders would be carried out at the fixed price agreed and according to the Service Level

Agreement. The planning, management, and risk of the transportation were within the responsibility of the LSPs.

- HubWays as a Fourth Party Logistics (4PL). HubWays planned and coordinated the fulfillment of transport demands. Consequently, HubWays purchased the transport capacity from LSPs and bore the risk.

On top of the conceptual design, the HubWays project also tested the business case and proved that the designed platform's benefits fit with the floriculture stakeholders' individual targets. "I think the proof of argumentation helps a lot in setting up the governance and getting the trust from the whole industry in the end," said HubWays Project Manager. HubWays project managed to prepare a solid foundation for the next phase. "The whole business model was developed," HubWays' Project Manager. The *revenue model* was already arranged. In the end, the HubWays project achieved its objective of formalizing the collaboration. FloraHolland was still the main initiator of the successor company. The Project Manager worked intensively with the legal parties and FloraHolland's Manager. The collaborations' stakeholders at this time are presented in Figure 25.

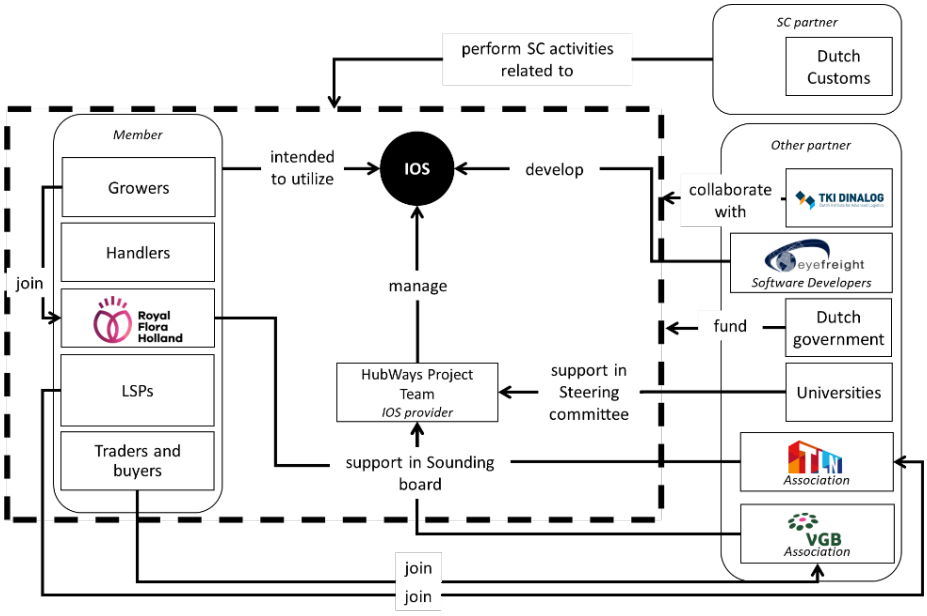


Figure 25. Pre-partnership collaboration phase of the Dutch Floriculture Supply Chain: HubWays Project

In 2012, Eyefreight joined the collaboration. Eyefreight is an IT company that became the HubWays platform developer. Eyefreight's Director mentioned that the vendor selection in 2012 included several steps – proposal submission, idea discussion, and *contract* negotiations. One of the main criteria in the selection was a standard solution enabling a quick-win project. This is confirmed by Eyefreight's Director, "If you are already capable of delivering the main functionality, that will help tremendously in shortening the cycle to deliver the product."

Eyefreight was involved in the establishment of HubWays NV. The establishment process was not smooth. Eyefreight's Director recalled an uncertain moment, "In 2012, we were done with the contract. What happened there, it was not established." Originally, HubWays was designed to be owned only by stakeholders in the floriculture industry. Eyefreight became a strategic partner and an owner in the next phase. "We also want to have an IT solution partner and not only a provider. Because if someone only makes money out of building software. It is a little bit different than you also own the company", FloraHolland's Manager. The Director of Eyefreight revealed that in the beginning, this idea was rejected by Eyefreight due to their negative experience in a similar arrangement. The idea was later accepted because the other stakeholders pushed the idea as the criteria for Eyefreight to get the job.

The company's establishment was postponed from 2012 to 2013 due to conflicts between the stakeholders. At the end of 2012, there was a conflict between FloraHolland and the LSPs. "By the time that (the agreement between FloraHolland and LSPs – TLN/VSV) was solved, unfortunately, FloraHolland increased their fee to the traders (which were represented by VGB)," Eyefreight's Director. Consequently, at the beginning of 2013, another conflict between FloraHolland and the traders needed to be cleared up.

Due to the conflicts, several issues emerged. The IOS development was started and later went on a temporary hiatus without a significant result. Moreover, Eyefreight's TMS (Transport Management System) software was proven to be unsuitable for HubWays' requirements. HubWays eliminated the concept of 4PL and was designed as an information hub. "We slowly started to work on some stuff, but we could not refer to anyone. It was hard. We had to restart at the end of 2013," Eyefreight's Director. The first Director candidate for Hubways NV was gone because the legal establishment was postponed. Afterward, the collaboration selected another candidate.

Despite the dynamics between the Floriculture stakeholders, HubWays started to work together with TKI Dinalog (Dutch Institute for Advanced Logistics) in February 2013 (TKI Dinalog, 2019). This partnership strengthened HubWays' connection with the Dutch research and academic parties. This early work became a foundation for the relationship between the established company and the research and academic parties in the next phase.

The partnership creation and consolidation phase: HubWays NV

HubWays NV was established on 29 November 2013 in Bunnik (Hamersveld, 2014; HubWays NV, 2020) as *a separate legal entity*. HubWays NV had a *steering group* with key representatives from all the stakeholders, including an independent academic as the chair, that was responsible for making *key decisions* (van der Vorst, Ossevoort, Verdouw, Schut, & Wenink, 2014). Based on the legal establishment, the *owner* of HubWays NV was an entity – STAK (Foundation of Administrative Office). STAK is a form of legal foundation based on Dutch legislation so that the owners can not immediately influence the Director of the company. It divides the rights of owners to get profits and to make

decisions based on the certificates. STAK is established to accommodate the stakeholders in the network: (1) FloraHolland and growers, (2) VSV and the logistic providers, (3) VGB and the buyers (the traders), and (4) Eyefreight. RvC is the *Supervisory Board* for HubWays. In Figure 2, HubWays NV's structure was designed to give more independence for the Director compared to other regular companies. "It was quite a well-organized structure in the legal framework. We have politics, and we have the entrepreneurial HubWays Director. They need to be together in the same room but not be influenced too much", said HubWays' Project Manager.

Although the organization structure gave a lot of freedom to the HubWays' Director by design, the Director was involved in a lot of discussions with the stakeholders during the *monthly board meeting*. In these discussions, one of the stakeholders – i.e., LSPs – was putting quite some stress on the collaboration. During this period, the Director maintained contact with the former Project Manager to get knowledge and insights about the collaboration. "The Director visited me a lot of times, that is different from (the Directors' communication with) the FloraHolland's Manager," HubWays' Project Manager.

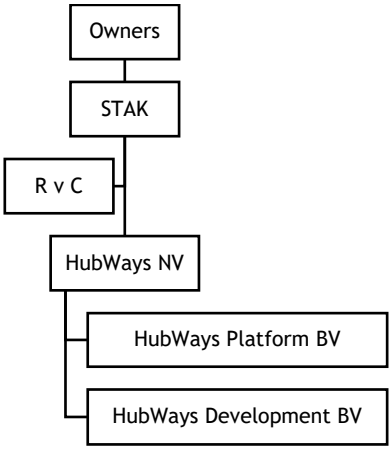


Figure 26. The design of HubWays NV's structure

Based on Figure 26, HubWays NV should have two subsidiaries, which are HubWays Platform BV and HubWays Development BV. However, these companies were not established legally. The reason was mentioned by the HubWays' Director, "We don't have any operation yet, and I do not see where we have an intellectual property yet because the software solution is owned by Eyefreight." Until the end of the cycle, HubWays NV was the only legal company established in this collaboration. The relations between HubWays NV and other stakeholders are presented in Figure 27.

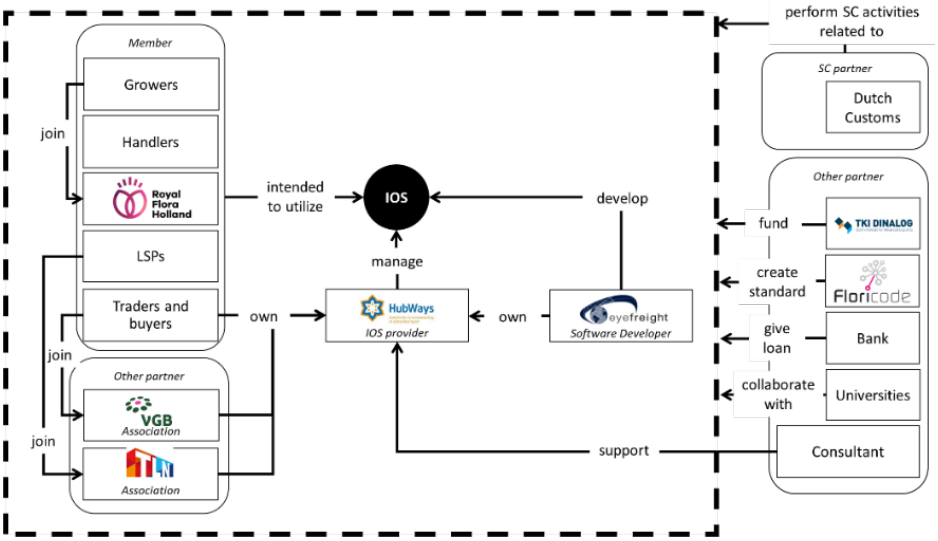


Figure 27. Partnership creation and consolidation phase of the Dutch Floriculture Supply Chain: HubWays NV

Hubways NV was *funded* by a bank loan and a small faction from a bank's free funding. In the beginning, Hubways NV did not have adequate cash because the company's capital was almost symbolic. Even HubWays NV could not pay the Director's salary directly. Eyefreight's Director proposed a solution which was implemented, "I suggest making sure that we could start, that we would pay the Director from one of my companies. It was meant to be a few months. But it turned out that until the end of the show, the Director was paid by me, and I was billing it to HubWays." The bank loan and funding were finally received by HubWays' Director at the beginning of 2014, "5 months later, I finally got money from the bank because I needed all 22 signatures of all involved parties."

HubWays NV was a single-employee company. HubWays' Director emphasized this fact on several occasions, such as in this statement, "HubWays is a very small organization in which I own do almost everything. From making business cards to preparing the annual budget, testing the application, supervising the pilot parties, preparing the newsletters, making a promotional video, and selling HubWays in the sector." (VGB, 2015a). HubWays did not employ permanent subordinates. The Director referred to the limited budget as follows, "Our budget is very low. Lots of money was already spent on the project, so there was not much left. So, I decided to do everything on my own. I only hire one person who knows the (technical) messages for two days in a week."

From the beginning, HubWays NV was designed to get *revenue* from the fees paid by the floriculture stakeholders. These fees are planned to be collected after the IOS is implemented. Basically, the fees are:

- Categorical fees. Growers and LSPs will pay HubWays based on the size of the companies. The company's size is measured based on the company's revenues.

- Standard fees. FloraHolland, import handlers, and buyers will pay the standard amount for each stakeholder.

In 2014, twenty-five SMEs joined the project (van der Vorst et al., 2014). The initial plan was to build the platform pilots in 2014 and start operating the platform in the fourth quarter of 2014 (Weerd, 2013). There were several steps in the development process of the platform (van der Vorst et al., 2014): (1) workshops, a series of follow-up interviews, and a web-based survey to collect and define the requirements; (2) evaluation and revision of the requirements and functional specifications of the platform's user Interface by a beta group of stakeholders; (3) demonstrations using mockups for the steering board, individual stakeholders and conferences to show the impact on the platform and the ability to use it, in the day-to-day activities.

During this phase, the *communication* between the Director of HubWays NV and Eyefreight was intense and open. This open culture was confirmed by the Director of Eyefreight, "She (the Director of Hubways) was having her office in our office… She could talk freely to any of our developers."

By 2015, the first part of the platform was ready and tested in November 2015 (VGB, 2015a). The pilot involved 40 parties (TKI Dinalog, 2019). The pilot testing includes several operational scenarios, i.e., the digital logistics messages processing, the mobile app, and the HubWays web application (VGB, 2015a). Moreover, HubWays also developed a game application together with its academic partner. The game aimed to simulate and explain the strategic benefits of collaboration via HubWays. The simulation served as a basis for *discussion* about the preconditions between the chain partners (TKI Dinalog, 2019).

HubWays' mobile and web application connected growers, traders, and logistic service providers (Floricode, 2015) by supporting information flows (1) transport orders: ETO and EPB (Electronic Packing Order Message); (2) transport order confirmation; (3) transport planning; and (4) real-time transport status information: ELS (Electronic Logistic Status). The HubWays platform gave information about the progress of all transport orders regarding what is in the order, when the order is expected, and on which dock the order will come in (VGB, 2015a). Moreover, HubWays also offered interfaces with other systems through Floricode interfaces for logistics (Floricode, 2015). First, potential members need to test their system's interoperability with the HubWays platform. This test could be done at the Floricode Test Center. The test ensured that XML and EDIFACT messages sent between applications conformed to the *technical and business standards* (Floricode, 2015). After acquiring the 'Declaration of Conformity' from Floricode's Test Center, potential members could join the HubWays platform (Floricode, 2015).

Two years after HubWays NV's establishment, the platform has not yet been completed. The politics in the HubWays NV partially caused this lateness. "They (the IT provider) did

not deliver what they promised. But on the other fact (this is) because the LSPs were frustrating the process," said FloraHolland's Manager.

The partnership termination phase

At the end of 2015, the HubWays project was officially closed (TKI Dinalog, 2019; VGB, 2015b). The *standardization* of ETO, EPB, and ELS messages is still practically challenging, depending on the integration with the traders' information system (such as ERP packages) (VGB, 2015b). This issue is more difficult for a large and fully automated trader – "HubWays for larger parties will only work if there is full integration with their systems. For parties with a low degree of automation, the HubWays platform is a sufficient solution," HubWays's Director (VGB, 2015a).

The collaboration was floundering. The relationship between HubWays NV and Eyefreight was deteriorating in 2016. According to Eyefreight's Director, HubWays NV sued Eyefreight in 2016 for the undelivered solution. However, the lawsuit was rejected, and they reverted to mediation. In 2017, both parties decided to terminate the *contract* between Eyefreight and HubWays NV. In February 2017, the Director was changed (Drimble, 2020). The change was a part of steps to stop the operation of HubWays NV. HubWays's website (http://www.HubWays.nl/) has been on since 22 February 2011 (HubWays, 2020), and the information on this website was not accessible anymore in 2019. HubWays NV was dissolved on 2 May 2019 by a decision of the board meeting (Drimble, 2020).

8.3 Discussion

8.3.1 HubWays' Governance Lifecycle

Even though the HubWays project was a success, HubWays NV was dissolved and failed to deliver its planned service. From the visualization in Figure 23, some notable findings are observed.

First, the phases in each cycle do not have to be complete. Previous studies on the lifecycles of governance (Dissa R. Chandra & van Hillegersberg, 2018; Dissa R Chandra & van Hillegersberg, 2019) have confirmed that the cycles and the phases can overlap one another. However, these studies did not find any incomplete cycle. The cycle of HubWays NV is important empirical proof that even though the basic sequence of the phases was maintained, jumping from one phase to another next-in-line phase is possible. In this case, the reason was that the incomplete IOS was not implemented, so HubWays NV did not start *the partnership program delivery phase*. In other cases, skipping a phase will also be possible if a major event takes place – for example, a legislative enactment that changes the industrial environment, a withdrawal of a major member from the collaboration, and a sudden change in the collaboration's financial arrangement. This finding completes the governance phase framework by Lowndes and Skelcher (1998) by providing a new insight that the phase framework helps identify the

development of the collaboration. Yet, the phases in each cycle do not have to be complete and may overlap.

Second, the governance of the HubWays project was transformed to support the collaboration. The collaboration governance in a cycle is not a static state and may be transformed to adapt to the collaboration. The governance in the *pre-partnership collaboration phase* (see Figure 25) was informal and was not legally bound. The governance was transformed into a legal entity by establishing HubWays NV (see Figure 27). This finding addresses the lack of longitudinal understanding in the inter-organizational governance study highlighted by the latest literature (Roehrich et al., 2020; Jos van Hillegersberg & Chandra, 2020). The governance lifecycles in the case of HubWays were the result of adaptation to the need for legal certainty for developing and operating the IOS. The legal structure also adopted a vision to involve all stakeholders in the floriculture network but still limit their influence. This finding is in accordance with studies that mention the importance of legal arrangements for IOS-based collaboration (Markus & Bui, 2012; Provan & Kenis, 2008).

The detail of governance in the *pre-partnership collaboration phase* and the *partnership creation and consolidation phase* is presented in Table 19. The legal establishment of HubWays NV resulted in significant differences. Those differences are observed in formal governance mechanism, capital investment, and governance entities – which includes the entities' owners and board composition.

Table 19. The governance mechanisms and aspects in the case of HubWays[10]

Governance Aspect	***The Pre-Partnership Collaboration Phase* (HubWays Project Team)**	***The Partnership Creation and Consolidation Phase* (HubWays NV)**
Mechanism		
Informal governance mechanism	The HubWays project was mainly supported by *informal coordination* and *networking*.	The *informal mechanism* was maintained by HubWays NV, e.g., *contacts* with the former Project Manager and *communication* in the shared office.
Formal governance mechanism	The HubWays project had a team structure, but there was no legal binding.	The ***monthly board meetings*** were held by HubWays NV.
Aspects		
Membership	The stakeholders on or affiliated with the various Greenports in the Netherlands (location-based membership).	The stakeholders on or affiliated with the various Greenports in the

[10] The bold words in a phase indicate significant differences from the previous phase.

Governance Aspect	*The Pre-Partnership Collaboration Phase* (HubWays Project Team)	*The Partnership Creation and Consolidation Phase* (HubWays NV)
		Netherlands (location-based membership).
Capital investment	• Royal FloraHolland was the initiator of the HubWays Project. • HubWays project was funded by the Dutch Ministry of Economy, Agriculture, and Innovation together with the province of South Holland.	• HubWays NV was funded by a **bank loan** and a small faction from a bank's free **funding**. Due to a lack of cash in the beginning, **Eyefreight** paid the Director's salary.
Operational funding	The HubWays project was not designed to get any direct revenue, but the revenue model was already arranged.	HubWays NV was designed to get revenue from the fees paid by the floriculture stakeholders. Until the end, HubWays NV had not earned operational funding yet.
Decision making	HubWays's project manager was supported by the Sounding Board and Scientific Advisory Board.	HubWays NV's structure was designed to give more independence to the Director and was supported by a **Supervisory Board**. HubWays NV was **a single-employee company**.
Data governance	Data governance has not been formally implemented yet.	Data governance has not been formally implemented yet.
Governance entities	HubWays Project Team coordinated the collaboration without any legal binding.	HubWays NV should have two subsidiaries, which are HubWays Platform BV and HubWays Development BV. However, these companies were not established legally.
Equity owners	There was no owner because the HubWays project was an informal governance entity.	HubWays NV was owned by **STAK**, which consisted of (1) Royal FloraHolland and growers, (2) VSV and the logistic providers, (3) VGB and the buyers (the traders), and (4) Eyefreight.
Board composition	The HubWays project had a steering group with key representatives from all the stakeholders (*members* and *other partners*), including an independent academic as the chair. However, this board had no legal standing.	HubWays NV's board members were representatives of **Royal Flora Holland, VGB, TLN, and Eyefreight**.

The last finding is related to the adaptability of the governance mode. In the first phase, the mode fits the NAO governance modes proposed by Provan and Kenis (2008), which are widely referred to in inter-organizational governance research. Studies (Markus & Bui, 2012; Provan & Kenis, 2008) suggested that using IOS in a network will push the network towards establishing a neutral legal entity, namely *NAO governance mode*. In the first phase of the HubWays Project, the legal entity was absent. The project team was designed as a neutral entity, yet the project did not have any legal standing. Consequently, the relationship between the floriculture stakeholders and the project team was mainly based on *informal contacts*. Later, this situation changed with the *contracts* between the stakeholders and HubWays NV in the second phase. Thus, this case proves that governance entities don't need to have legal standing, as stated by Provan and Kenis (2008), Dissa R. Chandra and van Hillegersberg (2018), and Markus and Bui (2012). Governance entities could be all of the collaboration members, a particular leading member, or a separate entity – legal or non-legal forms – from the members.

8.3.2 The Failure of HubWays

The HubWays NV was dissolved in 2019, and the IOS was not implemented. Using our longitudinal data collected, we analyzed the reasons for this failure. Other collaborations that are envisioning an IOS implementation can benefit from these lessons.

The first obvious problem is the unfinished software. Thus, the first blame was pointed to the IT vendor – Eyefreight. The Eyefreight's Director mentioned that the initial plan to use a standard solution was not fully executed, "In the end, it turned out that it was not so standard." The IT provider encountered problems with the data governance and the software architecture. A study by van der Vorst et al. (2016) specifically mentions the importance of data governance, i.e., data ownership, data reliability, and security, for the success of collaborations. Although the test in 2015 was successful, the project was already late, and the trust was lost. "At the end of 2015, when there was a test. The outcome was still very positive. We had two teams working on this, but we could not deliver at the speed that was expected from us. By that time, the trust was flying out of the window." These facts stress the lack of understanding of the technical complexity of the IOS implementation, which is reflected in poor planning and execution.

The struggle of HubWays was a common challenge for collaboration. One of the crucial factors in the failure of HubWays is the lack of resources. The HubWays' Director was almost a single fighter in the execution of the idea. Even though this strategy aimed to save the budget, the condition backfired and led the Directors to inefficient work and time management. Moreover, the budget was also limited. This fact is reflected in our interview with the Director of Eyefreight, "We have appointed a software architect that has worked on a project for Rotterdam Harbour. There also has this huge project, and it took nearly ten years to overcome this…. We didn't have that kind of money. So we

started suggesting to do it in a different way to compensate for it." Sutanto, Kankanhalli, Tay, Raman, and Tan (2008) mention that in an inter-organizational collaboration, digital transformation needs support from its *members'* leaders. If the leaders work together to pool resources and manage resistance, it will be easier to supply the IOS provider with sufficient capital and human resources.

There was also a lack of change agents during the *partnership creation and consolidation phase*. After their long and deep involvement in the HubWays project, FloraHolland's Manager and HubWays Project Manager were neither appointed as the Board nor the Director. This decision was made to ensure the neutrality of HubWays NV by reducing the dominance of FloraHolland – the change agent organization, which was the organization that promoted IOS development and implementation. The neutrality also encouraged new ideas, points of view, and innovations. However, an unpredicted implication was the loss of initial vision and spirit. Regarding this issue, FloraHolland's Manager mentioned his regret, "We should have appointed the Project Manager to be the Director of HubWays." Even though the communication between the Director and the former Project Manager was maintained, the knowledge and vision of the initiators – in this case, FloraHoland's Manager and the Project Manager - were not realized in HubWays NV. HubWays NV had no apparent change agents at the organization and individual levels.

The stumbling block that is apparent now for HubWays has been predicted since the beginning of this collaboration – "HubWays can only succeed if we have a good concept that is widely accepted. The second is probably more difficult than the first. Changing people is more difficult than convincing people of the content," HubWays' Project Manager (Veen Streek, 2011). "Through a bottom-up approach, the HubWays project got individual stakeholders involved and committed to a shared ambition" (van der Vorst et al., 2014). The bottom-up approach was designed to address the involvement issue. However, later on, the governance that was built based on this bottom-up approach backfired.

"When the Director came in … the first thing that she did was to go and talk to the Board members. But then she got into politics.", FloraHolland's Manager. In the HubWays Project, politics was avoided since the beginning, yet they fell into this issue. "She (the Director) had too many contacts with the Advisory Board.", FloraHolland's Manager. He added, "Even though we set up a legal framework for her to be entrepreneurial, she did not take that opportunity." The former Project Manager confirmed the political challenge for HubWays' Director, "I think we have underestimated the political context where the Director had to work in." Eyefreight's Director and the HubWays' Director also pointed out the political challenge.

LSPs kept stressing the collaboration, and HubWays failed to manage the haunting conflict. "They (LSPs) always doubted our motives," FloraHolland's Manager said. The LSPs' doubt was explained by Eyefreight's Director explicitly. "Were they (FloraHolland) transforming themselves to some kind of super LSP that other LSP will only do what

FloraHolland wants?". The HubWays Project identified and tried to address the hesitation. Later, this neutrality issue was carried into the platform's development by HubWays NV. HubWays Project Manager emphasized the communication problem, "the argumentation level of the LSPs was on the operational level, while people on the board from FloraHolland and the Director working on the tactical and strategical level." Moreover, there is only one major company among the LSPs. Obviously, this prominent company led TLN / VSV. "It is always difficult to understand whether you are talking on behalf of all of the LSPs or are you just talking about your own company," Eyefreight's Director. The issue became a snowball effect that brought the development to a delayed time plan.

The complexity of the legal governance structure was a challenge. "A large part of the budget for the start of Hubways was spent on the legal structure," Eyefreight's Director. Moreover, this complexity also affected the operation of the collaboration. For example, the initial capital was delayed because the HubWays' Director needed to get signatures from 22 different parties involved in the collaboration.

The involvement of Eyefreight in the HubWays' Board brought an unexpected drawback. In the pre-partnership collaboration phase, Eyefreight was invited to join in order to emphasize the sense of ownership by the IT company. "By that vision, we thought that we have a construct where we can minimize the investment but maximize the effect.", FloraHolland's Manager. However, this idealistic idea was crushed when the platform was not delivered according to the time plan. "I think the second mistake that we made was that we brought in the ICT company in the board member. If the relationship is more of the customer and supplier relationship and they are part of the Board itself, In my perspective, reduce the independencies of HubWays with the IT Supplier," HubWays' Project Manager said. The Director of Eyefreight mentioned his contradictive role in the Board, "My role in the Board was to help HubWays. How can we make sure that we would not discuss with me as a supplier if something is wrong?" In addition, during the two years of the IOS development, Eyefreight got a new Director. The change shifted the IT company's focus from the HubWays platform development.

8.3.3 Future Innovation in Dutch Floriculture

The challenges in the floriculture sector have been quite persistent. Modern logistics still need to address increasing congestion, shortage of drivers, demand for sustainable transport, and virtualization (van Veen & van der Vorst, 2011). Nowadays, Royal FloraHolland has FloraMondo – a digital flowers and plants marketplace (Royal FloraHolland, 2020b). International and cross-border agreements are crucial for the efficiency of floriculture logistics. For example, there is a difference between the Dutch policy regarding the size of trucks and the policies in Belgium and Germany; logistic service providers from the Netherlands need to overhaul the cargo into a smaller vehicle for onward transportation on the Belgian or German border (Kort-Boreas, 2014).

Moreover, the development of ICT – such as IoT – enables us to bring innovations to the perishable logistic process.

There is a continuous attempt to establish collaboration in the Dutch floriculture sector. FloraHolland's Manager is still optimistic about the benefits of a floriculture platform for the LSP, "I still think that logistic service providers can benefit from this (kind of) collaboration." However, he added that the vertical integration between the buyers and the growers is much more promising. Vertical integration possibly brings different points of view from stakeholders at different levels.

Besides HubWays, there were other collaboration projects in Dutch floriculture logistics. One of them is DAVINC^{3}I (Dutch Agricultural Virtualised International Network with Coordination, Consolidation, Collaboration, and Information Availability) (van der Vorst et al., 2014). The project aims to develop innovative logistics concepts supported by an information platform and collaborative business modes supporting the Dutch competitive strength (van der Vorst et al., 2016). Another collaboration in this sector is the Holland Flower Alliance – an enterprising group of floricultural industry professionals dedicated to logistics innovation and sustainability; It was founded in 2016 by Royal FloraHolland, Schiphol Cargo, and KLM Cargo (Holland Flower Alliance, 2020).

8.4 Conclusion

Our study contributes to the development of the theory of inter-organizational governance. Using visualization and longitudinal analysis, we find that: (1) The governance of this collaboration in the Dutch floriculture network was a dynamic concept. A collaboration's governance is not a static state and may be transformed to adapt to the collaboration. HubWays is a unique case of a coalition of willing parties, which is different from the top-down approach; (2) The phases in each cycle do not have to be complete and may overlap one another; and (3) The inter-organizational governance mode is possibly adapted to the collaborations' context, and the current theory needs to accommodate that the governance entities could be a separate entity – legal or non-legal forms – from the members.

The Dutch floriculture network is a massive network of SC stakeholders. Inter-organizational collaboration, especially vertical integration, is a complex governance context. "You have a complete sector in one table," FloraHolland's Manager stressed the complexity. This collaboration initiated the HubWays Project, which later evolved into Hubways NV, to implement IOS in pursuing digital transformation. The ideal goal was that the potential benefit to the sector exceeds the sum of the individual benefits. However, this idealistic idea has yet to be achieved in the case of the Dutch floriculture sector. "Collaboration will not work without a good governance structure in which pain and gain sharing is defined" (van der Vorst et al., 2016). This study confirms that the governance was designed according to the needs of the collaboration over time. Yet, the design may be late or unsuitable for collaboration. The longitudinal data and analysis

show that the problems in the governance design – i.e., the lack of resources, the politics, the complex structure, the problems in change management, the conflict management, and the involvement of the IT provider on the Board – contributed to the failure at the end of the collaboration. These governance issues clearly exacerbate the technical issue.

Moreover, this study finds that the individual leadership and change agent skills of HubWays NV influenced the whole course of the IOS implementation. The need for this leadership skill became apparent during change management, conflict management, and creative acts, putting the vision into real action. Even though literature discusses the key role of CIOs during companies' digital transformation, the study on inter-organizational context is still limited. We suggest future studies focus on the individual role in this kind of inter-organizational digital transformation.

Chapter 9
Cross-Case Discussion

Abstract – We use the building blocks of IOS-based inter-organizational collaboration governance to analyze the four case studies presented in previous chapters. The analysis compares the interactions of various collaborations stakeholders, which define their roles, across their lifecycle timeline. Inter-organizational governance is decomposed into coordination arrangements using specific governance mechanisms for each aspect. Lastly, we categorize the collaborations' governance into specified governance modes based on their identified governance arrangements. Using the cross-case comparison, we can observe any ambiguity or inaccuracy of conceptualization proposed in the building blocks. We evaluate the constructs' definitions according to the empirical evidence. The results of this analysis are a revision of the initial research framework and insights to achieve a successful IOS-based collaboration. This chapter also presents nine noteworthy observations that we learned from the cases.

9.1 Evaluation of The Governance Building Blocks

There are four case studies presented in previous chapters. Three of them – i.e., Rotterdam Port Collaboration, Schiphol Air Freight Collaboration, and Dutch Electricity Market – are successful collaborations with working IOSs. The IOSs are Portbase's PCS, Cargonaut's CCS, and EDSN's IOS, respectively. The collaborations' governance has been evolving over time. For each successful case, more than one lifecycle is analyzed. The last case – Dutch Floriculture Supply Chain – failed to implement its IOS during its lifecycle.

The governance building blocks proposed have been proven to be a suitable framework for observing the evolution of governance in the case studies. The lifecycles help us to identify the governance phases and reconstruct a timeline for each analysis. The IOS-based collaborations' governance structures are clearly illustrated using the identified stakeholders' roles. For example, the evolution of Port Infolink into Portbase involved additional stakeholders and created changes in the stakeholders' roles (see Figure 12 and Figure 13). The governance modes provide us with categories to grasp the governance state. By understanding the stakeholders and their roles, it is easier to observe the mechanisms that are practiced in the collaboration to govern various aspects of the collaboration.

9.1.1 Lifecycles

The timelines of the cases' governance lifecycles are presented in Figure 11, Figure 14, Figure 18, and Figure 23. These timelines are used to compare the cases in this section. During the collaboration's initiation, challenges emerged. Some lifecycles (i.e., PCR, PCR-RIL, Hubways) hit rock bottom without delivering an IOS. Some cycles transformed to address changes (i.e., Port Infolink to Portbase) or to solve problematic conditions (i.e., ECH to EDSN and Cargonaut's lifecycles). In our case studies, the collaborations' lifespan varies from 11 to 42 years. Each cycle occurred over a period of 4 to 26 years, and some *partnership program delivery phases* are still ongoing.

Governance is a dynamic concept. The collaborations' governances have been evolving from the first governance lifecycle to the next lifecycle. As an example, the evolution is apparent in the governance entity's *equity owners* and the involvement of the *software developer* in Schiphol Air Freight Collaboration's governance. Looking into the lifecycle timeline of Schiphol Air Freight Collaboration (see Figure 14), there are overlaps between lifecycles and between phases in a lifecycle. This kind of overlap is also apparent in the case of the Rotterdam Port Collaboration (see Figure 11) and in the case of the Dutch Electricity Market (see Figure 18). The overlap periods are highlighted in our cross-case comparison (see Table 20).

These overlapping periods exist because of the following:

- SC process' dependency on the IOS, and
- the nature of the partnership creation and consolidation phase (2nd phase) and partnership succession phase (4th phase).

After an IOS is already implemented in an SCC, it becomes impossible to stop the IOS service without losing the collaboration's ability to do the SC process. Thus, the start of the *partnership succession phase* does not end the *partnership program delivery phase*. The *partnership program delivery* normally goes on until the next IOS goes live. Another possibility is that the IOS stays the same across lifecycles.

For example, for the SC stakeholders in Port of Amsterdam, the IOS was shifted from PortNET's PCS to Portbase's PCS after Portbase was established. For the SC stakeholders in Port of Rotterdam, the IOS stayed the same – which is based on Port Infolink's IOS. Because of this situation, the *partnership program delivery phase* in the 3rd lifecycle (2002 – 2009) – which overlapped with the *partnership succession phase* (2008-2009) – went on until the *partnership program delivery phase* in the 4th lifecycle (2009 – now) started – which was overlap with the *partnership creation and consolidation phase* (2009 - ±2010).

The *partnership succession phase* in a lifecycle is basically identical to the *pre-partnership collaboration phase* in the next lifecycle. In this phase, major adjustments are conducted to the governance. Governance is re-designed by planning a re-assertion

	Rotterdam Port Collaboration		Schiphol Air Freight Collaboration			Dutch Electricity Market			Dutch Floriculture SC
Lifecycle	**3rd Port Infolink**	**4th Portbase**	**1st Cargonaut: Schiphol's Ownership**	**2nd Cargonaut: Shared Ownership**	**3rd Cargonaut: Part of Schiphol**	**1st ECH**	**2nd EDSN: Market Oriented**	**3rd EDSN: DSOs & TSOs Oriented**	**1st HubWays**
Years	1990s - 2009 (10 years)	2008 - now (15 years in 2022)	1981 - 1996 (16 years)	1995 - 2020 (26 years)	2019 - now (4 years in 2022)	2000 - 2007 (7 years)	2006 - 2014 (9 years)	2013 - now (10 years in 2022)	2008 - 2019 (11 years)
Phase 1st	1990s - 2002	2008 - 2009**[1]	1981 - 1985	1995 - 1996**[2]	2019 - 2020**[3]	2000 - 2001	2006 - 2007**[4]	2013 - 2014**[5]	2008 - 2013
2nd	2002	2009 - ±2010	1985 - 1988	1996 - ±1997	2020 - ±2021	2001 - 2002	2007 - ±2008	2014 - ±2015	2013 - 2016
3rd	2002 - 2009*[1]	2009 - now*[1]	1988 - 1996*[2]	1996 - 2020*[2]	2020 - now*[2]	2002 - 2007*[3]	2007 - 2014*[3]	2014 - now*[3]	-
4th	2008 - 2009**[1]	-	1995 - 1996**[2]	2019 - 2020**[3]	-	2006 - 2007**[4]	2013 - 2014**[5]	-	2016 - 2019

Table 20. Cross-case comparison of governance lifecycles

overlap periods *continuous processes **identical processes

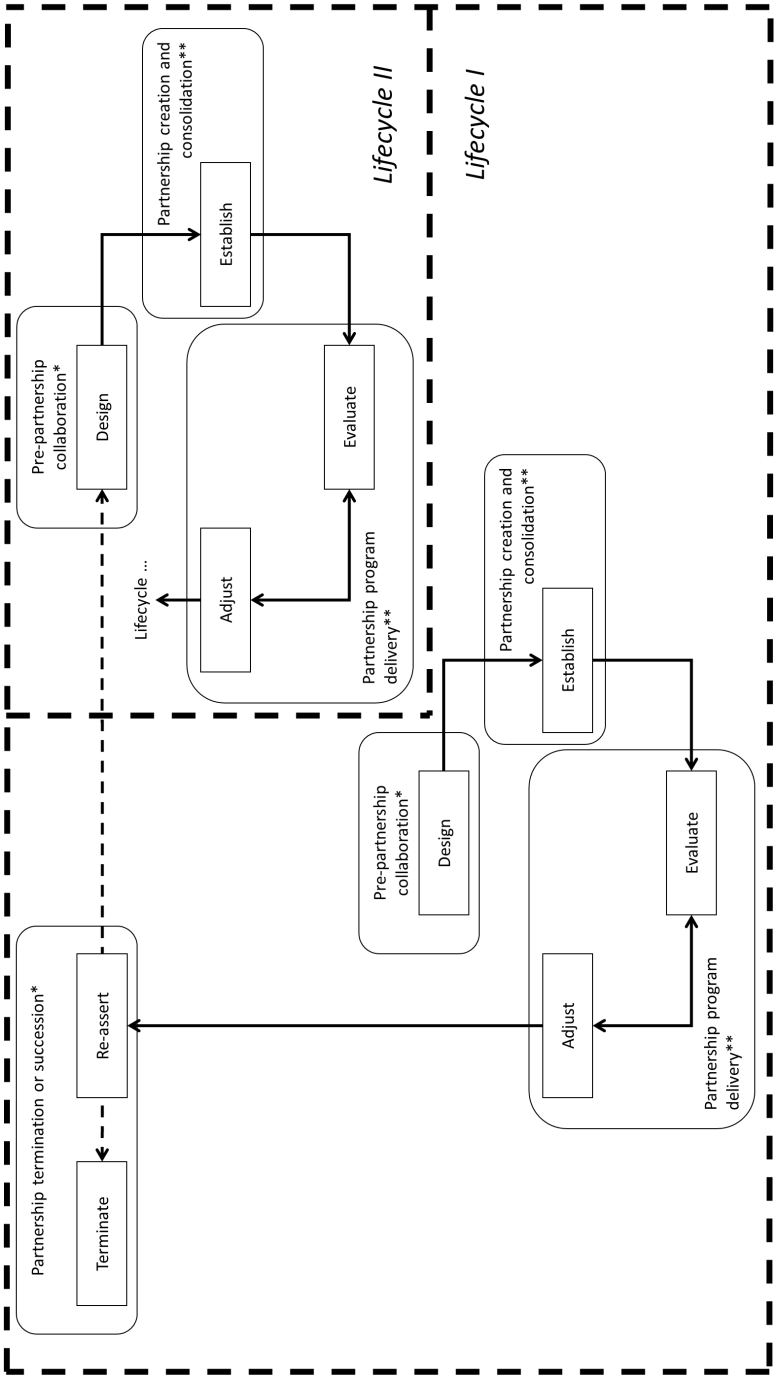


Figure 28. Concept of governance evolution processes in lifecycles

of governance mechanisms, changing stakeholders' roles, or arranging new policies about governance aspects. Because there are changes inside a collaboration and in its environment, an SCC needs to adapt its governance continuously (C. Jones et al., 1997). In this phase, governance modes may be adapted. This governance adaptation may be a gradual or a vital transformation.

Examples of gradual adaptation are *board composition* turnover, revision of *members'* payment regulation for *operational funding*, and new *informal meetings mechanism* utilization. Most gradual adaptations occur as a part of the collaboration's natural dynamic. For example, *board composition* turnover may result from an employee's resignation or retirement, and *informal meetings* are held because the companies work in the same area. In the case of Schiphol Air Freight Collaboration's 1st and 2nd lifecycles, the board's chairman was elected for a 4-year term, so the *board composition* was adjusted accordingly.

On the other hand, major evolution happens if the modification has a major impact on the collaboration or its IOS. The vital transformations occur when collaborations need to address a strategic challenge or opportunity. For example, Schiphol Air Freight Collaboration incurred losses at the end of its first lifecycle, and Rotterdam Port Collaboration served a larger set of members in its second lifecycle. Thus, the lifecycle is basically a cycle of processes to design, establish, evaluate, adjust, and re-assert the governance. We present an illustration of the evolution process concept in Figure 28.

Inter-organizational governance evolves from one lifecycle to the next. Each cycle can consist of a complete set of phases (*pre-partnership collaboration*, *partnership creation and consolidation*, *partnership program delivery*, until *partnership termination or succession phases*) or may be terminated in the middle and skip the *partnership creation and consolidation* and the *partnership program delivery phases*. Figure 23 shows that Hubways NV in the Dutch Floriculture Supply Chain did not manage to implement an IOS and enter the *partnership program delivery phase*.

According to our case study findings, we propose adjusting the illustration in the governance building block. The illustration highlights the timeline of *partnership program delivery* and *partnership termination or succession phases* that can be parallel with other phases. Moreover, the phases are differentiated into essential and optional phases. The adjustment is presented in Figure 29.

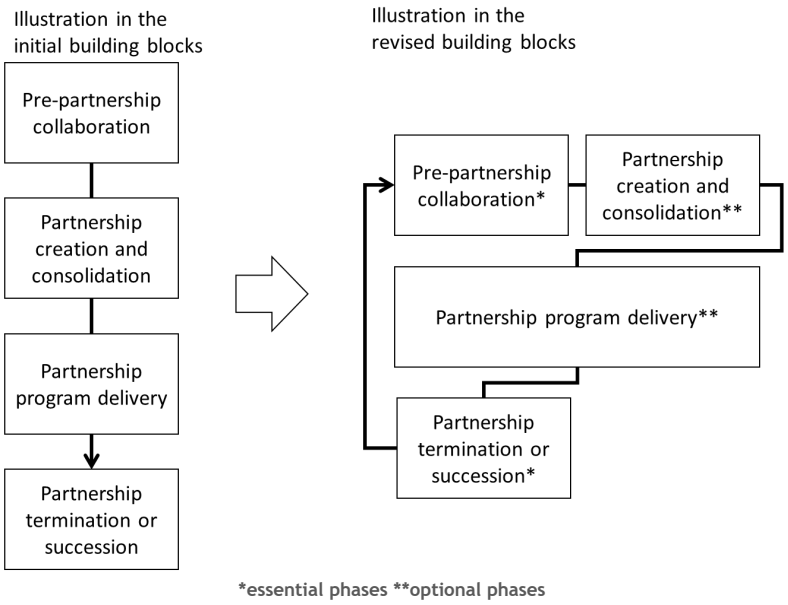


Figure 29. Adjustment on the illustration of IOS-based inter-organizational governance lifecycle

9.1.2 Stakeholders

The roles of stakeholders in an IOS-based collaboration are categorized into *members*, *IOS providers*, *orchestrators*, *SC partners*, and *other partners* (see Figure 9). Using this categorization, we identify the SCCs' stakeholders and their roles in the inter-organizational SCC in Figure 12, Figure 13, Figure 15, Figure 16, Figure 17, Figure 19, Figure 20, Figure 21, Figure 22, Figure 25, and Figure 27. The cross-case comparison is presented in Appendix F, and the summary is shown in Table 21.

It is apparent that all SCCs continue to accommodate more *members* in their evolution by reaching out to their potential members – the *SC partners*. The *orchestrator* in Rotterdam Port Collaboration, Portbase, claims to optimize and coordinate the SC activities in its' SCC. Besides these findings, we observe several interesting phenomena: (1) brokerage activities by *IOS providers*, (2) ownership of *IOS providers* by *other partners* (such as *software developers* and *associations*), and (3) involvement of *other partners* (such as *consultants* and *universities*) and *SC partners* in IOS providers' decision making.

Due to the nature of the inter-organizational business process in SC, IOS is a complex system. An IOS connects companies that use different standards, data structures, processes, and systems. *IOS providers* are responsible for providing IOS according to industry-wide business rules. Often, *IOS providers* decide to outsource the IOS development and some of the underlying services. Outsourcing is a strategic business

Table 21. Cross-case comparison of governance stakeholders - summary

outside SCCs (grey) | not applicable (black)

● observed stakeholders +additional members =same members *brokerage activities

	Rotterdam Port Collaboration		Schiphol Air Freight Collaboration			Dutch Electricity Market			Dutch Floriculture SC
Lifecycle	3rd Port Infolink	4th Portbase	1st Cargonaut Schiphol's Ownership	2nd Cargonaut Shared Ownership	3rd Cargonaut Part of Schiphol	1st ECH	2nd EDSN Market Oriented	3rd EDSN DSOs & TSOs Oriented	1st HubWays
Members - SC companies	●	+	●	+	=	●	+	+	●
IOS providers	●	●	●	●*	●*	●*	●*	●*	●*
Orchestrators		●							
Software developers	●	●	●	●	●	●	●	●	●
Associations	●	●	●	●	●	●	●	●	●
Consultants	●	●	●	●	●	●	●	●	●
Universities	●	●	●	●	●	●	●	●	●
SC partners	●	●	●	●	●	●	●	●	●
Others						●			●

decision (Tan & Sia, 2006) that moderates a company's flexibility and innovation performance (Martínez-Sánchez, Vela-Jiménez, Pérez-Pérez, & De-Luis-Carnicer, 2009).

Brokerage activities are observed in Cargonaut, ECH, EDSN, and HubWays NV (see Table 21). EDSN' Director mentioned it clearly in Computable (2012). "EDSN does not develop itself but purchases software from an external supplier and wants to demonstrate to customers that the software is adequate. We add value by testing it functionally." Moreover, based on the evidence in the Schiphol Air Freight Collaboration case in Figure 16 and the Dutch Floriculture Supply Chain case in Figure 27, the IOSs were developed by the *software developers* (Westlake and Eyefreight) and implemented by the *IOS brokers* (Cargonaut Holdings and Hubways NV). Thus, the *IOS provider* can comprise the *IOS broker* and the *software developer*. Together, both stakeholders have responsibilities for developing, managing, and maintaining the IOS.

In Table 21, it is also apparent that Schiphol Air Freight Collaboration in its second lifecycle and Dutch Floriculture SC had broader boundaries than our proposed framework. Westlake Systems (*software developer*) was a shareholder of Cargonaut. Ownership by *software developers* also existed in HubWays NV. Moreover, HubWays NV added SC *associations* (VGB and TLN) as its owners. Thus, our predetermined boundary in Figure 9 needs to be adjusted. *Other partners* (such as *software developers* and *associations*) possibly become a part of the collaboration – through investment or ownership in the *IOS broker* – or stay outside the collaboration.

Last, we find that the decision making in IOS providers may involve *other partners* (such as *consultants* and *universities*) and *SC partners*. The involvement may be informal, such as during irregular meetings or networking events. EDSN's Innovation Manager mentioned their informal connectivity with SC *partners* and *associations* around its SCC. In addition, the *partners'* involvement may be formalized in the boards' membership. Port Infolink and Portbase enrich their boards with the SC *association* (Deltalinqs, ORAM, and VITO) and the authorities representative from their *SC partners* (Dutch custom). Moreover, Portbase added a *consultant* (Management in motion) to their Supervisory board. HubWays project's Steering Committee is led by an academician from a Dutch *university*.

However, *other partners' and SC partners'* involvement in the IOS broker's decision making does not always mean that the partners are inside the boundary of the IOS-based collaboration. By the nature of SC, organizations are connected to each other in a network of stakeholders. The interconnectivity of organizations creates multiple links that may not be presented in our model - for example, the ownership of a *member* company by other *members* or *SC partners*. In the case of an SC association, SCC's *members* and *SC partners* may join and become the *association's* members. Thus, the existence of the associations' representatives enables the *IOS providers* to gain a neutral position.

We adjust the boundary representation in the governance building block and adopt the *IOS broker* stakeholder to our framework. The revision is presented in Figure 30.

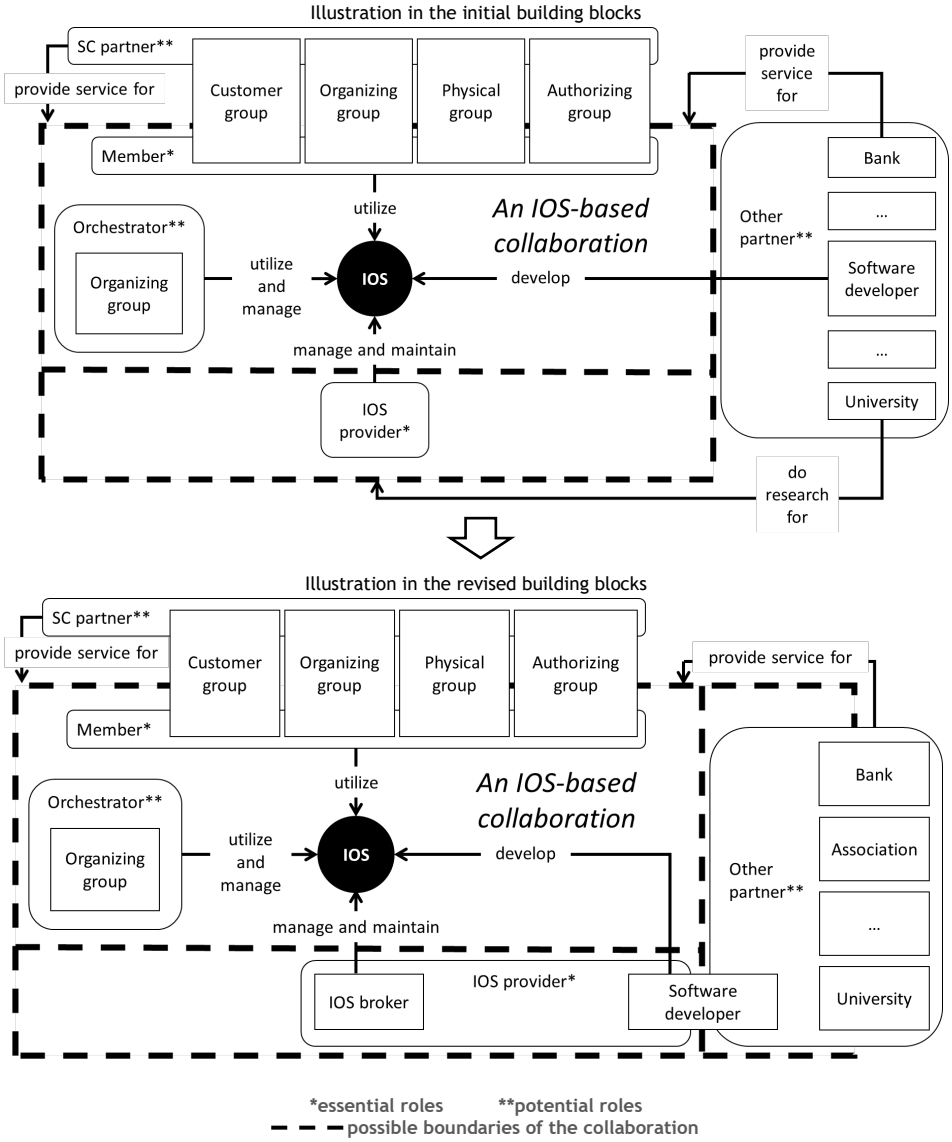


Figure 30. The adjustment of roles and examples of organizations in an IOS-based collaboration

9.1.3 Aspects

Inter-organizational governance consists of aspects: *membership, governance entities, capital investment, operational funding, decision making, data governance, equity*

owners, and *board composition*. While the *equity owners* and *board composition* depend on the legal status of the *governance entity*, other aspects should also be analyzed according to the *governance entity*'s status. The cross-case analysis is done by using the information in Table 13, Table 15, Table 17, and Table 19.

In the cross-case comparison of governance aspects (see Table 22), our governance entities are the *IOS providers/brokers*. In all cases, the *IOS providers/brokers* have legal status. This legal status was established in the *partnership creation and consolidation*. In the *pre-partnership collaboration phase*, the SCCs collaborated and prepared the legal company for non-legalized projects. This finding is apparent in the Dutch Floriculture Supply Chain and is implied in the other SCCs – e.g., Port Infolink was established during the third lifecycle in Rotterdam Port Collaboration after two failed projects to build an IOS-based collaboration.

The SCCs' *memberships* are based on the location of SC activities and contracts with the *IOS providers/brokers*. The *members* in each SCC are companies that conduct SC activities related to a specified location, i.e., a port, an air cargo airport, a country-wide energy network, and Greenports in a country. Those companies use or were intended to use (in the case of the Dutch Floriculture Supply Chain) the IOSs in supporting their collaboration. To access these IOSs, companies signed contracts and NDAs. One of the reasons for this *formalized governance mechanism* is because of the importance of *data governance*. Data ownership, data reliability, and security are sensitive issues in IOS-based SCCs (van der Vorst et al., 2016).

Developing and maintaining the IOS are the roles of the *IOS providers/brokers*. These companies also coordinate the *members'* IOS usage. In Schiphol Air Freight Collaboration and Dutch Electricity Market, the *IOS brokers* (Cargonaut and EDSN) execute these activities based on industry-wide business rules that are enacted by other *associations* (ACN and MFF-BAS together with the Dutch government). In Rotterdam Port Collaboration, Portbase's *board composition* is not limited to shareholders and members but consists of representatives from all stakeholders in the SCCs. This *board composition* ensures Portbase's neutrality.

IOS providers/brokers need *capital investments* and *operational funding* to coordinate the IOS-based SCCs. The sources of this funding in our cases are different. In most cases, the operational funding is paid by *members*. This policy is formalized in contracts between *members* and the *IOS providers/brokers*. In the Dutch Electricity Market, the *operational funding* is paid by the shareholders, but these shareholders also charge a service fee to other members. Consequently, the fees are indirect *operational funding* for EDSN.

The *capital investment* is paid by the shareholders, which are the *members* or a combination of *members* and *other partners*. The majority of the capital comes from government funding (state-owned organizations) or leading *members*. Sometimes, IOS-

Table 22. Cross-case comparison of governance aspects

	Rotterdam Port Collaboration		Schiphol Air Freight Collaboration			Dutch Electricity Market			Dutch Floriculture SC
Lifecycle	3rd **Port Infolink**	4th **Portbase**	1st **Cargonaut Schiphol's Ownership**	2nd **Cargonaut Shared Ownership**	3rd **Cargonaut Part of Schiphol**	1st **ECH**	2nd **EDSN Market Oriented**	3rd **EDSN DSOs & TSOs Oriented**	1st **Hubways**
Governance entities	An IOS provider (a legal company)	A new IOS provider (a legal company), which is a result of a merger	An IOS broker (a legal company), which ownerships were changed overtime			An IOS broker (a legal company)	A new IOS broker (a legal company), which is a result of a merger		An IOS broker (a legal company) which predecessor was a non-legalized project
Membership	Location-based membership, contract with the IOS provider	The location is broader, contract with the IOS provider	Location-based membership, contract with the IOS provider/broker			Location-based membership (nation-wide), contract with the IOS provider			Location-based membership, contract with the IOS provider
Capital investment	By *members* (state-owned organizations)		By a *member* (state-owned organization)	By *members* (a combination of public-private organizations)	By a *member* (a state-owned organization)	By major *members* (a combination of public-private organizations)	By *members* (a combination of public and state-owned organizations)	By major *members* (state-owned organizations)	By *members*, *associations*, and *software developers* (a combination of public-private organizations)
Operational funding	• By the shareholder (a state-owned organization) in the beginning • Later, by *members*		By *members*			By *members*	By *shareholders*		By *members* (not yet implemented)

	Rotterdam Port Collaboration	Schiphol Air Freight Collaboration				Dutch Electricity Market			Dutch Floriculture SC
Lifecycle	3rd **Port Infolink**	4th **Portbase**	1st **Cargonaut Schiphol's Ownership**	2nd **Cargonaut Shared Ownership**	3rd **Cargonaut Part of Schiphol**	1st **ECH**	2nd **EDSN Market Oriented**	3rd **EDSN DSOs & TSOs Oriented**	1st **HubWays**
Decision making	• A Management Board • A Supervisory Board	• A Management Board • A Supervisory Board • An Advisory Board	• A Management Board • A Supervisory Board	• A Management Board	• The shareholder (a state-owned organization) • An Advisory Board	• A General Board • A Management Board • A Customer Council	• A Steering Committee: CMF Board • A Supervisory Board	• A Management Board	• HubWays project: a manager, a Sounding Board, and a Scientific Advisory Board • HubWays NV: a Director and a Supervisory Board
Data governance	Formalized data governance		Formalized data governance			Formalized data governance, focus on data standardization and access			Was not formally implemented
Equity owners	A single investor-owned	Add a new investor	A single investor-owned	Add several members as investors	A single investor-owned	Investors-owned	The investors are a specific catgory of members		A combination of investors and members
Board composition	• Shareholders • SC partners • Other partners • Major members		Experts in the industry			• Shareholders • Members			• HubWays project: members and other partners • HubWays NV: shareholders

based SCCs also gather funding from *other partners*. For example, Cargonaut's additional investments were sourced from TopSector Logistics, Dutch customs, Logius, ACN, the Netherlands Organization for Scientific Research, and TKI Dinalog. Without a strong commitment to providing *capital investment*, the IOS-based SCC in the Dutch Floriculture Supply Chain floundered and failed. *Capital investment* is closely related to the *equity owner* aspect. In all cases, the *equity owners* are the shareholders that invest capital in the IOS development. HubWays NV tried to accommodate members as its equity owner by implementing the STAK legal foundation. This arrangement is not common in other SCC cases.

9.1.4 Mechanisms

The analysis of governance mechanisms (formalized and informal mechanisms) is embedded in our explanation of the SCCs' stakeholders, governance lifecycles, and governance aspects in Sub Chapters 5.2, 6.2, 7.3, and 8.2. Table 23 shows some important notes regarding our cases. Terms related to governance mechanisms – such as networking, meetings, companies' mergers, contracts, and NDAs – are constantly used in our case studies to describe the coordination process in the IOS-based SCCs. In general, the companies are closely connected in our cases. The *membership*s are related to the location of the *members'* SC activities. Consequently, the interdependences of the SCCs' members and partners are high. *Informal mechanisms* are very helpful in the *pre-partnership collaboration* phase.

Most *formalized mechanisms* are present after the *governance entities* – *IOS providers/brokers* – are legally established in the *partnership creation and consolidation phase*. The *membership* boundary is stated in the *members' contracts* with IOS providers/brokers. These *contracts* also incorporate *procedures* for benefit and cost-sharing, monitoring access, and conflict resolution. Due to the SCCs' concern about *data governance*, specific *contracts* (NDA) and *rules* are enacted by the *governance entities*. As an example, in Rotterdam Port Collaboration, Portbase decides the *rules* and *procedures* through its board's *decision making*. Another *association*, Deltalinqs, gives input and works together with Portbase to optimize the SCC in Rotterdam Port.

Informal and *formalized mechanisms* are not independent of each other. SCCs use both kinds of mechanisms to coordinate the *members* during their operation. For example, the Dutch Energy Market maintains companies' connectivity in *informal events*. At the same time, the *contracts* and *policies* enacted by its *IOS broker* – EDSN - follow Dutch law regarding the energy market.

Table 23. Cross-case comparison of governance mechanisms

	Rotterdam Port Collaboration		Schiphol Air Freight Collaboration			Dutch Electricity Market			Dutch Floriculture SC
Lifecycle	**3rd Port Infolink**	**4th Portbase**	**1st Cargonaut Schiphol's Ownership**	**2nd Cargonaut Shared Ownership**	**3rd Cargonaut Part of Schiphol**	**1st ECH**	**2nd EDSN Market Oriented**	**3rd EDSN DSOs & TSOs Oriented**	**1st HubWays**
Informal	Informal mechanism has been apparent since the *1st phase*	Informal mechanism has been apparent since the *1st phase*	Informal mechanism is apparent due to the SC activities			Informal mechanism is apparent due to companies' history (unbundling process)			• Informal mechanism has been apparent since the *1st phase* • In the 2nd phase it floundered
Formal	*Data governance* was a priority in 3rd phase	Decision making procedures are formalized in the 2nd phase	Decision making procedures are formalized in the 2nd phase	The information standards are formalized	Following the shareholder' policies.	National law affected the formal policies	• National law affected the formal policies • A single information standard is formalized		Still limited

9.1.5 Modes

Governance mode identification focuses on collaboration structures that are identified in Sub Chapters 5.3, 6.3, 7.4, and 8.3. The main criterion in this categorization is the existence of a separate governance entity. IOS-based SCCs are most likely governed by *NAO governance mode* because a separate entity is considered more neutral than the members. However, the governance arrangements for each aspect can differ among several collaborations and be adjusted for a particular entity. For example, Schiphol Air Freight Collaboration has the same governance mode in its first and second lifecycles – *NAO governance mode*, but the IOS brokers' *equity owners* were changed over time. Another example is EDSN's decision making aspect in the second and third lifecycles of the Dutch Energy Market. The SCC retains *NAO governance mode,* but DSOs' and TSOs' dominance in decision making for the SCC was apparent in the third lifecycle.

In all cases, the *lead organization* governance mode was adopted in the first *pre-partnership collaboration phase*. It is clearly observed in the first lifecycles of the SCCs due to the absence of a separate legal governance entity. After the *governance entities* – i.e., Port Infolink, Portbase, Cargonaut, ECH, EDSN, Hubways project, and HubWays NV - are established, the *NAO governance modes* are observed. In the case of Schiphol Air Freight Collaboration, the SCC adopts the *lead organization mode* in its current lifecycle. Even though Cargonaut retains its separate legal status, the company is operating under the Cargo Department of Royal Schiphol - the leading *member*.

Categorizing into governance modes is beneficial for simplifying our understanding of an SCC's governance arrangement. Even though this classification may reduce some complexity in the governance arrangements, Table 24 shows that the cross-case comparison helps us to get an overview of the cases. In addition, we find that relationships between this classification and other building blocks of inter-organizational governance - i.e., governance mechanism, aspects, stakeholders, and lifecycles – need to be defined explicitly.

We propose to specify the classification criteria into:

- The existence of a stakeholder (e.g., *IOS provider* or *IOS broker*) that becomes the separate *governance entity* and other governance aspects related to the entity – such as its *ownership* and *board composition.*
- The dominance of a particular governance mechanism, especially *contracts* or an *assembly of members*, in coordinating the governance aspects.

Table 24. Cross-case comparison of governance modes

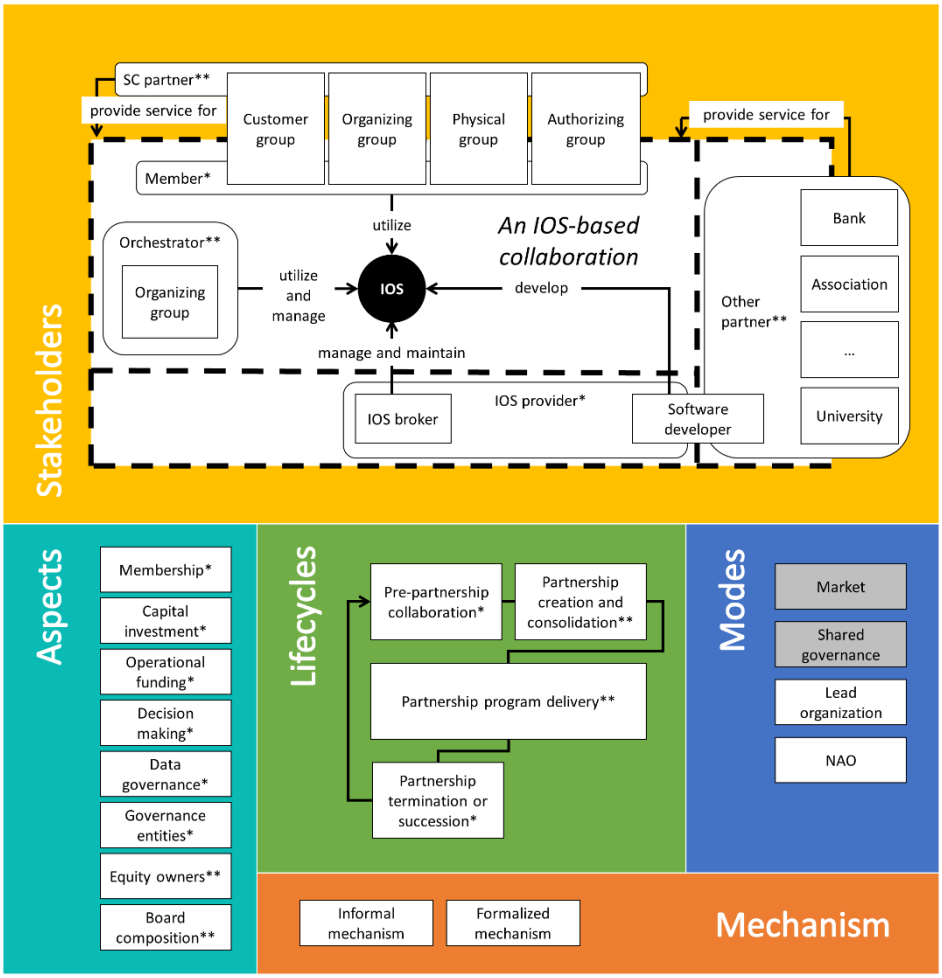
	Rotterdam Port Collaboration		Schiphol Air Freight Collaboration			Dutch Electricity Market			Dutch Floriculture SC
Lifecycle	**3rd Port Infolink**	**4th Portbase**	**1st Cargonaut Schiphol's Ownership**	**2nd Cargonaut Shared Ownership**	**3rd Cargonaut Part of Schiphol**	**1st ECH**	**2nd EDSN Market Oriented**	**3rd EDSN DSOs & TSOs Oriented**	**1st HubWays**
Governance Mode	• The Port of Rotterdam Authority was the *lead organization* for the initiation of Port Infolink • The establishment of Port Infolink was an indicator that the collaboration adopted a *NAO governance mode*	Portbase maintains the governance best practices from Port Infolink, preserving the *NAO governance mode*	• Royal Schiphol Group was the *lead* organization for the initiation of Cargonaut • The establishment of Cargonaut was an indicator that the collaboration adopted a *NAO governance mode*	Cargonaut preserved the *NAO governance mode*, yet the ownership was changed	The Cargonaut's status as a separate legal entity was preserved, but the ownership was reverted. The *lead organization mode* is adopted.	• Before the establishment of HubWays project, the governance mode was *lead organization* by three big incumbent firms • The establishment of ECH was an indicator that the collaboration adopted a *NAO governance mode*	EDSN maintains the *NAO governance mode*	EDSN maintains the *NAO governance mode*, yet the board governance was changed	• Before the establishment of HubWays project, the governance mode was *lead organization* by Royal Flora Holland • The establishment of HubWays project team and HubWays NV showed that the collaboration adopted a *NAO governance mode*

9.2 Revisiting The Building Blocks

Despite the building blocks' aid in giving us a comprehensive view of each collaboration's governance, we find that some improvements need to be made. First, we add annotations on the phases in governance lifecycles about the cut-off points, the timeline, and how the collaborations jump from one phase to the next phase, as well as to the following lifecycle. The phases in lifecycles are presented in a loop for a better interpretation. Second, stakeholders' roles are clarified. The IOS-based inter-organizational collaboration's boundary is redefined. Third, we highlight connections between the building blocks. Our evaluation accentuates the relations between the five points of view of IOS-based collaboration governance.

During the evolution of governance, networks combine *informal* and *formalized governance* in different ways over time (De Pourcq & Verleye, 2022). A combination of these mechanisms is observed in the governance aspects: *membership, governance entities, capital investment, operational funding, decision making, data governance, equity owners,* and *board composition*. Figure 31 shows the refined building blocks of IOS-based inter-organizational collaborations' governance. This framework is a conceptual definition of IOS-based inter-organizational governance. We tested the conceptual framework in case studies to accommodate the contextual nature of inter-organizational governance. Accordingly, these building blocks have been revised to follow the guidelines for conceptual definition (Wacker, 2004):

- terms that are used are common in the inter-organizational governance field,
- each term's meaning is unambiguous and consistent, and
- relations between concepts are clearly explained.



*essential elements **potential elements

predicted to be less preferred — — — possible boundaries of the collaboration

Figure 31. Building blocks of IOS-based inter-organizational collaborations' governance - revised[11]

Stakeholders

We can observe that the stakeholders' existence and activities are dynamic. The categories of these stakeholders are *members*, *IOS providers*, *orchestrators*, *SC partners*, and *other partners*. IOS may be provided by *IOS providers* or *IOS brokers* together with *software developers*. *IOS broker* is a party that facilitates the

[11] Examples of organizations with other partner role are banks, insurance companies, internet providers, software developers, universities, research institutes, associations, and labor organizations. For examples of organizations in customer, organizing, physical, and authorising groups, please refer to Table 11.

collaboration to deal with software developers. The broker maintains the software architecture and ownership. System brokerage is possible because of recent technological developments that support modular architecture. An *IOS broker* analyzes the software packages in the market. Then, the broker may decide to implement a suitable standard package or make a contract to develop tailor-made software with a *software developer*. The integration between modules and services is the *broker's* responsibility.

Modes

In addition, identifying a *governance entity* is also the first step in analyzing its *governance modes* and some *governance aspects*. Consequently, correctly identifying *governance entities* is critical in understanding inter-organizational governance. *Governance entities* could be all of an SCC's *members* (see an example in Figure 32), a particular leading *member* (see an example in Figure 33), or a separate entity from the *members* – in legalized or non-legalized forms (see an example in Figure 36). This *governance entity's* status also affects the SCC's governance modes.

Figure 32, Figure 33, and Figure 34 are examples of SCCs that have members from customer, organizing, physical, and authorizing groups. In Figure 32, the members join hands to govern the SCC and implement the *shared governance* mode.

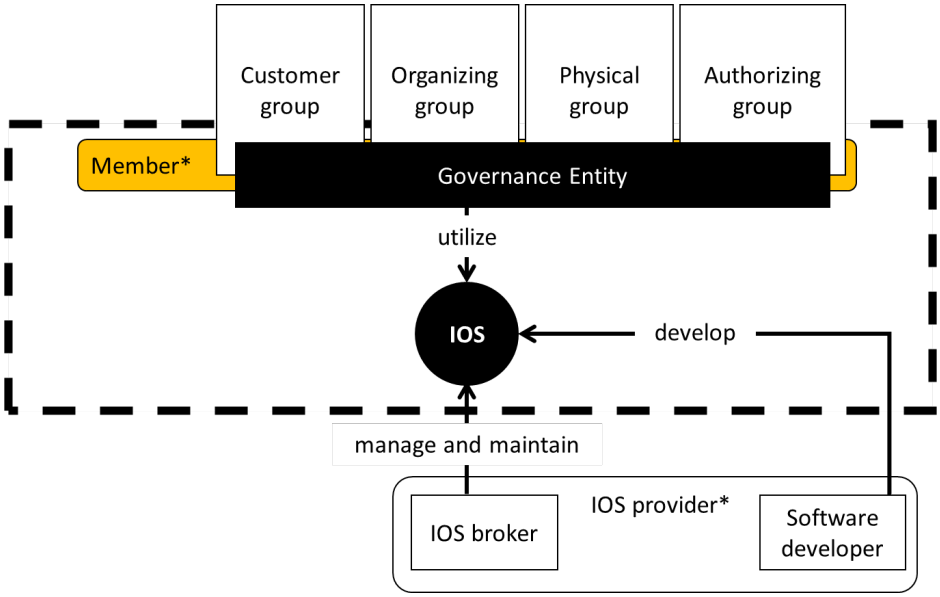


Figure 32. An example of an SCC with all members as governance entities

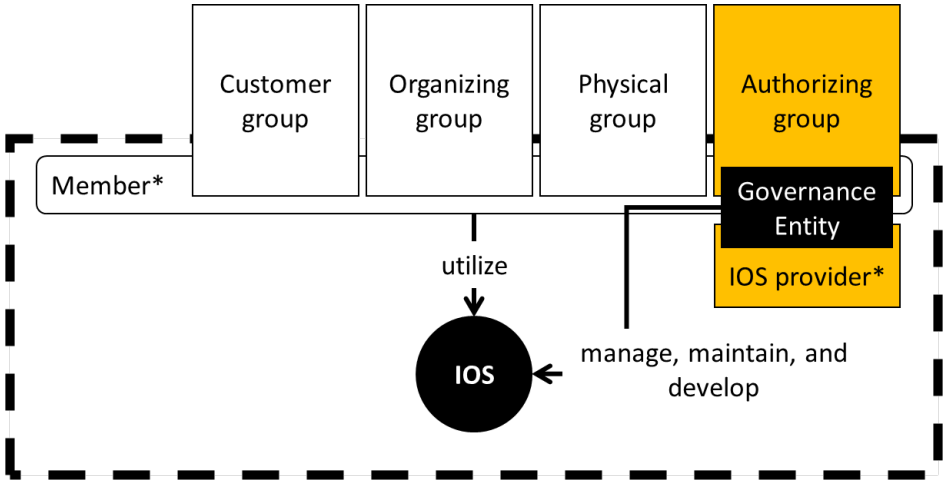


Figure 33. An example of an SCC with a leading member as a governance entity

Figure 33 is an example of the *lead organization* governance mode. A particular leading *member* as a *governance entity* in an SCC indicates this governance mode. Most of the time, this leading member is also the *IOS provider*. There is a high probability that prominent *members*, especially authorizing groups and associations, have dominance. In Figure 33, we illustrate if the *governance entity* is an organization that belongs to the authorizing group and provides IOS for the SCC.

For IOS-based SCCs, the *lead organization* governance mode is expected in the *pre-partnership collaboration phase*. A leading *member* is an initiator that provides *capital investment*. *Capital investments* in this phase are paid for designing and developing an IOS, reaching out to potential *SC partners*, and coordinating outsourcing strategies. In this phase, the SCC has no sustainable operational revenue yet. Most of the time, the initiator is a dominant stakeholder who anchors the network and influences the potential members' interaction mechanisms (South et al., 2018).

Figure 34 shows an example of *IOS providers/brokers* and *orchestrators* in *NAO governance mode* as *governance entities*. In this kind of SCCs, the *members* may own or become a part of the *board composition* in the *governance entity*.

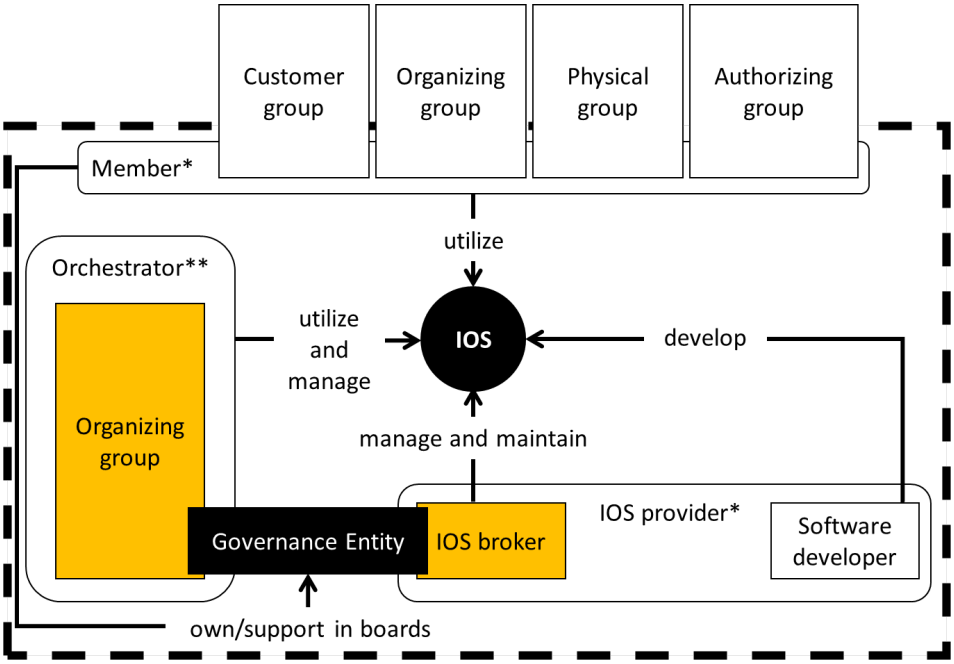


Figure 34. An example of an SCC with a separate entity as a governance entity

The complete governance modes classification is presented in Figure 35. The building blocks classify inter-organizational collaborations into *market*, *shared governance*, *lead organization*, and *NAO governance mode*.

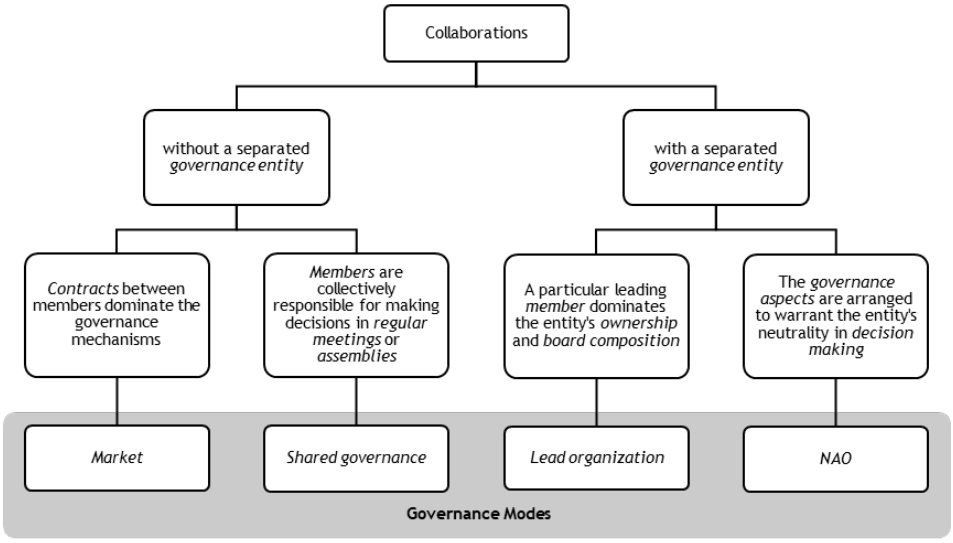


Figure 35. Governance modes classification

Lifecycles

Identifying a collaboration's current phase is necessary for observing its history and is relevant for preparing for the typical challenges in its current and subsequent phases. Previous studies (e.g., Popp et al. (2014) and Lowndes and Skelcher (1998)) define the phases in a governance lifecycle. However, there is a limited explanation of the cut-off points between phases. From our case studies, we find that defining clear cut-off points is a necessity.

Our guidelines are presented in Figure 36. The cut-off points are events, which are specific moments in time. Even though it is sometimes difficult to determine the precise time of some events – such as a decision to initiate, a decision to change, and a continuation of IOS usage from a previous lifecycle, these events reveal a clear cut between the phases. Even though Figure 36 illustrates a serial timeline of phases, overlaps between lifecycles and between phases can happen in a collaboration's lifecycles. For example, suppose a collaboration decides to maintain and deliver its IOS after making a decision to change. In that case, *the partnership program delivery phase* will overlap with *the partnership succession phase*. Meanwhile, this *partnership succession phase* will also overlap the following lifecycle's *pre-partnership collaboration phase*.

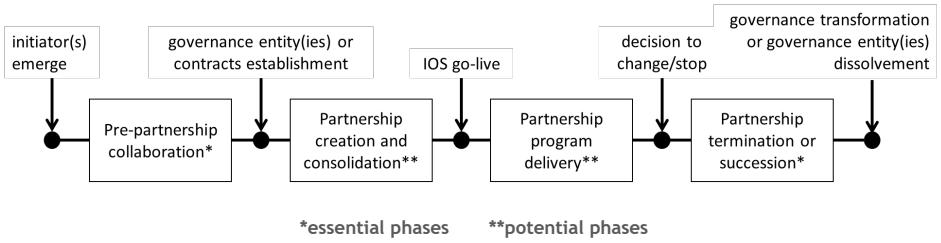


Figure 36. The cut-off points between governance phases

In each phase, there are dominant governance elements (stakeholders, aspects, mechanisms, and modes) and elements that are predicted to be less preferred.

The pre-partnership collaboration phase - the partnership succession phase

Our case studies show that the *pre-partnership collaboration phase* in a particular lifecycle is the *partnership succession phase* of a previous lifecycle. The connection between the governance points of view in these phases is highlighted in Figure 37. The figure presents the dominant governance elements. In our cases, due to the high uncertainty, informal mechanisms exist before or complement formalized mechanisms. This finding is congruent with Alvarez et al. (2010) that the moderating effect of informal mechanisms on the need for formal contractual mechanisms is evident in the inception of a collaboration.

The highest uncertainty in this phase exists in the first lifecycle. A collaboration does not yet exist, and the *members* are not certain about the IOS that will be needed. “When destinations are unclear, and there are no pre-existent goals, causal road maps are less useful than effectual exchanges of information between all stakeholders involved in the journey” (Sarasvathy, 2001).

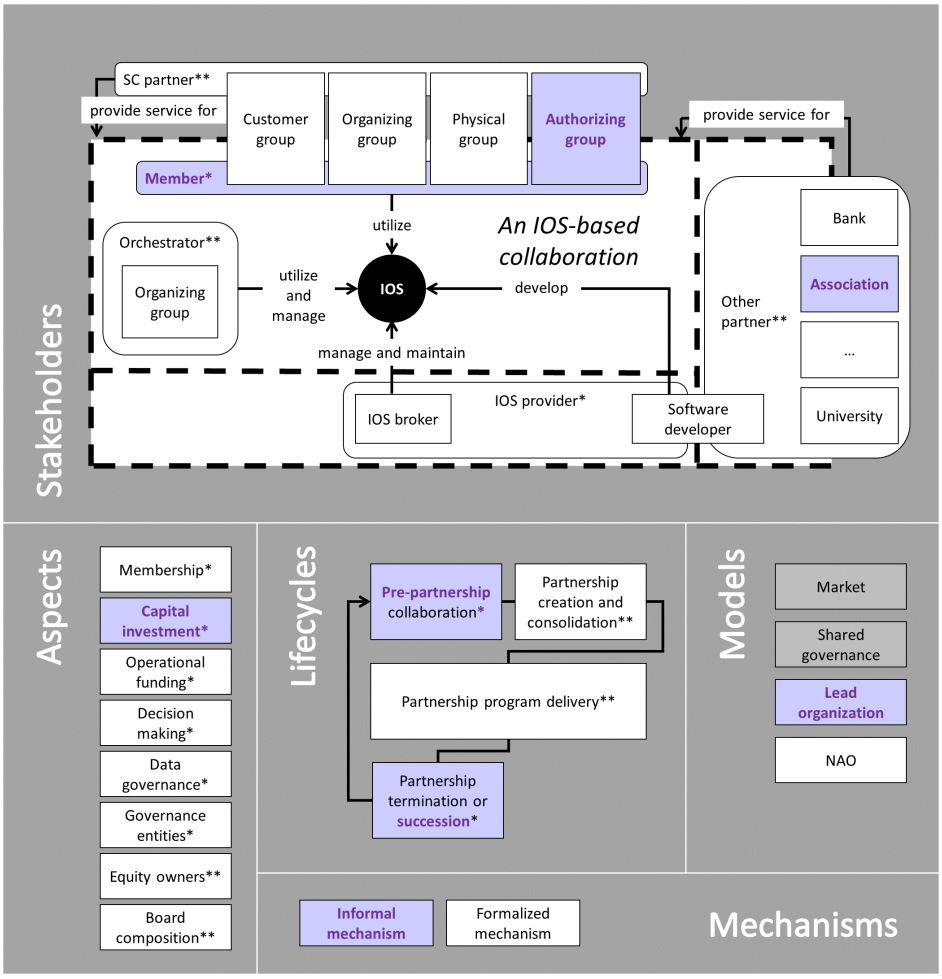


Figure 37. Dominant elements in the pre-partnership collaboration and the partnership termination and succession phases

Most of the time, at the beginning of this phase, the initiators are the firms that are more knowledgeable about IOSs than the *members* (Gopalakrishnan et al., 2022). Thus, the initiators utilize their innate power and the given *capital investments* to coordinate and exercise control over the potential *members*. Usually, the collaboration starts to

explore the available options in developing or selecting IOS. IOS-based collaborations tend to form *NAO governance mode*.

The partnership creation and consolidation phase

Due to the tendency to *NAO governance mode*, it is prevalent to find that a separate *governance entity* – in legal or non-legal (project) form – whose role is an *orchestrator* or *IOS broker* is established in the *partnership creation and consolidation phase*. The connection between the governance points of view in *the partnership creation and consolidation phase* is highlighted in Figure 38. In this phase, the *governance entity* enacts the *formalized mechanism*. The entity designs *procedures, rules, and legal*

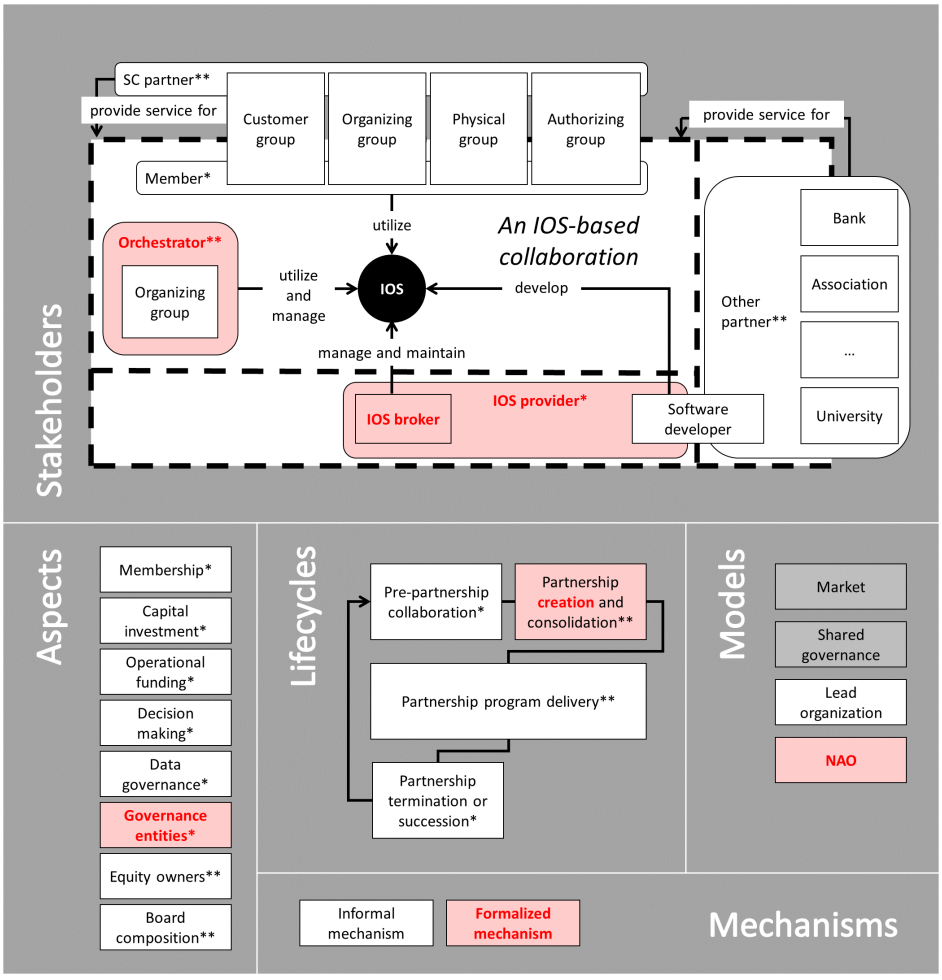


Figure 38. Dominant elements in the partnership creation and consolidation phase

documents to prepare for the IOS installation and use in the next phase. The discussion topic in this phase will be related to *data governance* (data ownership, standardization, and access) and *operational funding* schemes.

The partnership program delivery phase

After the IOS goes live, these formalized mechanisms that have been prepared are used to coordinate the IOS use. The dominant elements in this *partnership program delivery phase* are highlighted in Figure 39. In this phase, the IOS *providers/brokers* focus on delivering their IOS to the SCCs. In this phase, governance adjustments are inevitable.

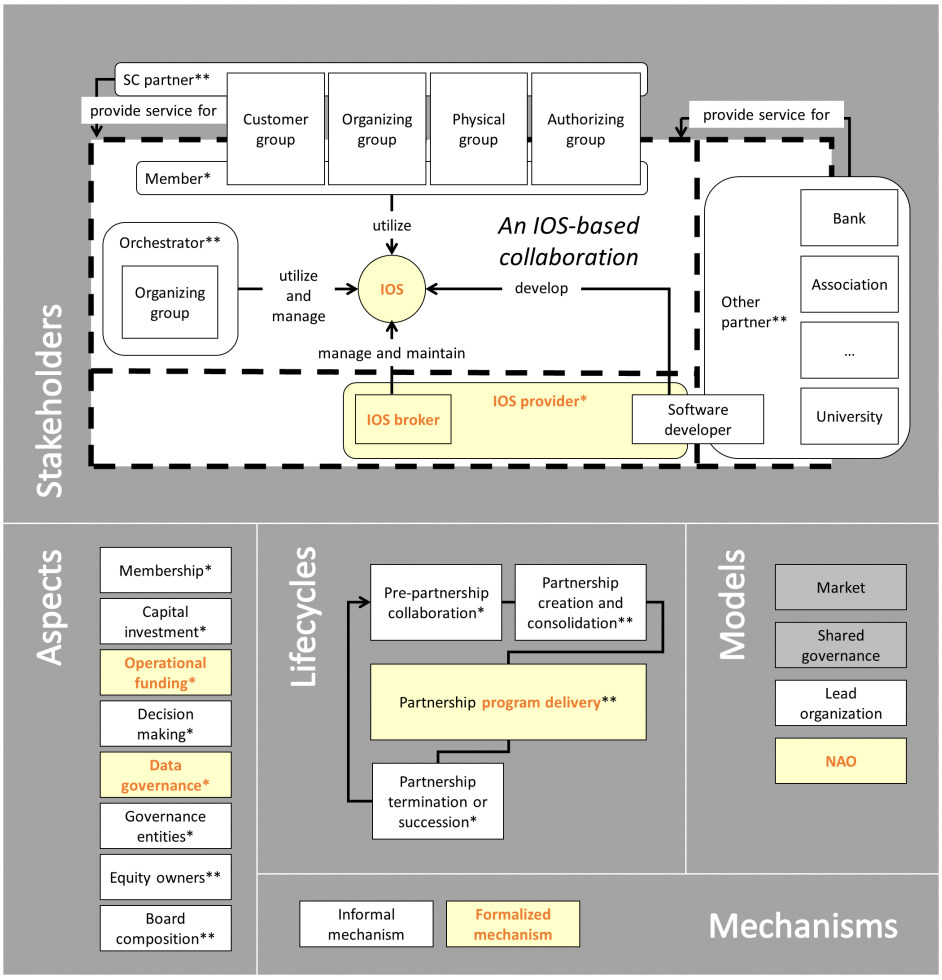


Figure 39. Dominant elements in the partnership program delivery phase

The adaptation is a result of the collaboration's learning process. Rogers (2010) discusses the diffusion of innovations that enclose the learning process. During its lifetime, a collaboration will acquire new members, and its IOS will be updated or overhauled. Technology diffusion is a continuous process – deutero learning (Wijnhoven, 2022) – in an IOS-based collaboration.

Revisiting Case Studies

Using the revised building blocks, we analyze and describe the inter-organizational governance in our sample cases of IOS-based SCCs. The result is presented in Appendix G, Appendix H, Appendix I, and Appendix J. We identify the collaboration context and the inter-organizational governance perspectives for each case:

1. The governance lifecycles: year, important events, and IOS.
2. The governance modes: market, shared governance, lead organization, or NAO.
3. The stakeholders: within collaboration (e.g., *members, orchestrators, IOS providers, IOS brokers*) and outside collaboration (e.g., *SC partners, other partners*).
4. The governance mechanisms: informal mechanism and formalized mechanism.
5. The governance aspects: membership, capital investment, operational funding, decision making, data governance, governance entities, equity owners, and board composition.

9.3 Lessons Learned

The IOSs support the collaborations' SC activities by enabling centralized data sharing. Besides straightforward benefits from the real-time and paperless process, the collaborations also make remarks on the information and knowledge-generating process. This benefit empowers one of the *IOS providers* – Portbase – to continuously enhance its services (Carlan et al., 2016). Using the insight into the SC activities, Portbase orchestrates the SC activities in several Dutch ports and creates an agile port collaboration. In other collaborations, the *members* use the SC insight to improve their SC activities, such as reducing congestion and arranging a partnership with other *members* (Douven, 2013; Letschert, 2022). This finding is aligned with Popp et al. (2014) identification of collaboration's benefits.

Many lessons can be learned from mistakes and success stories in the Dutch SCCs analyzed. These lessons learned have not been defined in the building blocks due to the framework's primary goal to analyze and describe. As defined by Gregor (2006), this kind of theory for analyzing is the foundation for other studies in explaining, predicting, designing, and implementing the described concept. Accordingly, during our study, we observed some lessons learned for success in operating IOS-based collaborations, specifically for SCCs. Some of these topics, such as collaborations' sustainability, have been discussed in previous studies of inter-organizational governance. Other topics –

e.g., the presence of individual leaders and the change agent's role - have not been widely discussed in research on inter-organizational governance. Nevertheless, these topics emerged during our case study analysis and intrigued us.

Resources and individual skills

The most substantial hurdle in the *pre-partnership collaboration phase* is the provision of resources, especially funding. The investment problem was evident in the early phase of HubWays case, and the problem pervaded until the end of the lifecycle. IOS-based collaborations are huge projects and long-term commitments. The availability of resources, the presence of individual leaders, and the change agent's role are vital in an IOS-based collaboration. In the *pre-partnership collaboration phase*, the initiator is the leader. The initiator has to assign individual leaders who are capable of pooling resources and communicating with the potential *members*. The leader may act as a change agent or work together with other change agents to lead the business transformation.

Popp et al. (2014) discuss that one of the critical concepts in collaboration is leadership and management. Leadership skill – which includes leading the technology and information systems – is related to coordinating other individuals, groups, organizations, or even countries (Chou & Naimi, 2020). In digital transforming companies, CIOs are the central icon and the key person (Bongiorno, Rizzo, & Vaia, 2018). This fact also applies to the leaders of IOS implementations in inter-organizational collaborations. Yet, having an IT background and a set of leadership skills, just like a CIO in a company, is not enough to lead an inter-organizational IOS-based collaboration. Leading an industry-wide IOS implementation requires different skills from leading an intra-organizational IT/IS development. Besides, a leader in an IOS-based collaboration must also ensure that change agents are present to empower the business transformation.

Later, the *partnership creation and consolidation phase* also requires tedious work. It is the leader's responsibility to be a change agent – convince and change people's way of thinking and the companies' way of working. This work is a long-drawn-out effort and requires sufficient funding so that the leaders can get assistance from other employees, consultants, or universities. In unison with the study by Srour et al. (2008) and Lowndes and Skelcher (1998), the stumbling blocks in the *partnership creation and consolidation* and the *partnership program delivery phases* in our cases include the governance design misfit and the *members'* detachment. Cargonaut's governance arrangement in its first lifecycle resulted in the collaboration's financial loss. EDSN had only reached 100% service coverage for the Dutch network by 2020, almost 20 years after ECH establishment.

Sustainability

Sustainability is a big challenge for collaborations (Popp et al., 2014). Gathering members is mentioned as an essential step for establishing a collaboration. However, sometimes members' contribution is not long-lasting. IOS-based SCC is a collective SC

collaboration using an IOS as a common pool resource for its *members* and *SC partners*. After the collaborations are established in the *partnership creation and consolidation phase*, the collaborations have to address environmental changes, competitions, conflicts, power struggles, and members' changes of mind. This finding is in line with the studies by Srour et al. (2008) and K. Kumar and Dissel (1996).

Software developers

Moving from traditional SC collaboration to integrated data-sharing collaboration is an extensive project for the *members*. Sometimes, the initiator and *members* do not understand their own needs at the beginning of the project. It happens due to the business process change that is still ongoing or has not been implemented yet. For example, the HubWays project decided to work together with Eyefreight because they would use Eyefreight's TMS (transportation management system) as a foundation for the Dutch Floriculture Supply Chain's IOS. However, after HubWays NV was established, they found out that Eyefreight's TMS was not enough for the SCC. In this situation, HubWays and Eyefreight were already tightly connected to each other. Thus, a strategic relationship with the selected software developers is a determining factor for the collaboration's success.

Gradual change

To support the IOS adoption, the *members* need to do Business Process Reengineering (BPR) and change management. In BPR and change management, it is fundamental to plan the changes and arrange strategies to prioritize the adaptation (AbdEllatif, Farhan, & Shehata, 2018). For example, Port Infolink's early success is claimed as a result of the quick win scenario – the automation of the import process that was preferred by the Dutch government and was a complicated administrative process for the *members*. These changes in collaborations are continuous. As an example, technology develops over time. The IOSs in our case studies were enhanced from EDI data sharing to web-based and cloud-based systems. Technology development enables collaborations to move forward and make use of data transparency. Nowadays, Portbase claims to be an orchestrator that increases the efficiency and effectiveness of the members' SC activities. This is a step forward compared to the role of Port Infolink, which was limited to integrating the data and operating the PCS.

Ownership

As mentioned in our building blocks, the IOS-based collaboration will prefer the *NAO* governance mode rather than other modes. This arrangement means that there will be a *separate (legal or non-legal) entity (an individual, a team, or a company)* established to govern a collaboration. Public *ownership* by the government authorities is a way to guarantee the entity's neutrality. Portbase is owned by Dutch Port Authorities. Cargonaut's initiation was successful due to its neutral *ownership* in the beginning (100% *ownership* by the Royal Schiphol Group, which is a state-owned company). Private *ownership* emerged after the collaboration was stable, and the goal was to improve its

profitability. Later, Cargonaut reverted back to state ownership in the third lifecycle to support its big overhaul IOS project. In the other case, the Dutch Authorities are also involved in EDSN *ownership* through the TSOs.

Legal governance structure

Most of the time, the collaborations adopt complex legal structures to accommodate the complicated relationship between SC companies and their associations. The legal structure is directly related to the decision making and the neutrality of the entity. However, this solution may backfire and create administrative problems and political conflicts. This situation happened in the Dutch Floriculture Supply Chain. Moreover, Cargonaut also got back to sole ownership and adopted *lead organization* governance mode in its current lifecycle to simplify the decision making process.

The government

The involvement of the government may also encourage the SC companies to join a collaboration. It is imperative that the government enacts certain laws, political strategies, and national standards to support collaborations. The *members* are pushed to adopt the IOS to abide by these rules and laws. Thus, IOS adoption will be accelerated. In the case of the Dutch Electricity Market, it is obvious that the collaboration is a top-down collaboration. The IOS development was initiated because of the free trade market movement. Other studies (Provan & Kenis, 2008) also mentioned the involvement of the government in establishing NAO governance modes, especially for location-based or regional collaboration.

However, policies also may become a barrier for an IOS-based SCC. In the healthcare industry, a study finds that government policies are not clear and tend to slow down collaborations (Payton, 2000). In our case, the Dutch Energy Market's need to implement IOS emerged due to the liberalization law in the energy market. In the beginning, this liberalization process had some issues regarding the law's implementation. This issue also affected the ECH's IOS use by the *members*. In some cases – Dutch Energy Market and Schiphol Air Freight Collaboration – the SCCs established associations – MFF-BAF and CAN – to maintain consensus about industry-wide policies.

IOS broker and orchestrator

In two of our cases – the Schiphol Air Freight Collaboration and the Dutch Floriculture Supply Chain – the *software developers* were owners of the *IOS brokers*. The involvement of a software developer in the decision making process brings an unexpected drawback. The developer may be more concerned about saving resources and delivering the system than maintaining the collaboration in the long run. This is apparent in the case of HubWays NV. However, the *ownership* by the *software developer* for Cargonaut was not a massive problem. The *software developer* joined as one of the shareholders after the IOS was successfully running. Thus, the situation was already stable.

An IOS development is fundamentally an exercise to realize a collaboration's agreement. Consequently, the decision making processes have to include the IOS-based collaboration's *members* and its other *SC partners*. In this regard, the IOS broker needs to communicate with the relevant associations. In our cases, the associations (e.g., ACN, NEDU, Deltalinqs) hold a responsibility to gather the SC stakeholders and achieve agreements on the SC process. This arrangement simplifies the work for *IOS brokers* in providing suitable IOSs for collaborations.

A collaboration's boundary

Due to the high degree of inter-dependency between companies in the SC field, sometimes it is not easy to define a clear boundary for a collaboration. The presence of various associations and collaboration projects is common. In the SC field, a company is not able to work alone. Contracts are established between customers, suppliers, and LSPs. The same companies assemble in various associations for diverse yet connected goals. A stakeholder may have many affiliations, so the navigation between the associated identities becomes complicated (Heath & Isbell, 2017).

9.4 Conclusion

We use the building blocks of IOS-based inter-organizational collaboration governance to analyze the cases presented in previous chapters: Rotterdam Port Collaboration, Schiphol Air Freight Collaboration, Dutch Electricity Market, and Dutch Floriculture Supply Chain. For the first three successful cases, more than one lifecycle is analyzed. The last case - Dutch Floriculture Supply Chain - failed to implement its IOS during its first and only lifecycle.

The analysis is carried out by comparing the interactions of various collaborations stakeholders, which define their roles, across their lifecycle timeline. The lifecycle is basically a cycle of processes to design, establish, evaluate, adjust, and re-assert the governance. It is apparent that all SCCs continue to accommodate more *members* in their evolution by reaching out to their potential members – the *SC partners*. We observe several interesting phenomena: (1) brokerage activities by *IOS providers*, (2) ownership of *IOS providers* by *other partners* (such as *software developers* and *associations*), and (3) involvement of *other partners* (such as *consultants* and *universities*) and *SC partners* in IOS providers' decision making.

Inter-organizational governance is decomposed into coordination arrangements for each governance aspect using certain governance mechanisms. In the cross-case comparison of governance aspects, our governance entities are the *IOS providers*/*brokers*. In all cases, the *IOS providers*/*brokers* have legal status. Terms related to governance mechanisms – such as networking, meetings, companies' mergers, contracts, and NDAs – are constantly used in our case studies to describe the coordination process in the IOS-based SCCs. In general, *informal mechanisms* are very helpful in the *pre-partnership collaboration* phase. Most *formalized mechanisms* are present after the *governance*

entities – IOS providers/brokers – are legally established in the *partnership creation and consolidation phase*. *Informal* and *formalized mechanisms* are not independent of each other. SCCs use both kinds of mechanisms to coordinate the *members* during their operation.

Lastly, we categorize the collaborations' governance based on their identified governance arrangements into specified governance modes. Governance mode identification focuses on collaboration structures. The main criterion in this categorization is the existence of a separate governance entity. Another criterion is the dominance of a particular governance mechanism, especially *contracts* or an *assembly of members*.

Using the cross-case comparison, we can observe any ambiguity or inaccuracy of conceptualization that is proposed in the building blocks. We evaluate the constructs' definitions according to the empirical evidence. The results of this analysis are a revision of the initial research framework and insights to achieve a successful IOS-based collaboration. First, we add annotations on the phases in governance lifecycles about the cut-off points, the timeline, and how the collaborations jump from one phase to the next phase, as well as to the following lifecycle. The phases in lifecycles are presented in a loop for a better interpretation. Second, stakeholders' roles are clarified. The IOS-based inter-organizational collaboration's boundary is redefined. Third, we highlight connections between the building blocks. Our evaluation accentuates the relations between the five points of view of IOS-based collaboration governance.

Lastly, we observe some lessons learned for achieving success in operating IOS-based collaborations, specifically for SCCs. Our noteworthy observations are: (1) IOS adoption in collaboration is a gradual change, (2) public ownership in establishing a neutral governance entity is preferable to private ownership, (3) the government involvement may empower or inhibit a collaboration, (4) resources and individual skills (e.g., leadership and change agent) are equally important as the governance in the collaborations, (5) the complexity of legal governance structure is a challenge, (6) strategic relationship with software developers is a determining factor for the collaboration's success, (7) IOS broker and orchestrator are not enough to facilitate decision making process for an IOS development, (8) a collaboration's boundary is not always a clear cut, and (9) sustainability is a bigger challenge for IOS-based collaborations, rather than collaboration formation.

Chapter 10
Conclusion

10.1 Summary of Research Findings

In this sub-chapter, we will restate the critical findings from this study. Three main research questions (RQ1, RQ2, and RQ3) are introduced in Chapter 1.

RQ1: *How can inter-organizational governance for IOS-based collaboration be explained using a dynamic perspective?*

Chapters 2, 3, 4, and sub-Chapter 9.2 address the first research question. The literature review in Chapter 2 resulted in the state of the art of inter-organizational governance. Our findings show a gap in the conceptualization of inter-organizational governance for IOS-based collaborations. In Chapter 3, we utilize the knowledge from literature and stakeholder theory in the exploration study. We define the influential organization groups according to their roles - members, IOS providers, orchestrators, SC partners, and other partners - and complement the description of companies' relationships in SCCs beyond the dyadic level. This conceptualization is combined in Chapter 4, which proposes a theoretical framework of inter-organizational governance for IOS-based collaborations. Later, this framework is improved according to empirical findings. Through cross-case comparison, the study revises the research framework. We clarify stakeholder roles, redefine collaboration boundaries, and highlight interconnections between building blocks.

The inter-organizational governance for IOS-based collaboration can be explained using the modified building blocks in sub-Chapter 9.2 (see Figure 31). The building blocks – stakeholders, governance mechanisms, governance aspects, governance modes, and governance lifecycles – are a systematic foundation to analyze inter-organizational governance. We define constructs in each building block. Thus, the building blocks work as a "language" to establish a common ground for researchers in inter-organizational collaboration and SC analysts.

Based on a dynamic perspective, a collaboration's governance evolution can be analyzed based on events in its timeline. The events lead us to determine its lifecycles and the phases (*pre-partnership collaboration*, *partnership creation and consolidation*, *partnership program delivery*, until *partnership termination or succession phases*) in each lifecycle. There may be overlaps between lifecycles and between phases in a

lifecycle. Each cycle can consist of a complete set of phases or may be terminated in the middle of a cycle.

For the analysts, the cut-off points for phases and lifecycles are sometimes unclear at the beginning of the study. Therefore, the lifecycle building block can not be separated from other building blocks, especially the stakeholders. The building blocks give us a definition of each stakeholder's role and illustrate their relationships. During the timeline, stakeholders' roles certainly change over time. Organizations may join and leave a collaboration. These changes may depend on or affect the collaboration's governance mechanisms in all aspects and the organizations' strategic decisions. Accordingly, identifying organizations associated with a collaboration and their roles helps us to analyze the governance mechanisms and aspects in the collaboration's dynamic evolution along the lifecycles. Then, the governance modes categorization simplifies the information transmitted to consolidate our knowledge of the collaboration. This conceptualization is our contribution to connect the segregated state of the art by utilizing stakeholder theory.

These building blocks are explanatory. The building blocks are tools to communicate inter-organizational governance. For example, we identify the IOS-based collaborations' tendency to lean on formalized governance mechanisms and NAO governance mode after the partnership creation and consolidation phase. This tendency is illustrated using the building blocks in Figure 38 and Figure 39. We describe this tendency using the constructs from the building blocks. This understanding of the building blocks builds a common communication ground for researchers and practitioners to solve a bigger problem, e.g., the collaborations' agility and sustainability.

RQ2: *How does the governance of IOS-based collaborations evolve in practice?*

Chapters 5, 6, 7, and 8 concentrate on the second research question by describing and analyzing governance transformation in four longitudinal case studies. The cases are Rotterdam Port Collaboration, Schiphol Air Freight Collaboration, Dutch Electricity Market, and Dutch Floriculture Supply Chain. In our case studies, the building blocks help communicate the governance evolutions from the first pre-partnership collaboration phase until the partnership termination phase or the collaborations' succession to the next cycle.

The second research question is also addressed in sub-Chapter 9.1. The study analyzes the governance of IOS-based inter-organizational collaborations using building blocks and applies this analysis to the four cases. Cases that successfully implemented their IOSs exhibit multiple lifecycles, while the Dutch Floriculture Supply Chain failed in its single attempt to implement its IOS.

The building blocks systematically deliver our cases' descriptions and cross-case analysis. The lifecycles give us standardized timeline categories. Based on the timeline, the SCCs' governance arrangements can be reviewed.

The collaborations' governance has evolved, and two lifecycles are analyzed for each successful case. Some stakeholders had been involved since the beginning of collaborations (pre-partnership phase in the first lifecycle), and other stakeholders joined or established a relationship with the collaborations afterward. Their roles change over time, together with the governance adjustment. Governance aspects are decomposed using mechanisms, with informal methods pivotal in pre-partnership stages and formal methods gaining prominence after legal establishment. Later, the governance modes are concluded based on arrangements, focusing on structures and dominant mechanisms. The analysis compares stakeholder interactions across the lifecycle, revealing phenomena such as brokerage activities, ownership effects, and partner involvements.

The phenomena emphasize the goal of inter-organizational collaboration as a strategy to achieve an otherwise impossible objective. The brokerage activities emerge due to the distinctive expertise of software developers and IOS brokers. Control and flexibility are issues that are widespread in outsourcing. Consequently, the involvement of software developers as one of the SCCs' partners may vary from one SCC to the others. The ownership of a governance entity also reflects the gravity of a collaboration. While an entity may maintain its separate status, the ownership can be changed to accommodate the collaboration's dynamic.

In our cases, the SCCs members' business processes intertwine with their IOS. After an IOS is already implemented in an SCC, it becomes impossible to stop the IOS service without losing the collaboration's ability to do the SC process. This finding matches the popular belief about data sharing and technology adoption to boost SC performance.

Documenting the case studies is valuable for sharing knowledge about a specific context. Our study's description and analysis deliver documentation about governance arrangement in the Dutch SCCs context. While a case study is never a complete story, the documentation is a starting point for others interested in the governance topic or the Dutch SCC context. For example, the Dutch Energy Market case may open an engaging discussion between practitioners in European countries due to the hype in the energy market.

RQ3: *What can we learn from the governance lifecycles to achieve a successful IOS-based collaboration?*

Sub-Chapter 9.3 addresses the third research question. Using the proposed building blocks to evaluate the history of four IOS-based collaborations in the SC field, the case studies also give us insight into the collaborations' success and failure and how the governance was executed. Collaboration creation is a challenging process, and IOS development is initially uncertain. Notable insights include the gradual nature of IOS adoption, the preference for public ownership, the impact of government involvement, the significance of resources and individual skills, legal complexity challenges, the importance of strategic relationships with software developers, and the complexities of

collaboration boundaries and sustainability. These findings are the compelling lessons that we learn to achieve a successful IOS-based collaboration.

We observed four longitudinal case studies. Three collaborations successfully implemented their IOSs, and one collaboration failed. Across all cases, the success is slow, unsteady, and rarely has a static ending point. The installed IOS is not the only success measurement. Instead, collaborations are concerned about their success after the implementation. Changes and disruptions could detract from the present governance arrangement that was a success before. Moreover, the metrics are numerous, and their priority shall be adapted to the ongoing phases. Once again, the mixed state of success and the continuous adaptation highlight the dynamic paradigm in inter-organizational governance.

This study will benefit large companies, SMEs, and start-ups in joining or establishing SCCs by forming inter-organizational governance state of the art knowledge, specifically in the SC context with a similar situation to the Netherlands. It is not limited to companies in the SC but also helps the IOS providers and brokers who target SCCs as their market. While our findings will benefit collaborations, we do not recommend generalizing this study's results to settings that are poles apart from our research scope. The Netherlands is a leading country in SC. It is connected to global networks, and Dutch democratic culture affects the SCCs to behave accordingly. Thus, negotiation, coordination, and collaboration are substantial in Dutch culture.

10.2 Research Limitations

This study is designed to collect data from a specific cultural context, Dutch collaborations. The design warrants external validity. Besides the benefits, this design has a limitation. SC industry mainly includes multiple companies from different countries (Alade, Bukoye, Roehrich, & Edelenbos, 2022). SC is not a pre-existing system with a stable and pre-defined boundary; SC is constructed and dynamically changing due to firm relations (Hald & Spring, 2023). Thus, to implement the lesson learned, a multi-cultural or cross-countries SCC needs to analyze its context and adapt accordingly.

Our initial scan started to explore the inter-organizational governance for IOS-based collaborations in the early stage of cloud technology adoption by SCCs. Most of our interviewees worked at the management level as Directors, partners, CEOs, owners, or project initiators. We selected persons with strategic positions in the companies or projects as interviewees. This selection was due to the interviews' governance and business model topics.

The selection criteria had an impact on our data collection. The interviewees were more focused on the management side of the SCCs than on the technical side of their cloud technology. Thus, we got limited information about their cloud technology. It is indeed possible to get more information from other people in their companies, such as technical

experts. However, at the time of the exploration study's data collection (2014-2015), cloud technology was a new trend in SC. During the adoption process, it is not easy to be sure about the success of the technology adoption itself. Consequently, the effort to gain the information would be paramount.

The adoption of cloud-based SCCs can shift the SCCs' tendency to adopt NAO governance mode to market and shared governance modes. The fundamental reason lies in the main feature of cloud computing to provide service of infrastructure, platform, and software as a service over the internet. However, the longitudinal case studies in this work are still limited to the NAO governance mode. Thus, this study does not explore cloud technology's implication for inter-organizational collaboration.

Later, we applied data triangulation in the longitudinal case studies to warrant the study's validity. The analysis is based on interview transcriptions, documentation, and confirmations to interviewees. Some of the collected documentation was in the Dutch language. It is not anticipated at the beginning of the study. Google Translate engine was useful for translating documents, reports, and web pages. Due to this language gap, we realize there is a possibility of mistranslation. In this case, the confirmations to our interviewees helped to detect such kind of misunderstanding. Participants in all cases were asked to review the written reports and give input or corrections.

In addition, despite the research design, a case study is not immune from bias and mitigated truth. This weakness becomes more apparent in collecting data about conflicts in our sample SCCs. In this kind of situation, more pieces of evidence are needed in the data collection. However, in our study, there was a time when interviewees avoided giving a statement, and there was limited documentation about the conflict. Thus, the data was collected after the conflict was solved. The resolution was enacted by then, and some vital information about the conflict could not be retrieved.

The last limitation is related to the stakeholder theory. Despite the benefit of stakeholder theory for the IOS-based inter-organizational governance field, this theory also has some limitations. Fassin (2008) lists some critiques on the graphical representation of the stakeholder theory: heterogeneity within stakeholders, multiple inclusion of individuals in more than one stakeholder classifications, differences in dependence among stakeholders, the variability in salience and the impact of the various stakeholders, the firm's central place with multiple linkages that are not present in the model, and the network of stakeholders that exist due to the interconnectivity of firms. Moreover, the stakeholder theory is a "macro" rather than a "micro" approach (Barringer & Harrison, 2000). This theory is not designed to provide prescriptive theory. Further research needs to be executed based on the result of this study so that other inter-organizational collaborations can succeed in their governance.

10.3 Recommendations for Future Studies

"Stakeholder theory goes well beyond the descriptive observation that organizations have stakeholders" (T. Donaldson & Preston, 1995). It is a technique to manage the stakeholders (Freeman et al., 2007): stakeholder assessment, stakeholder behavior analysis, understanding stakeholders in more depth, assessing stakeholder strategies, developing specific strategies for stakeholders, creating new modes of interaction with stakeholders, and developing integrative value creation strategies. Thus, in the future, practitioners and academicians should use the technique to expand the results of this study.

The building blocks proposed in this study can help future studies as a conceptual framework definition to explain further, design, and predict IOS-based inter-organizational collaborations. Future studies can explain why a particular governance arrangement is successfully implemented, how to develop inter-organizational governance to achieve agile collaborations, and what governance design will fit specific circumstances. For example, studies based on TCE and social network theories can specifically address the formation of collaboration in the pre-partnership collaboration phase or the influence of resource transition in the partnership succession phase. For IOS-based collaborations, the dynamic perspective of inter-organizational governance helps identify its current phase and address the typical challenges in its current and next phases.

The lessons learned in this study can be used to build hypotheses for achieving success in operating IOS-based collaborations, specifically for SCCs. For example, our finding about the individual's leadership skills aligns with previous studies, such as Popp et al. (2014) and Bongiorno et al. (2018). However, we find that leading an inter-organizational IOS-based collaboration needs more than an IT background and leadership skills. It is an intriguing finding that can be addressed in future studies.

Future studies can consider other theories from different perspectives – such as economic, organizational, or social – to explain the dynamic and complex networks (Barringer & Harrison, 2000; Wang et al., 2022). "Stronger and fuller theory can result if we regard our efforts in building one type of theory as part of a larger whole and remain aware of potential connections between the subpart" (Gregor, 2006). One of the popular theories in the information system field is design theory. While the concept of design theory has been expanded in this field – e.g., D. Jones and Gregor (2007), future studies using design science need to be aware of the critics surrounding it. Iivari (2020) identifies four categories of design theory, which can be useful in setting the research foundation.

The design science method (Gregor & Hevner, 2013; Hevner, March, Park, & Ram, 2004) can be used to propose SCCs' governance design process and methods to measure collaboration success in each phase. Future studies must be aware of distinctive success

measurements for SCCs. For example, a metric for consumer satisfaction and average annual mark-ups in energy collaboration (Pepermans, 2018) can be used to measure an energy market SCC's performance. Another example is designing governance to achieve sustainability by considering its business model. Prior studies and practitioners have not explicitly stated the connection between SCCs' governance and its business model. In contrast, many business-model-driven factors – internal factors such as the characteristics of its members and their relationships, and external factors such as CaaS technology – have been discussed in SCCs' governance literature. The alignment is also indicated by the endorsement of inter-organizational coordination's mission and task as the factors affecting the governance structure's fit (Alexander, 1995), which are defined by business value and critical activities in the business model, respectively. We propose that understanding SCCs' governance and its business model alignment will lead to a more effective governance design.

In contrast to the extensive discussion about a business model for a company, there is only a little attention given to the inter-organizational collaboration business model. Furthermore, even though the literature in this area discusses how to design collaborative business models, they lack a solid understanding of an inter-organizational business model. Some examples of this literature are: (1) Fragidis, Tarabanis, and Koumpis (2007), who propose a business model of customer-centric business ecosystems based on a service-oriented architectures technological platform; (2) Ilayperuma and Zdravkovic (2010), who propose a method for exploration of business value models from a business collaboration life-cycle perspective, which is a part of the business model concept as observed by Zott, Amit, and Massa (2011); and (3) Concha, Espadas, Romero, and Molina (2010) suggests a business model for a service provider of an open technological platform providing a set of collaborative electronic solutions to support collaborative business processes among small and medium-sized enterprises. These studies focused on certain parts of a business model but have not proposed a comprehensive model for an inter-organizational collaboration business model.

Researchers can also explore another perspective of the inter-organizational lifecycle: organizational learning. Organizational learning is a cycle of knowledge development (Wijnhoven, 2021). This description of organizational learning conforms with the lifecycle conceptualization of inter-organizational governance. During the phases in a lifecycle, individuals and companies in a collaboration learn, build, and accumulate knowledge – e.g., about the integrated business process and the strategic coordination. Moreover, IOSs may provide collaborations with new services that traditional collaborations will not be able to achieve with paper-based information-sharing. Companies need to address this learning process as a part of the cooperation process at the inter-organizational level.

As a part of this learning process, collaborations may also improve their IOSs with recent technologies, such as cloud technology, blockchain, and artificial intelligence (AI). Despite the hype about these advanced technologies, researchers and practitioners must

exercise precautions regarding the adoption cost and risk. Moreover, the technology adoption will affect the stakeholders' relationships and the coordination activities in the collaboration's governance.

At the beginning of this study, we expected that cloud-based SCCs (SaaS-based or CaaS-based) could be configured to be compatible with other types of governance modes, primarily market and shared governance. The cloud technology boundary was dropped after our exploration study due to the immaturity of its adoption in the IOS context at that time. Nowadays, the concept of integration platform as a service (iPaaS) has been developed. "iPaaS is a suite of cloud services that enable users to create, manage, and govern integration flows connecting a wide range of applications or data sources without installing or managing any hardware or middleware," (Serrano, Hernantes, & Gallardo, 2014). IPaaS can connect any combination of on-premises and cloud-based services according to the implementation scenarios and IT architecture arrangements (Ebert, Weber, & Koruna, 2017). This technology is the cornerstone for a cloud-based IOS that supports a collaboration in which members' IT architectures are heterogeneous. Consequently, it will benefit future researchers and practitioners to dive into the technology's adoption by collaborations and its impacts on inter-organizational governance.

Blockchain is a trust engine in the transaction and information-sharing processes; its implementation in a collaboration can boost stakeholders' trust – a form of informal governance mechanism (Alvarez et al., 2010; Aulakh & Gençtürk, 2008; Cropper et al., 2008). Nevertheless, blockchain is not advisable for all collaborations because of the high overhead cost (A. Kumar, Liu, & Shan, 2020). Blockchain brings many benefits to SCCs, but its adoption is still limited, and its success is scarce (Sternberg, Hofmann, & Roeck, 2021). The decentralized, replicated, and immutability characteristics of blockchain strengthen the trust between SCC members and alter the data governance (A. Kumar et al., 2020). A study by Rikken, Janssen, and Kwee (2019) identifies challenges of blockchain governance that are categorized into several layers (infrastructure, application, company, and institution/country) across different stages (design, operate, and evolve/crisis). This study's perspective on governance conforms with our study, which focuses on the governance dynamic and its changing stakeholders' involvements. However, the study's main contribution is still limited to the technology layers of governance, and its governance elements are unclear. Thus, the governance building blocks proposed in this study is a structured framework for future research in this topic.

Meanwhile, AI adoption may help SCCs in conflict resolution, risk management, and member selection. For example, supplier selection for a company is a multi-criteria decision making that will benefit from AI. In the SCC context, this decision making complexity is amplified by the fact that the companies and the suppliers may become members of the SCC. AI algorithm in a collaboration's IOS needs to accommodate the benefit and cost-sharing among the members instead of a company's interest.

Furthermore, the result of this algorithm may affect the SC pattern and the power distribution in an SCC.

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Appendix

Appendix A List of Abbreviations

ANT	Actor network theory
BV	*Besloten vennootschap*
CaaS	Coordination as a service
CCS	Cargo community systems
CEO	Chief executive officer
EDI	Electronic data interchange
IOS	Inter-organizational systems
iPaaS	Integration platform as a service
IT	Information technology
LSP	Logistic service provider
NAO	Network administrative organization
NDA	Non-disclosure agreement
NV	*Naamloze vennootschap*
PCS	Port community system
SaaS	Software as a service
SC	Supply chain
SCC	Supply chain collaboration
SLA	Service level agreement
TCE	Transaction cost economy theory
TMS	Transport management system

Appendix B Questions in Exploration Study

Topic	Questions
General Questions	

Value proposition	• What activities does your product/service perform related to the management and orchestration of the multiple (cloud) services?
	• How would you describe the main capabilities of your product/service?
	• Does your product/service also provide support for the integration of their (cloud) services?
	  o What are typical cloud services that are integrated?
	  o Does this support only contain technical support or organizational support?
	  o What issues are related to this integration?
	• What are the benefits for the whole supply chain? What are the individual benefits for your customers?
	  o No-upfront investment,
	  o Lower operations costs and maintenance costs,
	  o Highly scalable,
	  o Easy access,
	  o Reduced risks, etc.
	• What are important activities to deliver your value proposition?

Information technology: cloud services	• What is the role of cloud technology in your product? • What is the added value of cloud technology in an ICH? • Do you use other technologies? Which?

Stakeholders	• Do you have partnerships with:
	  o ICT providers?
	  o Government/regulatory bodies?
	  o University/research organization?
	  o Besides these, are there other partners and suppliers we forgot to identify?
	• How do they contribute?

Cloud-based SCCs' Governance Aspects Questions	

Organizational form and legal status	• What is the organizational form of your business?
	  o A joint venture,
	  o A virtual company,
	  o An independent company, etc.
	• Do you make a profit from your organization?

Owners	• Who are the equity owners of your company? • Are your owners also your customers?

Decision making	• How is decision making organized in your company?
	  o Who?
	  ▪ Do you have a board that does decision making?
	  ▪ Are your customers part of the decision making process?

Topic	Questions
	▪ Who else contributes to decision making? o When and where? ▪ Regular meetings, etc. o How? ▪ Voting, ▪ Discussion, etc.
Data governance	• Do your customers ever feel reluctant to share their data? o Why? o What strategy do you use in order to solve this? o How do you safeguard their data? o What activities do your product/services provide to prevent these issues? • Are there other issues regarding data sharing in your collaboration?
Investment & Operational Funding	In our research, we identified two types of costs: investment costs and operational costs. • How would you categorize your investment costs? Is it low or high? o To design, develop, and implement your software, o Partnership with the ICT provider, etc. • In relation to capital investment: o How did you attract investments to cover these costs? o Did your customers co-invest? • What are your operational costs? Low or high? o Call center/helpdesk, o Maintenance & development, o Fee for ICT providers, etc. • How are the operational costs charged to the customers? o Pay per use, o Monthly/yearly fee, etc. • Are these customers your only revenue center?
Members	• Does being your customer automatically give a company membership in your collaboration? • How many members/existing customers do you have? • How diverse are your members? • Do you have different roles for members? • Who are your typical customers? o Shippers/manufacturers/retailers, o Shipping companies, o End customers, etc. • Are there any specific requirements? • What is the role of these customers in the supply chain? • How do you communicate with your customers/members? o Call center/helpdesk, o Regular meetings, or o Other mechanisms. • How do you reach new customers?

Topic	Questions
	○ Exhibitions/conferences, ○ Through your existing customer's supply chain network, or ○ Other channels.
Other Questions	
Competitor	Who are your direct and indirect competitors?
Potential Customer's Motivation to Join	• What do you think about your potential customers' enthusiasm for your products and services? • Are there any issues that prevent them from joining your collaboration?

Appendix C Exploration Study Result

Case	A	B
Interviewees	1	2
Interviewees' roles	Director Operations in Company A	Partners in Company B
Companies	2010	2008
Establishment	Netherlands	Belgium
Value proposition	A logistic cross-SCC orchestration A neutral and transparent orchestrator SC consultation Logistic operations outsourcing Cost & CO^2 reduction	A logistic horizontal cross-SCC orchestration SC consultation Cost & CO2 reduction
Information technology: cloud services	Logistic data center SC collaboration platform and software Owned by company A	Logistic data center SC collaboration platform and software Owned by Company B
Stakeholders	Logistic agents, logistic service providers, customs, IT providers, members' IS providers, universities	An IS developer, IT providers, members' IS providers, universities, legal advisors
Cloud-based SCCs' Governance Aspects		
Governance entities	-	-
Entities' owners	Company A has shareholders	Company B has shareholders
Investment and funding	Company A's shareholders invest in the IOS development	Company B's shareholders invest in the IOS development
Decision making	Decision making based on contracts	Decision making based on contracts
Data governance	Non-Disclosure Agreement (NDA)	NDA, multilateral contracts between customers
SCCs members	Private companies	Private companies Logistic service providers
How to be SCCs members	Contracts with Company A	Contracts with Company B

Case	C	D
Interviewees	2	1
Interviewees' roles	Company C's Partner and Technical expert	CEO in Company D
Companies	2014	1980s
Establishment	Netherlands	Netherlands
Value proposition	Omni-channel logistic SCCs Cost & CO^2 reduction	A location and transportation channel-specific logistic collaboration orchestration Cost reduction
Information technology: cloud services	A system that looks like social media for SCC, owned by Company C	SC information exchange platform and software, owned by Company D
Stakeholders	Company C, IT providers, members' IS providers, a logistic research institute, universities	An IS developer, IT providers, members' IS providers, a trade association, universities
Cloud-based SCCs' Governance Aspects		
Governance entities	Governed by the members	Non-profit private company D
Entities' owners	Company C has shareholders	Shareholders, which are major members
Investment and funding	Company C's shareholders invest in the IOS	Shareholders & government
Decision making	Members' discussion	Shareholders and a trade association as members' representation
Data governance	NDA, members have full data ownership and access to its privacy setting	NDA
SCCs members	Retailers & E-retailers Private and public organizations Logistic service providers	Transportation hubs Logistic service providers Warehouses Customs
How to be SCCs members	Contracts with Company C and members' connections	Location-based community and contracts with Company D

Case	E	F
Interviewees	2	1
Interviewees' roles	Owners in Company E	Managing director in Company F
Companies	2014	2002
Establishment	Netherlands	Netherlands
Value proposition	A transportation marketplace Cost & CO^2 reduction Information transparency	A location and transportation channel-specific logistic collaboration orchestration A neutral orchestrator Increase in efficiency Cost reduction
Information technology: cloud services	A location-based cargo and transport search engine Companies rating system Owned by Company E	SC information exchange platform and software, owned by Company F
Stakeholders	Business angels, a logistic research institute, a financial auditor, an IS developer, an IT provider, a university	An IS developer, IT providers, members' IS providers, community employer organization
Cloud-based SCCs' Governance Aspects		
Governance entities	Not yet well-defined	Non-profit private company F (est. in 2009)
Entities' owners	Not yet well-defined	Shareholders, which are transportation hubs
Investment and funding	Not yet well-defined	Shareholders
Decision making	Not yet well-defined	Managing, supervisory, and advisory board as community representation
Data governance	NDA	NDA, members have full data ownership, access transparency
SCCs members	Small and medium private companies Logistic service providers	Transportation hubs Logistic service providers Warehouses Customs Authorities
How to be SCCs members	Not yet well-defined	Location-based community and contracts with Company F

Case	G	H
Interviewees	1	1
Interviewees' roles	Director in Company G	Project initiator and business analyst in Company H
Companies	2012	2013
Establishment	Netherlands	Netherlands
Value proposition	An industry-specific SCC orchestration Increase in efficiency and accessibility for members Cost & CO^2 reduction	A distribution collaboration Transportation operational data visibility
Information technology: cloud services	E-auction and logistic platform and software Mobile application Owned and customized by a cloud provider	Traffic data center Logistic control tower platform and software Owned and customized by a cloud provider
Stakeholders	Logistic service providers, an industry-specific wholesaler association, a platform provider, members' IS providers, university	A platform provider, an IS integrator, members' IS providers, IT providers
Cloud-based SCCs' Governance Aspects		
Governance entities	Non-profit public company G	Governed by the members
Entities' owners	Shareholders, which are major members	The platform provider has shareholders
Investment and funding	Bank, creditors	The platform provider's shareholders invest in the IOS
Decision making	Board of directors as community and system developer representation	Members and an IS integrator
Data governance	NDA, members have full data ownership, access transparency	NDA, members have full data ownership, access transparency
SCCs members	Producers Large traders An auction company	A supermarket chain Logistic service providers (company H is one of them)
How to be SCCs members	Industry-based community and contracts with Company G	Partnerships with a supermarket chain and contracts with a platform provider

Appendix D Examples of Data Confirmation

Data Source	Source Types	Quotes from sources	Conclusion
De Langen (2004)	**Academic Article**	"Table 12 investments of RMPM (The Rotterdam municipal port authority) Web-based port community system: Substantial investments."	"As of early 2009, the next governance lifecycle's *partnership creation and consolidation phase* was marked by the merger of Port Infolink in Rotterdam and PortNET in Amsterdam, which provided the Ports of Rotterdam and Amsterdam with one joint PCS (Hong Kong Shippers' Council, 2008)."
Hong Kong Shippers' Council (2008)	**Magazine article**	"As of 1 July 2009, the ports of Rotterdam (www.portofrotterdam.com) and Amsterdam (www.portofamsterdam.com/) will have one joint port community system."	
An interview in 2014	**Interview (transcript & note)**	"The initiator in the core was the Port Authority. … They finance the whole thing, and then that was 2002."	
Portbase (2018)	**Webpage**	"De organisatie is in 2009 opgericht door Havenbedrijf Rotterdam en Haven Amsterdam en heeft de brede steun van het havenbedrijfsleven." "The organization was founded in 2009 by the Port of Rotterdam Authority and the Port of Amsterdam and has the broad support of the port business community."	

Data Source	Source Types	Quotes from sources	Conclusion
An interview in 2014 with HubWays NV's Director	**Interview (transcript & note)**	"Our budget is very low. Lots of money was already spent on the project, so there was not much left. So, I decided to do everything on my own. I only hire one person who knows the (technical) messages for two days in a week."	"HubWays NV was a single-employee company."
VGB (2015a).	**Magazine article**	"HubWays is een zeer kleine organisatie waarin ik bijna alles zelf doe. Van het maken van visitekaartjes tot het opstellen van de jaarbegroting, testen van de applicatie, begeleiden van de pilotpartijen, opstellen van de nieuwsbrieven, maken van een promotievideo en het verkopen van HubWays in de sector." "HubWays is a tiny organization that I own do almost everything. From making business cards to preparing the annual budget, testing the application, supervising the pilot parties, preparing the newsletters, making a promotional video, and selling HubWays in the sector."	
An interview in 2020 with FloraHolland's Supply Chain Development Manager and HubWays' Project Manager	**Interview (transcript & note)**	"You should ask the Director (why the Director was mainly alone in the company's structure). At the end of the day, when I ran the project, my project didn't look for one project."	

Appendix E Data Sources for Case Descriptions

	Data Source Types	Rotterdam Port Collaboration	Schiphol Air Freight Collaboration	Dutch Electricity Market	Dutch Floriculture SC
Primary Data	**Interview (transcript & note)**	1	2	2	3 (4 interviewees)
	Correspondence & confirmation	✓	✓	✓	✓
	Presentation Material[12]	-	-	2 (Fokkema, 2016, 2021)	-
	Archival Record	-	1 (LexisNexis, 2019)	1 (Bloomberg L.P., 2020)	-
Secondary Data	**Academic Article**	7 (Carlan et al., 2016; Lewandowski, 2005; Oosterhout et al., 2007; Otten, 1988; Srour et al., 2008; van Baalen et al., 2009; van der Horst & van der Lugt, 2011)	1 (Christiaanse et al., 1995)	1 (Cace & Zijlstra, 2003)	1 (van Veen & van der Vorst, 2011)
	Book Section	3 (Koeman, 1992; Lakshmanan, 2001; Yip et al., 2016)	-	1 (Guayo et al., 2010)	1 (van der Vorst et al., 2014)

[12] The presentation materials were presented directly by interviewees and acquired afterwards.

Data Source Types	Rotterdam Port Collaboration	Schiphol Air Freight Collaboration	Dutch Electricity Market	Dutch Floriculture SC
Thesis	-	2 (Dac, 1996; Meijer, 2007)	1 (Rukanova, 2005)	-
Company's report	1 (Portbase, 2017a)	3 (Royal Schiphol Group, 2018a, 2020, 2022a)	8 (ACM, 2014; Alliander NV, 2012, 2013, 2021; CGI, 2021; Enexis Holding NV, 2014; Siöstedt & Wang-Hansen, 2021; Stedin Group, 2022)	1 (VGB, 2015b)
Magazine article	2 (Hong Kong Shippers' Council, 2008; Porter, 1992)	4 (Arendsen et al., 2004; Buijze, 2013; Cargonaut, 2014; Douven, 2013)	3 (EDSN, 2009a, 2009b; Hofman, 2005)	1 (VGB, 2015a)
Webpage	5 (Maritime Information Services Ltd., 2009; Port of Rotterdam Authority, 2017a; Portbase, 2017b, 2017c; The Journal of Commerce Online, 2008)	34 (Air Cargo News, 2010, 2016a, 2017a, 2017b, 2018; Air Cargo World, 2016; Brinkmann, 2016; Buxbaum, 2016; Cargo Forwarder Global, 2020; CargoHub Magazine, 2014; Cargonaut, 2016a, 2016b, 2016c, 2016d, 2020a, 2020b; Dijkhuizen, 2018; Drimble, 2022; Limburg, 2020; Nederlands Genootschap van Bedrijfsjuristen, 2021; Nieuwsblad Transport, 1993, 1994, 1995a, 1995b, 1995c, 1996, 1997; Riege Software, 2021; Rouss, 2016; Royal Schiphol Group, 2018b; 2019 Royal Schiphol Group, 2022 #16124; Schoeters, 2020; Trademarkia, 2019)	18 (Computable, 2012; Consultancy.nl, 2012; DeEnergieGids.nl, 2018a, 2018b, 2018c, 2019; EDSN, 2014, 2015, 2016, 2019; Gorber, 2012; kWh People, 2020; Letschert, 2022; Metri, 2020; MFFBAS, 2022; NEDU, 2022; Technolution, 2008; TenneT Holding BV, 2020a)	11 (Drimble, 2020; Floricode, 2015; Hubways, 2010a, 2010b, 2012, 2020; HubWays NV, 2020; Redactie TTM.nl, 2011; TKI Dinalog, 2019; Veen Streek, 2011; Weerd, 2013)
Presentation Material	1 (Gardeitchik, 2020)	-	-	1 Hamersveld, 2014 #16011

Appendix F Cross-case Comparison of Governance Stakeholders

outside SCC *IOS brokerage activities

	Rotterdam Port Collaboration		Schiphol Air Freight Collaboration			Dutch Electricity Market			Dutch Floriculture SC
Lifecycle	**3rd Port Infolink**	**4th Portbase**	**1st Cargonaut Schiphol's Ownership**	**2nd Cargonaut Shared Ownership**	**3rd Cargonaut Part of Schiphol**	**1st ECH**	**2nd EDSN Market Oriented**	**3rd EDSN DSOs & TSOs Oriented**	**1st HubWays**
Members - SC companies	Shipping line agents, sea carriers, sea terminal operators, carrier inland operators, and the Port Authority	Portbase's IOS added connection to shippers, consignees, and forwarders	Airlines, airport authorities (Royal Schiphol Group), handling agents, freight agents/forwarder	Cargonaut focused on getting more shippers and truckers on the IOS	The *members* remain the same	Incumbent companies, balance responsibles, TSOs	EDSN's customers were incumbent companies that had gradually separated	100% of market parties have been connected by EDSN's IOS	Greenport (Royal FloraHolland), growers, traders, buyers, and transport companies
IOS providers	Port Infolink developed, owned, and managed the IOS	Portbase developed, owned, and managed the IOS	Cargonaut developed, owned, and managed the IOS	Cargonaut managed the IOS and collaboration with software developers*	Cargonaut manages collaboration with software developers for the old IOS* and develops the new IOS with in-house teams	ECH managed the IOS and collaboration with software developers*	EDSN managed the IOS and collaboration with software developers*	EDSN manages the IOS' in-house development and collaboration with the software developers*	Hubways NV managed collaboration with software developers*
Orchestrators	-	Portbase	-	-	-	-	-	-	-

	Rotterdam Port Collaboration		Schiphol Air Freight Collaboration			Dutch Electricity Market			Dutch Floriculture SC
Lifecycle	**3rd Port Infolink**	**4th Portbase**	**1st Cargonaut Schiphol's Ownership**	**2nd Cargonaut Shared Ownership**	**3rd Cargonaut Part of Schiphol**	**1st ECH**	**2nd EDSN Market Oriented**	**3rd EDSN DSOs & TSOs Oriented**	**1st HubWays**
Software developers	Oracle, Sogetti, and other developers developed the IOS based on contracts		Westlake Systems developed the IOS based on contracts	Westlake Systems was a shareholder of Cargonaut	Software developers develop the old and new IOS based on contracts	Logica developed and owned the IOS based on contracts	CGI developed and owned the IOS based on contracts	Software developers develop the IOS based on contracts	Eyefreight developed and owned the IOS
Associations	Deltalinqs supported Port Infolink in the Supervisory Board	• Deltalinqs, ORAM, and VITO are on Portbase's Advisory Board • Deltalinqs is on Portbase's Supervisory Board	The association of freight forwarders was involved in the Cargonaut's establishment	• ACN decides industry-wide rules for Cargonaut's IOS development and SC activities in the SCC • Other associations give inputs to Cargonaut		The association did not actively involve	• NEDU maintained the Dutch energy market model • Other associations give inputs to EDSN	• In 2022, NEDU was replaced by MFF-BAS	VGB and TLN were shareholders of HubWays NV in the *pre-partnership collaboration phase*
Consultants	Consultants worked based on contracts	Management in Motion is in Portbase's Supervisory Board	Consultants worked based on contracts			Consultants worked based on contracts			Consultants worked based on contracts

	Rotterdam Port Collaboration		Schiphol Air Freight Collaboration			Dutch Electricity Market			Dutch Floriculture SC
Lifecycle	**3rd Port Infolink**	**4th Portbase**	**1st Cargonaut Schiphol's Ownership**	**2nd Cargonaut Shared Ownership**	**3rd Cargonaut Part of Schiphol**	**1st ECH**	**2nd EDSN Market Oriented**	**3rd EDSN DSOs & TSOs Oriented**	**1st HubWays**
Universities	Universities collaborate with the SCC		Universities collaborate with the SCC			Collaboration with a university was not specifically mentioned			HubWays project's Steering Committee is led by an academician
SC partners	• Dutch Food & Consumer Product Safety Authority and Dutch customs utilize the IOS • Dutch customs is in Port Infolink's Supervisory Board		Dutch customs utilize the IOS			• Customers utilize data shared in the IOS		• SC partners can join MFF-BAS	Dutch customs had not utilized the IOS yet
Others	-		-			Organization for standardization	-	-	Research institute, Organization for standardization

Appendix G Cross Case Analysis – Rotterdam Port Collaboration[13]

Rotterdam Port Collaboration is an IOS-enabled (an EDI-based IOS and later a web-based IOS) information-sharing collaboration to execute SC activities related to the port of Rotterdam. Later, cloud-based services are delivered to companies in the port of Rotterdam and several other Dutch ports.

Lifecycle	3rd Lifecycle: Port Infolink	4th Lifecycle: Portbase
Year	End of the 1990s - 2009 (10 years)	2008 - now (15 years in 2022)
Important events	1990s - 1st and 2nd failed lifecycle 2002 - Port Infolink BV establishment 2007 - Members started to pay for operational funding	2009 - The merger of Port Infolink and PortNET into Portbase BV 2018 - Cloud-based IOS was released
IOS	• The first module development is to support a paperless import process. • The development target is a single modular PCS using a single XML format. • In 2008, the PCS consisted of 24 services.	• Port Infolink's PCS is used as the foundation for Portbase's PCS. • The PCS retains Port Infolink's PCS modular architecture approach. • *Members* also have **access to build their own services** on top of Portbase's platform. • Nowadays, Portbase offers around 40 services.
Governance Mode	The establishment of Port Infolink was an indicator that the collaboration adopted the *NAO governance mode*.	Portbase maintains the governance best practices from Port Infolink, preserving the *NAO governance mode*.
Stakeholders		
Within collaboration (*members, orchestrators, IOS providers*)	• Shipping line agents, sea carriers, sea terminal operators, carrier inland operators, and the Port of Rotterdam Authority (*members*) • Port Infolink (*IOS provider*)	• Added **the shippers, consignees, and forwarders** - which were not connected by Port Infolink's IOS (*members*) • **Portbase** (IOS provider and orchestrator)
Outside collaboration (*SC partners, other partners*)	• Consignees, shippers, forwarders, Dutch Customs, and Dutch Food & Consumer Product Safety Authority (*SC partners*) • Consultants, software developers, universities, associations in the Rotterdam region (*other partners*)	• Sea police, Dutch Customs, and Dutch Food & Consumer Product Safety Authority (*SC partners*) • Consultants, software developers, universities, associations in Rotterdam and **Amsterdam region** (*other partners*)

[13] The bold words in a lifecycle indicate significant differences from the previous lifecycle.

Lifecycle	3rd Lifecycle: Port Infolink	4th Lifecycle: Portbase
Mechanism		
Informal governance mechanism	The informal mechanism has been apparent since the *pre-partnership collaboration phase*, for example, contacts between the Port Authority's employees and the Dutch Customs' employees, as well as trust in the Port Authority.	The collaboration depended on the *informal mechanism* before the *formal mechanism* was enforced through the merger.
Formal governance mechanism	*Data governance* was their priority in the *partnership program delivery phase* by establishing strict and *documented rules, procedures, and policies*.	Portbase has an **Advisory Board,** and the arrangement of representatives in Portbase's Supervisory Board is different from Port Infolink's Supervisory Board.
Aspects		
Membership	The membership was limited to organizations that conducted SC activities in or related to the Port of Rotterdam (location-based membership).	In the beginning, the membership was limited to organizations that conducted SC activities in or related to the Port of Rotterdam and **Port of Amsterdam** (location-based membership). Now, **other Dutch ports** are also included.
Capital investment	The Port of Rotterdam Authority (a joint venture between the Municipality of Rotterdam and the Dutch government) was the sole investor.	The Port of Rotterdam Authority and **the Port of Amsterdam Authority** share the investment for Portbase.
Operational funding	• 2002 – 2007: The Port of Rotterdam Authority paid the operational cost. • 2007 – 2009: Members paid access fees.	Members pay Portbase access fees based on their transactions and can opt to pay **subscription fees**.
Decision making	• The benefit and cost-sharing were decided by Port Infolink's Management Board and Team. • The Supervisory Board decided on the strategy and set the priorities for the collaboration.	• The Management Board and Team decide on the operational, tactical, and strategical decisions, such as benefit and cost-sharing (via access fees and subscription fees), infrastructure maintenance and development, as well as a selection of software developers and other partners.

Lifecycle	3rd Lifecycle: Port Infolink	4th Lifecycle: Portbase
		• The Supervisory Board is responsible for evaluating Portbase's performance and deciding on its IOS development strategy. • **The Advisory Board** gives advice, proactively or reactively, on the Portbase's IOS and the services that are to be developed in the IOS.
Data governance	Regulations, policies, and procedural approaches are enforced.	
Governance entities	Port Infolink BV	**Portbase BV**
Equity owners	Investor-owned: Port Infolink's shareholder is the Port of Rotterdam Authority.	Investor-owned: Portbase's shareholders are • The Port of Rotterdam Authority (75%) • **The Port of Amsterdam Authority** (25%)
Board composition	Port Infolink had a Supervisory Board (Port of Rotterdam Authority, Dutch Customs, Deltalinqs, and the major companies in the port collaboration).	In the beginning, Portbase was supported by the board of directors from both prior companies. Later in 2018, Portbase was supported by: • A Supervisory Board (Port Authorities, Deltalinqs, Cosco, ECT, and Management in Motion) • **An Advisory Board** (Port Authorities, Deltalinqs, ORAM, VITO, and the major companies in the port collaboration)

Appendix H Cross Case Analysis – Schiphol Air Freight Collaboration[14]

Schiphol Airport Collaboration is an information-sharing collaboration (EDI-based and later a web-based IOS infrastructures) in the Amsterdam Schiphol Airport community. Currently, a big project to modernize their IOS and cloud solution is ongoing.

Lifecycle	1st Lifecycle: Cargonaut – Full Ownership of Schiphol Group	2nd Lifecycle: Cargonaut – Shared Ownership	3rd Lifecycle: Cargonaut – Part of Schiphol Group
Important events	1981 - First preparation studies 1985 - Cargonaut Holding BV establishment 1988 - Cargonaut's first software, Piconaut, came into operation 1995 - Cargonaut's first financial crisis	1996 - The addition of new shareholders 1996 - Cargonaut's IOS 2.0 was launched and connected to the internet 2003 - ACN establishment 2008 - Groupe ADP (Aéroports de Paris) invested in Schiphol Group 2016 – A cloud solution was introduced	2020 - Schiphol Group takes full ownership
Year	1981 - 1996 (16 years)	1995 - 2020 (26 years)	2019 - now (4 years in 2022)
IOS	• In the beginning, Piconaut only supported the airlines' reservations and status information. The IOS adoption was slow. • After Piconaut connected to Sagitta – Import, the adoption rate was improved. • In 1995, Piconaut was replaced by an integrated package for import and export – CargoMate.	• By the end of the 1990s, Cargonaut evolved from processing EDI transactions to providing **an integrated system using an internet network**. • In the 2010s, Cargonaut continued its development and connected the CCS to other CCSs and services. • The software development was supported by information standardization. • In 2016, Cargonaut's services for the air freight community were categorized into six groups.	Until the beginning of 2023, Cargonaut's old CCS has been operating as usual while preparing the new CCS.

[14] The bold words in a lifecycle indicate significant differences from the previous lifecycle.

Lifecycle	1st Lifecycle: Cargonaut – Full Ownership of Schiphol Group	2nd Lifecycle: Cargonaut – Shared Ownership	3rd Lifecycle: Cargonaut – Part of Schiphol Group
Governance Mode	The establishment of Cargonaut was an indicator that the collaboration adopted the *NAO governance mode*.	Cargonaut preserved the *NAO governance model*, yet the ownership was changed.	The Cargonaut's status as a separate legal entity was preserved, but the ownership was reverted. Cargonaut is a part of the Royal Schiphol. The ***lead organization mode*** is adopted.
Stakeholders			
Within collaboration (*members, orchestrators, IOS providers*)	• Airlines, airport authorities (Royal Schiphol Group), handling agents, freight agents/forwarders (members) • Cargonaut (IOS provider)	• **Truckers** joined the collaboration at the end of the first lifecycle; Cargonaut focused on getting more shippers on the IOS (*members*) • Cargonaut (***IOS broker***) • Westlake Systems (*software developer*)	The *members* remain the same
Outside collaboration (*SC partners, other partners*)	• Shippers, Dutch Customs, logistics providers/truckers (SC partners) • Consultants, software developers, universities, associations (other partners)	**ACN** was established in 2003 and emerged as an association for the members (*other partners*)	The *partners* remain the same
Mechanism			
Informal governance mechanism	The *informal mechanism* was apparent in the community.	The companies were *working together* and *communicating* on a lot of occasions, also outside the needs to manage the IOS. This connection managed to bring excellent results for the whole community, for example, the NLIP project.	The **SCMP** by Royal Schiphol Group helps to *connect* the stakeholders in Schiphol Air Freight Collaboration.

Lifecycle	1st Lifecycle: Cargonaut – Full Ownership of Schiphol Group	2nd Lifecycle: Cargonaut – Shared Ownership	3rd Lifecycle: Cargonaut – Part of Schiphol Group
Formal governance mechanism	Cargonaut had a Supervisory Board and established *rules, procedures, and policies* together with the Authorities.		As a part of the Schiphol Group, Cargonaut is following the ***Authorities' direction.***
Aspects			
Membership	The membership was limited to organizations that conducted SC activities in or related to the Schiphol Airport (location-based membership).		
Capital investment	Royal Schiphol Group (the Schiphol Airport Authority) was the main investor.	The shares were transferred from Schiphol Group to **other shareholders**. There were **additional investments** or funding by TopSector Logistics, Dutch customs, Logius, ACN (Air cargo industry association), the Netherlands Organization for Scientific Research, and TKI Dinalog.	**Schiphol Group** (the Schiphol Airport Authority) bought the whole shares of Cargonaut. The **Dutch Government** gave some funds.
Operational funding	Cargonaut's operational funding was generated from the members, including: (1) one-time payment (2) pay-per-use payment (3) optional fee for tailor-made solutions	Cargonaut's operational funding was generated from the members based on **different bundles** for its various customer groups.	Cargonaut is preparing **new cost-sharing cases** for every development project to ensure the members' commitment.
Decision making	The Supervisory Board decided on the strategy and set the priorities for the collaboration.	Cargonaut's IOS development is based on business rules that are decided by the *members* of **ACN**.	• The decision making is done by the Cargo Department in Schiphol Group. • The Advisory Board, together with ACN, is responsible for giving inputs to the Cargo Department.

Lifecycle	1st Lifecycle: Cargonaut – Full Ownership of Schiphol Group	2nd Lifecycle: Cargonaut – Shared Ownership	3rd Lifecycle: Cargonaut – Part of Schiphol Group
Data governance	Regulations, policies, and procedural approaches are enforced.	The system has implemented **detailed data governance** using contracts and NDAs (Non-Disclosure Agreements).	
Governance entities	Cargonaut BV	**Cargonaut Holding BV**, which owns: • Cargonaut Nederland BV • Cargonaut IP BV • Cargonaut International BV	Cargonaut Holding BV operates **under the Cargo Department** of Schiphol Group.
Equity owners	Investor-owned: Schiphol Group (100%)	Investor-owned. In 1995, the **stakeholders** were: • Schiphol Group (40%) • KLM and Martinair (12.5%) • Three handlers (19%) • 13 air freight forwarders (28.5%) • Westlake Systems BV (an **IT provider**) later became Cargomate BV. Later, the shareholders' composition slightly changed over time.	Investor-owned: **Schiphol Group (100%)**
Board composition	The members of the Cargonaut Holding BV Supervisory Board were people in the logistics, air cargo, and aviation industries. The chairman was elected for a 4-years term.		The **Strategic Advisory Board**'s members are people with backgrounds in the air cargo industries.

Appendix I Cross Case Analysis – Dutch Energy Market[15]

Dutch Energy Market is a Dutch electricity and gas free trade market that is supported by an IOS.

Lifecycle	1st Lifecycle: ECH	2nd Lifecycle: EDSN – shared governance	3rd Lifecycle: EDSN – DSOs and TSOs governance
Important events	1998 - Market liberalization initiation, TenneT was established 2001 - ECH establishment 2002 - Market liberalization for B2B and green electricity B2C, ECH's IOS implemented 2004 – Full market liberation (electricity and gas) 2005 - Chaotic situation in the market 2006 – Stroomopwaarts project started, EDSN initiation	2007 - ECH merged with B'con and EBO into EDSN B.V. 2007 - NEDU establishment 2013 – Stroomopwaarts' new standard was implemented 2013 – EDSN's IOS (C-AR) was fully adopted by the market 2013 – DSO and TSO started the discussion to fully govern EDSN	2014 - The administrative model (DSO and TSO governance) was stabilized 2020 - 100% of Dutch connections were serviced by EDSN's IOS 2022 - MFFBAS replaced NEDU
Year	2000 - 2006 (9 years)	2006 - 2014 (9 years)	2013 – now (10 years in 2022)
IOS	• ECH's IOS early development focused on the switching process by the customer and balance check. • The IOS used the ECH protocol (fixed format file messages) for members and the EDINE protocol for communication with non-members.	• In the beginning, EDSN continued the use of ECH's IOS. • Central metering administration (C-AR) was ready in 2009 but was implemented in 2011 and fully adopted by the market in 2013. • A bridge between C-AR and ECH's IOS was implemented in 2011 and ended in 2013. • XML standard has been used since 2013.	• The parties in the Dutch Energy Market continue using EDSN's IOS. • EDSN provides services for suppliers as per Dutch law. • The IOS development is shifting into in-house development.

[15] The bold words in a lifecycle indicate significant differences from the previous lifecycle.

Lifecycle	1st Lifecycle: ECH	2nd Lifecycle: EDSN – shared governance	3rd Lifecycle: EDSN – DSOs and TSOs governance
Governance Mode	The establishment of ECH was an indicator that the collaboration adopted the *NAO governance mode*.	EDSN maintains the N*AO governance mode*.	EDSN maintains the *NAO governance mode*, yet the board governance was changed.
Stakeholders			
Within collaboration (*members, orchestrators, IOS providers*)	• Incumbent companies (e.g., metering companies, suppliers, and DSOs before unbundling processes), balance responsibles, TSOs (*members*) • ECH (IOS broker)	• EDSN's customers were companies (e.g., suppliers, DSOs, and metering companies) that had gradually separated (*members*) • **EDSN** (IOS broker)	100% of market parties have been connected by EDSN's IOS (*members*).
Outside collaboration (*SC partners, other partners*)	• Producers, customers (*SC partners*) • Consultants, software developers, universities, associations *(other partners*)	NEDU was established in 2007 to create consensus and maintain the Dutch energy market model (*other partners*).	In 2022, NEDU was replaced by MFF-BAS (*other partners*). Everybody can join MFF (including parties that use the data).
Mechanism			
Informal governance mechanism	In the market, some companies are already *closely connected* because of acquisitions, mergers, and splits. Moreover, individuals are *closely connected* due to their memberships in projects and associations in the energy sector.		
Formal governance mechanism	• Members signed a *contract* and agreed upon a *Service Level Agreement* (SLA) with ECH. ECH provided *monthly operation reports*. • Dutch Government Authority enacted *legal laws* to address problems in 2005. • ECH arranged *procedures and protocols* to ensure	• *Data* standardization was the main issue for the initiation of EDSN. • EDSN divided the responsibilities of DSOs and EDSN clearly. *Rules,* communication *protocols, and management procedures* are authorized for the collaboration *members* (EDSN's customers and non-customers). • Yearly and quarterly *meetings* are held for the board.	

Lifecycle	1st Lifecycle: ECH	2nd Lifecycle: EDSN – shared governance	3rd Lifecycle: EDSN – DSOs and TSOs governance
	that the *members* abided by the law.		
Aspects			
Membership	The membership is limited to organizations that conduct free trade market activities in the Dutch energy (gas and electricity) network (location-based membership).		
Capital investment	Three big incumbent firms (producers and suppliers) – NUON, ESSENT, and ENECO – invested capital in establishing ECH. ECH got loans from banks.	The capital was pooled from the **market** (mostly **DSOs and TSOs**) and loans from banks.	The capital was pooled from the **DSOs and TSOs**.
Operational funding	All parties paid for the cost. The *members* pay ECH's operational cost based on the number of customers (for suppliers) or the number of connections (for DSOs).	**DSOs and TSOs** pay the market facilitation cost.	
Decision making	ECH had: • a general board, • a management board, and • a customer council. The council was responsible for deciding on new functionality, the release moment, and the exchange platform. The general board was responsible for the investment and strategic decisions.	• The **Central Market Facilitation (CMF)** Board (Steering Committee) discussed EDSN boundaries and what needs to be done within the boundaries. • The **Supervisory Board** interprets the information into EDSN's vision, mission, strategies, and programs for the CEO and CFO.	EDSN's board addressed the request from stakeholders (DSOs and TSOs).
Data governance	There was a severe problem regarding data standardization.	EDSN's data governance ensures that the data is **standardized** and that the central Hub does not monopolize the ownership. The data is maintained by the grid operators (DSOs and TSOs), suppliers,	

Lifecycle	1st Lifecycle: ECH	2nd Lifecycle: EDSN – shared governance	3rd Lifecycle: EDSN – DSOs and TSOs governance
		and metering companies. EDSN monitors the use of data and the data structure.	
Governance entities	Energie Clearing House (ECH) was a neutral and independent foundation (Stichting).	Energie Data Services Netherlands (**EDSN**) BV.	
Equity owners	Investor-owned: Three big incumbent firms – NUON, ESSENT, and ENECO – owned 70% of the infrastructure in the Netherlands.	Investor-owned: **DSOs and TSOs** legally own EDSN BV.	
Board composition	• The customer council consists of representatives of ECH's members – all energy suppliers and network operators operating in the Netherlands who are affiliated with the ECH. • The general board consists of representatives of the three big incumbent firms.	• CMF board (Steering Committee) consisted of the representatives of **DSOs**. • The Supervisory Board members were all **market parties**.	• The board members **are DSOs and TSOs**. • The Supervisory Board of EDSN and the Board of NEDU maintain a close relationship.

Appendix J Cross Case Analysis – Dutch Floriculture Supply Chain

Dutch Floriculture Supply Chain is a collaboration that initiated integrated information sharing in the Dutch Floriculture Supply Chain Network, which transactions are related to Dutch Greenports.

Lifecycle	1st Lifecycle (Hubways Project & Hubways NV)
Important events	2010 - The HubWays project was started 2012 - Eyefreight was selected 2013 - HubWays NV establishment 2015 – The first IOS testing 2017 - Contract termination between Eyefreight and HubWays NV 2019 - HubWays NV was dissolved
Year	2008 - 2019 (11 years)
IOS	In the initial design, the HubWays' digital platform consisted of an IOS, a physical holding, and other supporting services. The pilot part of the platform was ready and tested but was not implemented.
Governance Mode	The establishment of the HubWays project team and the HubWays NV showed that the collaboration adopted the *NAO governance mode*.
Stakeholders	
Within collaboration (*members, orchestrators, IOS providers*)	• Greenport (Royal FloraHolland), growers, traders, buyers, and transport companies (*members*) • VGB and TLN became shareholders of HubWays NV (*other partners*) • Eyefreight, which joined the collaboration in the partnership creation and consolidation phase (*software developer*) • HubWays NV, which was initiated by HubWays Project Team (*IOS broker*)
Outside collaboration (*SC partners, other partners*)	• Universities, TKI Dinalog, FPC, bank, Floricode, consultant, Dutch government (*other partners*) • Dutch customs (*SC partners*)
Mechanism	
Informal governance mechanism	The HubWays project was mainly supported by *informal coordination* and *networking*. Later, the *informal mechanism* was maintained by HubWays NV, e.g., *contacts* with the former Project Manager and *communication* in the shared office.
Formal governance mechanism	The HubWays project had a team structure, but there was no legal binding. The *monthly board meetings* were held by HubWays NV.
Aspects	

Lifecycle	1st Lifecycle (Hubways Project & Hubways NV)
Membership	The stakeholders on or affiliated with the various Greenports in the Netherlands (location-based membership).
Capital investment	• Royal FloraHolland was the initiator of the HubWays Project. HubWays project was funded by the Dutch Ministry of Economy, Agriculture, and Innovation together with the province of South Holland. • HubWays NV was funded by a bank loan and a small faction from a bank's free funding. Due to a lack of cash in the beginning, Eyefreight paid the Director's salary.
Operational funding	• The HubWays project was not designed to get any direct revenue. • HubWays NV was designed to get revenue from the fees paid by the floriculture stakeholders. Until the end, HubWays NV had not earned operational funding yet.
Decision making	• HubWays's project manager was supported by the Sounding Board and Scientific Advisory Board. • HubWays NV's structure was designed to give more independence to the Director and was supported by a Supervisory Board. HubWays NV was a single-employee company.
Data governance	Data governance was not formally implemented.
Governance entities	• There was no legal binding in the partnership creation and consolidation phase (HubWays Project). • Later, HubWays NV was established in the partnership creation and consolidation phase. HubWays NV should have two subsidiaries, which are HubWays Platform BV and HubWays Development BV. However, these companies were not established legally.
Equity owners	HubWays NV was owned by STAK, which consisted of (1) Royal FloraHolland and growers, (2) VSV and the logistic providers, (3) VGB and the buyers (the traders), and (4) Eyefreight.
Board composition	• The HubWays project had a steering group with key representatives from all the stakeholders (*members* and *other partners*), including an independent academic as the chair. However, this board had no legal standing. • HubWays NV's board members were representatives of Royal Flora Holland, VGB, TLN, and Eyefreight.

English and Dutch Summary

Governance of Inter-organizational System based Collaboration: supply chain cases

An inter-organizational system (IOS) enables agile collaborations. However, disagreement and power struggles induce failure in many IOS-based collaborations. The stakeholders' emergence and involvement fluctuate across a collaboration's timeline. Inter-organizational governance coordinating the stakeholders and their relationships is needed to achieve sustainable cooperation. However, most researchers and practitioners jump on the trend of "governance" as a buzzword. Three main research questions are introduced in this study:

RQ1: How can inter-organizational governance for IOS-based collaboration be explained using a dynamic perspective?
RQ2: How does the governance of IOS-based collaborations evolve in practice?
RQ3: What can we learn from the governance lifecycles to achieve a successful IOS-based collaboration?

The stakeholder theory complements the state of the art of inter-organizational governance for IOS-based collaborations. We identify the dynamic relationships of organizations in collaborations by using a network model of stakeholder theory. This study proposes, utilizes, evaluates, and revises building blocks of IOS-based inter-organizational collaboration governance to fill the gap. The building blocks – stakeholders, governance mechanism, governance aspects, governance modes, and governance lifecycles – are applied as a framework in four longitudinal studies on Dutch supply chain cases. Three collaborations (Rotterdam Port Collaboration, Schiphol Air Freight Collaboration, and Dutch Electricity Market) successfully implemented their IOSs, and one collaboration (Dutch Floriculture Supply Chain) failed.

In our case studies, the building blocks help communicate the governance evolutions from the first pre-partnership collaboration phase to the partnership termination phase or the collaborations' succession to the next cycle. The governance modes classify collaborations to simplify our descriptions of inter-organizational governance. The cases reveal that identifying stakeholders' roles – members, IOS providers, orchestrators, supply chain partners, and other partners - is essential to understanding the collaborations' boundary context. These stakeholders exercise formalized and informal mechanisms in all governance aspects – membership, governance entities, capital investment, operational funding, decision making, data governance, equity owners, and board composition. The governance mechanisms and aspects in each case give us tools to observe the governance transformation along the lifecycle phases. The case studies

also provide insight into the collaborations' success and failure and how the supply chain collaborations executed inter-organizational governance.

Governance van interorganisatorische systeemgebaseerde samenwerking: supply chain-cases

Een interorganisationeel systeem (IOS) maakt flexibele samenwerkingen mogelijk. Onenigheid en machtsstrijd leiden echter tot mislukking in veel op IOS gebaseerde samenwerkingen. De betrokkenheid en inzet van de belanghebbenden varieert over de levensduur van een samenwerking. Interorganisationeel bestuur om de belanghebbenden en hun relaties te coördineren is nodig om tot duurzame samenwerking te komen. De meeste onderzoekers en praktijkmensen springen echter in op de trend van 'governance' als modewoord. In dit onderzoek worden drie hoofdonderzoeksvragen geïntroduceerd:

RQ1: Hoe kan interorganisationeel bestuur voor IOS-gebaseerde samenwerking worden verklaard vanuit een dynamisch perspectief?
RQ2: Hoe evolueert het bestuur van IOS-gebaseerde samenwerkingen in de praktijk?
RQ3: Wat kunnen we leren van de levenscycli van inter-organisationeel bestuur om een succesvolle op IOS gebaseerde samenwerking tot stand te brengen?

Stakeholdertheorie vormt een aanvulling op de state-of-the-art van interorganisationeel bestuur voor IOS-gebaseerde samenwerkingen. We brengen de dynamische relaties van organisaties in een samenwerking in kaart door gebruik te maken van een netwerkmodel van stakeholdertheorie. Deze studie stelt bouwstenen voor, gebruikt, evalueert en herziet bouwstenen van IOS-gebaseerd inter-organisationeel samenwerkingsbeheer om de leemte op te vullen. De bouwstenen – stakeholders, governancemechanisme, governanceaspecten, governancemodi en governancelevenscycli – worden als raamwerk toegepast in vier longitudinale studies over Nederlandse supply chain cases. Drie initiatieven (De Rotterdamse Haven ketensamenwerking, Schiphol Luchtvracht samenwerking, De Nederlandse Energiemarkt ketensamenwerking) hebben hun IOS succesvol geïmplementeerd en één (Nederlandse sierteelt supply chain) is mislukt.

In onze casestudy's helpen de bouwstenen bij het communiceren van de bestuursevoluties van de eerste samenwerkingsfase vóór het partnerschap tot de beëindigingsfase van het partnerschap of de opvolging van de samenwerking tot de volgende cyclus. De bestuursmodellen classificeren samenwerkingsverbanden om het beschrijven van interorganisationeel bestuur te vereenvoudigen. De cases laten zien dat een duidelijke identificatie van de rollen van belanghebbenden - leden, IOS-providers, orkestrators, supply-chain-partners en andere partners - essentieel is om de context van de samenwerking te begrijpen. Deze belanghebbenden oefenen geformaliseerde en informele mechanismen uit in alle aspecten van het bestuur: lidmaatschap, bestuursentiteiten, kapitaalinvesteringen, operationele financiering, besluitvorming, gegevensbeheer, eigenaren van aandelen en samenstelling van het bestuur. De bestuursmechanismen en -aspecten geven ons in elk geval instrumenten om de bestuurstransformatie langs de levenscyclusfasen te observeren. De casestudies geven

ook inzicht in het succes en falen van de samenwerkingsverbanden en hoe de supply chain samenwerkingen's interorganisationeel bestuur hebben uitgevoerd.

Disagreements and power struggles induce failure in many collaborations based on an inter-organizational system (IOS). The stakeholders' emergence and involvement fluctuate across a collaboration's timeline. Inter-organizational governance is needed to achieve sustainable cooperation. However, most researchers and practitioners jump on the trend of "governance" as a buzzword.

This thesis utilizes the stakeholder theory - the network model perspective - to complement the state of the art conceptualization. Building blocks of IOS-based inter-organizational collaboration governance are applied as a framework in longitudinal studies of supply chain cases. The building blocks are stakeholders, governance mechanisms, governance aspects, governance modes, and governance lifecycles.

The building blocks help to analyze the governance evolutions from the first pre-partnership collaboration phase to the partnership termination phase or the collaborations' succession to the next cycle. The governance modes classify collaborations to simplify our descriptions of governance. The roles of stakeholders - members, IOS providers, orchestrators, supply chain partners, and other partners - define the collaborations' context. These stakeholders exercise formalized and informal mechanisms in all governance aspects. The cases also provide insights into the collaborations' success and missteps in executing inter-organizational governance.

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