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**Exploring Cross-Border Interoperability in the Public Sector –  
A Case Study on EUCARIS as a Successful EU-wide Data Exchange Initiative**

Master's Thesis  
Programme Technology Governance and Digital Transformation

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I hereby declare that I have compiled the thesis independently and all works, important standpoints and data by other authors have been properly referenced and the same paper has not been previously presented for grading. The document length is 12,394 words from the introduction to the end of conclusion.

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## List of Abbreviations

CITIS	Center of IT Impact Studies
DGR	Digital Government Research
EFTA	European Free Trade Association
EIF	European Interoperability Framework
EReg	European Vehicle and Driver Registration Authorities
EU	European Union
EUCARIS	European Car and Driving License Information System
G2G	Government to Government
ICT	Information and Communication Technologies
IF	Interoperability Framework
MS	Member States
NIIIS	Nordic Institute for Interoperability Solutions
PA	Public Administration
RDW	Dutch Vehicles and Driving Licences Registration Authority
TESTA	Trans European Services for Telematics between Administrations
TKN	Transnational Knowledge Network

## **ABSTRACT**

After more than two decades of EU efforts to promote cross-border data exchange, the European interoperability landscape remains fragmented and heterogeneous. This research addresses the research gap of a comprehensive overview of existing interoperability solutions and their interconnections in the context of the EU. With the objective of exploring one public sector data exchange approach in more detail, this thesis conducted a single case study. The selected case is the European Car and Driving License Information System (EUCARIS), which facilitates data exchange between registration authorities across the EU. This study indicates that several factors have contributed to the successful EU-wide adoption and expansion of the system. Throughout all layers (organisational, legal, and technical), aspects of simplicity, sense of control and autonomy, and adaptability were identified as relevant drivers. Further research is suggested to explore other cross-border interoperability initiatives approaches, following the conceptual model. As this thesis is limited to one case, further research could help to identify general conclusions on cross-border data exchange approaches and identify key success factors.

**Keywords:** Data Exchange, Cross-Border, Interoperability, EUCARIS, European Interoperability Framework, Digital Government

# 1 INTRODUCTION

*“The spread of information and communications technology and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide and to develop knowledge societies [...]”* (2030 Agenda for Sustainable Development, 2015, p. 5)

The vision of the European Union (EU) is to evolve towards an interconnected digital Europe that remains competitive in the international market. Enabling the four freedoms (free movement of goods, persons, services and capital) in the virtual sphere is essential to realise this vision (Digital Single Market Strategy, 2015). Hence, reducing digital barriers on all levels of government. Interoperability enables the seamless flow of information, essential for data exchange across public and private organisations. This data exchange is vital to realise the goal of pan-European digital service delivery.

The EU plays a crucial role in promoting interoperability standards between Member States (MS). Several political efforts aim to promote national digital transformation towards a joint direction to enhance interoperability between European public administrations and businesses. Several policies, action plans, and funding programmes were pushed forward to promote interoperability across EU borders. Among others are the Single Digital Gateway Regulation, eGovernment Action Plan, Digital Europe Programme, CEF Digital, or TOOP.

Since the nineties, public administrations (PA) have cooperated to harmonize their systems and exchange electronic information across borders. This cooperation has resulted in the emergence of numerous bilateral and multilateral data-exchange initiatives such as X-Road, EUCARIS, BRIS, and eHDSI. Some were initiated at the local level (PA) or the national level (governments), and others were initiated at the supranational EU level.

After two decades of EU efforts to promote cross-border interoperability, public administrations still fail to seamlessly exchange information across EU borders on a large scale. Thus, the overall European digital landscape remains fragmented and heterogeneous. Incompatible systems result in digital barriers and inefficiency. Several governments across Europe have invested financial and human resources to develop similar but inoperable technical systems.

Electronic cross-border data exchange has been addressed in academic literature since the nineties. Nevertheless, to date, the overall academic contribution in the field remains limited. Several

scholars have recognised shortcomings in previous attempts to approach and conceptualise forms of cross-border data exchange (Gharawi & Dawes, 2010; Goldkuhl & Röstlinger, 2015; McBride & Draheim, 2020; Navarrete et al., 2009; Pardo et al., 2013).

The Nordic Institute for Interoperability Solutions (NIIS) emphasizes the importance of understanding different approaches to cross-border data exchange solutions to explore the European interoperability landscape and its interconnections. The institute identified a research gap in a comprehensive overview of existing interoperability solutions and interconnections.

This thesis is conducted in parallel of the European Interoperability Report, initiated by NIIS, in order to address the present research gap. The aim of the report is to map existing cross-border data exchange solutions, explore their approaches, and find interconnections between them. The research was carried out by the CITIS<sup>1</sup> research team at the University of Tartu in 2022. Within the scope of the project, ten data-exchange solutions were analysed. A new conceptual model was developed for the analysis based on the interoperability layers of the European Interoperability Framework (EIF). To report is yet to be published. While this thesis is based on the work in the project, it is the creation of the author alone, including where overlap exists, such as the chapter on the EU policy background.

The overall objective of this thesis is to explore one selected approach to cross-border data exchange in more detail. For that reason, a case study on the data-exchange initiative EUCARIS is conducted. Following the aim to gain insights from an organizational, legal and technical perspective, this study examines what influenced the successful implementation of EUCARIS across Europe. In order to address the research objective, the following research question is posed: “How and why did EUCARIS succeed in facilitating cross-border data exchange between all EU Member States?”. The research is carried out in the form of an exploratory case study, following the framework developed under the European Interoperability Report. The motivation of this research derives from the project involvement of the NIIS European Interoperability Landscape Report.

The thesis consists of six chapters: 1) Introduction, 2) Background, 3) Methodology, 4) Case Study EUCARIS, 5) Discussion, and 6) Conclusion. Chapter 1 provides a general overview of the thesis and defines the scope, objective, and research question. In chapter 2, relevant research in the context of cross-border data exchange is provided in the form of a literature review. This is

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<sup>1</sup> Center of IT Impact Studies

followed by an EU policy background to provide an overview of relevant policies, initiatives, and funding programmes that shape the EU interoperability landscape. Furthermore, a background of the case is provided. The research design and methodology used to address the research question are described in chapter 3. Chapter 4 presents the findings of the case study on EUCARIS, along the lines of organisational, legal, and technical specifications. In Chapter 5, the results are discussed and evaluated. Finally, the findings of the thesis are concluded in chapter 6.

## 2 BACKGROUND

This chapter provides background knowledge on cross-border data exchange and interoperability with a European focus. First, general context is given on the digital transformation of governments and the role of data exchange and interoperable systems. Then, the findings of the literature study are presented in the literature review to provide an overview of relevant academic publications and studies in the respective field. Following that, the framework sub-chapter provides definitions of relevant concepts and an analytical lens through which data exchange and interoperability are perceived in this work. Moreover, it introduces a new conceptual model, which was developed as part of the European Interoperability Landscape project, referred to at the beginning. Relevant EU policies and programmes are reviewed and summarised in the next sub-chapter. The objective is to provide context and an overview of interoperability efforts at the EU level that have shaped the European data exchange landscape. At the end of the chapter, background information is given on the selected case of EUCARIS.

Governments worldwide face a profound global transition from the industrial age to the digitalisation of the economy and society (European Center for Digital Competitiveness, 2022). A new era of digital governments has emerged within this transition, using information and communication technology (ICT) (Fromm et al., 2015). Ding (2020) describes how governments struggle to meet citizens' growing demands for digital services in the public sector, resulting in increased public pressure. A key challenge of the public sector is to realise the full potential of those technologies to meet the expectations of citizens that already experience a higher degree of digitalisation in the private sector (van der Linden, 2019).

Interoperable government systems significantly improve the exchange and flow of information (Pardo et al., 2013). This information exchange enables organisations to generate new data to support the decision-making processes (Dener et al., 2021). Furthermore, interoperable systems are considered core components for achieving effective digital governments and delivering seamless digital public services to citizens (Pardo et al., 2013). Lallana (2008) highlights the benefits of cross-border interoperability as enhanced international cooperation and trade, reduced cross-border issues such as criminal offences, and better public service delivery across national borders. From an economic perspective, a higher level of interoperability across borders enables a wider variety of services and goods in the market (Stember et al., 2019).

While most countries have formulated and adopted national digital transformation plans, public administrations (PA) struggle to seamlessly exchange electronic data across different systems - within but also outside of national borders (*UN E-Government Survey, 2020*). A study in 2020 indicates that 94 countries worldwide had adopted a national Government interoperability framework (Dener et al., 2021, p. 30).

Over the years, several regional partnerships and cross-border initiatives have emerged to enable electronic data exchange between systems and across borders (*UN E-Government Survey, 2020*). These partnerships aim to strengthen national digital systems towards a joint direction that allows for interconnection between PAs (*UN E-Government Survey, 2020*). Thus, facilitating interoperability between systems. The basis for this cooperation is common standards, guidelines, and policy recommendations to promote developments in a joint direction that allows for connectivity (*UN E-Government Survey, 2020*).

## **2.1 Literature Review**

Electronic cross-border data exchange has been addressed in academic literature since the 1990s. Nevertheless, to date, the overall academic contribution in the field remains limited (Charalabidis et al., 2022). Concepts and terminology have changed over time due to the nature of digitalisation and ever-evolving technologies (Gottschalk & Solli-Sæther, 2009). A number of terminologies have been used in scientific literature to address forms of cross-border data exchange, such as but not limited to; multinational e-government information sharing (Navarrete et al., 2010), transnational public sector knowledge networks (Dawes & Gharawi, 2012), cross-boundary information sharing (Navarrete et al., 2009), inter-organisational information sharing (Goldkuhl & Röstlinger, 2015), cross-border e-government services (Kalvet et al., 2018), and pan-European e-government services (Peristeras et al., 2007). The variety of terminologies addressing overlapping concepts makes it more difficult to channel existing knowledge.

Gharawi & Dawes (2010) find that most existing research on digital government in a cross-border setting is conducted in the European context, addressing EU integration goals. The European Interoperability Framework builds a critical element for guiding European national interoperability frameworks in a common direction (European Commission, 2017).

The literature shows that early interoperability research has dominantly been addressed from a technical perspective (Charalabidis et al., 2022). Scholars have recognized the need to move

towards perceiving interoperability as the interplay of technical and social factors (Goldkuhl & Röstlinger, 2015; Navarrete et al., 2009; Pardo et al., 2013). Gharawi and Dawes (2010) address data exchange within trans-governmental networks as a “(...) complex and dynamic phenomenon where many factors may influence the exchange process” (Gharawi & Dawes, 2010, p. 123).

Furthermore, several analytical approaches were developed to conceptualize linkages between regional and national innovation systems (Binz & Truffer, 2017). McBride & Draheim (2020) provide a systematic literature review on digital government architectures and provides insight into their interconnections across borders. The authors point out that the traditional approaches of digital government scholars have significant shortcomings and that a holistic approach is needed.

Gharawi & Dawes (2010) conceptualise cross-border data exchange from a global networks integration perspective. The authors emphasize that transnational knowledge networks (TKNs) are part of digital government systems in should not be addressed isolated. Their research addresses the gap in previous studies on transnational information sharing that involved technical and organisational aspects but did not involve political, legal, institutional, and cultural factors. Daws & Gharawi (2012) applied the concept of TKNs to the public sector and introduced the term ‘transnational public sector knowledge networks’ (TPSKNs). Their research provides insight into factors (internal and external) and conditions that influence public sector networks and involved actors (Dawes & Gharawi, 2012). However, this theory did not seem to be adopted and tested in the wider academic discourse.

Navarrete *et al.* (2009) developed a theoretical framework for public sector information sharing in a cross-border setting. It combines the theory of borders and concepts of cross-border information sharing. The framework addresses the dynamics of information use and sharing across borders. The authors incorporated the technical dimension of data exchange with economic, political, and cultural factors that impact cross-border interaction.

One year later, Navarrete *et al.* (2010) further developed the framework and connected the respective cross-border information sharing model with the phenomena of multinational e-government collaborative networks. It combines theoretical approaches (inter-organizational collaboration theories, value network theory, theory of borders) to build a new theoretical approach to multinational e-government collaboration information sharing and interoperability. While this theory provides a holistic approach, its complexity makes it challenging to apply to real-life cases

due to the multitude of factors from multiple academic disciplines. This theory did not prevail in the academic discourse.

Pardo *et al.* (2010) examined the topic of collaborative governance from a cross-boundary information sharing (CBIS) perspective. The authors address data exchange between public administration in the context of globalisation and the internationalization of the public sector in order to explore multidimensional capabilities for government interoperability. Gil-Garcia *et al.* (2016) revised the work of Pardo *et al.* (2010) and found that existing research on CBIS does not sufficiently address complex interactions of cross-boundary information sharing. To address this gap, the authors introduced a socio-technical approach to CBIS as a socio-technical phenomenon (Gil-Garcia *et al.*, 2016). This approach set a focus on the network and actors of information sharing.

More recently, the research of Krimmer *et al.* (2021) specifically addressed different approaches to e-governance within the EU cross-border context. The authors provided research on the following European interoperability initiatives: CEF eDelivery, BRIS, EESSI, EUCARIS, OpenPEPPOL, and TOOP (Krimmer *et al.*, 2021). The initiatives were analysed along the layers of the European Interoperability Framework to identify drivers and barriers to cross-border digital service delivery. The authors highlight the relevance of enabling cross-border interoperability to achieve integrated public service governance at the EU level (Krimmer *et al.*, 2021). The publication is critical literature for this thesis due to its EU focus and the linkage to the European Interoperability Framework. Moreover, as it provided insights on EUCARIS, among other data-exchange solutions, and evaluated it as a decentralised organisation with a distributed system and a private network (Krimmer *et al.*, 2021).

The literature review shows that, to date, the academic field concerning cross-border data exchange is still not well-established. Several authors have identified lacking research and built new models. However, no model seems to be widely adopted by other researchers. In the late 1990s and early 2000s, research focused on technical aspects, as systems were still not fully developed at that time (Charalabidis *et al.*, 2022). When the first systems were fully developed, and technical aspects were not considered the main challenge anymore, the research focus moved towards organisational and legal aspects.

In the 2010s, the literature strongly emphasised the need for a more holistic framework to address cooperation aspects of cross-border data exchange. Particularly social, political, and economic

factors were emphasised to be included in assessing cross-organisational cooperation. However, while several authors have identified the need to address cross-border interoperability from a more holistic perspective, Pardo *et al.* (2013) describe how researchers and practitioners struggle to grasp the complexity of multidimensional interoperability. In that sense, scholars address the issues and provide complex theoretical frameworks which are difficult to fully address in practice.

Different terminologies and fast-changing concepts in the field of digitalisation make it harder to channel existing knowledge. In general, Charalabidis *et al.* (2022) observed that literature dominantly addresses digital governance in positive terms and lacks a critical reflection.

## **2.2 Framework**

This sub-chapter provides definitions of core concepts, describes the European Interoperability Framework, and introduces the new conceptual model. While the literature review provided an overview of existing and insightful theoretical frameworks, they certainly had different research foci compared to the objective of this research and were also too complex to address within the scope of this thesis.

The EIF specially addresses interoperability within Europe and is relevant in the context of this research as it is used as a basis for the new conceptual model. However, the EIF is aimed more at public administrations in a practical sense and to facilitate interoperable systems across Europe. It provides guidance on common standards and principles to align technical systems all over Europe in one common direction (European Commission, 2017). As this research is concerned with conceptualising data-exchange solutions, the layers of the EIF were used as guidance. The developed model is presented at the end of this chapter.

### **2.2.1 Defining Interoperability**

For the purpose of this study, the definition of the term interoperability follows the definition of the EIF:

Interoperability is “(...) the ability of organisations to interact towards mutually beneficial goals, involving the sharing of information and knowledge between these organisations, through the business processes they support, by means of the exchange of data between their ICT systems.” (European Commission, 2017, p. 5).

In short, interoperability is characterized by three factors: 1) interaction between organisations, 2) sharing of information and knowledge, and 3) exchange of data through ICT systems. The meaning of the term derives from Latin *inter* “between” and operate from *opus* “work” - the ability to work together. Pardo *et al.* (2013) argue that interoperability is a crucial enabler for governments to improve digital service delivery. Nevertheless, the authors emphasize that “citizens do not demand interoperability; rather, systems must be interoperable to effectively meet citizens’ demands” (Pardo et al., 2013, p. 17).

Interoperability Frameworks (IFs) address interoperability within a governmental context. They can be defined as:

“(…) a document or group of documents that specify a set of common elements such as vocabularies, concepts, principles, policies, guidelines, recommendations, standards, and practices for agencies that wish to work together towards the joint delivery of public services.” (Lisboa & Soares, 2014, p. 638)

Stember *et al.* (2019) highlight interoperability standards as essential for cross-border data exchange. Interoperability across borders can be achieved by aligning several national IFs (Lisboa & Soares, 2014). Their implementation helps to tackle and address interoperability on a holistic level (Stember et al., 2019, p. 22).

Peristeras *et al.* (2007, 2008) provide definitions of public services in a cross-border setting. The authors introduce the term pan-European Public Services (PEPS). Cross-border services refer to services provided from one country to citizens based in another country. The term Cross-border e-services include the aspect of electronic services. Pan-European public services (PEPS) and Pan-European e-government services (PEGS) are public services provided by a public administration in the EU to citizens of another MS, and electronic public services, respectively (Peristeras et al., 2007, 2008).

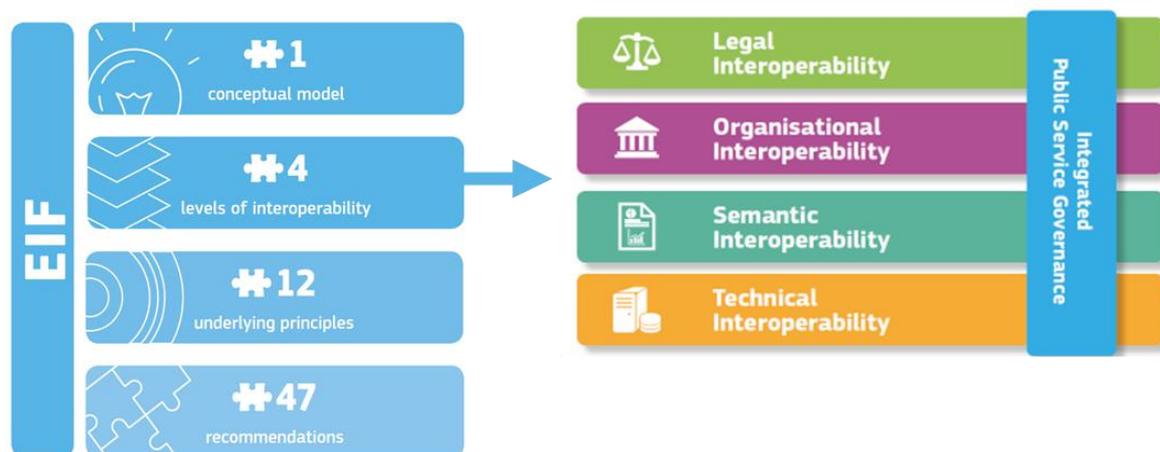
## **2.2.2 European Interoperability Framework (EIF)**

In the early 2000s, the EU developed the first supra-national EIF to promote interoperability across the Member States. The EIF provides guidance to public administrations. It sets out common principles, a conceptual model, and recommendations to enhance the national interoperability framework of EU MS in a joint direction. The first version of the EIF (for pan-European e-Government services) was published in 2004, followed by the second version of the EIF in 2011 (towards interoperability for

European public services) (European Commission, 2011). It was updated in 2017 to the current EIF version with the focus on promoting seamless services and data flows for European PAs (European Commission, 2017).

The four building blocks of the EIF are illustrated in Figure 1. They are composed of the conceptual model, four layers of interoperability, underlying principles, and a set of recommendations for public administrations (European Commission, 2017). For the purpose of this research, the layers are explained in more detail. Integrated public service governance is a cross-cutting component of the four layers of interoperability, as illustrated in Figure 1. It enables public administrations to work together in order to provide European public services in an integrated way. In order to achieve this, legal, organisational, semantic, and technical aspects need to be enabled on all levels (European Commission, 2017).

Figure 1 - European Interoperability Framework - Four Layers of Interoperability



Source: European Commission (2017, pp. 8, 22)

Legal interoperability is concerned with coherence between legislations. It aims to ensure that “organisations operating under different legal frameworks, policies and strategies are able to work together.” (European Commission, 2017, p. 27). In other words, legal interoperability addresses the question of how to handle different legal and political landscapes. This is a crucial requirement to enable cross-border interoperability, as the success of European public services comes down to the compatibility of national legal frameworks and their governmental systems. For a successful implementation of European public services, the EU recommends that national legislation should be adopted were contradictory to supra-national agreements. The EIF recommends that it should be assessed as a first step.

Organizational interoperability refers to “the way in which public administrations align their business processes, responsibilities and expectations to achieve commonly agreed and mutually beneficial goals.” (European Commission, 2017, p. 28). Business process alignment and organizational relationships are two relevant aspects of organizational interoperability. Business process alignment refers to documenting and aligning the processes and information exchange within public administrations. Public administrations may have to align or establish new business processes. Organizational relationships are relationships between service providers and service consumers. They must be clearly defined. The overall objective is service orientation and meeting the users’ needs. Relevant principles to consider are, for example, service availability, accessibility, and user-friendliness.

Semantic interoperability deals with the format and meaning of exchanged data and information to avoid miscommunication. It is distinguished between semantic and syntactic aspects. Syntactic aspects deal with the grammar and the exact format of information. The semantic aspects are concerned with the “actual meaning of data elements and the relationship between them” (European Commission, 2017, p. 29). In order to ensure a common understanding among European public organisations, information standards are required; this can be in the form of common vocabularies, taxonomies, code lists, or schemata to describe data elements.

Technical interoperability refers to the linkage of systems and services on a technical level. This can be achieved through common standards on, e.g. data exchange, communication protocols, and interface specifications. As governmental organisations have developed applications and information systems based on different technological standards, the current EU landscape is referred to as “fragmented ICT islands” (European Commission, 2017, p. 30). Since technical solutions in the Member States were developed individually to solve domain-specific and local problems, systems are often inoperable and cannot be connected. Thus, creating interoperability barriers and highlighting the need for common technical standards.

### **2.2.2 Conceptual Model for European Cross-Border Data Exchange Initiatives**

The conceptual model for European Cross-Border Data Exchange Initiatives was developed as part of the earlier mentioned European Interoperability Landscape Report. It was developed by the CITIS research team at the University of Tartu. The model composes of organisational (business) specifications, legal specifications, and technical specifications. The aim was to conceptualise approaches to cross-border initiatives in Europe. Moreover, to provide a tool that helps to compare

several initiatives based on the same criterion. The framework provides an analytical lens to look at cross-border initiatives. It is based on the EIF and adjusted for the purpose of this project.

The framework is structured in three categories, legal specifications, organisational (business) specifications and technical specifications of cross-border data-exchange initiatives. Legal specifications address the legislations forming the basis for the cross-border data exchange, and that enables the data exchange from a legal level. Organisational specifications provide an overview and details of cross-border data exchange solutions, such as the description, vision, objectives, and governance. Technical specifications address criteria relevant for data exchange across borders, such as data exchange (messaging) models, data transmission communication methods, network usage, code openness, and solution’s specialisation. An overview of the model and its criterion for each category is shown in Table 1.

Throughout the research process of this thesis and based on the findings of the case study, the conceptual model was adjusted, as explained in Chapter 5. The adjusted version of the model is displayed in Table 1. It includes three specifications, twelve criteria, and provides descriptions for each criterion. The original table is attached to Appendix 1.

*Table 1 - Conceptual Model for European Cross-Border Data Exchange Initiatives*

<b>Specifications</b>	<b>Criterion</b>	<b>Description</b>
<b>Organisational (business) Specifications</b>	Description of initiative	The description provides information about the initiative, as well as how and why it was developed. This criterion provides information on key characteristics and features.
	Vision and objectives	The vision and objectives indicators provide information on the goals and aims of the data exchange solution. This will provide insights into the future developments of the initiative.
	Governance	Governance of the solution is the criterion that provides an overview of who governs the solution and who is responsible for managing, updating, and monitoring the data exchange solution. It provides information on the implications of the existing governance structure. Furthermore, this indicator describes if the initiative emerged from a top-down or bottom-up approach.
	Type of data exchange solution	This indicator defines the type of data exchange solution. The first type is the national infrastructure solution. The second type is solutions developed within the EU Large Scale Pilots. The third type is the Member State-driven cross-border solution. Furthermore, this indicator describes whether the initiative is sector-specific vs holistic approach.

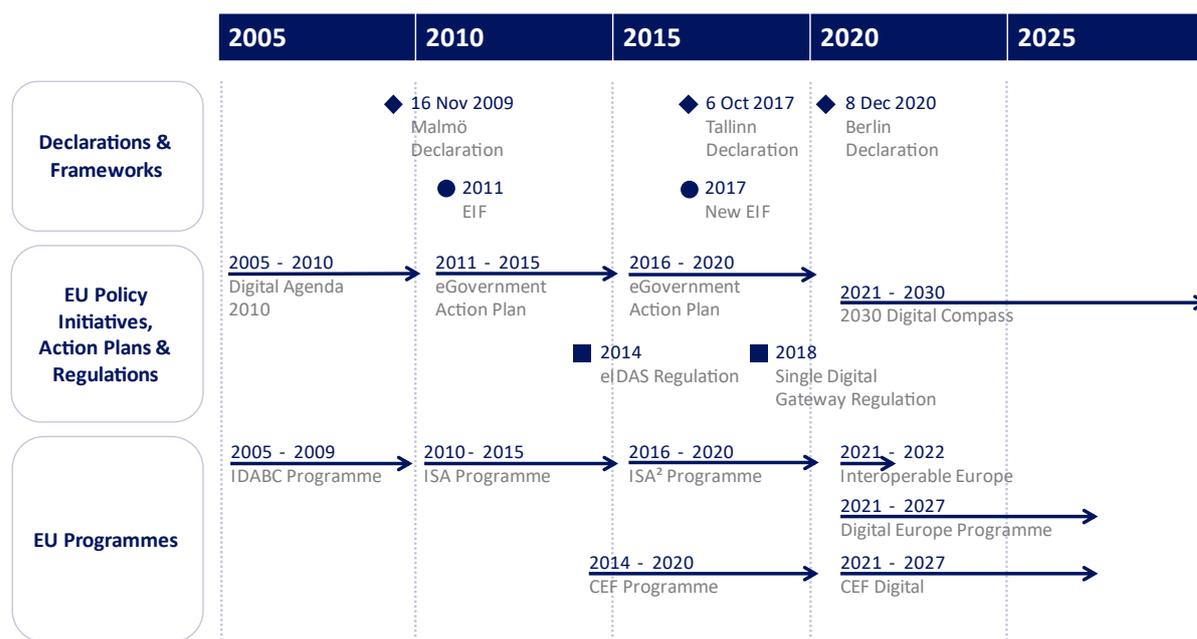
<b>Legal Specifications</b>	Legal basis	This indicator aims to provide information on the legal acts that regulate the exchange of data across borders. The aim is to provide an overview of the legal basis of the initiative.
	Type of agreement	This criterion looks at the type of legal agreements, whether they are bi-lateral (between two countries) or multi-lateral (between several countries)
	EU reference	The EU reference indicator describes if the initiative is part of the EU legal framework and/or has a legal reference to the EU.
<b>Technical Specifications</b>	Technical approach	The criterion describes the technical system and the technical approach to data exchange. It includes the system distribution of the initiative, which distinguishes between a purely distributed system and central platform/routing components.
	Network usage	The data exchange solution network usage criterion addresses the network the solution connects to and uses to exchange data or documents (public internet vs closed network). Solutions using the public internet are connected to the wider network. Solutions using private internet are connected to closed networks such as the sTESTA network developed by the EC.
	The openness of standards and specifications	This criterion address whether the data-exchange solution uses specific standards or specifications that are either open code, standards and specification or proprietary, developed specifically for the purpose of the data-exchange solution.
	Data-exchange specialization	The data-exchange specialization criterion addresses the integration of the data exchange among the organizations, whether data exchange is organised among similar functional domain databases or among different functional domain databases.

Source: Based on *European Interoperability Landscape Report (forthcoming)*

## 2.3 EU Policy Background

This sub-chapter provides an overview of declarations, policies, and initiatives that are relevant in the context of cross-border data exchange in Europe. The insights into the EU interoperability landscape help to understand the current state of cross-border interoperability and in which direction it aims to develop. This background helps to assess existing initiatives within the European context. Figure 2 provides an overview of the most relevant declaration, policies, and projects from 2005 to 2030. The most relevant policies and programmes for the research objective are addressed in this chapter.

Figure 2 - European Cross-Border Interoperability Policy Overview



Source: European Interoperability Landscape Report (forthcoming)

The EU Member States and European Free Trade Association (EFTA) countries have expressed their commitment to the digital transformation of their governments in the form of several Ministerial Declarations. Dating back to the early 2000s, ministers have declared to make the digital transformation of governments their priority and, at the same time, strengthen coordination between MS to reinforce cross-border interoperability. Among the most relevant declarations for cross-border aspects are the Malmö Declaration and the Tallinn Declaration (*Malmö Declaration*, 2009; *Tallinn Declaration*, 2017). They specifically set out the objective to promote interoperability and seamless cross-border services between public administrations. As part of the Tallinn Declaration, the basis for further action and policies was defined in commonly agreed-upon principles such as digital-by-default, once-only, and interoperability by default. Furthermore, this declaration promotes open, transparent, inclusive, personalised, and user-friendly digital public services (*Tallinn Declaration*, 2017).

The launch of the Digital Single Market Strategy started a new era of digital transformation in Europe (A Digital Single Market Strategy for Europe, 2015). The strategy defines the European vision to move from 28 national digital markets to only one single market in the digital sphere. The overall objective of the Digital Single Market is to ensure Europe's leadership in the digital economy. It calls on the public and private sectors to ensure the digital ecosystem's four freedoms of movement (*of goods, services, people, and capital*). The strategy recognises the importance of interoperability across borders and aims to reduce trade barriers. It defines coordinated EU action

to ensure a harmonised internal market, as the Member States repeatedly expressed similar problems with digital cross-border activities.

The eGovernment Action Plan 2011-2015 was launched by the EC to realise policy goals and principles set out in the Malmö Declaration (EGovernment Action Plan 2011-2015, 2010). It provides a political instrument to join European efforts by discussing and exchanging good digital government practices between the MS. Building on the eGovernment Action Plan 2011-2015, the second eGovernment Action Plan 2016-2020 was launched to enhance the Digital Single Market by further reducing digital barriers and virtual borders (EGovernment Action Plan 2016-2020, 2016). Member States recognise the digital transformation of governments as a critical element to achieving this objective. The action plan promotes coordination of digital government efforts and resources on the EU level to combat digital fragmentation across European public administrations.

Both eGovernment Action Plans follow the principles of the EIF that was introduced earlier in this chapter. The objective of the EIF is to enhance the interoperability of European public administrations (European Commission, 2011). The initial version of the EIF was published in 2004, updated in 2011, and further developed into its current version in 2017 (European Commission, 2017). The new EIF provides a common framework with 47 principles based on the four main interoperability layers, legal, organisational, semantic and technical. The aim is to support the Member States in developing their national interoperability frameworks and ensure interoperability between national systems. In addition, the overall objective remains to enhance seamless services and data flow between public administrations. Moreover, to prevent further digital fragmentation and promote a harmonised digital single market through a coherent European interoperability environment.

The eIDAS Regulation marks a milestone toward electronic identification and e-transactions across EU borders (Regulation (EU) No 910/2014, 2014). Member States agreed to enable e-signatures in all EU authorities and companies that provide public services. Moreover, it recognises that citizens and businesses should have access to online procedures in all EU countries without facing any discriminatory cross-border barriers. eIDAS is considered a key enabler for securing cross-border transactions in Europe. The aim is to facilitate eID access to key public services in the EU cross-border environment for at least 80% of citizens (European Parliament, 2021).

The Single Digital Gateway Regulation complements eIDAS by providing a European digital single-entry point to access information, administrative procedures, and services for citizens and businesses (European Commission, n.d.; Regulation (EU) 2018/1724, 2018). It was adopted in 2018 and defines common rules and guidelines for digital public services in order to further harmonise services across the MS. Thereby, it builds a critical regulatory element of the Digital Single Market Strategy and marks an important step toward realising the once-only principle. The MS countries committed to offering online access to 21 procedures through the digital gateway and in all EU countries by the end of 2023 (Regulation (EU) 2018/1724, 2018). Access is provided through the ‘Your Europe’ portal, which has operated since 2006 to provide information to EU citizens. Together with the eGovernment Action Plans, the Single Digital Gateway lays another foundation for future cross-border initiatives and formulates a comprehensive European vision.

European funding programmes in the context of data exchange between European administrations started in the nineties. Funding was facilitated through the following programmes: two IDA programmes (Decision 95/468/EC, 1995; Decision 1719/1999/EC, 1999), the IDABC programme (Decision 2004/387/EC, 2004), two ISA programmes (Decision (EU) 2015/2240, 2015; Decision No 922/2009/EC, 2009), the Interoperable Europe programme, the CEF and CEF Digital programme (Regulation (EU) No 1316/2013, 2013), and the Digital Europe programme (Regulation (EU) 2021/694, 2021). The most recent Digital Europe programme provides strategic funding (€7.5 Billion) for digital infrastructures in order to enhance seamless cross-border cooperation at the European level. The programme aims to shape the digital transformation of the European economy and society to improve Europe’s competitiveness in the digital global economy. One of the five objectives is to deploy and make the best use of digital capacity and interoperability by providing holistic, cross-sector and cross-border support.

After more than two decades of EU cross-border interoperability programmes, the 2030 Digital Compass (2021) was launched. It provides a shared vision and actions for Europe’s digital transformation and recognises the changing role and perception of digitalisation in society as a result of the COVID-19 pandemic. The pandemic highlighted prevailing barriers in the digital space and dependencies on a number of big tech companies and non-European technologies (Schmidt & Krimmer, 2022). The vision of the 2030 Digital Compass communication is based on four domains: (1) digital skills, (2) digital infrastructures, (3) digitalisation of public administrations, and (4) digitalisation of businesses (2030 Digital Compass, 2021).

## 2.4 Case Background: EUCARIS

In the late 1980s, a growing phenomenon of stolen vehicles and legal re-registrations across European countries was observed by public administrations (Cavaye, 1998; König, 2019). This problem was linked to the removal of border controls within Europe due to a growing European integration (König, 2019). While national authorities recognized the increasing problem of car theft, they could not identify whether a car was registered as stolen in another European country (Cavaye, 1997; König, 2019). This posed a growing need for better and faster cross-border cooperation to find out where stolen cars were exported (*Interview EUCARIS*, 2022).

At that time, stolen vehicles could receive legal documents from another country, as registration authorities had to register cars within a short time if they could not prove an existing registration in another country (Cavaye, 1998). Traditionally, when registration authorities doubted the legality of a vehicle, they reached out to foreign registration authorities by letter, email, phone, or fax (Cavaye, 1998). This process was time-consuming, inefficient and difficult to manage (Cavaye, 1998). The idea of EUCARIS was born to provide a solution to this problem - an electronic data exchange system to enable access to information from database registers in other countries (Cavaye, 1998). The system created the possibility to search and check car registration data instantaneously (Cavaye, 1998).

The initiative was officially established by five founding countries: Germany, Belgium, Luxembourg, the Netherlands, and the United Kingdom (EReg, 2019). The objective was to combat criminal offences, such as legally registering a stolen car in another country or using forged documents (EUCARIS Treaty, 2000). Especially the Netherlands and Germany were the driving forces as these were the countries that recorded a high number of stolen cars (Cavaye, 1997). Germany was considered a key transit country for stolen vehicles and a criminal hub for export and import (König, 2019).

EUCARIS aims to support law enforcement and police offices in order to increase road safety across Europe (Paul, 2009). Over the years, the collaboration has broadened its scope to a general exchange system for transport-related data, as well as expanded to 30 European countries (*Interview EUCARIS*, 2022). The participating countries connected to EUCARIS are displayed in Figure 3. Due to Brexit, the UK is currently disconnected and is working on reconnecting (*Interview EUCARIS*, 2022).

Figure 3 - European countries using the EUCARIS cross-border data exchange solution



Source: European Interoperability Landscape Report (forthcoming)

### **3 METHODOLOGY**

This thesis is conducted in parallel of the Nordic Institute for Interoperability Solutions (NIIS) report on the European Interoperability Landscape, carried out by the Center of IT Impact Studies at the University of Tartu, Estonia. Scholars and experts in cross-border e-governance composed the research team. The research was conducted between November 2021 and April 2022, including desk research and 11 semi-structured interviews. Leading cross-border solutions were identified as X-Road, eDelivery (BRIS, EESSI, OpenPeppol), EUCARIS, and OpenNCP. The final report has not yet been published.

Insights from existing work and publications of the research team have been incorporated into this project (Dedovic, 2021; Kalvet et al., 2018; Krimmer et al., 2017, 2021; Schmidt & Krimmer, 2022). In addition, the research team was able to provide inside knowledge based on work experience within EU Institutions, such as the European Commission. The project meetings and informal discussions provided valuable insights and background knowledge for this thesis.

As part of the report, a new conceptual model was developed. The EIF provides the basis for this model. It was adjusted since the EIF is aimed more at public administrations in a practical sense to facilitate interoperable systems across Europe. The EIF focuses on providing guidance and a set of common standards and principles to harmonise systems all over Europe in one common direction. The developed interoperability initiative model uses similar layers to investigate the approach of cross-border data exchange initiatives.

While the literature provides theoretical frameworks in the context of data sharing across borders, they were not considered suitable to address the research objective. On the one hand, as they approached cross-border information sharing from different angles, on the other hand, based on their complexity and difficult applicability. Additionally, the proposed theoretical frameworks were not sufficiently tested.

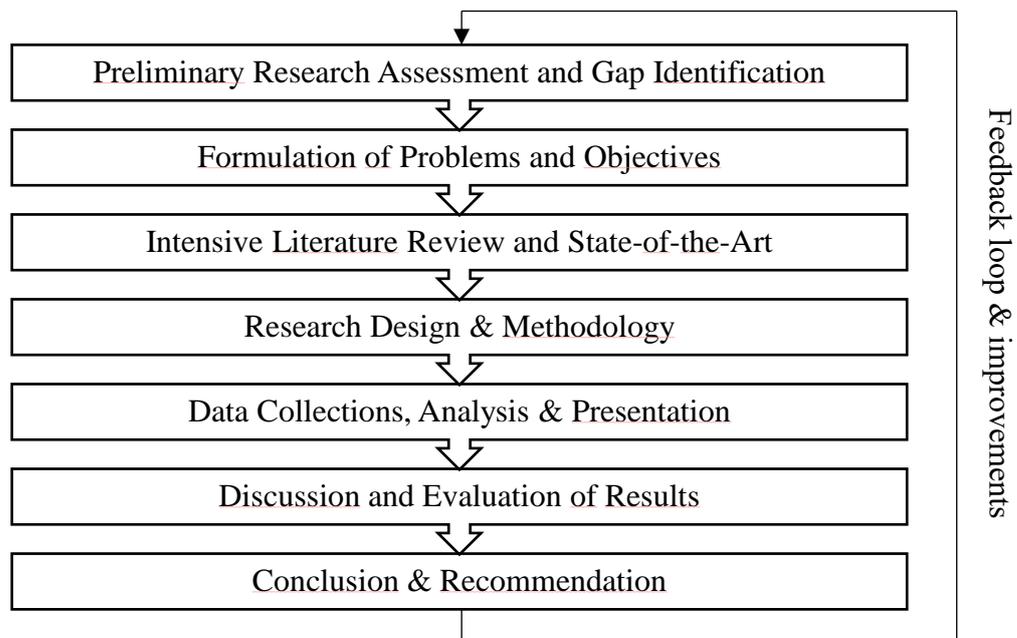
For the purpose of this thesis, the following research question was posed: “How and why did EUCARIS succeed in facilitating cross-border data exchange between all EU Member States?” This chapter explains how the research was addressed and how data was collected and analysed.

### 3.1 Research Design

The research design is inspired by three methodology books relevant in terms of topic and method selection. The book ‘Scientific foundation of digital governance and transformation’ (Charalabidis et al., 2022) was used for an initial overview of the scientific state of the art in digital governance research. Secondly, McNabb’s book ‘Research Methods in Public Administrations and Nonprofit Management’ was used to explore PA related research approaches and strategies (McNabb, 2018). Yin’s (2018) book ‘Case study research and applications’ provided valuable insights on multiple-case study research. The author’s approach of a ‘linear but iterative process’ guided the case study design. Its strength is the flexibility and adaptability along the way of the research once new insights are made (Yin, 2018, p. 30). This approach is especially useful in exploratory case studies (Yin, 2018).

The research process included the identification of the research problem and objective, conducting the literature review, deciding on a research strategy and methodology, gathering data, and analysing data. The findings were evaluated and discussed, and the conclusion summarized the overall results of the thesis. As the research is influenced by new information throughout the process, feedback loops were included for greater coherence and improvements. The research process of this thesis, adapted from Sileyew (2019, p. 2), is illustrated in Figure 4.

Figure 4 - Research Process



Source: Author based on Sileyew (2019, p. 2)

## **3.2 Methodological Approach**

A qualitative approach was chosen as the most suitable approach to address the research objective. The advantage of qualitative research is that it helps to explore and better understand a specific topic of investigation in order to provide explanations (McNabb, 2018). It was decided that the best empirical method to adopt for this investigation was an exploratory case study. This method is used to investigate real-world cases that are not been fully explored yet (Yin, 2018). For the purpose of this research, a single case design was favoured over a multiple-case design to explore the approach of one specific data exchange initiative in more depth. The unit of analysis is the selected initiative (EUCARIS). The case study follows a holistic approach (compared to an embedded approach) in order to explore factors that help to explain how and why EUCARIS managed to be successfully implemented in all EU countries. A conclusion is drawn based on evidence and reasoning (inference). To summarize, this research project follows a quantitative approach using the method of an exploratory case study with a single case (EUCARIS).

## **3.3 Case Selection**

Within the scope of the European Interoperability Landscape Report, ten data-exchange solutions were analysed. The case of EUCARIS was selected for this thesis as it provides a case of a well-established data exchange solution - the early forms of cooperation started about three decades ago. For that reason, EUCARIS offers a wide availability of data for analysis. Moreover, it is one of few cross-border data exchange initiatives that enable the exchange of information between public administrations of all EU Member States. Furthermore, EUCARIS offers an interesting case as it started as informal cooperation between five founding countries, followed by the first multilateral Treaty between the five countries in 2000, over to be partly integrated into the European legal framework. Although the cooperation has greatly expanded, the technical system itself is kept rather simplistic.

## **3.4 Data Collection**

In order to gather data for this research project, three types of qualitative data were collected. The data sources are categorized as follows:

- (1) Secondary data sources

- a. Academic literature
  - b. Non-academic literature
  - c. Legal documents
  - d. Reports
  - e. Websites
- (2) Primary sources
- a. Semi-structured interviews (conducted in February and March 2022)
- (3) Internal sources
- a. Research Team Meetings
  - b. Meetings with NIIS
  - c. Informal discussions

Data collection for the case study on EUCARIS explicitly included sources from different perspectives in order to validate the information and avoid the risk of solely relying on data from EUCARIS itself. This included academic literature, EU sources (legal documents, Commission reports, Joinup website), information from EReg (website and presentation slides), and EUCARIS sources (interview, website, presentation slides).

Eleven semi-structured interviews were conducted as part of the interoperability report. The questions followed the structure of the developed conceptual model in order to provide a possibility to compare initiatives based on common factors. Relevant to this thesis is the interview carried out with two representatives of EUCARIS on the 8th of March 2022 (61:00 minutes). The interview was analysed in detail and coded following the categories of the Cross-border Initiative Framework.

### **3.5 Data Analysis**

As this research is qualitative, the data analysis included the categorisation and interpretation of data. The first step was to go through the data in detail, interpret the meanings, and then extract the information that was most relevant to answer the research question. The approach used to analyse the data was thematic analysis which is a widely used approach that focuses on finding patterns in data (Kiger & Varpio, 2020). Braun & Clarke (2006) define six steps which were used as a guide for this research: 1) familiarising yourself with your data, 2) generating initial codes, 3) searching for themes, 4) reviewing themes, 5) defining and naming themes, and 6) producing the report.

## 4 CASE STUDY: EUCARIS

This chapter presents the findings of the case study on EUCARIS along the categories of the conceptual model developed as part of the European Interoperability Landscape Report (see chapter 2). This includes organisational, legal, and technical specifications. The aim is to explore the overall data-exchange approach of EUCARIS and gain insights into how and why the initiative managed to successfully facilitate cross-border data exchange between all EU Member States and other European countries.

### 4.1 Organisational Specifications

The early nineties mark the beginning of EUCARIS with the first forms of cooperation between the Netherlands, Belgium, and Luxemburg (EReg, 2019). Initiated by the Dutch Vehicles and Driving Licences Registration Authority (RDW), EUCARIS started as an informal working arrangement (Cavaye, 1998; König, 2019). The collaboration was a response to the opening of EU borders and rising numbers of car theft across countries (EReg, 2019; König, 2019). Its initial purpose was to enable trans-national checks of registration data on vehicles before registering new cars to combat cross-border crimes (EReg, 2019).

EUCARIS emerged from a Member State-driven bottom-up development that started more than two decades ago (*Interview EUCARIS, 2022*). As the EU did not develop many cross-border data exchange initiatives at that time, EUCARIS did not consider being developed as part of the EU framework (*Interview EUCARIS, 2022*). From the beginning, it became clear that the parties involved were interested in maintaining autonomy over their own registration system and not integrating them into a central database (Cavaye, 1997; *Interview EUCARIS, 2022*). Moreover, it was not considered feasible to integrate various incompatible national registration systems into one extensive system (Cavaye, 1998; *Interview EUCARIS, 2022*). It was also not considered necessary for the project's purpose (Cavaye, 1998). Cavaye (1998) points out that a central system was seen as a threat to the autonomy of individual registration authorities.

Over time, EUCARIS has developed into a formalised collaboration between all EU Member States and other European countries (*Interview EUCARIS, 2022*). It is now an EU-wide recognised information exchange system and forms part of the EU interoperability landscape (*Interview EUCARIS, 2022*). EUCARIS has expanded its scope and serves as a general exchange mechanism

for transport-related data (Dijkstra, 2010). The exchanged information is on vehicle and driving license data, vehicle owner and holder insurance data, data on traffic offenders, and other transport-related data (*Interview EUCARIS, 2022*). EUCARIS is mainly used by registration authorities, the police, and customs authorities (Dijkstra, 2010). It is open to governmental organisations or entities with a public mandate (Marek, 2016).

EUCRAIS follows a decentralised approach, with countries maintaining their own registries and adhering to a minimum of harmonization required for reduced complexity (*Interview EUCARIS, 2022*). The basic level of harmonization allows for communication across borders in a standardised way, based on agreements and standards on how to exchange information (*Interview EUCARIS, 2022*). EUCARIS provides a shared software that participating parties run on their own system, enabling connections across borders (*Interview EUCARIS, 2022*). The overall objective of EUCARIS remains to combat cross-border related crimes in the transport sector (König, 2019).

EUCARIS is a non-profit organisation governed by representatives of registration authorities within Europe (*Interview EUCARIS, 2022*). Therefore, EUCARIS is owned and maintained by the EUCARIS community itself (*Commission Impact Assessment, 2012*). The EUCARIS General Assembly holds the highest authority and is composed of representatives of national registration authorities (*Interview EUCARIS, 2022; Marek, 2016*). The assembly manages the system, budget and takes overall decisions (*Interview EUCARIS, 2022*). It includes two nominated parties that are elected and assigned every three and five years. On the one hand, the secretariat and finances, and on the other hand, operations for IT-related aspects (*Interview EUCARIS, 2022*). The elected Chairman leads the General Assembly and is responsible for the daily management (*Interview EUCARIS, 2022*).

As EUCARIS is maintained by representatives of registration authorities, the positions within EUCARIS are fulfilled by members besides their regular jobs (*Interview EUCARIS, 2022*). Consequently, representatives running EUCARIS are not employees of EUCARIS itself (*Interview EUCARIS, 2022*). As an example, the current chairman is a board member of the Dutch vehicle registration authority, which has granted him a specific number of hours to fulfil his position within EUCARIS (*Interview EUCARIS, 2022*). The EUCARIS Treaty defines the rules of procedure and how positions should be taken over after new elections (*Interview EUCARIS, 2022*). Hence, it forms a governance element (*Interview EUCARIS, 2022*).

There is close cooperation between EUCARIS and the Association of European Vehicle and Driver Registration Authorities (EReg). EReg is a network of registration authorities concerned with joint strategies, policies, exchange of best practices, and future developments (EReg, 2019). Many registration authorities associated with EReg use EUCARIS as an exchange mechanism (EReg, 2019). The EUCARIS General Assembly meeting in 2021 announced that opportunities are being explored to intensify cooperation with EReg by establishing a joint EReg/EUCARIS Project Group (EReg, 2021).

The strategy to go for decentralisation was considered a significant factor in the adoption of the system in several European countries, as well as seeing the first practical result (König, 2019). The legal integration process followed after, due to increasing pressure for more institutionalization of the informal cooperation (König, 2019). When the police explored the potential of the data exchange solution for law enforcement, they became another important driver (*Interview EUCARIS*, 2022). Since the police expressed the growing need for a network to identify stolen cars and issue fines across national borders, public administrations showed a high willingness to join EUCARIS (*Interview EUCARIS*, 2022). Decentralisation was considered an appropriate model for the police to address the issue of trust, as data could be managed at the national level (König, 2019).

EUCARIS is currently adapting to the growth and expansion of the network. This expansion includes more opinions and conversations but also more diverse interests that need to be channelled (*Interview EUCARIS*, 2022). Considering that EUCARIS grew from a relatively small collaboration to an initiative of 30 countries, new organisational challenges are constantly arising (*Interview EUCARIS*, 2022). Additionally, there is the challenge of keeping members active as the system is running well (*Interview EUCARIS*, 2022). EUCARIS is currently working on an established joint vision for the future and reviews the way it is organised (*Interview EUCARIS*, 2022). The network is growing, and thus, the budget is increasing.

## **4.2 Legal Specifications**

After starting as informal cooperation, there was pressure to formalise the cooperation into a legal agreement (König, 2019). Countries, such as Germany and the UK, expressed their concerns about the lack of a legal basis for EUCARIS and pushed for legal formalisation (König, 2019). This led to the creation of the EUCARIS Treaty, which was signed by Belgium, Germany, Luxembourg,

the Netherlands, and the United Kingdom (EUCARIS Treaty, 2000). König (2019) highlights political pressure rather than practical pressure as the reason behind this decision.

Over the years, the cross-border collaboration increased rapidly, with more and more countries joining (König, 2019). This created the need to enhance professionalisation and institutionalisation (König, 2019). Throughout the system's expansion, it became clear that a strong legal basis is required to build trust towards EUCARIS and between the parties involved and the parties (*Interview EUCARIS, 2022*). Member States wanted to make sure that the rights and interests of their citizens were protected (*Interview EUCARIS, 2022*). Several stakeholders pushed to integrate EUCARIS into the institutional framework of the EU (König, 2019). Additionally, the European Commission strongly supported integrating EUCARIS (König, 2019).

The EUCARIS system can be seen as a technical platform that runs different applications within multiple judicial frameworks. Each application exchanges different types of data (EUCARIS, n.d.-b). For that reason, EUCARIS operates on the following legal bases: a) the EUCARIS Treaty, b) the EU legal framework, c) and bilateral agreements (EUCARIS, n.d.-b). While signatories of the EUCARIS Treaty are legal parties to the treaty, signatories of the EU Prüm council decisions and bilateral agreements are third parties to EUCARIS (Dijkstra, 2010). Besides the exchange of primary vehicle and driving licence data between EU members, the participating countries can choose which applications to use and which not to enable. Thus, which legal documents and treaties to sign (*Interview EUCARIS, 2022*).

The key legal components of EUCARIS and related types of exchanged data are displayed in Table 2. Several legal components on the EU level were added over time.

*Table 2 - EUCARIS' Legal Basis (2010)*

<b>Components legal basis</b>	<b>Area</b>	<b>Type of data</b>
EUCARIS Treaty	Registration authorities	Technical vehicle data and driving licence information
Prüm Treaty / Council Decisions	Police cooperation	Owner/holder insurance information and limited technical data
Bilateral Agreements	Traffic fines, toll, etc.	Defined within agreement

*Source: Based on Dijkstra (2010)*

The multilateral EUCARIS Treaty, signed in 2000, formed the initial legal basis for exchanging information on vehicles and driving licenses (EUCARIS Treaty, 2000). With this, members recognized the need to exchange information on driving licence data and vehicle data to ensure the validity of drivers and vehicle documents across European countries (EUCARIS Treaty, 2000). The Treaty defines three purposes for the data-exchange initiative: 1) to ensure accuracy and reliability of the vehicle and driving licence register; 2) to combat vehicle-related crimes; 3) to enable fast data exchange in order to increase efficiency between administrations (EUCARIS Treaty, 2000).

So far, almost ten countries have signed the EUCARIS Treaty and, with this, expressed their political effort to implement and use EUCARIS as a data exchange system (*Interview EUCARIS*, 2022). Moreover, by signing the Treaty, Member States agree to set up and maintain EUCARIS (*Commission Impact Assessment*, 2012). Other participating countries did not sign the Treaty but used the technical services of EUCARIS without political commitment (*Interview EUCARIS*, 2022).

The legal framework of the EU sets another legal foundation for the different services of EUCARIS (König, 2019). Most importantly, the EU Prüm Council Decisions (displayed in Table 2) on cross-border cooperation that the basis for the Prüm Service. The Council Decisions follow the intergovernmental Prüm Convention of 2005 on “the stepping up of cross-border cooperation, particularly in combating terrorism, cross-border crime and illegal migration” (Prüm Convention, 2005, p. 2).

Relevant EU Prüm Council Decisions for EUCARIS are Council Decision *2008/615/JHA* (the Prüm Decision) and the Council Decision *2008/616/JHA* (the Prüm Implementing Decision). They marked a critical turning point for EUCARIS, as the EU Member States agreed to make EUCARIS the official data-sharing platform within the EU (Council Decision 2008/615/JHA, 2008; König, 2019). From there on, all EU Member States were connected to EUCARIS, providing a single point of reference (*Interview EUCARIS*, 2022). This legal basis, as well as more countries connected via the system, enabled easier integration of new functionalities and services (*Interview EUCARIS*, 2022). The Prüm Council Decision (2008/616/JHA) states:

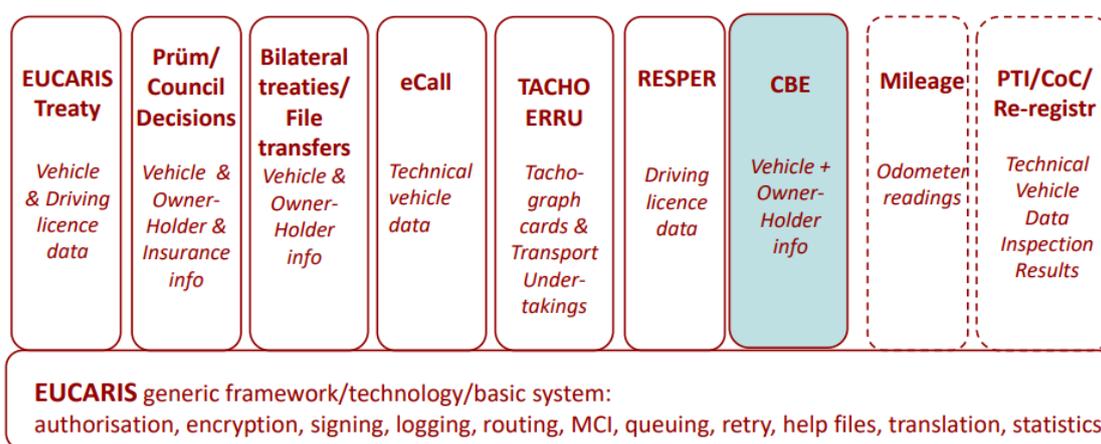
“For automated searching of vehicle registration data Member States shall use a version of the European Vehicle and Driving Licence Information System (Eucaris) software

application especially designed for the purposes.” (Council Decision 2008/616/JHA, 2008, p. 15)

Other relevant legal EU documents for enabling services in EUCARIS are the 3rd Driving Licence Directive 2006/126 (RESPER service); Directive (EU) 2015/413 (CBE service); Regulations (EU) No 1071/2009, 1072/2009, 1073/2009 and 1213/2010 (ERRU service); Delegated Regulation (EU) No 305/2013 (eCall service); and Council Regulation (EEC) No 3821/85 (TACHO service) (EUCARIS, n.d.-b). The CBE directive created a financial incentive for governments, as it enabled the issuing of fines across national borders (Directive 2011/82/EU, 2011, p. 82; *Interview EUCARIS*, 2022). Thus, national authorities could generate money by adapting a relatively cheap system (*Interview EUCARIS*, 2022).

Several bilateral agreements regulate further data exchange individually (EUCARIS, n.d.-b). Figure 5 illustrates how EUCARIS provides the technical platform that enables the exchange of different types of data by running services based on several legal bases - leaving it up to national authorities whether to use all of them or only selected ones. It also keeps the option open to integrating further services in the future.

Figure 5 - EUCARIS: One technical framework for different services



Source: Marek (2016, p. 9)

The main legal task for countries that wish to connect is to ensure that their legislation fits into the overall legal framework (*Interview EUCARIS*, 2022). The Interviewee emphasises that this is, in many cases, concerned with legislation on the local level.

In addition to Figure 5, the official list of EUCARIS currently states 20 services that are supported via the information system (EUCARIS, n.d.-a):

- |                  |                                   |                 |                     |
|------------------|-----------------------------------|-----------------|---------------------|
| 1) AVI and VInfo | 6) File Transfer                  | 11) ProDriveNet | 16) Salzburg        |
| 2) CBE           | 7) General Vehicle                | 12) Prüm        | 17) TACHOnet        |
| 3) DLInfo        | Owner/Holder                      | 13) PTI         | 18) Toll / EETS     |
| 4) eCall         | 8) IVI                            | 14) RESPER      | 19) VAT             |
| 5) ERRU          | 9) Mileage                        | 15) RSI         | 20) VHRNotification |
|                  | 10) Non-Sensitive<br>Vehicle Data |                 |                     |

To summarize, EUCARIS is a decentralised information system which had its initial legal basis in the multilateral EUCARIS Treaty. With the system's expansion and new types of shared information, the legal basis had to be adopted, and other legal instruments were included (EReg, 2019). Nowadays, EUCARIS is partly based on the EUCARIS Treaty, partly on EU legislation, and partly on bilateral agreements (König, 2019).

### 4.3 Technical Specifications

The EUCARIS information system was developed by and for governments, where national authorities remain holders of the data and responsible for their own registries (*Interview EUCARIS*, 2022; Paul, 2009). The initiating countries developed the first technical system. At that time, EUCARIS was still an informal collaboration with the aim to facilitate the exchange of information between databases and across national borders (König, 2019).

The original system (EUCARIS I) was developed in the nineties and used Tuxedo as the underlying technology (*Commission Impact Assessment*, 2012). The system was updated in 2006 based on the EUCARIS Board's decision in 2003 to develop a new generation of the system (EUCARIS II). By 2009, all members were connected to the new system (*Commission Impact Assessment*, 2012). This generation is based on open standards (XML and web service technology) and runs on a windows platform (EUCARIS, n.d.-c; *Commission Impact Assessment*, 2012). It is designed to send and receive XML messages.

The system itself was built in a pragmatic way to find a solution that works for all countries, as governments show different levels of e-government maturity (*Interview EUCARIS*, 2022). In that sense, EUCARIS is a relatively simple technical system that only provides the software to enable data exchange between existing base registries (Cavaye, 1997). From the early beginnings, countries expressed their intention to build the system precisely in that way (Cavaye, 1997). Based on the approach to avoiding technical complexity, developing the system was not considered a core challenge (Cavaye, 1997).

EUCARIS provides a standardised interface for participating parties (Dijkstra, 2010). Existing functionalities and possible future functionalities can be assessed through a single system (Dijkstra, 2010). Interoperability issues are addressed by providing a multilingual interface with standardised terms and codes (Dijkstra, 2010). The system enables to search for specific information in local databases of other countries through the common interface (Cavaye, 1997; *Commission Impact Assessment*, 2012). Inquiries are carried out in a synchronous way which means that requests are sent, and the application waits for a response (EUCARIS, n.d.-c; *Commission Impact Assessment*, 2012). Inquiries can be made to specific countries but also multiple countries.

The EUCARIS application includes the web client and the core application (EUCARIS, n.d.-c). The multilingual web client is used by administrative personnel to send requests to other countries. (EUCARIS, n.d.-c; Paul, 2009). The core application is used for the secure communication of the messages (Paul, 2009). It is connected to the national registry and provides information on the request of another country (EUCARIS, n.d.-c). The information is converted to standardised values (EUCARIS, n.d.-c). For example, specific codes for vehicle colours or a standardised way to mark a car as stolen (EUCARIS, n.d.-c). This is then displayed on the interface in the respective language, as shown in Figure 6.

Figure 6 - EUCARIS User Interface

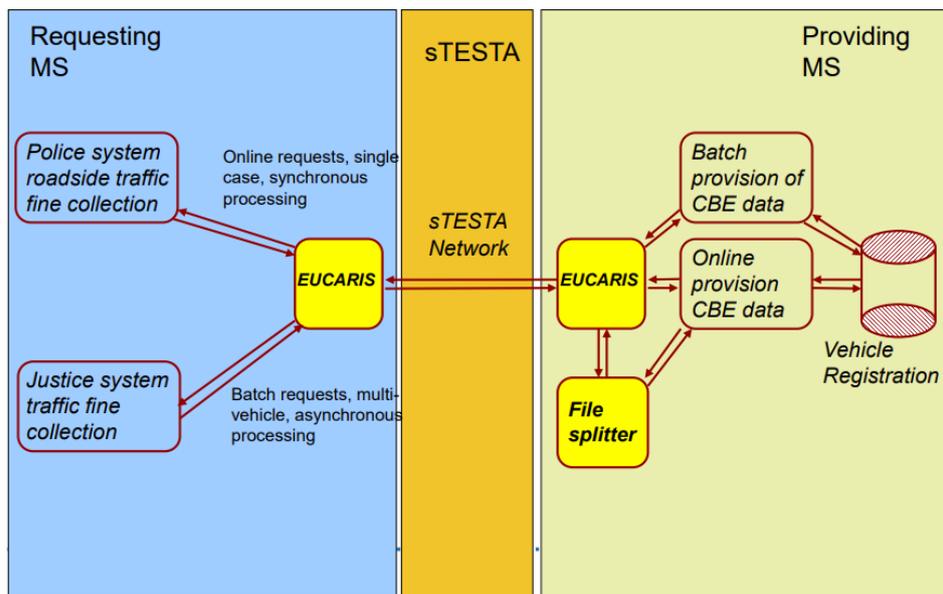
The screenshot displays the 'European Car and Driving Licence Information System (v4.1.0.11)' interface. The main section is titled 'Vehicle Search on License Number Query Information'. It includes a search form with the following fields: Country (GB - United Kingdom), Reason (Test), and License Number (H665POC). There are 'Submit' and 'Reset' buttons. Below the search form, a table displays the search results for 'GB - United Kingdom' with 'Found 1' entry. The table contains the following data:

GB - United Kingdom		Found 1
Message		
D1	Make	BMW
E	Chassis Number	WBAHD12050BF01898
A	License Number	H665POC
	Document ID	
- General vehicle data		
<b>Vehicle</b>		
D2	Type Variant	
D2	Type Version	
K	Type Approval	
D3	Commercial Name	535 I
J	Category	
R	Colors	Silver
P3	Fuels	Petrol
B	First Registration Date	26-05-1995
	Document Date	
	End Registration Date	08-09-1997
	Signals	Vehicle stolen
	Remarks	
+ Technical data		

Source: Dijkstra (2010, p. 23)

The data exchange between a requesting and providing Member State is illustrated in Figure 7. Displayed in the middle is the network used for the data exchange, which is the closed Trans European Services for Telematics between Administrations (TESTA) network (Interview EUCARIS, 2022). The system follows the approach of peer-to-peer communication, which means that countries communicate directly with each other between connected points of the Member States – no central component is needed (European Commission, 2019; Paul, 2009). The benefit of the system is that it provides participating members with real-time data in a synchronous manner but also with batch data in an asynchronous manner (Paul, 2009).

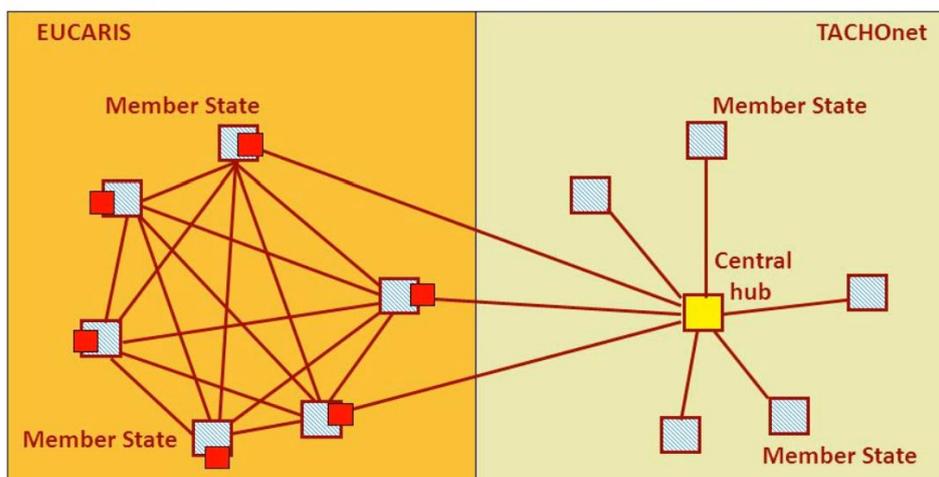
Figure 7 - EUCARIS data exchange model



Source: Marek (2016, p. 6)

A core characteristic of the information system is that additional connections and future extensions can be integrated into EUCARIS (Interview EUCARIS, 2022). Members can decide whether they

Figure 8 - EUCARIS / TACHOnet Integration



Source: Dijkstra (2010, p. 29)

want to build a connection in order to make use of the additional functionality (*Interview EUCARIS, 2022*). Figure 8 visualises how this is done in the case of TACHOnet. The Member States connected to EUCARIS can be connected to the central hub of TACHOnet and, in that way, exchange data.

## 4.4 Case Study Summary

The overall findings of the case study are summarised in

Table 3, based on the criterion of the conceptual model introduced in chapter 2 (see Table 1). The results are reflected and discussed in the next chapter.

*Table 3 - Case Study Summary*

<b>Specifications</b>	<b>Criterion</b>	<b>Description</b>
<b>Organisational (business) Specifications</b>	Description of initiative	EUCARIS is a cooperation of national registration authorities across Europe. The system enables registration authorities and authorised governmental institutions to share transport-related information from the databases of other participating countries.
	Vision and objectives	The overall objective of EUCARIS is to combat cross-border related crimes in the transport sector.
	Governance	EUCARIS is a non-profit organisation governed by representatives of registration authorities within Europe. Thus, owned and maintained by the EUCARIS community itself. The EUCARIS General Assembly holds the highest authority and manages the system and budget, and takes overall decisions
	Type of data exchange solution	EUCARIS is a Member State-driven data exchange solution. The initiative specifies data exchange within the transport sector by connecting base registries of registration authorities (sector-specific). EUCARIS is currently looking into new functionalities to expand its scope within mobility.
<b>Legal Specifications</b>	Legal basis	Different legal bases depending on the services: <ul style="list-style-type: none"> <li>a) EUCARIS Treaty</li> <li>b) Several bilateral agreements</li> <li>c) EU legal framework: <ul style="list-style-type: none"> <li>• EU Prüm Council Decisions (2008/615/JHA, 2008/616/JHA), Prüm service</li> <li>• 3rd Driving Licence Directive (2006/126) and amendments, RESPER service</li> <li>• Directive (EU) 2015/413, CBE service</li> </ul> </li> </ul>

		<ul style="list-style-type: none"> <li>• Regulations (EU) No 1071/2009, 1072/2009, 1073/2009 and 1213/2010, ERRU service), eCall service</li> <li>• Council Regulation (EEC) No 3821/85 (1985), TACHO service</li> </ul>
	Type of agreement	Both bilateral and multilateral agreements.
	EU reference	Partly built into the EU legal framework.
<b>Technical Specifications</b>	Technological approach	EUCARIS follows a simplistic technical approach based on decentralisation. The system provides the software to enable data exchange between existing base registries.
	Network usage	EUCARIS is connected to the closed sTESTA network developed by the EC (closed network).
	The openness of standards and specifications	EUCARIS is a proprietary data-exchange solution developed specifically for the purpose of cooperation. It uses standard-based technology.
	Data-exchange specialization	The data exchange is organised between different functional domain databases.

## 5 DISCUSSION

This chapter discusses the findings of the case study and interprets the results of the thesis. The research question is repeated at the beginning, followed by a reflection on the key findings and answering the research question. Furthermore, this chapter assesses whether the conceptual model provided a useful tool to conceptualise the cross-border initiative and if it helps to answer the research question sufficiently. At the end of the chapter, research limitations are identified, and future research is suggested. Finally, the relevance within the EU context is highlighted, and a future outlook is given.

The overall objective of this research was to explore approaches to cross-border data exchange in the public sector. For that reason, a case study on the data-exchange initiative EUCARIS was conducted. Guided by the aim to gain insights from an organisational, legal, and technical perspective, this research examined the reasons for the successful implementation of EUCARIS across the EU. To address the research objective, the following research questions were posed: “How and why did EUCARIS succeed in facilitating cross-border data exchange between all EU Member States?”.

The results on the organisation level show that EUCARIS is a Member State-driven cross-border initiative that enables the exchange of data between public administrations in Europe. It serves as a unique example of an established data exchange solution in the public sector which managed to connect all EU Member States and other European countries. Emerging as a solution to the increasing problem of car theft across Europe in the late 1980s, the initial objective of EUCARIS plays a crucial role in its success. Over the years, the objective has broadened to include tackling different forms of cross-border crime in the transport sector. This was a crucial factor for governmental authorities to realise the potential and social benefits of joining EUCARIS and enabling the fast exchange of information (*Interview EUCARIS, 2022*). EUCARIS' governance approach focuses on simplicity with low structures. It is governed by representatives of registration authorities within Europe. Thus, it is owned and maintained by the EUCARIS community itself and does not officially have its own employees, which keeps organisational costs low. From the beginning, EUCARIS incorporated the needs and concerns of participating parties as it was developed by and for public administration.

The legal dimension shows that EUCARIS runs on different legal bases depending on the used services. The legal basis includes the EUCARIS Treaty, the EU legal framework, and several

bilateral agreements. Initially, EUCARIS did not have a legal basis. The political pressure to formalise the cooperation led to the signing of the EUCARIS Treaty, which formed the first legal basis. It became clear that a legal basis is required to build up trust towards EUCARIS and between the involved parties. Over the years, several legal components on the EU level were added, and the scope of exchanged data expanded drastically. Besides the EU's decision for Member States to connect to EUCARIS in order to exchange a set of basic information, participating countries are free to choose whether or not they would like to make use of additional services. Meaning that they can decide which further agreements and Treaties to sign. In that sense, members can adopt the system but are not required to exchange the whole variety of data. Moreover, services can be easily adapted and expanded as the exchange platform connecting members is already in place. The interviewee emphasised that the sense of control was a critical aspect for countries to join.

From a technical perspective, EUCARIS follows a simplistic technical approach to keep harmonization to a minimum and reduce complexity. It essentially provides the software to enable data exchange between existing base registries and is installed by national public administrations. It is a decentralised system that enables a gateway between several MS registration authorities. Hence, implementing new systems, networks, or hardware is not required. EUCARIS is a proprietary data-exchange solution developed by the participating parties using standard-based technology with the core feature of a multilingual interface that translates the system into the language of the respective users. The possibility to further expand and adopt new functionalities to the existing system is a core element of EUCARIS and was an essential factor for its expansion. Additionally, it allows for incorporating new functionalities in the future. This is a key benefit for involved parties as they do not have to employ a new system for new forms of data exchange. Another benefit of EUCARIS is the decentralised technical system which avoids the risk of a single point of failure. If one register faces technical problems, it does not affect the general technical network but only affects the flow of information from this database.

The overall findings of this thesis show that a combination of several factors explain how EUCARIS has facilitated the EU-wide rollout and expansion of the system. The study identifies organisational, legal, and technical factors that have influenced the EU-wide adoption of EUCARIS. Throughout all layers, aspects of simplicity, sense of control and autonomy, and adaptability have been raised as success factors; the decentralised structure stands at the core of those aspects. The key success factors are summarised in the following.

The strong focus on keeping the organisation and technical system as simple as possible to reduce complexity was considered a key driver for the adoption of EUCARIS. It makes EUCARIS a low-cost technical solution that is cheaper and faster to implement than creating separate systems for each case. The EU Prüm Council Decisions constituted a key factor for the adoption of EUCARIS in all Member States. With this, the legal basis was set to make EUCARIS the official data-sharing platform within the EU. From there on, EUCARIS provided a single point of reference. While more countries were connected via one system, it became easier to integrate new functionalities and services. This is considered a critical success factor. Lastly, the strategy to go for decentralisation is considered a significant driver for the adoption of the system in the early stages. Involved parties were interested in maintaining autonomy over their own registration system and did not want to integrate them into a central database. The literature suggests that a central system was seen as a threat to the autonomy of individual registration authorities (Cavaye, 1998).

Another critical driver that was not captured by the conceptual model and that was highlighted in the interview was that public administrations recognised practical advantages and saw real-life benefits from countries that had already adopted EUCARIS, which motivated others to join. Public administrations realised that comparatively high benefits could be created with low costs (*Interview EUCARIS*, 2022). The Interviewee highlights the observed network effect within EUCARIS, meaning that the value grew significantly with increasing members and connections. Moreover, a key factor was pointed out as political feasibility and low entry hurdles by keeping the data exchange mechanism on a decentralised level (*Interview EUCARIS*, 2022). This preserves a sense of ownership at the national level, as every participating country runs their own register.

As mentioned in the literature review, the overall scientific basis on digital governance in a cross-border context remains limited and not applicable to address the research question. Therefore, and as part of the interoperability landscape report, a new conceptual model was introduced based on the European Interoperability Framework. In this research, the model is applied to the case of EUCARIS and further adjusted throughout the research process. The conceptual model was used to carry out the case study, and it provided three categories of investigation (organisational, legal, and technical). Throughout the study, several criteria for each layer were adjusted to emphasise the general approach and to better explore the successful expansion of the system. Thus, a higher emphasis was put on organisational and legal factors. On the other hand, less emphasis was given to technical specifications, and the focus was drawn to the overall technical approach.

After adjusting the conceptual model, it provided a helpful tool to capture the majority of aspects that were pointed out as drivers and success factors throughout the research. Therefore, this research finds that the model sufficiently addressed the research question and helped to provide answers to the expansion of EUCARIS. Having said that, it has to be noted that not all relevant factors were captured within the model, particularly political aspects and drivers for cooperation and networks. The literature review indicates a similar problem of relevant factors that are not captured by existing models or frameworks. While several authors have identified the need to address cross-border data exchange and interoperability from a more holistic perspective, researchers and practitioners struggle to grasp the complexity of multidimensional interoperability. In that sense, scholars address the issues and provide complex theoretical frameworks that are difficult to apply in practice. However, for the purpose of this thesis and research objective, the three categories of organisational, legal, and technical specifications were considered suitable to explore insight into the approach of EUCARIS. The limitations of this approach are recognized, and further research is recommended to analyse political and social factors.

The method of a single case study poses research limitations. While it helps to explore one case in more detail, it does not allow for drawing general conclusions that are applicable to other cases. Hence, further research is suggested to test the model on other cross-border initiatives. Moreover, the research is limited by the number of interviews. One interview was conducted with two representatives of EUCARIS. Hence, conducting more interviews for further research is recommended to provide a pluralistic view. In the context of the European Interoperability Landscape, future research could examine other cross-border interoperability initiatives, following the same conceptual model to draw a general conclusion. This would help to create a more comprehensive overview of the overall landscape. Moreover, future research could further explore the interconnection of cross-border initiatives and how they could be harmonized in the future.

Research in cross-border data exchange is crucial for European interoperability projects to understand in which direction the overall landscape is evolving. In all cases, data exchange initiatives should follow EU interoperability guidelines and standards to prevent further fragmentation. These guidelines and standards are defined in the EIF, which was introduced in chapter 2. The policy review highlighted the Union's vision to move from 28 national digital markets to one single digital market in the virtual sphere. This vision requires interoperability between all levels of the public and private sectors. Furthermore, cross-border interoperability is

a critical requirement for enabling pan-European digital public service, which means that EU citizens, independent of their location, should have access to European public services.

To give a glimpse of the future, EUCARIS is currently looking for possibilities to enhance cooperation beyond European borders to connect to countries outside of the EUCARIS network (*Interview EUCARIS, 2022*). Moreover, possibilities are assessed to connect EUCARIS to other European data-exchange systems, such as e-CODEX or the Single Digital Gateway (*Interview EUCARIS, 2022*). EUCARIS envisages expanding its scope within the mobility sector by looking into functionalities connected to drones and large sailing ships, etc. (*Interview EUCARIS, 2022*). Within the next ten years, a potential future scenario could be the development into a general European system in the field of mobility (*Interview EUCARIS, 2022*).

## 6 CONCLUSION

Cross-border interoperability is a core element in enabling data exchange between public administrations. This thesis aimed to explore how and why EUCARIS facilitated cross-border data exchange between registration authorities in all EU Member States. A new conceptual model, developed as part of the interoperability landscape report, was introduced and applied to approach the research question. The model was applied to the case of EUCARIS and further adjusted throughout the research process.

The case study shows that EUCARIS emerged as a decentralised system in the early nineties. It was developed by and for governmental authorities, following a bottom-up approach. Starting off as an informal collaboration, the initiative was formalised with the EUCARIS Treaty in 2000. Over the years, and with growing expansion, EUCARIS was partly integrated into the EU interoperability landscape. On the technical level, the data exchange solution is kept simplistic and decentralised. It provides the software to enable data exchange between existing base registries. EUCARIS does not require public authorities to implement new systems, networks, or hardware.

The results of this study indicate that several factors have contributed to the successful EU-wide adoption and expansion of the system. Throughout all layers (organisational, legal, and technical), aspects of simplicity, sense of control and autonomy, and adaptability were identified as relevant drivers. The year 2008 marked a significant turning point as it became mandatory for all EU Member States to connect to EUCARIS. A potential future scenario within the next ten years could be the development of a general European system in the field of mobility.

Further research is suggested to examine approaches of other cross-border interoperability initiatives following the conceptual model, as the present research is limited to one case. To create a more comprehensive overview of the overall interoperability landscape and to be able to draw more general conclusions, future research could further explore the interconnections of cross-border initiatives.

Research in cross-border data exchange is critical for European interoperability projects to understand in which direction the overall interoperability landscape is evolving. The research could support governmental organizations and businesses to adapt their solutions and act toward a harmonized digital Europe.

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## Appendix

### Appendix 1. Conceptual Model for European Cross-Border Data Exchange Initiatives

Table 4 - Conceptual Model for European Cross-Border Data Exchange Initiatives

Specifications	Criterion	Description
<b>Legal Specifications</b>	Legal background	Legal acts that regulate the exchange of data across borders.
<b>Business Specifications</b>	Solution vision, description, objectives, principles.	Solution vision, description, principles and objectives criterion/indicator provides information about the goals and aims of the data exchange solution. Furthermore, this criterion provides information on key characteristics, features, and objectives of the selected solution. The main purpose is to provide the reader with an overview of the solution's vision/goals and objectives.
	Solution governance	Governance of the solution is the criterion that provides readers with an overview of who governs the solution and who is responsible for managing, updating, and monitoring the data exchange solution. Furthermore, it provides information on the implications of the existing governance structure.
<b>Technical Specifications</b>	Data exchange (messaging) model	The data exchange model criterion describes the approach of the data exchange solution towards communication between several information systems.
	Data transmission communication method	The data transmission type criterion involves distinguishing between synchronous and asynchronous communication types. In the synchronous messaging type, a service consumer sends a request and must stay and wait for a response suitable for real-time data and document exchange. While in asynchronous communication, a service consumer sends a request and can continue processing other tasks.
	Network usage	The data exchange solution network usage criterion addresses the network the solution connects to and uses to exchange data or documents (public internet vs closed network). Solutions using the public internet are connected to the wider network. Solutions using private internet are connected to closed networks such as the sTESTA network developed by the EC.

	Openness of standards and specifications	This criterion address whether the data-exchange solution uses specific standards or specifications that are either open code, standards and specification or proprietary, developed specifically for the purpose of the data-exchange solution.
	Data-exchange specialization	Data-exchange solution specialization criterion addresses the integration of the data exchange among the organizations. (vertical integration vs horizontal integration. Vertical integration includes data exchange among similar functional domain databases, while horizontal integration includes data exchange among different functional domain databases.

*Source: European Interoperability Landscape Report (forthcoming)*

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