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Factors and dynamic capabilities in the development of knowledge interoperability at the European level.
The case of the Interoperability Academy

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Abstract

Knowledge interoperability is defined as "the compatibility of the skills, competencies, and knowledge assets of an enterprise with those of other enterprises" (Chen & Doumeingts, 2003, p. 159). It has been identified as a key sub-layer within organisational interoperability (Espadinha-Cruz & Cabrita, 2018; Gottschalk & Solli-Saether, 2008). Intimately linked to the organisational capability to share knowledge resources, knowledge interoperability has been recognized as crucial for establishing cross-organisational business processes, bridging knowledge gaps between organisations and for them to know how to act on the basis of shared information (Espadinha-Cruz & Cabrita, 2018; Rhazale & Bounabat, 2018).

To understand these unexplored aspects of the organisational dimension of interoperability, this research conducted an extensive literature review on the current state of the art in organisational interoperability and dynamic capabilities, identifying constructs and frameworks that could help conceptualise knowledge interoperability. Based on this review, a theoretical framework for e-government knowledge interoperability was developed involving a set of factors and knowledge-based dynamic capabilities. For this, the constructs were based on Espadinha-Cruz and Cabrita's (2018) knowledge interoperability framework and Zheng, Zhang, Wu and Du's (2011) knowledge-based dynamic capabilities.

The Interoperability Academy was identified as an appropriate case to explore how these constructs apply in the European Union (EU) context. The Interoperability Academy was selected as the European Commission's initiative that is fostering interoperability by reducing knowledge and skills gaps between public administrations. Triangulating different data collection techniques (i.e., document analysis, participant observation, semi-structured interviews), the researcher applied the adapted theoretical framework to the work conducted by the Interoperability Academy and extracted empirical insights about the dynamic processes involved in knowledge interoperability development in the European e-government context, as well as the factors both enabling and challenging its development.

As main results, this thesis contributes with a theoretical framework for e-government knowledge interoperability, as well as with empirical insights about the factors and dynamic capabilities involved in the development of e-government knowledge interoperability in the EU. As a theory-oriented research, this thesis holds theoretical relevance by setting the grounds to explore knowledge interoperability as a topic within the e-government interoperability field of research and by contributing to the conceptualisation of interoperability as a dynamic, multidimensional and context-dependent capability. Moreover, this thesis represents the first application of these constructs in the e-government field of practice, hence, indirectly contributing to interoperability practice by providing clarity around the human and knowledge aspects involved when transforming public administrations into interoperable organisations.

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Eternally grateful,

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Abbreviations

CEF	Connecting Europe Facility
DSM	Digital Single Market
EFISC	European Framework for Interoperability Skills and Competencies in the Public Sector
EIF	European Interoperability Framework (EIRA)
EU	European Union
B2B	Business-to-Business
DG	European Commission's Directorate-General
DG CNECT	Directorate-General for Communications Networks, Content and Technology
DIGIT	Directorate-General Informatics
G2G	Government-to-Government
GDPR	General Data Protection Regulation
ICT	Information and Communication Technologies
IDA	Interchange of Data between Administrations programme
IDABC	Interoperable Delivery of Pan-European eGovernment Services to Public Administrations, Business and Citizens programme
ISA	Programme on interoperability solutions for European public administrations.
ISA^2	Programme on interoperability solutions and common frameworks for European public administrations, businesses and citizens.
IT	Information technology
JRC	Joint Research Centre
Joinup	Collaborative platform facilitating the sharing and reuse of IT solutions developed for public administrations.
KAC	Knowledge Acquisition Capability
KGC	Knowledge Generation Capability
KCC	Knowledge Combination Capability
KBV	Knowledge-Based View
MS	Member States
NIF	National Interoperability Framework
NIFO	National Interoperability Framework Observatory
RBV	Resource-Based View
R&D	Research and Development
SDG	Single Digital Gateway

1 Introduction

This chapter presents the motivation behind this thesis and the research problem addressed. The author describes the conceptual dimensions the research problem implies and briefly explains the theoretical and methodological approaches that were chosen to address it. Afterwards, the author presents the research objectives and questions. The author argues the relevance of this research, referring to some of the main conclusions obtained. Finally, an overview of the structure of this thesis is presented.

1.1 Research motivation

Since approximately two decades ago, interoperability has considerably grown in importance within the European Union's (EU) strategies. Interoperability has been included as a central action in the current and the past European Digital Agendas, portraying it as a key factor for user-centred digital transformation and the consolidation of the European Digital Single Market (DSM) (European Commission, 2010a, 2010b, 2018b). It can be argued that interoperability is nowadays considered a crucial factor not only for user-centric and user-driven government digital transformation but also for sustainable development and inclusive economic growth.

In the 2016 EU eGovernment Action Plan, the revision of the 2010 European Interoperability Framework (EIF) was conducted by the ISA^2 Programme and led to the 2017 version, which is still currently in use (European Commission, 2016a). Due to the lack of uptake and implementation of the previous version by Member States (MS), the ISA^2 Programme published the 2017 EIF (European Commission, 2017c), aiming to prevent the emergence of diverging interoperability approaches and solutions within the region, which is hindering the realisation of the DSM (European Commission, 2017b).

The 2017 EIF describes an interoperability model composed of four layers (i.e., legal, organisational, semantic, and technical); one background layer (i.e., governance); and a cross-cutting component (i.e., integrated public service governance) (European Commission, 2017c). Supported by the 2017 Implementation Strategy and Interoperability Action Plan, the European Commission doubled the efforts to improve the alignment of each MS's National Interoperability Framework (NIF) with the EIF and to promote its implementation across all its layers (European Commission, 2017a). The 2017 EIF provides MS with a common definition of interoperability, as well as 12 principles and 47 commonly agreed recommendations to public administrations on how to improve interoperability (European Commission, 2017b, 2017c). Interestingly, many of these principles tend to stress the importance of considering interoperability a

sustainable endeavour (European Commission, 2017c), meaning an innovation that enables public sector organisations to learn and adapt in changing environments.

This is consistent with the literature on interoperability, which tends to define it as a dynamic, multidimensional and highly context-dependent capability (Cresswell, Pardo, Canestraro, Dawes, & Juraga, 2005; Malinauskienė, 2013; Pardo, Nam, & Burke, 2012). First, from an e-government perspective, public sector organisations are not exempt from the phenomenon of digital transformation and, thus, are increasingly pushed to develop mechanisms for "repeatable, continuous adaptation" (Vial, 2019, p. 133). A recent trend in research argues that public sector organisations need to develop dynamic capabilities, not only to overcome silos between policy domains but also so their structures become capable of learning and adapting to changes in the environment (Kattel & Mazzucato, 2018; Vial, 2019). Hence, the development of e-government interoperability can be considered a step towards a more dynamic and integrated form of government as it enables public administrations to meet citizens, businesses and other governments' changing demands (Cresswell et al., 2005; Pardo et al., 2012).

Second, even though early conceptualisations of interoperability focused almost exclusively on its technical aspects (e.g., Vernadat, 2010), interoperability is nowadays understood by both academics and practitioners in a broader sense; as a multidimensional innovation that involves policy, organisational and technology dimensions (Cresswell et al., 2005; Malinauskienė, 2013; Pardo et al., 2012; Scholl & Klischewski, 2007; Tripathi, Gupta, & Bhattacharya, 2013). This early technocentric focus is also visible in many suggested e-government maturity models that tend to relegate organisational aspects to later stages of interoperability development (Almeida Prado Cestari, Loures, Santos & Panetto, 2020). However, as literature has strongly argued, interoperability develops like a dynamic and highly context-dependent organisational capability (Maheswari & Janssen, 2012; Valdes et al., 2008) and therefore, it cannot be assumed that it will follow the same linear development path in every country or organisation.

Lastly, as the importance of context for the development of e-government has increasingly been acknowledged (Malinauskienė, 2013), so is interoperability being recognized as a highly-context dependent innovation based on the evidence that sometimes the same technological solution can have divergent applications because of legal, political, historical, financial and cultural factors (e.g., Otjacques, Hitzelberger, & Feltz, 2007). This may explain why many countries and standard bodies have come up with their own frameworks and definitions for interoperability in accordance with their specific objectives and environments (Cresswell et al., 2005; Tripathi et al., 2013). As aforementioned, this is a problem even within the EU where, despite the many initiatives

set in place to harmonise MS's NIF with the EIF, a quick revision of the National Interoperability Framework Observatory's (NIFO) interactive dashboard[I] reveals that most MS still have a long way to go in terms of interoperability alignment and implementation, especially regarding upper layers of the EIF (i.e., organisational interoperability and interoperability governance).

In answer to this, different authors (Pardo et al., 2012; Pardo & Burke, 2008; Scholl & Klischewski, 2007) argue that it is precisely because of the persistent over emphasis on the technology dimension that, in practice, interoperability development has been unable to address the necessary policy and organisational changes that it requires for the desired integration. Literature on the topic is still mostly dominated by publications that refer to interoperability from a technocentric perspective (Sharma & Panigrahi, 2015). Research on organisational interoperability is particularly scarce and fails to address critical aspects, such as what aspects does it entail and how can the evolution of organisational interoperability be monitored (Rhazale & Bounabat, 2018) as a dynamic and context-dependent e-government capability.

As such, this research will not further address the technical or semantical layers of interoperability but instead will dive deeper into the organisational layer of e-government interoperability to focus on a rather unexplored sub-layer of it that has received the name of knowledge interoperability (Espadinha-Cruz & Cabrita, 2018; Gottschalk & Solli-Saether, 2008).

1.2 Research problem

In the literature on interoperability, the relevance of making organisations compatible in terms of their knowledge resources, including human resources skills and competencies, has given grounds to the concept of knowledge interoperability (Chen & Doumeingts, 2003; Espadinha-Cruz & Cabrita, 2018; Gottschalk & Solli-Saether, 2008). This has been identified as a key sub-layer within the organisational interoperability layer (Espadinha-Cruz & Cabrita, 2018; Gottschalk & Solli-Saether, 2008), defined as "the compatibility of the skills, competencies, and knowledge assets of an enterprise with those of other enterprises" (Chen & Doumeingts, 2003, p. 159). As this definition implies, knowledge can be defined as a complex resource that involves explicit and tacit elements (Grant, 1996). This means that knowledge resources consist of both, codified knowledge as well

[I] Joinup. *NIFO – National Interoperability Framework Observatory. EIF Monitoring*. [website]. https://joinup.ec.europa.eu/collection/nifo-national-interoperability-framework-observatory/eif-monitoring (accessed 20 June 2021).

as knowledge embedded in organisational routines and individuals in the form of skills and practical expertise (Grant, 1996).

Knowledge interoperability has been considered a crucial basis for organisational alignment in terms of business processes and strategies for value creation in networks of organisations (Gottschalk & Solli-Saether, 2008). The organisational capability to share knowledge resources is recognized as a pre-condition for establishing cross-organisational business processes and for organisations to know how to act on the basis of shared information (Rhazale & Bounabat, 2018).

The conducted literature review (see chapter **3 Literature review and theoretical framework**) revealed a conceptual framework for knowledge interoperability, suggesting a series of factors that can influence knowledge sharing in a strategic alliance (Espadinha-Cruz & Cabrita, 2018). Furthermore, Espadinha-Cruz and Cabrita (2018) argue that the development of knowledge interoperability requires bridging knowledge gaps between organisations by fostering the learning and knowledge sharing processes among the organisations participating in the network.

In order to understand how these processes might take place, the knowledge-based dynamic capabilities framework provides further insights. According to Zeng et al., (2011, p. 1037) knowledge-based dynamic capabilities are "the [organisational] ability to acquire, generate and combine knowledge resources to sense, explore and address environment dynamics". They operationalise this construct by distinguishing three complementary sub-capabilities for the acquisition, generation and combination of knowledge (Zheng et al., 2011). Altogether, the co-joint deployment of these capabilities is associated with organisational innovation and sustained improved performance in the context of changing environments (Grant, 1996; Verona & Ravasi, 2003). Moreover, the development of these capabilities is positively influenced by the embeddedness of organisations within networks that foster the exchange of knowledge resources and the engagement in shared goals (Zheng et al., 2011).

Despite these concepts are scarcely explored and they lack applications in the e-government field of research, it can be argued that the EU already offers an appropriate case to apply these frameworks. Tackling the knowledge interoperability problem in the EU, the Interoperability Academy was created to reduce the digital skills gap that is seen as one of the main factors delaying the adoption of the 2017 EIF and the development of e-government interoperability (European Commission, 2019a, 2020a).

Launched in 2019 by the ISA^2 Programme, the initiative performs as an umbrella academy for all public administrations within the EU in subjects related to interoperability

and public sector digitalisation. The Interoperability Academy action entails the set-up of an e-learning platform with a catalogue of resources, that allows public servants from all over the EU to follow different learning paths according to their occupational backgrounds (European Commission, 2019a, 2020a). Furthermore, the platform is also designed to allow European institutions and MS public administrations develop their own courses and training resources on the subject. In its third year of activities, the team of the Interoperability Academy has published the European Framework for Interoperability Skills and Competences in the public sector (EFISC) (Casiano Flores, Chantillon, Crompvoets, de Groof, González Ríos, Kruger, Kyriakopoulou, Manojlovic, Mayot, Sorgi, & Tan, 2021) and is working on the development of an interoperability curriculum to guide and structure the development of courses and training resources.

This research thesis adapts Espadinha-Cruz and Cabrita's (2018) knowledge interoperability framework and Zeng et al.'s (2011) knowledge-based dynamic capabilities to examine how they apply to the EU's e-government context. Starting from the premise that the way factors influence knowledge interoperability is highly context-dependent (Rico-Pinto & Sánchez-Torres, 2019), this research will examine how a set of factors influences knowledge interoperability development at the European level. In addition, the knowledge-based dynamic capabilities proposed by Zheng et al. (2011) will be identified in relation to the development of knowledge interoperability. In applying these concepts to the activities performed by the Interoperability Academy, this research is attending to the problem of currently not understanding how knowledge interoperability is developed in the European e-government context.

1.3 Research objectives and questions

The overarching objective of this thesis can be summarised as follows:

To identify the factors enabling and challenging the development of knowledge e-government interoperability in the European context and the dynamic capabilities involved in this process, by providing empirical insights from the work conducted by the Interoperability Academy.

As such, this thesis' main research question is formulated as:

What factors enable and challenge e-government knowledge interoperability development in the European context and what dynamic capabilities are involved in this process?

In order to achieve this objective, three intermediary objectives with respective research sub-questions were established:

1. Review the state of the art in the scientific literature on organisational interoperability and dynamic capabilities, identifying existing conceptual frameworks and constructs that can be used to conceptualise the sub-layer of knowledge interoperability. Hence,

- What theoretical constructs can help us conceptualise knowledge interoperability?

2. Develop a knowledge interoperability framework that can be used to study e-government knowledge interoperability. Hence,

- What theoretical framework can be used to study e-government knowledge interoperability?

3. Apply the theoretical framework to the work conducted by the Interoperability Academy, to extract empirical insights about the factors that enable and challenge e-government knowledge interoperability development in the EU and the dynamic capabilities involved in this process. Hence,

- How does this framework apply to e-government knowledge interoperability development in the EU?

1.4 Relevance

As a theory-oriented research, this thesis possesses theoretical relevance in the sense that it directly contributes to the development of a theoretical body of knowledge in the field of e-government knowledge interoperability. Aiming to expand the e-government interoperability field of research, this thesis adapted constructs from the business management literature and applied them to e-government interoperability development in the EU. Via a single case study of the Interoperability Academy initiative, this thesis identifies the factors and dynamic capabilities involved in the development of knowledge e-government interoperability in the European context. Moreover, this thesis represents the first application of these concepts in the e-government field of practice and research, setting the grounds to explore e-government knowledge interoperability and contributing to the conceptualisation of interoperability as a dynamic, multidimensional and context-dependent capability.

In addition, this thesis indirectly contributes valuable information that may be useful for e-government interoperability practice. This thesis provides clarity around the human and knowledge aspects involved when transforming public administrations into interoperable

organisations. Furthermore, it may instigate new developments around the concept of knowledge interoperability and contribute from a dynamic capabilities perspective to solve some of the problems associated with e-government interoperability development, particularly regarding the organisational layer.

1.5 Structure of the thesis

This research is structured in nine chapters. The following chapter (Chapter 2) introduces the research context by reviewing relevant grey literature on the topic of e-government interoperability in the EU. Chapter 3 presents the results of an extensive literature review conducted over two main research fields: organisational interoperability and dynamic capabilities. As an outcome of reviewing the scientific literature, a theoretical framework for e-government knowledge interoperability is developed. Chapter 4 is dedicated to the methodological characteristics of this research, including explanations of the research design, strategy, methods, data collection techniques and data analysis process for the application of the theoretical framework. The case study (i.e., the Interoperability Academy) is described in Chapter 5. It provides information about the history of the initiative and its most recent developments. Chapter 6 presents the main findings resulted from the analysis of the information collected via different sources of evidence. Chapter 7 is dedicated to the discussion of these results in light of the research questions posed by this study. Afterwards, the limitations encountered by this research are clearly stated in Chapter 8. Finally, this thesis closes by summarising the main conclusions and future lines of research in Chapter 9.

2 Contextual background

This chapter presents an overview of the place e-government interoperability takes within the EU's digital policy. Besides introducing the reader to the contextual background of this research's empirical work, this chapter frames the practical relevance of its results. In the first section, the author presents the most important grey literature that guides European institutions and MS in matters related to interoperability and the digital transformation of public administrations across Europe. The second section is dedicated to the 2017 EIF, along with its relation to the ISA^2 Programme.

2.1 Interoperability for Europe's digital transformation

Even though the need for interoperability was already identified by European administrations back in 1999[II], it can be argued that since 2010 interoperability has exponentially grown in importance within the EU's Digital Agendas[III]. In the last decade, interoperability has become a pre-condition not only to achieve the targets associated with a digital European future but also to attain other policy priorities such as sustainability and an inclusive economy.

The Europe 2020 Strategy put forward three mutually reinforcing priorities (European Commission, 2010c): (1) Smart growth, (2) Sustainable growth, (3) Inclusive growth. Going into detail, these priorities were materialized into seven flagship initiatives, among which the most relevant one for this research is the 'Digital Agenda for Europe' (European Commission, 2010c).

The overall aim of the 2010 Digital Agenda was "to deliver sustainable economic and social benefits from a digital single market based on fast and ultra-fast internet and interoperable applications" (European Commission, 2010a, p. 3). Since the lack of interoperability is considered among the most significant obstacles to this aim (European Commission, 2010a), the fifth action of the Digital Agenda was dedicated to this topic, describing lines of action aimed at improving standards setting, along with the adoption of a revised EIF (European Commission, 2010a).

[II] See Decision No. 1719/1999/EC of the European Parliament and of the Council of 12 July 1999 on a series of guidelines, including the identification of projects of common interest, for trans-European networks for the electronic interchange of data between administrations (IDA).

[III] Before 2010, some relevant antecedents for European policy on interoperability are the 2009 Malmo Ministerial Declaration; the Interoperable Delivery of Pan-European eGovernment Services to Public Administrations, Business and Citizens (IDABC) programme (2004 - 2009); the 2007 Lisbon Ministerial Declaration; and the Interchange of Data between Administrations (IDA) programmes (1995 -2004). Due to space and scope limitations, this section focuses on policy from the last decade.

During the 2010-2020 decade, the European Commission made ambitious progress towards the consolidation of a DSM (European Commission, 2015). Defining it as a market where "the free movement of goods, persons, services and capital is ensured and where individuals and businesses can seamlessly access and exercise online activities under conditions of fair competition, and high level of consumer and personal data protection" (European Commission, 2015, p. 3). Achieving a DSM was considered a priority to take a leading position in the current global digital economy.

The need of braking down silos and tearing down barriers within the EU was seen, not only as beneficial for the economic growth of the region, but also for the better provision of services to European citizens (European Commission, 2015). As such, the strategy for a DSM included a total of 16 actions organised in three priorities, including the elaboration of a new eGovernment Action Plan which was published a year later and addressed the period of 2016-2020 (European Commission, 2015).

Continuing the work of the previous eGovernment Action Plan 2011-2015, which made considerable contributions to the exchange of technological interoperability enablers between MS, the 2016 Action Plan pushed even further for the consolidation of the DSM (European Commission, 2016a). The 2016 Action Plan made a clear emphasis on the need of digitally transforming and modernising public administrations, in order to make them more "open, flexible and collaborative" (European Commission, 2016a, p. 3). As such, suggesting a common vision and seven underlying principles[IV], the 2016 Action Plan lists a total of 20 actions among which the needs of submitting a proposal for the Single Digital Gateway (SDG), presenting a revised version of the EIF and ensuring its uptake by MS, are mentioned (European Commission, 2016a).

Almost together with the publication of the 2017 version of the EIF, the Tallinn Declaration was published. This Declaration reinforced the vision of the 2016-2020 Action Plan and the 2017 EIF of striving "to be open, efficient and inclusive, providing borderless, interoperable, personalised, user-friendly, end-to-end digital public services to all citizens and businesses – at all levels of public administration" (Council of the European Union, 2017, p. 3). As such, following the principles defined by the 2016 Action Plan, the Declaration sets clear five-year objectives and lines of policy action to be undertaken by the 32 signatory countries (Council of the European Union, 2017). In specific relation to the principle of 'Interoperability by default', the Declaration emphasises the importance of using open-source standards and re-using joint solutions (Council of the European Union, 2017). It also stresses the need of implementing the EIF

[IV] These seven principles are: Digital by default; Once only principle; Inclusiveness and accessibility; Openness and transparency; Cross-border by default; Interoperability by default; Trustworthiness and security (European Commission, 2016a).

within all Commission services (Council of the European Union, 2017). Finally, it defines a list of eight principles[V] for the design and delivery of user-centric digital public services (Council of the European Union, 2017).

A year after the publication of the 2017 EIF, the European Parliament and the Council published Regulation (EU) 2018/1724 establishing a single digital gateway to provide access to information, to procedures and to assistance and problem-solving services and amending Regulation (EU) No 1024/2012. Aiming for the realization of the once-only principle and supporting some of the user-centricity principles, the Regulation (EU) 2018/1724 describes in considerable detail the general characteristics the SDG should have, along with the services it should provide, the requirements it should fulfil, the technical solutions it should rely on, among other aspects.

In the Digital Europe Programme for the period 2021-2027, interoperability appears as the focus of the fifth specific objective, referred to as a key digital technology area that is to be approached in a holistic and sustained way (European Commission, 2018b). Focusing on the digital transformation of key public sector areas and industries, the programme aims at supporting the implementation of "a coherent eco-system of cross-border digital services infrastructure" (European Commission, 2018a, p. 3) with the purpose of facilitating the re-use and update of existing digital public services, interoperable solutions and common frameworks. The strategy for 'Shaping Europe's digital future' lies down three main objectives for the coming five years: technology that works for the people; a fair and competitive economy; and an open, democratic, and sustainable society (European Commission, 2020b). Here, interoperability is mentioned as a key line of action towards the first objective pointing out the need for a reinforced EU governments interoperability strategy (European Commission, 2020b).

Confirming its alignment with the Tallinn Declaration, the Berlin Declaration stresses the need of strengthening digital participation and digital inclusion for conducting value-based processes of digital transformation (Council of the European Union, 2020). As such, it suggests the adoption of seven principles[VI] and an according list of policy actions. In relation to interoperability, the Declaration confirms the relevance of reusable and open-source solutions and suggests the need of strengthening the EIF so that it ensures

[V] The Tallinn Declaration sets the following principles: digital interaction; accessibility, security, availability and usability; reduction of administrative burden; digital delivery of public services; citizen engagement; incentives for digital service use; protection of personal data and privacy; redress and complaint mechanisms (Council of the European Union, 2017).

[VI] The Berlin Declaration sets the following principles: Validity and respect of fundamental rights and democratic values; Social participation and digital inclusion to shape the digital world; Empowerment and digital literacy; Trust and security in digital government interactions; Digital sovereignty and interoperability; Human-centred systems and innovative technologies in the public sector; Towards a resilient and sustainable digital society (Council of the European Union, 2020).

digital sovereignty (Council of the European Union, 2020). Notably, the Berlin Declaration also refers to the importance of digital literacy, switches the term citizen-centredness for human-centredness, and emphasises the relation between digital transformation and the global Sustainable Development Goals (Council of the European Union, 2020).

Most recently, the publication of the 2030 Digital Compass suggests key milestones across four cardinal points that represent the EU's digital transformation ambitions for the next ten years (European Commission, 2021a; 2021b). It is worth noticing that two out of the four cardinal points are focused on fostering digital capacities and skills. Interoperability here is mentioned within the fourth cardinal point targeting the digital transformation of public services, with a particular focus on key areas such as health, justice, transportation, energy, and the take-up of an e-ID solution (European Commission, 2021a; 2021b).

2.2 The 2017 European Interoperability Framework

By 2016 there was a general consensus among different stakeholders about the need of updating the existing EIF, due to the insufficient alignment achieved with NIF from MS and, therefore, its lack of implementation (European Commission, 2017b). Aiming to avoid the emergence of diverging approaches that may lead to incompatible solutions, the ISA^2 Programme lead the revision of the EIF and the publication of a new version in 2017 (European Commission, 2017b)

Born from this revision, the 2017 EIF encourages coordinated efforts for the digitalisation of public administrations both at the European and MS levels (European Commission, 2017b). Aiming to avoid further fragmentation that may hinder the realisation of the DSM and the design of interoperable user-centric public services, the 2017 EIF was shaped following a wide consultation process (European Commission, 2017b).

As the EU requires common policies and legislation to facilitate interactions across borders and sectors, the 2017 EIF reinforces the importance of interoperability as a concept that captures the "ability of organisations to interact towards mutually beneficial goals, involving the sharing of information and knowledge between these organisations, through the business process they support, by means of exchange of data between their ICT systems" (European Commission, 2017c, p. 7).

The 2017 EIF provides a set of 47 commonly agreed recommendations to public administrations on how to improve governance of their interoperability initiatives based on 12 principles[VII] (European Commission, 2017c). The aim of the framework is:

> *to develop a European public services ecosystem in which owners and designers of systems and public services become aware of interoperability requirements, public administrations are ready to collaborate with each other and with businesses and citizens, and information flows seamlessly across borders to support a digital single market. (European Commission, 2017c, p.7)*

In most of the 2017 EIF principles, there is an underlying consideration that interoperability requires organisations that can, not only act in coordination but also learn and adapt to face changing environments. For example, many recommendations refer to the requirement of public administrations and public services to be highly adaptable to citizens' needs, to changes in the technological landscape, and in the information security and privacy standards (European Commission, 2017c). In consequence, the components that enable interoperable public services should be guaranteed over time, making interoperability a sustainable endeavour (European Commission, 2017c).

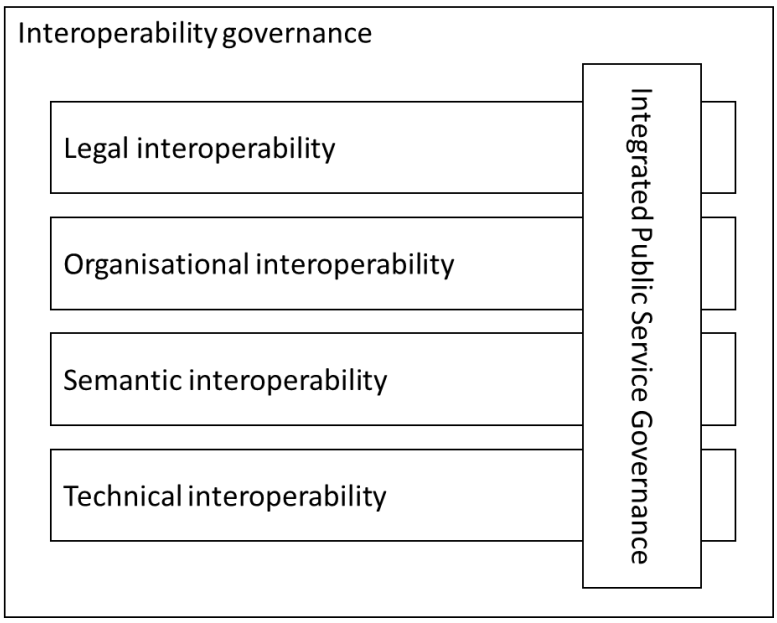

Figure 1 – 2017 EIF (European Commission, 2017c)

[VII] The 2017 EIF principles are: subsidiarity and proportionality; openness; transparency; reusability; technological neutrality and data portability; user-centricity; inclusion and accessibility; security and privacy; multilingualism; administrative simplification; preservation of information; assessment of effectiveness and efficiency (European Commission, 2017c).

Besides these principles and recommendations, the 2017 EIF describes a model composed of four interoperability layers (i.e., legal, organisational, semantic, and technical); one background layer (i.e., interoperability governance); and a cross-cutting component (i.e., integrated public service governance') (European Commission, 2017c) (see **Figure 1**). With regards to its layers, the EIF, even in its 2004 version[VIII] (European Communities, 2004), has been highlighted as the first one to introduce the organisational aspects of interoperability from an e-government perspective (Nada & Ali, 2014).

According to this framework, the organisational layer -where lies the main focus of this research- involves all matters related to "the way in which public administrations align their business processes, responsibilities and expectations to achieve commonly agreed and mutually beneficial goals" (European Commission, 2017c, p. 30) while also meeting user requirements.

Aiming to improve the alignment of NIF with the EIF and orient the national governance of interoperability, the recommendations of the 2017 EIF were accompanied by the Interoperability Action Plan 2017-2020 to support the implementation of the 2017 EIF (European Commission, 2017a). Interestingly, this Interoperability Action Plan focused on five main areas, among which one is entirely dedicated to the development of organisational interoperability (European Commission, 2017a). Here, the emphasis is made on proposing ways to formalise public administration organisational relationships, as well as identifying key cross-border business processes (European Commission, 2017a). Additionally, the Interoperability Action Plan reinforced the idea that users (i.e., businesses and citizens) should be "involved in the design, analysis, assessment and evolution of European public services" (European Commission, 2017b, p.7) and defined actions to promote the reuse and development of interoperability solutions (European Commission, 2017a; 2017b).

Monitoring the implementation of the 2017 EIF in the MS and the execution of the Interoperability Action Plan, was the ISA^2 Programme. This programme was the follow-up programme to ISA (2010 – 2015) and, since its creation, it has played "a key role in developing, establishing, maturing, operating, reusing, improving and promoting interoperability solutions facilitating cooperation between public administrations" (European Commission, 2017b, p. 6).

[VIII] The 2017 EIF is actually the third version of the EIF. Previous versions were published in 2004 and 2010 as part of the IDABC programme (2004 – 2009) and the ISA Programme (2010 – 2015), respectively. These versions already included an organisational layer of interoperability (European Commission, 2010b; European Communities, 2004)

3 Literature review and theoretical framework

This chapter is dedicated to present the literature review, as well as the theoretical framework. The most relevant scientific research in the fields of organisational interoperability and dynamic capabilities is examined following a thematic synthesis approach (Saunders et al., 2009). These fields correspond to the two first sections in which this chapter is divided. In turn, each one contains three thematic sub-sections, the content of which is summarised at the beginning of each section. The theoretical framework that guides the processes of data collection and analysis is presented in the last section.

3.1 Interoperability

In this section, the author first approaches the concept of interoperability, describing it as a dynamic, multidimensional and context-dependent e-government capability. This leads to reviewing the concept of organisational interoperability in the following sub-section. Here, the author examines how the literature has defined and approached the assessment of this layer. Despite the lack of exploration of this phenomenon, the author highlights conclusions that point out the importance of developing compatibilities in terms of human resources and organisational cultures. Finally, this leads to the last sub-section, which is entirely dedicated to the discovered concept of knowledge interoperability as a key sub-layer within organisational interoperability.

3.1.1 Dynamic, multidimensional, context-dependent e-government capability

Public administration interoperability has essentially been defined as "the ability of public agencies to work together" (Almeida Prado Cestari et al., 2020, p. 1071) overcoming different kinds of human, technological and organisational barriers (Bouallouche, Chenouard, Da Cunha, & Bernard, 2017). The ability to work together is exhibited in the sharing of information, resources and authority beyond the organisational boundaries of the members of a network (Pardo & Burke, 2008; Vernadat, 2010).

The concepts of 'networks of organisations' and 'network forms of government' appear at the core of interoperability (Pardo & Burke, 2008). Interoperability implies consolidating a network of organisations that interact with one another and that are, to some extent, interdependent (Bouallouche et al., 2017). Controlling this interdependence is key to ensure the coherence and compatibility needed to enable collaborative processes between heterogeneous organisations (Bouallouche et al., 2017). As such, interoperability has also been defined as the "capacity of systems, natively strangers one from another, to interact in order to establish harmonious and finalized collective behaviours, without the

necessity of profound changes in their individual structure of behaviour" (Pingaud, 2009, in Bouallouche et al., 2017, p. 155).

In order to balance the required levels of interdependence and autonomy, different approaches have been suggested towards interoperability (i.e., integrated, unified or federated systems; fully integrated, tightly coupled or loosely coupled systems) (Bouallouche et al., 2017; Vernadat, 2010), implying different schemes of compliance and control (i.e., mandatory or voluntary; centralized or decentralized) (Sharma & Panigrahi, 2015). These aspects are even harder to determine when the network involves public sector organisations and as networks grow (Scholl & Klischewski, 2007). In addition, common standards and frameworks have been developed to provide "principles, guidelines, best practices, vocabulary and concepts" (Mačinković & Aničić, 2016, p. 102). Standards and frameworks help to manage the architectural domains of interoperability (i.e., business, services, technology and information) in different settings (Mačinković & Aničić, 2016).

Nevertheless, interoperability still requires that all network members be somewhat willing and ready to make changes in response to externally agreed or contingent requirements in order to keep the network alive and functional (Pardo & Burke, 2008; Sharma & Panigrahi, 2015). In this sense, interoperability is an inherently dynamic capability (Pardo & Burke, 2008) that enables organisations to meet citizens, businesses and governments' changing demands (Cresswell, Pardo, Canestraro, Dawes, & Juraga, 2005; Pardo, Nam, & Burke, 2012).

Even though early conceptualisations of interoperability focused -almost exclusively- on its technical aspects (e.g., Vernadat, 2010), nowadays different authors stress that interoperability is a socio-technical construct that also requires organisational and political considerations (Espadinha-Cruz & Cabrita, 2018; Gottschalk & Solli-Saether, 2008; Jimenez, 2012, in Henning, 2018; Pardo et al., 2012; Sta, 2018). Interoperability is nowadays understood by both academics and practitioners in a broader sense: as a multidimensional innovation that involves policy, management and technology dimensions (Cresswell et al., 2005; Malinauskienė, 2013; Pardo et al., 2012; Scholl & Klischewski, 2007; Tripathi, Gupta, & Bhattacharya, 2013). A pioneering example of this perspective is shown in Otjacques, Hitzelberger and Feltz (2007), who referred to the implementation of interoperability solutions as a triplet-package consistent of legal, organisational, and technical measures.

Despite the emergence of this more holistic definition, literature on the topic is still mostly dominated by publications that refer to interoperability as a "capacity of information systems to process, store and exchange electronic documents using uniform technology

standards and processes" (Casalino, Cavallari, Marco, Gatti, & Taranto, 2014, p. 400), that is, from a technocentric perspective (Sharma & Panigrahi, 2015). Different authors (Pardo & Burke, 2008; Pardo et al., 2012; Scholl & Klischewski, 2007) argue that it is precisely because of this persistent over emphasis on the technology dimension that, in practice, interoperability development has been unable to address the necessary policy and organisational changes that it requires for the desired integration.

Public administration interoperability is also intimately related to concepts such as e-government and open government, which have also transitioned from very technocentric to more holistic definitions (Malinauskienė, 2013). According to Casalino et al. (2014, p. 401) "Open Government is an interoperable government model in which people and systems communicate easily [thanks to] the role of Information and Communication Technologies (ICT)". Interoperability is therefore understood as a mature e-government capability (Malinauskienė, 2013; Sharma & Panigrahi, 2015), associated with advanced levels of integration that should enable seamless interaction between government authorities, businesses and citizens (Casalino et al., 2014), and guarantee the provision of tailored services through a one-stop digital portal (Layne & Lee, 2001; Rhazale & Bounabat, 2018; Rico-Pinto & Sánchez-Torres, 2019; Sharma & Panigrahi, 2015; Sta, 2018; Tripathi et al., 2013).

E-government interoperability should contribute to good governance by improving the cost-effectiveness of public operations, the responsiveness and citizen-centricity in the delivery of services, as well as the transparency, accountability and efficiency in collaborative decision-making processes (UNDP, 2008, in Almeida Prado Cestari et al., 2020; Casalino et al., 2014; Sharma & Panigrahi, 2015; Tripathi et al., 2013). Interoperability enables synergies that allow the network to produce more value than the sum of its members would do (Vernadat, 2010). Such a horizontally and vertically networked form of government should be able to become agile, resilient and innovative enough to respond to global challenges and rapid changes in the environment (Malinauskienė, 2013; Nada & Ali, 2014). It is argued that such challenges cannot be easily met by our current public administration structures that are characterised by high levels of hierarchical bureaucracy, compartmentalisation of expertise, siloed practice domains, closed organisational cultures, lack of trust and aversion to risk (Layne & Lee, 2001; Pardo & Burke, 2008).

The importance of context for the development of e-government has increasingly been acknowledged (Malinauskienė, 2013). At the same time, interoperability is being recognized as a highly-context dependent innovation, based on the evidence that sometimes the same information technology (IT) solution can have divergent applications

because of legal, political, historical, financial and cultural factors (Otjacques et al., 2007). In some circumstances, these divergences may be intentional and even desired by the different administrations (Otjacques et al., 2007). In consequence, many countries and entities have come up with their own frameworks for interoperability in accordance with their specific objectives and environments (Cresswell et al., 2005; Tripathi et al., 2013). Rico-Pinto and Sánchez-Torres (2019) contribute with an exhaustive list of 25 factors that could act as inhibitors or enablers of interoperability depending on the context of the specific entity or initiative under assessment. However, the relationship between contextual factors and interoperability development in specific settings has been considerably less explored, only highlighting that country, institutional and organisational landscapes should be taken into account when assessing interoperability development (Malinauskienė, 2013).

To summarise this sub-section, the literature argues that public administration interoperability should be understood as a complex dynamic, multidimensional and context-dependent e-government capability (Cresswell et al., 2005; Malinauskienė, 2013; Pardo et al., 2012). It is required by integrated and network forms of government in order to operate efficiently and effectively (Layne & Lee, 2001; Pardo & Burke, 2008). It contributes to good governance and open government principles (Casalino et al., 2014), as well as to respond to global challenges and rapid changes in the environment determined by the needs of citizens, businesses and other public administrations (Pardo & Burke, 2008; Rhazale & Bounabat, 2018). Lastly, interoperability has increasingly been acknowledged as a highly context-dependent innovation crossed by policy, management and technology dimensions (Cresswell et al., 2005; Malinauskienė, 2013; Pardo et al., 2012; Scholl & Klischewski, 2007; Tripathi, Gupta, & Bhattacharya, 2013). However, literature on the topic is still mostly dominated by technocentric perspectives (Sharma & Panigrahi, 2015) and not enough publications address the dynamic, multidimensional and context-dependent aspects of interoperability.

3.1.2 Organisational interoperability

Organisational interoperability concerns the ability of two or more organisational entities to align their processes so they can work together (European Commission, 2017c). This implies the ability to exchange services, tasks, and processes for the purpose of inter-operating (Tripathi et al., 2014), as well as to define “business goals, aligning and coordinating business processes and bringing collaboration capabilities to organizations that wish to exchange information and may have different internal structures and processes” (Vernadat, 2010, p. 142). In the words of Rhazale and Bounabat (2018, p. 2) it can also refer to defining agreements regarding “how to act on the data exchanged”.

Business process alignment, coordination and collaboration are terms usually associated to this "fuzzy" layer (Rhazale and Bounabat, 2018, p. 2).

Some authors would refer to this layer as 'Business Interoperability', particularly when referring to how two or more enterprises cooperate thanks to IT-supported relationships (Kubicek et al. 2011, in Rhazale & Bounabat, 2018; Nada & Ali, 2014). Moreover, Vernadat (2010, p. 142) would define it as "the ability of business organisations to provide services to each other as well as to users or customers or to the wider public in the case of administrative organisations".

Organisational interoperability has become a topic of major concern for practitioners in the last decade (Rhazale & Bounabat, 2018). However, there is no considerable progress regarding its formalisation beyond legalistic aspects (Bouallouche et al., 2017). Despite Rhazale and Bounabat (2018) review recent efforts from five different approaches on how to formalise this dimension, they conclude that most of these efforts fail to address critical aspects, like how can the evolution of organisational interoperability be monitored. Approaches such as process standardization, the definition of global business processes, the establishment of process agreements (Rhazale & Bounabat, 2018) are some of the most commonly used, but they focus on the planning of organisational interoperability, rather than on its implementation and assessment.

The literature emphasises the lack of methodological basis and measurement instruments to assess interoperability between organisations or areas (Almeida Prado Cestari et al., 2020; Maheswari & Janssen, 2012). This is especially evident when referring to the organisational dimension of interoperability and trying to analyse the organisational factors that might influence its development and adoption (Henning, 2018).

Interoperability assessment consists mostly of studies that either measure the potential of interoperability based on maturity models, compare compatibilities across dimensions and management levels, measure interoperability's performance in terms of operational efficiency and/or by detecting interoperability problems (Bouallouche et al., 2017; Mačinković & Aničić, 2016).

Out of all these alternatives, existing frameworks for interoperability assessment tend to rely on maturity/capability reference models[IX] (Almeida Prado Cestari et al., 2020). Considering that these models have a strong connection with homologous e-government

[IX] A maturity or capability model is a representation that is usually organised by levels or stages that describe a recommended evolutionary path for an organisation. Each level or stage builds on the previous ones and represents an improvement in terms of organisational performance with respect to a practice area or group of practice areas (Almeida Prado Cestari et al., 2020). Layne and Lee's (2001) growth model for e-government is one of the most cited ones in interoperability literature, suggesting four stages: (1) cataloguing, (2) transaction, (3) vertical integration, and (4) horizontal integration.

maturity models, it has been argued that they focus almost entirely on the technical dimension (Almeida Prado Cestari et al., 2020). Following Valdes et al. (2008), these models assume a linear development of interoperability based on a technology-first strategy (as opposed to a business-first strategy), in which the focus is on establishing technical standards and frameworks, relegating to a later stage the concern for other dimensions using enterprise architecture methods. Considering that many countries have followed the example of the United Kingdom and chosen a technology-first strategy (Valdes et al., 2008), it should not be surprising that technological interoperability is frequently seen as a pre-condition for organisational interoperability by both researchers and practitioners (e.g., Gottschalk & Solli-Saether, 2008; Sta, 2018; Tripathi et al., 2013; Vernadat, 2010). In addition, maturity/capability models tend to rely on quantitative data collection techniques, such as surveys and questionnaires to determine the maturity levels based on absolute scores that are assumed to be comparable across organisations (Almeida Prado Cestari et al., 2020). As such, it can be argued that these assessment models may neglect the multidimensional and context-dependent qualities of interoperability.

An example of a maturity model to measure organisational interoperability is the one proposed by Maheswari and Janssen (2012). These authors tested a total of 15 measurement constructs associated with this layer of interoperability finding that the constructs linked to human resources skills and communications were considered highly relevant by the civil servants surveyed. They conclude that further exploration needs to be conducted in order to determine measures for benchmarking on these key organisational aspects, however, they also admit that developing a maturity model instrument for measurement may be particularly difficult as public organisations vary considerably in terms of objectives and complexity (Maheswari & Janssen, 2012).

Other studies focus on comparing organisations in terms of interoperability dimensions (i.e., policy, organisational and technology) and/or management levels (i.e., business, services, technology and information) in order to make recommendations for organisational homogeneity (Bouallouche et al., 2017). In this regard, Cresswell, Canestraro and Pardo (2008, p. 4) point out that interoperability capability also depends on the "alignment among technical (i.e., physical) resources, social and organizational norms & cultures, and knowledge resources", meaning that these elements should be "sufficiently similar and compatible". In addition to this, other studies would argue that "not all organisations involved in a network need to have the same capabilities to achieve interoperability" (Pardo & Burke, 2008, p. 9), instead "the success of information sharing depends on the combination of capabilities that exist among the sharing partners" (Cresswell et al., 2005, p. 10). As such, each member within a network may exhibit

different combinations of policy, organisational and technology interoperability capabilities, which implies that every entity should be understood in its own specificity in order to advance the network's interoperability development process (Pardo & Burke, 2008). In addition, as a dynamic capability, interoperability requires ongoing assessment efforts to ensure that this alignment is sustained and adapts to changes in the network's goals, as well as changes in the context of the network's members (Bouallouche et al., 2017; Pardo & Burke, 200).

When analysing which capability dimensions should be compatible within network forms of government, organisational capabilities and resources strike as the least explored. To review some examples; some authors (Pardo & Burke, 2008; Pardo et al., 2012) suggest that cross-organisational collaboration implies collaboration readiness and organisational compatibility meaning, on the one hand, having the practices and resources needed to support collaboration while, on the other hand, having similar cultures and workstyles. In a similar sense, Rico-Pinto and Sánchez-Torres (2019) mention IT staff capability, as well as knowledge of information assets and organisational processes, as key organisational factors influencing interoperability initiatives. Tripathi et al. (2013) also consider the importance of organisational factors such as counting with top management support, technical expertise, internal motivation, financial resources and a collaborative mindset within and between organisations. Sharma and Panigrahi (2015), in turn, suggest a roadmap for planning and implementing e-government interoperability capability in which it is noticeable the importance of training the staff, as well as putting in place incentives to ensure compliance in operations. Kompella (2016) argues that developing knowledge management systems, enabling agile mechanisms and the institutionalisation of good governance routines to gather the value perception of diverse stakeholders, are essential enablers for organisational interoperability. In general, organisational structures, decision-making approaches, management styles, business processes and goals, work cultures and human skills appear to be key organisational factors to look into when assessing the compatibility between organisations (Vernadat, 2010).

To summarise this sub-section, literature tends to agree on organisational interoperability still lacking a clear definition (Rhazale & Bounabat, 2018) and measurement instruments (Maheswari & Janssen, 2012). Albeit this lack of exploration, different authors point out that among the numerous constraints that e-government interoperability has to face, organisational factors might be the most essential, yet the hardest to address (Pardo & Burke, 2008; Rico-Pinto & Sánchez-Torres, 2019; Scholl & Klischewski, 2007). In order to monitor and assess organisational interoperability development, previous studies have shown the limitations of certain instruments, such as maturity models (e.g., Maheswari & Janssen, 2012). Instead, other studies looking at the compatibility between organisations,

emphasise the importance of having qualified human resources, as well as similar cultures, knowledge, work styles and leadership (e.g., Pardo & Burke, 2008; Pardo et al., 2012; Rico-Pinto & Sánchez-Torres, 2019; Tripathi et al., 2013; Vernadat, 2010).

3.1.3 Knowledge interoperability

Knowledge interoperability was first defined by Chen and Doumeingts (2003, p. 159) as "the compatibility of the skills, competencies, and knowledge assets of an enterprise with those of other enterprises". In line with the aforementioned studies that have explored the organisational layer of interoperability, the concept of knowledge interoperability comes to highlight the importance of developing compatibilities within a network of organisations in terms of their knowledge resources.

Going back to interoperability definitions, the need of sharing knowledge between organisations has been highlighted as a pre-condition for establishing cross-organisational business processes and for organisations to know how to act on the basis of shared information (Rhazale & Bounabat, 2018). Gathering inputs from literature, the capability to share knowledge involves all actions of an organisation's staff in creating, storing, sharing and using such organisational knowledge, including the required training and experience to work with knowledge management-technologies, as well as the development of a knowledge-sharing and learning culture (Cresswell et al., 2005; Espadinha-Cruz & Cabrita, 2018; Gottschalk & Solli-Saether, 2008; Luna-Reyes, Juiz, Gutierrez-Martinez, & Duhamel, 2020; Pardo & Burke, 2008; Pardo et al., 2012).

The literature review revealed that only two sources address the concept of knowledge interoperability as such, in both cases as a sublayer of organisational interoperability.

Gottschalk and Solli-Saether (2008) describe a four-stage model for organisational interoperability development, in which the second stage concerns knowledge sharing practices, including collecting, storing and exchanging knowledge between collaborating organisations (see **Figure 2**). This model is illustrative of how shared knowledge and its effective application can be the basis for added value creation in networks of organisations (Gottschalk & Solli-Saether, 2008). Furthermore, knowledge sharing can be interpreted as a capability needed to move from pure business process alignment towards strategic alignment between organisations; a stage in which learning in inter-organisational relationships becomes important (Gottschalk & Solli-Saether, 2008).

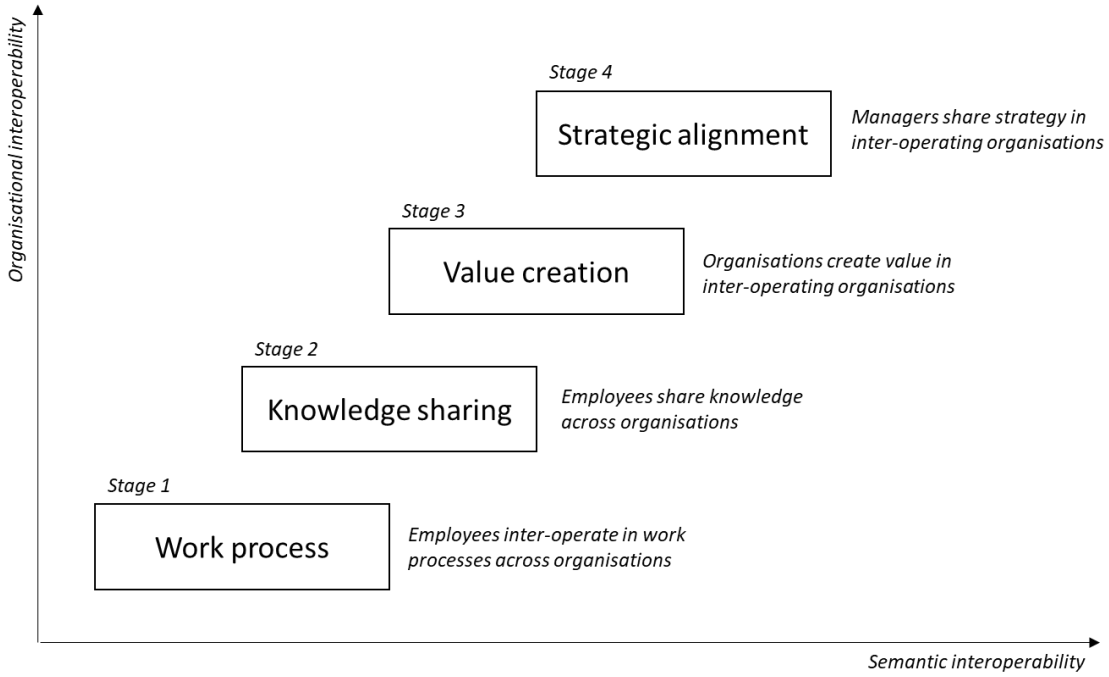

Figure 2 – Organisational interoperability (Gottschalk & Solli-Saether, 2008, p. 314)

In turn, Espadinha-Cruz and Cabrita (2018) suggest a conceptual framework for knowledge interoperability that describes factors that can influence knowledge sharing in a strategic alliance. Their framework considers strategic, knowledge management, cultural, legal, human resource, process and data-related factors (see **Figure 3**). Although they provide a framework with broad categories of factors that might influence knowledge interoperability -making a pioneering contribution in a rather unexplored field of research- the author of this thesis could not find further operationalisation and empirical validation of these categories.

As they explain it, decisions at the strategic level of business can also be understood in terms of what an organisation currently knows (i.e., as-is state) and what it should know (i.e., to-be state). In between, there is a knowledge gap to reach the strategic goals that can only be surpassed by enhancing the learning capability of the organisations (Espadihna-Cruz & Cabrita, 2018). One effective way to do this is through collaborations because they allow to combine knowledge resources and boost the learning capability of the network (Espadihna-Cruz & Cabrita, 2018).

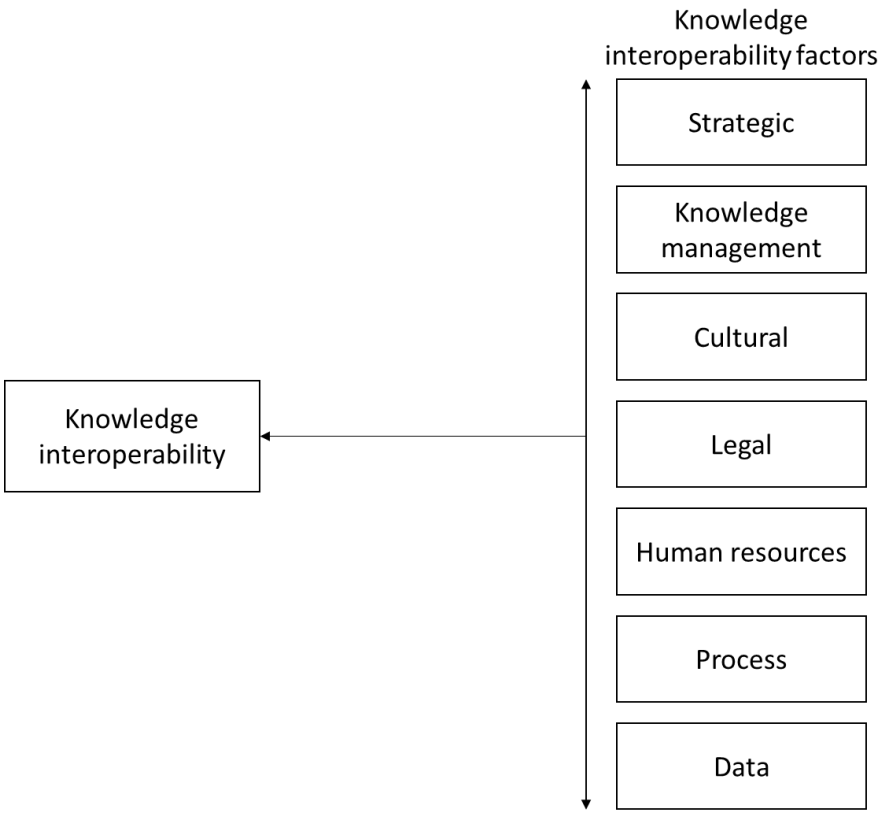

Figure 3 – Knowledge interoperability (Espadihna-Cruz & Cabrita, 2018, p. 247)

To summarise, the author focused on the concept of knowledge interoperability as proposed by organisational interoperability theory. Knowledge interoperability has been scarcely explored and developed as a theoretical concept; however, existing frameworks identify it as a crucial sub-layer between business process and strategic alignment among organisations (Espadinha-Cruz & Cabrita, 2018; Gottschalk & Solli-Saether, 2008). This concept highlights the relevance of knowledge resources (tacit and explicit) and knowledge management practices (i.e., creating, storing, sharing and using organisational knowledge), as well as the learning capability of organisations within networks (Espadinha-Cruz & Cabrita, 2018; Gottschalk & Solli-Saether, 2008).

3.2 Dynamic capabilities

This section dives into the dynamic capabilities theory in order to reach a better understanding of its foundations, how it has been used and what conceptual constructs are associated with it. The first sub-section is dedicated to reviewing a recent trend of studies that applies this approach to public sector organisations. The following sub-section goes deeper into the traditional constructs used by this theory, as well as its relations with Resource-Based View (RBV) of the firm. The last sub-section addresses a variation of this theory that focuses on knowledge as the most important and strategic resource for an organisation's performance and value creation in changing environments.

3.2.1 Public sector dynamic capabilities and digital transformation

Dealing with turbulent environments can represent many challenges for organisations. Technological advances can generate changes in consumer behaviour, in the competitive landscape, and in the availability of data, all of which can, in turn, generate huge disruptions on the internal structure, processes and even on the culture of organisations (Vial, 2019). This phenomenon has been called digital transformation, meaning "a process wherein organizations respond to changes taking place in their environment by using digital technologies to alter their value creation processes" (Vial, 2019, p. 119). It characterises what is nowadays taking place within and outside organisations and that can be seen both as a threat or as a source of opportunities (Vial, 2019). Based on an exhaustive literature review, Vial (2019) highlights that digital transformation triggers strategic responses from organisations that enable them to create value in new ways. Organisations are increasingly expected to develop strategies that take advantage of the opportunities afforded by digital technologies so they can be able to respond to a demanding environment efficiently and effectively (Vial, 2019).

Concerning how public sector organisations are going through this process of digital transformation Mergel (2016) provides guidance on how to develop a collaborative and agile innovation management approach in government. Stressing that "the main challenge for government is the cultural change that needs to go hand in hand with the procedural changes" (Mergel, 2016, p. 522), the author would refer to the need of developing and keeping talent inside the public sector through innovative acquisition and human resources policies (Mergel, 2016). Additionally, the author emphasizes the importance of counting with internal managerial commitment towards change and innovation, fulfilling a leadership role to assume openness by default and counteract possible risk-aversion (Mergel, 2016). Consequently, collaborative and agile innovation management would bring the benefits of experimentation and iterations in order to keep the feedback of end-users and contractors constantly in the loop, thus enabling a government that proactively adapts to its environment (Mergel, 2016).

In order to face the phenomenon of digital transformation, Vial (2019) concludes that public sector organisations need to assume a change-oriented mindset and incorporate new kinds of skills among their human resources. The author suggests taking a dynamic capabilities' theoretical perspective, to better comprehend how public sector organisations can design mechanisms for "repeatable, continuous adaptation" (Vial, 2019, p. 133) when dealing with rapidly changing environments.

The theory of dynamic capabilities has been historically applied to the private and for-profit sectors (Pablo, Reay, Dewald, & Casebeer, 2007). Despite evolutionary elements

are also present in public sector innovation literature (Kattel, 2015), it is only recently that a new research trend has started to use the dynamic capabilities' theory to understand the changes in the public sector. As Pedersen (2017) argues, the dynamic capabilities' theory has become key to understand public sector organisational transformation in relation to e-government, even though it is still not widely used within public administration research (Klievink & Janssen, 2009; Pablo et al., 2007; Pedersen, 2017).

Kattel and Mazzucato (2018) argue the need for developing public sector dynamic capabilities when describing the contemporary transformations that innovation policies around the globe have experienced. These authors also refer to the growing relevance of non-technological innovations when arguing that the states' roles towards innovation have become more proactive, risk-taking, and agile (Kattel & Mazzucato, 2018; Mazzucato, Kattel, & Ryan-Collins, 2020). Current challenges demand that innovation policies work across sectors and domains (Mazzucato et al., 2020), enable feedback loops from the environment, and deploy a more experimental approach (Kattel & Mazzucato 2018; Mazzucato et al., 2020). As such, these authors argue that public organisations need to become more dynamic, not only to overcome the silos between policy domains but also so their structures become capable of learning and adapting (Kattel & Mazzucato 2018). Moreover, states that possess and deploy these capabilities can be described as 'entrepreneurial states', meaning states that count with innovation bureaucracies characterised for being "constellations of public organisations that deliver agile stability" (Kattel, Drechsler, & Karo, 2019, p. 3). Crucial for enabling agile stability, are public sector capabilities for learning and adapting to changes in the environment, as well as for establishing partnerships with other public and private organisations to encourage innovation (Mazzucato et al., 2020).

After a literature review on the topic of dynamic capabilities applied to public sector organisations, Piening (2013) argues that despite some researchers have provided insight into the antecedents and outcomes of organisational change in public sector organisations, the actual processes they involve have remained largely unexplored. So far, literature has revealed that public sector dynamic capabilities are highly influenced by performance evaluation processes conducted by management and therefore, managerial commitment, autonomy and incentives play a key role in their deployment (Piening, 2013). Also, that public sector dynamic capabilities have an indirect influence on an organisation's technical and evolutionary fitness (i.e., efficiency and effectiveness), which is not necessarily always positive (Helfat et al., 2007, in Piening, 2013). However, only a few studies have focused on the processes of how public sector organisations develop and deploy dynamic capabilities (e.g., Pablo et al., 2007), and therefore more empirical

research should be conducted on how and why public sector dynamic capabilities are deployed (Gupta, Panagiotopoulos, & Bowen, 2017; Piening, 2013).

To summarise this sub-section, the author reviewed the main propositions of a recent trend in public administration literature that is arguing for the concept of public sector dynamic capabilities (e.g., Gupta et al., 2017; Kattel & Mazzucato 2018; Piening, 2013; Vial, 2019). Understanding and developing dynamic capabilities becomes a necessity for public sector organisations to lead -and not only face- the phenomenon of digital transformation (Kattel & Mazzucato 2018; Kattel et al., 2019). However, exploration on this topic is still scarce and there is a need for further empirical research on the processes implied by public sector dynamic capabilities (Luna-Reyes et al., 2020; Piening, 2013).

3.2.2 The resource-based view and the dynamic capabilities theory

Dynamic capabilities theory was first suggested as an alternative approach to understanding organisational change within strategic management research (Helfat & Peteraf, 2003, 2009; Teece, Pisano, & Shuen, 1997). This approach can be considered an extension of the RBV (Eisenhardt & Martin, 2000; Gupta et al., 2017; Helfat & Peteraf, 2009; Hsu & Wang, 2012; Hung, Yang, Lien, McLean, & Kuo, 2010; Klievink & Janssen, 2009; Teece et al., 1997).

According to the RBV, the differences in performance of firms is a consequence of resources and capabilities being heterogeneously distributed (Barney, 1991; Eisenhardt & Martin, 2000; Helfat & Peteraf, 2003). It is the idiosyncratic attributes of their resources and how they are used and complemented (i.e., an organisation's capabilities), that makes the difference in how organisations perform (Eisenhardt & Martin, 2000; Hung et al., 2010). Altogether, resources (tangible and intangible) and capabilities constitute the organisation's resource base (Helfat & Peteraf, 2009).

Dynamic capabilities enable the intentional reconfiguration of an organisation's resource base (Helfat & Peteraf, 2009; Piening, 2013; Teece, 2007). The term 'dynamic' refers to this intentional capacity to adapt in order "to achieve congruence with the changing business environment" (Teece et al., 1997, p. 515) and the term 'capability' links to managerial roles that have responsibility for this kind of strategic decisions (Teece et al., 1997). The most cited definition belongs to Teece et al. (1997, p. 516): a "firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments."

At the very foundations of the dynamic capabilities' theory is the Schumpeterian concept of innovation and an evolutionary perspective of organisations (Helfat & Peteraf, 2009;

Nelson & Winter, 2002; Teece, 2007). Organisational evolutionists argue that organisations and their environment co-evolve (Abatecola, Belussi, Breslin, & Filatotchev, 2016; Teece, 2007; Zollo & Winter, 2002). Mostly used to explain change and competition within and among organisations, evolutionary scholars have focused on routines as units of analysis (Abatecola et al., 2016; Nelson & Winter, 2002; Zollo & Winter, 2002).

Routines can be understood as repeated patterns of practice and learning (Teece et al., 1997) that have been studied as both, adaptive automatic reactions to changes in the environment (e.g., Hsu & Wang, 2012), and the result of deliberated learning practices executed by individuals (Abatecola et al., 2016; Nelson & Winter, 2002; Zollo & Winter, 2002). Furthermore, for the dynamic capabilities' theory "organizations depend on simultaneously exploiting existing technologies and resources to secure efficiency benefits and create variation through creativity and exploratory innovation" (Winter, 2003, in Ferreira, Coehlo, & Moutinho, 2020, p. 12). This links the dynamic capabilities' theory with the categories of exploration and exploitation suggested and the ability to balance them properly (i.e., ambidexterity) (March, 1991, in Ferreira et al., 2020).

Entrepreneurialism is another concept that is highly relevant to this theory. According to Teece (2007, p. 1321) "the element of dynamic capabilities that involves shaping (and not just adapting to) the environment is entrepreneurial in nature" and is what essentially marks a difference between the dynamic capabilities' approach and the change management field of research (Helfat & Peteraf, 2009). Nelson and Winter (2002, p. 27) would refer to this as the assumption of "limited path dependency". Entrepreneurialism is, therefore, highly associated with strategic change, creativity, foresight, risk-taking decisions to innovate, proactively adapting to environmental changes, and seizing market opportunities (Ferreira et al., 2020; Zahra & George, 2002).

Dynamic capabilities have been mostly studied as drivers of sustained competitive advantage, improved organisational performance, and organisational change and survival (Eisenhardt & Martin, 2000; Piening, 2013). However, most recent definitions try to avoid possible tautologies, by stating that dynamic capabilities -even though aiming for it- do not necessarily lead to these outcomes (Piening, 2013). Instead, dynamic capabilities have an indirect effect on organisational performance, as they can only transform an organisation's capabilities, but they cannot ensure that these changes would be inevitably for the best (Helfat & Peteraf, 2009).

An organisational capability can be understood as "the use and deployment of resources and assets to accomplish its organisational goals" (Luna-Reyes et al., 2020, p. 152). When building his framework, Teece et al. (1997) would argue that organisational capabilities

can be either operational or dynamic. According to Teece (2007; 2018), while operational capabilities are those that allow firms to operate, dynamic capabilities can be differentiated between lower and higher levels. Lower-level dynamic capabilities are those that allow firms to orchestrate their resources and operational capabilities to improve their performance, while higher-level dynamic capabilities reconfigure lower-level dynamic capabilities through entrepreneurial managerial interventions (Teece, 2018). Consequently, dynamic capabilities are responsible for extending, modifying and creating dynamic and operational capabilities, as well as for reconfiguring an organisation's resource base (Piening, 2013).

Higher-level dynamic capabilities consist of three kinds of activities, namely sensing, seizing, and transforming (Teece, 2007, 2018). Even though all of these capabilities are key to enable innovative and sustainable organisational growth, organisations may not have them at equally strong levels (Teece, 2018). The strength of a firm's dynamic capabilities depends on its organisational culture, as well as on how well their employees -especially their managers- can play operational, entrepreneurial and leadership roles (Teece, 2016). As such, dynamic capabilities are highly idiosyncratic in the way organisations develop and deploy them (Zahra & Georges, 2002).

The sensing capacity refers to the ability to identify, shape and assess opportunities and threats (Teece, 2007, 2018). As Teece (2007, p. 1322) would describe it, it is "a scanning, creation, learning, and interpretive activity". It is highly associated with the creative capacity of individuals and the learning capacities of the organisation (Teece, 2007). Research and development (R&D) activities to gather knowledge about user needs and novel solutions in the organisations' ecosystem are key for sensing (Teece, 2007).

The seizing capacity consists in the ability to take advantage of the opportunities/threats, by creating and capturing value from them through organisational innovations in terms of business models, products, processes, or services (Teece, 2007, 2018). Being able to create, adapt and deploy business models in response to changing strategies and/or changing environmental needs, is a sign of strong seizing (Teece, 2018).

Finally, transforming refers to the ability to periodically realigning an organisations' structure of tangible and intangible assets, including its business models, to continue capturing value (Teece, 2007, 2018). In the words of Teece (2007, p. 1335) this capability "is needed to maintain evolutionary fitness and, if necessary, to try to escape from unfavourable path dependencies". It expresses a top management ability to maintain the organisation agile, so it can rapidly test, implement and refine new business models whenever the ecosystem reveals a valuable opportunity (Teece, 2007, 2018).

To summarise this sub-section, the author has focused on explaining the basic constructs associated with the dynamic capabilities' theory born in strategic management literature. The concepts of resources, organisational capabilities, operational and dynamic capabilities, as well as their links with constructs like ambidexterity and entrepreneurialism were defined. Finally, the traditional types of dynamic capabilities suggested by Teece (2007, 2018) were explained.

3.2.3 Knowledge-based dynamic capabilities

Organisations evolve following specific trajectories that, not only shape organisational routines but also outline management's strategic choices (Teece et al., 1997). As routines build based on repeated practice (Eisenhardt & Martin, 2000; Piening, 2013), they require the combination of experiential learning (i.e., accumulated experience) and deliberate cognitive processes (i.e., knowledge articulation and codification) (Zollo & Winter, 2002). It can be argued that the development of organisational capabilities is strongly associated with organisational learning in terms of how organisations systematically accumulate knowledge over time (Helfat & Peteraf, 2003; Zollo & Winter, 2002) and, hence, dynamic capabilities evolve thanks to organisational learning mechanisms (Eisenhardt & Martin, 2000; Zollo & Winter, 2002). As the change in organisational routines is often triggered by the failure of existing ones (Nelson & Winter, 2002), a learning orientation appears essential to develop more effective routines and business strategies that successfully respond to turbulent environments (Eisenhardt & Martin, 2000; Zahra & George, 2002)

Building on the RBV, the dynamic capabilities theory and organisational learning theory, the Knowledge-Based View (KBV) of organisations stresses the importance of knowledge as the fundamental and most strategically significant resource for the sustainable improved performance of organisations (Grant, 1996). Central to the KBV is the idea that knowledge integration is at the core of organisational capabilities that provide the basis for sustainable competitive advantage (Grant, 1996). As a resource, knowledge is considered strategic because it is valuable, rare, hard to imitate and substitute (Barney, 1991).

According to this view, knowledge is a complex resource that involves tangible and intangible elements, also referred to as explicit or tacit (Grant, 1996). Explicit knowledge refers to information that can be "written down" (Grant, 1996, p. 377) or, in other words, codified in the form of documents, databases, images, e-mails, etc. Implicit knowledge refers to specialised skills, practical knowledge, experiences that are learned and stored within individuals and are, therefore, harder to codify and integrate without losing knowledge in the process (Grant, 1996). Routines -which are highly unique and

idiosyncratic to an organisation- are a way in which organisational knowledge can be communicated in an implicit form, and networks of organisations and individuals are a way to transfer such knowledge (Grant, 1996).

The relevance attributed to knowledge as the most important resource for organisations would give grounds to the emergence of the knowledge-based dynamic capabilities approach. This approach has had a few attempts of operationalisation through the development of categories as variations of the sensing, seizing and transforming capabilities proposed by Teece (2007; 2018).

For example, Zahra and George (2002), without referring to the concept of knowledge-based dynamic capabilities as such, suggest four dimensions of an absorptive dynamic capability[x]: knowledge acquisition; knowledge assimilation; knowledge transformation; and knowledge exploitation. The deployment of the first two capabilities would manifest an organisation's potential absorptive capacity, while the deployment of the second pair would imply the realisation of this capacity (Zahra & George, 2002). To move from potential to realised absorptive capacity, the authors argue that knowledge sharing, and socialisation mechanisms are essential (Zahra & George, 2002).

Similarly, Verona and Ravasi (2003) suggest the sub-capabilities of knowledge creation and absorption, knowledge integration, and knowledge reconfiguration. According to Verona and Ravasi (2003), conjoint deployment of these three capabilities is at the core of a company's continuous product innovation.

Later on, knowledge-based dynamic capabilities appear defined as "the ability to acquire, generate and combine knowledge resources to sense, explore and address environment dynamics" (Zheng, Zhang, Wu, & Du, 2011, p. 1037). After providing the first definition, Zheng et al. (2011) suggest three sub-capabilities to operationalise this construct: knowledge acquisition capabilities (KAC); knowledge generation capabilities (KGC); and knowledge combination capabilities (KCC) (see **Figure 4**).

[x] The notion of absorptive capacity was first introduced by Cohen and Levinthal in 1989 within the management literature, and has been defined as "a dynamic capability pertaining to knowledge creation and utilization that enhances a firm's ability to gain a competitive advantage" (Zhara & Georges, 2002, p. 185)

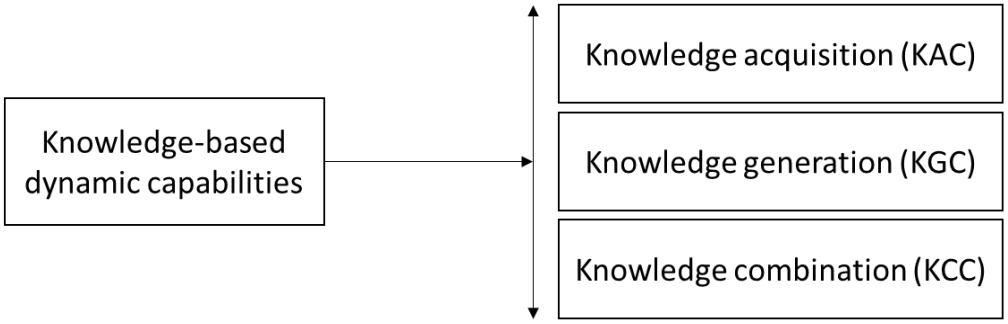

Figure 4 – Knowledge-based dynamic capabilities (Zheng et al., 2011)

Furthermore, these authors investigated how alliance networks (i.e., network embeddedness) influence the development of knowledge-based dynamic capabilities, by fostering the exchange of knowledge resources and the engagement in shared goals, joint problem solving and commitments (Zheng et al., 2011). Their findings revealed that knowledge-based dynamic capabilities, in particular KAC and KCC, were "greatly influenced by network embeddedness" (Zheng et al., 2011, p. 1048).

More recently, Denford (2013) developed a comprehensive knowledge-based dynamic capabilities typology building on top of the categories suggested by previous frameworks. The author applies three differentiating dimensions to suggest a total of eight knowledge-based dynamic capabilities[XI], even though they admit that capabilities characterised by opposite dimensions can overlap and appear simultaneously in some cases. These dimensions are whether the source of knowledge is internal or external; whether the focus of the processes is on exploration or exploitation of knowledge; and finally, whether knowledge is changed through processes of exchange of knowledge resources (i.e., combination) or transformation (i.e., absorption) (Denford, 2013).

To summarise this sub-section, the author presented the main concepts associated with a fairly recent variation of the traditional dynamic capabilities' theory linked to the RBV: the knowledge-based dynamic capabilities approach based on the KBV. Different typologies were reviewed, highlighting the increasing relevance acquired by knowledge resources in terms of organisational performance and innovation. Since this thesis is focusing on e-government interoperability in terms of knowledge resources, this trend of research was deemed appropriate to understand knowledge-related processes within networks of organisations, be they public or private.

[XI] The eight knowledge-based dynamic capabilities suggested by Denford (2013) are: creating, integrating, reconfiguring, replicating, developing, assimilating, synthesizing, and imitating.

3.3 Theoretical framework

This section is dedicated to present and describe the theoretical framework developed and used in this thesis. The author starts by adapting Espadinha-Cruz and Cabrita's (2018) knowledge interoperability framework. Afterwards, the dynamic capabilities approach is added to the adapted framework by referring to the categories of knowledge-based dynamic capabilities suggested by Zheng et al. (2011).

As previously introduced, Espadinha-Cruz and Cabrita (2018) start from Chen and Doumeingts's (2003, p. 159) definition of knowledge interoperability as "the compatibility of the skills, competencies, and knowledge assets of an enterprise with those of other enterprises". According to their framework, knowledge interoperability can be traced to other dimensions of interoperability that imply factors that can influence knowledge sharing in a strategic alliance (Espadihna-Cruz & Cabrita, 2018). However, Espadihna-Cruz and Cabrita's (2018) factors lack further operationalisation and validation through empirical research. More importantly, their framework was designed for interoperability between business enterprises -also referred to as Business-to-Business (B2B)-, meaning that some of their definitions are not directly applicable to interoperability between governmental organisations (i.e., Government-to-Government, also abbreviated as G2G) which is the focus of this research. As such, complementing Espadihna-Cruz and Cabrita's (2018) categories with the relevant G2G interoperability factors identified by Rico-Pinto and Sánchez-Torres's (2019), the following stipulative definitions[XII] are suggested for each category of factors:

Factors influencing e-government knowledge interoperability	
Strategic	The definition and alignment of strategic goals between organisations engaged in a cooperation relation, implying the political and managerial commitment and leadership towards the fulfilment of these goals. This also involves governance aspects, such as the definition of decision-making schemes, conflict resolution mechanisms and instruments to assign and monitor the fulfilment of responsibilities among the different entities involved.

[XII] Stipulative definitions are formulated by the researcher and represent "neither the truth, nor an accepted formulation [but rather] a definition that fits within the purpose of the research" (Verschuren et al., 2010, p. 132).

Knowledge management	The management of knowledge resources, including the management of intellectual property, the revision of skills and competencies, the formalisation of internal processes and the deployment of organisational learning mechanisms.
Cultural	The compatibility of organisational cultures and the mitigation of language barriers.
Legal	The harmonization of legislation and regulations that apply to the different organisations, including security and privacy requirements for data and knowledge exchange. Legal frameworks can legitimize the cooperation and establish rewards and penalties to foster it.
Human	The skills and competencies of human resources involved in the cooperation relation. The ability of human resources to create, store and share knowledge, as well as qualified personnel in ICT and project management. It can also involve trust and reciprocity as attitudinal factors that enable knowledge sharing and abide by agreements.
Process	The alignment of internal processes from different organisations and thus, the compatibility of organisational structures, work methods and the knowledge exchanged about these processes.
Data	The sharing of data for common use which concerns data formats, semantics, ontologies, databases' management systems.

Table 1 – e-Government Knowledge Interoperability factors

It is important to clarify that not all of these factors are assumed to be verifiable in every context. As Rico-Pinto and Sánchez-Torres (2019) point out, which factors manifest is highly context-dependent, and so is the way they can influence interoperability. As such, based on Rico-Pinto and Sánchez-Torres's (2019) definitions, this research considers an enabler of knowledge interoperability any factor within these categories that promotes or facilitates the compatibility of skills, competencies, and knowledge assets of an organisation with those of another organisation. In turn, a challenge for knowledge interoperability would be any factor within these categories that inhibits or puts barriers to the compatibility of the skills, competencies, and knowledge assets of an organisation with those of another organisation.

In addition, this thesis' theoretical framework is based on the dynamic capabilities approach to identify how they are involved in the development of knowledge

interoperability. To do this, in what follows the author refers to the categories of knowledge-based dynamic capabilities suggested by Zheng et al. (2011). This framework was chosen among the other ones reviewed because of its proven applicability in the context of networks of organisations and the clearer delimitation among its categories.

The first of Zheng et al.'s (2011) sub-capabilities, is the knowledge acquisition capability (KAC), defined as "the [organisation's] ability to identify and acquire useful external knowledge", implying the processes of "searching and strategic sense-making" (Zheng et al., 2011, p. 1038). Secondly, the knowledge generation capability (KGC), which is strongly linked to Teece's seizing capability, and is defined as an organisation's "ability to develop and refine the activities and processes that facilitate creating/generating new knowledge" (Zheng et al., 2011, p. 1039). Finally, the knowledge combination capability (KCC) is defined as "the [organisation's] ability to integrate and apply internal and external knowledge" (Zheng et al., 2011, p. 1039), thus implying processes of mixing different sources of knowledge and experimenting new applications.

To conclude this section, **Figure 5** presents this research's theoretical framework.

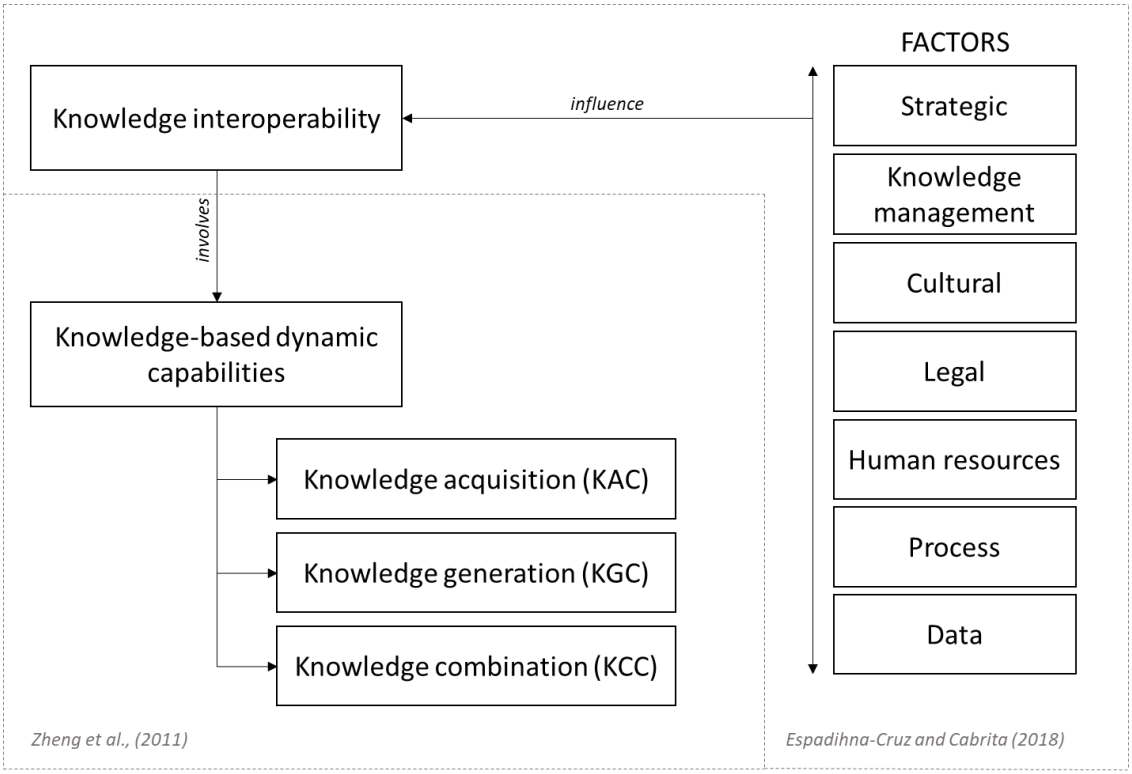

Figure 5 – E-government knowledge interoperability framework

4 Methodology

This chapter describes the research design, strategy and framework followed by this thesis. Here, the methodological choices taken in terms of the type of research, methods and techniques for data collection and analysis, will be explained and justified. The first section describes the overall research design, strategy and framework. This section is followed by an explanation of the chosen research methods. Finally, this chapter closes by describing and justifying the chosen techniques for data collection and analysis.

4.1 Research design, strategy and framework

A research design consists of the process of "creating a blueprint of the activities to take in order to satisfactorily answer the research questions identified [and it] includes selecting a research method, operationalizing constructs of interest, and devising an appropriate sampling strategy" (Bhattacherjee, 2012, p. 21-22). In this section, the author will argue the relationship between the chosen research methods and the questions guiding this research. In the following sections, the methods will be further described, the selected case for the study will be justified and, finally, the operationalisation of the constructs via semi-structured interview questions will be reasoned.

According to Yin (2018, p. 60), a research design "is the logical sequence that connects the empirical data to a study's initial research questions and, ultimately, to its conclusions". Here, the main research question[XIII] and objective[XIV] indicate that this is an exploratory research that can help us find out "what is happening; to seek new insights; to ask questions and to assess phenomena in a new light" (Robson, 2002, in Saunders, Lewis, & Thornhill, 2009, p. 139). The main intention behind exploratory research is to produce descriptive knowledge about a certain object (Verschuren et al., 2010).

Having the advantage of being flexible (Saunders et al., 2009), exploratory studies are particularly convenient to infer new hypotheses and propositions that can be the basis for further investigation (Yin, 2018). As such, this thesis' objective falls in the category of theory-oriented research in which the central aim is to contribute to the development of a theoretical body of knowledge, in this case, in the field of e-government knowledge interoperability (Verschuren, Doorewaard, & Mellion, 2010). The theoretical contribution would be the identification of factors enabling and challenging e-government

[XIII] *What factors enable and challenge e-government knowledge interoperability development in the European context and what dynamic capabilities are involved in this process?*

[XIV] *To identify the factors enabling and challenging the development of knowledge e-government interoperability in the European context and the dynamic capabilities involved in this process, by providing empirical insights from the work conducted by the Interoperability Academy.*

knowledge interoperability development in the European context and the dynamic capabilities involved in this process.

In other to make this contribution, this research has opted for an in-depth research strategy involving the use of qualitative research methods consisting of both, desk and empirical research. In-depth research is characterised by the choice of "a small-scale approach that yields knowledge that can be generalised to a lesser extent but nevertheless will enable the researcher to achieve depth, elaboration, complexity and soundness" (Verschuren et al., 2010, p. 156). For this, qualitative or interpretative research methods are better suited to gain profound insight and comprehension about the research object (Verschuren et al., 2010).

First, an extensive literature review was conducted to determine the state of the art in research about organisational interoperability and dynamic capabilities focusing on the knowledge-related aspects within these fields. The exploration of the scientific literature was combined with a preliminary examination of the context in which this research decided to focus i.e., e-government interoperability in the EU. The combined examination of these secondary sources yielded a theoretical framework that was adapted to the research at hand (Verschuren et al., 2010).

Second, the adapted theoretical framework was used as a pair of lenses to observe the defined research object (Verschuren et al., 2010). The Interoperability Academy is, for this thesis, the research object under study "about which [the author] will be making statements based on the research be carried out" (Verschuren et al., 2010, p. 71). Since this research focuses on gaining a holistic understanding of this organisation (i.e., the perspective of the people who integrate it and their work processes), the researcher relied on the triangulation of methods and sources for generating data (Verschuren et al., 2010). As such, a combination of individual semi-structured interviews, participant observation and content analysis were used to collect data. Further information about the case selection process will be addressed in the following section.

Figure 6 presents the research framework, which summarises the internal logic followed by this research thesis (Verschuren et al., 2010). Furthermore, this graphical representation should help to notice that this thesis' research questions were defined by the method of subdividing the research framework into three consecutive stages (Verschuren et al., 2010).

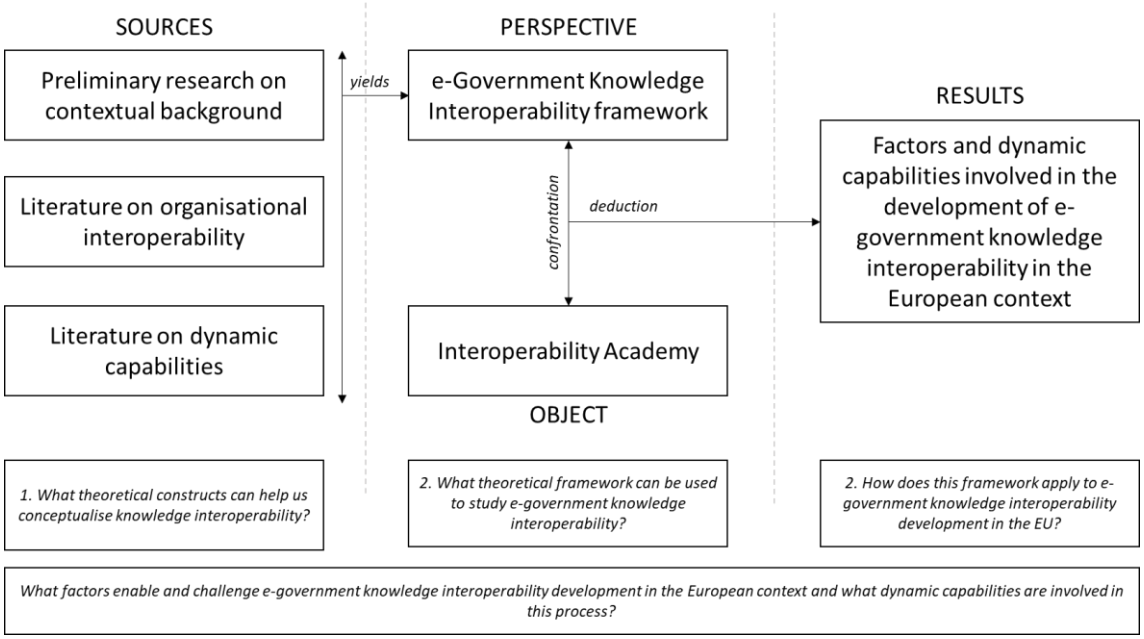

Figure 6 – Research framework (based on Verschuren et al., 2010, p. 70)

4.2 Research methods

This research employs interpretative methods as it relies heavily on qualitative data. Interpretative methods, as opposed to positivist methods, consists of "an inductive approach that starts with data and tries to derive a theory about the phenomenon of interest from the observed data" (Bhattacherjee, 2012, p. 35).

4.2.1 Extensive literature review

The phase of desk research consisted of an exhaustive literature review following careful processes of search and selection. The recommendations of Webster and Watson (2002) supported these processes to make a transparent selection of the final publications being considered. The results of this desk research were systematised revealing the main topics, analytical concepts and frameworks being used in the two broad fields of research that were considered relevant for this thesis. This research focused on the merger of two fields of research: the business and strategic management field and the interoperability field. Within them, Following the comparison of different frameworks suggested by the literature, and the merger of constructs from both fields, a theoretical framework for e-government knowledge interoperability resulted from this process.

This phase matches the process of theory development that is an essential activity before any data collection (Yin, 2018). By doing this, this research benefits from a sounder design, but also properly orients the empirical phase towards further developing theoretical propositions (Yin, 2018). Conducting a proper review of the literature that

might be relevant for the research subject also facilitates the analytical generalisability of the results gathered from empirical research that comes after this phase (Yin, 2018).

Following Saunders et al. (2009) the literature review started with careful consideration of the research questions and objectives set by this research. This allowed the definition of parameters and keywords needed to narrow the scope and conduct the first round of literature search.

The Scopus database was selected as one of the most recognized repositories of scientific literature, and the search was conducted with no date range. Afterwards, the review process started by using two strings of keywords and searching by the parameter of 'Title, keywords, and abstracts':

1. 'Organisational interoperability' AND 'Public organisations'
2. 'Dynamic capabilities' AND 'Public sector' AND 'Public Administration'

As a result, from the first string, Scopus database retrieved 391 publications, while for the second string it gave 358 publications[XV].

In more general terms, Scopus analytics revealed that, since 2016, the topic of organisational interoperability has declined, as there are, every year, fewer publications concerning this subject (**Figure 7**). The results also show an even distribution between scientific articles (43,5%) and conference papers (36,6%). The disciplines dominating this topic come from the computer sciences (28,9%,), followed by medicine (14,6%), and social sciences (12,4%). Finally, regarding their country of origin, the United States leads by a considerable margin, followed by The Netherlands and the United Kingdom.

[XV] The database was consulted on November 16th of 2020, and later on January 22nd of 2021.

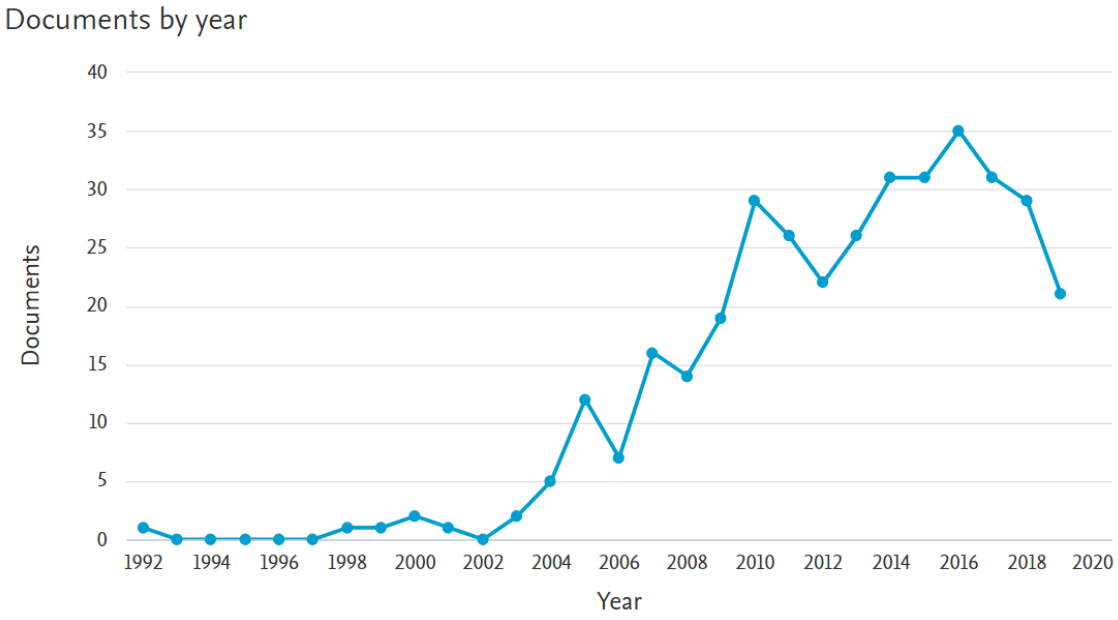

Figure 7 – Publications on organisational interoperability (Scopus)

Regarding the second string of keywords, Scopus analytics revealed that the dynamic capabilities theory has received increased attention since 2015 (**Figure 8**). The literature is mostly composed of scientific articles (75,4%) coming from business and management disciplines (34,8%) and social sciences (16,4%). Also, most of the publications come from the United States, followed by the United Kingdom and Spain.

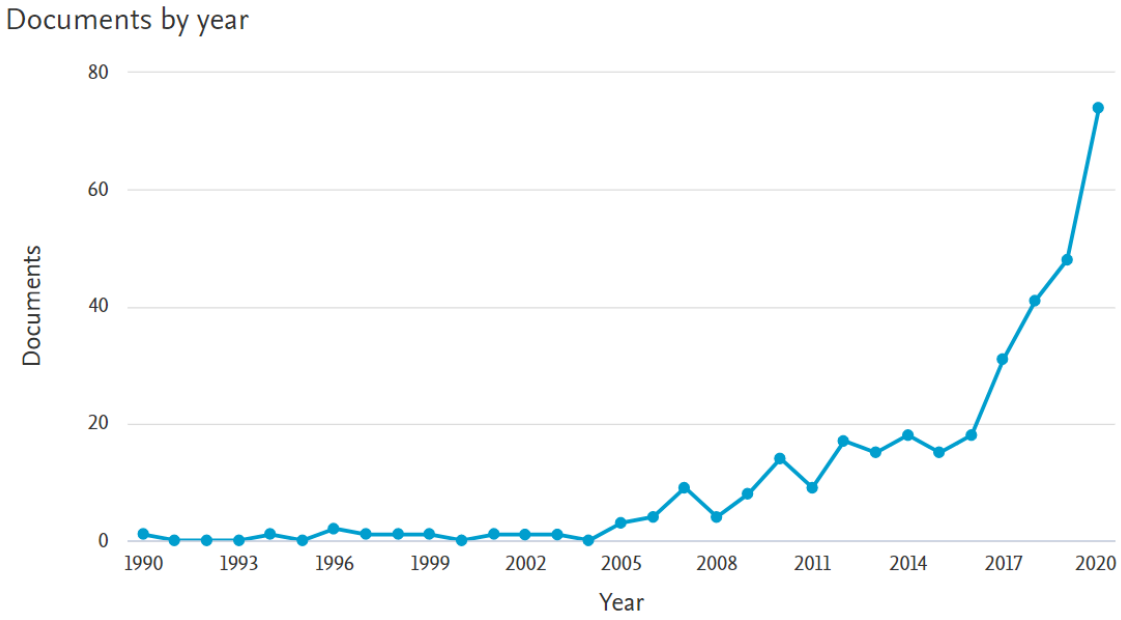

Figure 8 – Publications on dynamic capabilities (Scopus)

Two separate spreadsheets with these publications' details were elaborated to determine which were more relevant for this particular research. Each spreadsheet included columns

to identify the publication by title; authors; type of publication; year of publication; the authors' keywords; abstracts; and finally, the number of times the publication appeared cited in Scopus. The abstracts of these publications were then carefully read in order to select the ones more relevant.

In addition, a conceptual matrix was elaborated (Webster & Watson, 2002) by adding to each spreadsheet six concepts that acted as inclusion/exclusion criteria. These concepts were: 'Dynamic capabilities', 'Organisational Interoperability', 'Public Sector', 'e-Government', 'Knowledge sharing' and 'Knowledge resources'. Insignificant variations of these concepts were also accepted (e.g., 'Public administration' or 'Public organisation', instead of 'Public sector'). Publications that mostly referred to other layers of interoperability, such as sematic or technological layers, were excluded. Books and publications not available without incurring financial costs were also excluded.

As an outcome of this first screening process, 18 publications were selected from the organisational interoperability string, and 14 publications from the dynamic capabilities string. Afterwards, these publications were fully read, analysing their content and citations, and a backward and forward search was conducted (Webster & Watson, 2002). Finally, the literature review concluded with the selection of 57 topic-relevant publications, 27 related to organisational interoperability and 30 related to dynamic capabilities. A full overview of the list of publications reviewed by this research can be found in **Appendix A: Literature review conceptual matrix.**

4.2.2 Single case study

This research chose a case study strategy to apply the theoretical framework on e-government knowledge interoperability that resulted from the phase of desk research. This empirical method was deemed ideal because this research requires an in-depth exploration of a contemporary phenomenon within a real-life context over which the researcher has no control (Yin, 2018). Case studies are a good choice for explorative studies such as this one because they allow to "discover a wide variety of social, cultural, and political factors potentially related to the phenomenon of interest that may not be known in advance" (Bhattacherjee, 2012, p. 40). This method is associated with greater levels of internal and external validity while, at the same time, providing highly contextualised results (Bhattacherjee, 2012).

The choice for a single case study responded to the scope and the conceptual design of this thesis, where the focus is set on studying the development of European e-government interoperability in all matters related to sharing and compatibilization of knowledge resources. The background literature review on the EU's approach towards

interoperability revealed that there was already an initiative currently addressing these issues: the Interoperability Academy. As such, the Interoperability Academy was identified as an appropriate instance where the phenomenon under research could be investigated.

Additionally, since the generalizability of results coming from single case studies relies strongly on the triangulation of research methods (Verschuren et al., 2010; Yin, 2018), the selection of the Interoperability Academy was also a strategic decision since the researcher had access to study this case in its natural context through participant observation, interviews, and document analysis. In this regard, it is important to clarify that part of this thesis's preparation took place in the context of a three-month full-time internship at Trasys Luxembourg, a subsidiary of the NRB group, between January and April 2021. During these months, the researcher fulfilled the position of a Junior Business Consultant and joined the team dedicated to the Interoperability Academy project, conducted under the scope of the ISA^2 Programme of the European Commission's Directorate-General of Informatics (DIGIT – Interoperability Unit). This internship facilitated getting acquainted with the team implementing this initiative and supported the data collection phases of this thesis. Considering this case specificities, it must be stressed that the results of this study serve to expand theory on e-government knowledge interoperability by making analytical generalizations, instead of making statistical generalizations (Yin, 2018).

Even though case studies can rely on quantitative evidence, this research thesis opted for an interpretivist perspective to design and conduct the case study (Yin, 2018). As such, the author of this thesis used different data collection techniques "attempting to capture the perspectives of different participants and focusing on how their different meanings illuminate [the] topic of study" (Yin, 2018, p. 47).

4.3 Data collection techniques

This research conducted the process of data collection in two phases: a phase of desk research, followed by a phase of empirical research. It considers three complementary sources of evidence (i.e., participant observation, documentation and interviews) which will be further reviewed in the following sub-sections. The challenges associated with each of these types of sources will not be addressed here, but instead in chapter **8 Limitations**.

4.3.1 Documentation

This source of evidence generally involves all kinds of documentation, from e-mails to agendas, minutes of meetings, progress reports, studies, videos, among many other possibilities (Yin, 2018). For this research, the adaptation of its theoretical framework required the realisation of an extensive literature review. As explained before, this process implied the careful search, collection, analysis, and selection of academic publications included mostly in scientific journals and conferences.

Furthermore, these publications were combined with grey literature, including government publications, regulations, reports, governmental studies, mostly conducted by European institutions (i.e., European Commission, European Parliament, European Council, among the most important ones). These documents served to write the background literature review of this research (see chapter **2 Contextual background**).

Finally, the page dedicated to the Interoperability Academy on the Joinup platform[XVI] was also carefully explored and relevant resources contained in it were used to extract and corroborate information for this thesis. All documentation used by this research corresponds to resources made publicly available by the Interoperability Academy team.

4.3.2 Participant observation

According to Yin (2018, p. 167) participant-observation "is a special mode of observation in which [the researcher] is not merely a passive observer [but instead] assume a variety of roles within a fieldwork situation and may actually participate in the actions being studied". The possibility to use participant-observation as a source of evidence is directly linked to fact that the researcher had the opportunity to work as a team member of the Interoperability Academy for three months. This allowed the researcher to grasp the insiders' viewpoint and gain access to meetings and resources that were otherwise inaccessible. Both of these opportunities enabled the researcher to gain a more accurate understanding of the Interoperability Academy's internal perspectives and work processes.

4.3.3 Semi-structured interviews

Semi-structured interviews are a type of research interview where the researcher has "a list of themes and questions to be covered" (Saunders et al., 2009, p. 320). Although the structure and the content may vary from interview to interview, the researcher still "controls the agenda by asking questions to the respondent" (Johannesson & Perjons,

[XVI] Joinup. *Interoperability Academy*. [website]. https://joinup.ec.europa.eu/collection/digital-skills-public-sector/solution/interoperability-academy

2014, p. 57). This type of interview is especially useful for exploratory studies investigating complex issues, as they allow to reveal and understand data in more depth, potentially allowing to reach unexpected discussion points (Johannesson & Perjons, 2014; Saunders et al., 2009).

Semi-structured interviews were conducted as part of the case study. Interviews were addressed to all team members involved in the Interoperability Academy initiative, to capture relevant insights from the participants' perspectives about internal processes and external factors influencing their work. Because of time constraints, external views were excluded from the scope of this thesis. The full list of interviewees and their roles within the Interoperability Academy can be found in **Table 2**.

Interviewee	Role
Georges Lobo	ISA² Programme portfolio manager and ISA² Programme manager
Victoria Kalogirou	Programme Manager for EU policies and a Seconded National Expert at the European Commission's Directorate-General for Informatics (Interoperability Unit – D2).
Ludovic Mayot	Country Manager / Trasys team
Katarina Manojlovic	Deputy Project Manager / Trasys team
Konstantina Kyriakopoulou	Senior Consultant / Trasys team
Barry Kruger	External Senior Consultant on e-learning

Table 2 – List of interviewees

The structure of the interviews was based on a fixed list of open questions which followed a rather suggested order. The interviewer, however, was allowed to jump from one question to another maintaining the flow of the conversation, and respondents were allowed to openly formulate their answers in their own words (Johannesson & Perjons, 2014). The interview outline can be found in **Appendix B: Interview outline**.

The interviewer also made use of useful techniques to facilitate the conversation with the interviewee, namely prompting to trigger the conversation, asking for details, and checking that the meaning of a statement was correctly understood (Johannesson & Perjons, 2014). The interviews were recorded and transcribed to facilitate their

subsequent analysis. The audio recording of the interviews was kept, and these were complemented with the notes taken by the researcher (Johannesson & Perjons, 2014).

4.4 Data analysis

This thesis relied on the adapted theoretical framework to analyse the collected data. As such, a theoretical orientation guided and organised the entire analysis (Yin, 2018) for which a qualitative content analysis technique was implemented. Data analysis techniques aim at transforming volumes of raw data into structured and meaningful information to understand the phenomenon under investigation (Johannesson & Perjons, 2014). These techniques can be either qualitative or quantitative depending on the type of data being analysed (Johannesson & Perjons, 2014). Since data sources are qualitative, qualitative data analysis was assumed as the best fit for this research: content analysis.

Qualitative content analysis is used to classify the elements of a document into different thematic lines, categories or constructs. It implies selecting a sample of documents, developing categories for analysis, coding fragments of the document according to the categories and afterwards extracting conclusions about the found thematic trends (Johannesson & Perjons, 2014; Bhattacherjee, 2012). This technique is frequently used to quantify the frequency of appearance of a determined set of categories in pieces of texts, namely documents or transcripts of interviews, among other possibilities (Johannesson & Perjons, 2014). However, when used to extract qualitative inferences, like the state of the art in determining fields of research, it is not mandatory to quantify the contents. This was the case for this research, in particular, for the literature review process in which a thematic synthesis approach was implemented to extract the main areas of consensus among researchers, identify research gaps and infer complementarities between fields to propose an adapted theoretical framework. This process was supported by Citavi[XVII], a reference manager software used by researchers to analyse text, save quotations and organise lists of references.

In turn, for the analysis of the case study documentation and the transcripts of the interviews, the researcher used the theoretical framework categories to classify segments of the texts and deduce conclusions about the constructs under study. Based on the coded segments, each construct was analysed and confronted with the theoretical framework. The coding process was supported by the qualitative data analysis software Atlas.ti[XVIII] and an overview of the codes' book can be found in **Appendix C: Codebook.**

[XVII] Citavi. *Home page*. [website]. https://www.citavi.com/en
[XVIII] Atlas.ti. *What is Atlas.ti*. [website]. https://atlasti.com/product/what-is-atlas-ti/

5 Case study: The Interoperability Academy

This chapter introduces the case study, which for this research is the Interoperability Academy. As the policy framework of the initiative has already been presented in chapter **2 Contextual background**, the sections on this chapter are dedicated to map the antecedents of the initiative within the European Commission's ISA and ISA^2 Programmes and to describe the current state of the initiative.

5.1 The ISA/ISA^2 Programmes

The 2010-2015 Programme for Interoperability Solutions for European Public Administrations (ISA) and its successor, the 2016-2020 Programme on Interoperability Solutions and Common Frameworks for European Public Administrations, Businesses and Citizens (ISA^2), "are the main instruments through which the current European interoperability strategy and European Interoperability Framework have been implemented" (European Commission, 2017b, p. 3). As previously mentioned, the ISA/ISA^2 Programmes were framed in the context of the Europe 2020 Strategy among other initiatives that aimed to contribute to the modernisation of European public administrations and the implementation of the DSM.

The ISA Programme was established in 2009, by Decision No 922/2009/EC of the European Parliament and of the Council on interoperability solutions for European public administrations (ISA). Based on the experiences gained by the IDA Programmes (1995 - 2004) and the IDABC Programme (2004 - 2009), the ISA Programme had the objective "to support cooperation between European public administrations by facilitating the efficient and effective electronic cross-border and cross-sectoral interaction between such administrations" (Decision No 922/2009/EC, p. 23). This decision already warns about the rapid development of ICT, the risk of MS developing incompatibilities and therefore to think interoperability as a continuous effort to "establish and maintain common and shared approaches, specifications, standards and solutions [through] close cooperation, coordination and dialogue" (Decision No 922/2009/EC, p. 21).

In 2016, the final programme evaluation was published, and ISA was favourably assessed against its intended objectives (European Commission, 2016b). On the few lower points, the report suggests that higher levels of awareness about the programme and its interoperability solutions could have been achieved. As such, the report recommends fostering more synergies with other initiatives from the Directorate-General for Communications Networks, Content and Technology (DG CNECT), as well as a communications strategy directed to MS, other European Commission's Directorates-General (DG) and European institutions to encourage the adoption of ISA solutions.

Other strategic recommendations point to the need of focusing more on organisational and legal interoperability, as well as on developing a business-case approach to assess the rationale of every action within the programme. Finally, the report recommends "develop a more systematic approach to support the use of common services and generic tools" (European Commission, 2016b, p. 201) through the promotion of their use and the design of indicators to monitor their adoption.

Building on the results of the ISA Programme, ISA^2 was established in 2015 by Decision (EU) 2015/2240 of the European Parliament and of the Council establishing a programme on interoperability solutions and common frameworks for European public administrations, businesses and citizens (ISA^2 Programme) as a means for modernising the public sector. This follow-up programme incorporated the aforementioned recommendations and was set to "consolidate, promote and expand the activities of the ISA Programme [as well as to] ensure a common understanding of interoperability through the EIF and its implementation in Member States' administrations" (Decision (EU) 2015/2240, p. 8).

ISA^2 was designed consisting of nine work packages that grew to involve a total of 54 actions focused on the development of digital solutions in the area of interoperability (European Commission, 2019a). Considering that the existing gaps between public administrations delay the adoption of the EIF, the ISA^2 Programme included a work package called 'Supporting instruments for public administrations' (European Commission, 2016c; 2019a). This work package involves all sorts of actions to develop solutions that can help public administrations build interoperable services (European Commission, 2016c; 2019a). Initially, this work package included a total of 11 actions, such as the European Interoperability Reference Architecture (EIRA), the European Maturity Model (IMM), the EUSurvey, the European Collaborative Platform and Catalogue 'Joinup', and NIFO, among others (European Commission, 2016c). Progressively, this work package grew until involving 17 different actions by the last year of the programme (2020), among which is the Interoperability Academy (European Commission, 2020a).

In 2019, an interim evaluation of ISA^2 was conducted, revealing that raising awareness among public administrations about interoperability is still an ongoing challenge (European Commission, 2019b). The report emphasises the need of assessing the impact of ISA^2 solutions on the performance of public administrations, as well as promoting the sharing of best practices between public administrations. The Interoperability Academy action is here mentioned as a key initiative to facilitate these processes. Additionally, the report mentions the need to move from user-centric to user-driven solutions, meaning the

involvement of users in the design and co-creation of an interoperability solution. Finally, one last recommendation refers to the sustainability of ISA^2 vision and solutions, highlighting the need for strong political commitment and solid funding. In this regard, assessing the potential impact of possible biding interoperability instruments is also mentioned. Beyond these recommendations, the overall interim evaluation of ISA^2 was optimistic about the transition to a new multiannual financial framework.

5.2 The Interoperability Academy

Launched in January 2019, the Interoperability Academy is one of the latest initiatives developed within the ISA^2 work package 'Supporting instruments for public administrations' (European Commission, 2019a). Aiming to overcome the digital skills gap existent between public administrations in the EU, this action was created under the responsibility of DG Informatics (DIGIT), to develop digital skills in the public sector in the area of interoperability and ensure public servants have the right skills and competences to understand and implement interoperability solutions (European Commission, 2019a; 2020a).

Complementary to the Digital Skills and Job Coalition, which aimed at developing "a large digital talent pool and ensure that individuals and the labour force in Europe are equipped with adequate digital skills" (European Commission, 2020a, p. 749), the Interoperability Academy focused on delivering training offer on interoperability and interoperability solutions particularly targeting public servants in MS and EU institutions (European Commission, 2019a; 2020a).

The ultimate objective of the action is to contribute to the implementation of the 2017 Interoperability Action Plan, meaning: increasing the implementation of the EIF and the adoption of interoperability solutions proposed in the scope of ISA/ISA^2 Programmes (European Commission, 2019a; 2020a). To achieve this, the action proposes the development of an e-learning programme and educational platform to deliver online and face-to-face training resources in the form of Massive Open Online Courses (MOOC), seminars, workshops and seasonal schools (European Commission, 2019a; 2020a).

In developing this training offer and promoting the courses, the action is also raising awareness on the EIF and ISA^2 interoperability solutions and, at the same time, giving a sustainable and coherent structure to all existing educational resources that have already been produced by other ISA^2 actions, as well as new resources that may be produced (European Commission, 2019a; 2020a). As such, the Interoperability Academy is set to work in close collaboration with other ISA^2 action owners and MS's representatives, who are to suggest and participate in the co-creation of courses, as well as with DG that are

responsible for other digital skills initiatives (European Commission, 2019a; 2020a). As for communications and engagement, the Interoperability Academy relies on ISA^2 communication channels and on the Joinup platform where it has its own page[XIX] (European Commission, 2019a; 2020a).

The action also considers providing certificates of attendance, developing a catalogue of e-learning resources, suggesting different learning paths according to user profiles and enabling mechanisms to incorporate user feedback to improve the platform (European Commission, 2019a; 2020a). Delimiting its scope, the action states that it will not address the broader topic of e-government, nor it will focus on interoperability in specific sectors (European Commission, 2019a; 2020a). Although some materials may incorporate these perspectives, "the training offer will have a focus on the generic solutions and addressing interoperability at large scale" (European Commission, 2019a, p. 452).

Since the training offer is made available in open source and for free to any interested party, the Interoperability Academy action expects to generate financial and time savings for public administrations which, in turn, should motivate greater adoption of interoperability solutions and increased quality of digital public services (European Commission, 2019a).

As of 2020, the action is planned also to support the Open PM^2 solution, which is the official European Commission project management methodology followed by all European institutions (European Commission, 2020a). The planned support consisted mainly in making the methodology more accessible, improving the access to its training and supporting its adoption by MS public administrations, as well as contractors and EU citizens in general (European Commission, 2020a).

For the end of the year 2020, the action set as targets to develop a total of 20 training resources, to propose 4 courses in the catalogue, to provide 20 courses through the platform and to reach a total of 100 enrolled students (European Commission, 2019a; 2020a). In practice, the Interoperability Academy did not fully reach these targets by the end of 2020 but managed to complete several achievements. In line with the aforementioned targets, the Interoperability Academy has published nine courses, coordinated multiple events on the platform and awarded 100 certificates of course completion (ISA^2 Programme, 2021). Additionally, the Interoperability Academy successfully organised by the end of 2019, a Winter School in collaboration with the KU Leuven Public Governance Institute and created a Catalogue of Educational and Training Resources with over 250 educational resources produced in the context of ISA/ISA^2

[XIX] Joinup. *Interoperability Academy*. [website]. https://joinup.ec.europa.eu/collection/digital-skills-public-sector/solution/interoperability-academy

(Interoperability Academy, 2021a), which had to be collected, assessed and categorised to make them available and ready for reuse.

Following the user-centricity principle, the Interoperability Academy also defined learning paths and role-based learners' profiles (Interoperability Academy, 2020a). The profiles were developed with the purpose of understanding learning and user-experience requirements, as well as to develop according learning paths (Interoperability Academy, 2020b). Based on established standards and stakeholders' feedback, 10 learner profiles were defined in learner canvasses[xx]. These learner profiles were the basis to define according learning paths taking into consideration the different learners' motivations, objectives, contexts and suitable learning styles (Interoperability Academy, 2020c).

During these first years, the Interoperability Academy published a Study on the development of a European framework for interoperability skills and competences (EFISC) in the public sector. In a team lead by a group of researchers from the KU Leuven Public Governance Institute, this project resulted in the publication of the EFISC as a suggested framework that could be applied to all public sector administrations in the region (Casiano Flores et al., 2021). **Figure 9** shows EFISC's final version, which comprehends a total of 42 elements distributed in five pillars: 1) Attitudes, 2) Soft skills, 3) Hard skills, 4) Knowledge elements and 5) Values (Casiano Flores et al., 2021).

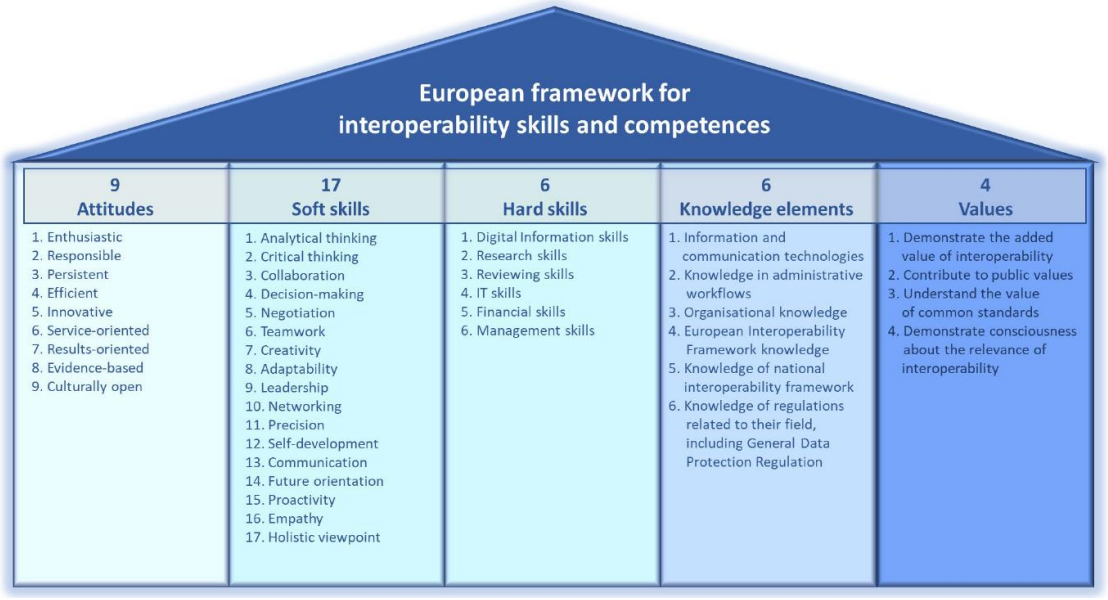

Figure 9 – EFISC (Casiano Flores et al., 2021)

[xx] Learner profiles: chief information officer; systems architect; software developer; policy manager; project manager; public administration manager; town/city councillor; legal advisor; civil engineer; and financial manager (Interoperability Academy, 2020a).

Moreover, EFISC suggests definitions of each of the pillars and constructs within them (Casiano Flores et al., 2021). These 42 elements should be considered as of core importance for interoperability in the public sector (Casiano Flores et al., 2021). However, the application of the EFISC is not mandatory and should be tailored according to different occupational backgrounds, sectoral areas, as well as to the different national and administrative contexts, to explore the potential of developing tailor-made training programmes (Casiano Flores et al., 2021).

Another achievement during these years was the publication of a set of resources for course development, managing and testing, aimed at supporting future course owners in the process of co-creating an online course or organising a training event in the EU Academy platform[XXI], which is where the Interoperability Academy's courses are hosted (Interoperability Academy, 2021b). Focusing on action owners, but also on MS public administrations, these resources explain how to propose an educational activity (course or event), how to develop and repurpose content and materials, as well as how to create, maintain and test a course on the platform (Interoperability Academy, 2021b).

Finally, in terms of engagement, the Interoperability Academy action has integrated Open PM² activities, as well as materials produced by the Connecting Europe Facility (CEF) programme. It has promoted knowledge exchange through the Joinup community by interacting with other initiatives and organisations which are targeting digital skills in the public sector (ISA^2 Programme, 2021).

Currently, the Interoperability Academy is focused on raising awareness about its activities; increasing engagement from MS and ISA^2 action owners; boosting the creation of high-quality e-learning courses and events on the platform; developing a dedicated training curriculum in the area of interoperability; and defining the governance and sustainability of the action to ensure its continuity in the Digital Europe Programme (ISA^2 Programme, 2021).

[XXI] European Union. *EU Academy*. [website]. https://academy.europa.eu/

6 Results

This chapter reviews the main findings gathered by the different processes of data collection. It is mostly focused on integrating the results obtained from the empirical part of this research, i.e., the semi-structured interviews with the Interoperability Academy team and the participant observation. The results were collected, analysed and presented in a structured manner following the **3.3 Theoretical framework**. The first section discusses the results obtained regarding the Interoperability Academy's perspective on the knowledge interoperability concept. The second section covers all the predefined categories of factors, plus a sub-section for other factors revealed by the case. Finally, the third section is dedicated to the results regarding the knowledge-based dynamic capabilities.

6.1 Interoperability Academy and knowledge interoperability

As a general result, it must be first highlighted that all team members of the Interoperability Academy tend to agree with the concept of knowledge interoperability and to identify it -to a certain extent- with the work they are conducting. Although to some the term seems too ambitious in relation to what they currently doing, the general perception of the Interoperability Academy's mission is that it is contributing to align or level the plane field between public servants from different public administrations, in terms of their knowledge on interoperability and their advanced digital skills.

However, all team members are also very clear in stating that the Interoperability Academy is in its early stages and, as such, they are still covering the basics; increasing awareness about the initiative, creating more educational resources and activities, and developing a curriculum that will provide structure to organise the courses on the platform.

6.2 Factors influencing knowledge interoperability

This section covers all the results gathered for the predefined categories of factors that can influence e-government knowledge interoperability. Additionally, a sub-section for other factors revealed by the case is included at the end.

6.2.1 Strategic

In general, the perception of team members of the Interoperability Academy is that there is a strategic framework already in place that supports the work conducted by the action. They see that the multiple stakeholders with which they have to interact (i.e., EU

institutions, other ISA^2 action owners, MS public administrations, other digital and public administration academies) are already aligned towards the fulfilment of common goals which go in line with Interoperability Academy's work. The Interoperability Academy is seen as a means towards the fulfilment of broader goals, such as the digitalisation of public administrations, the enhancement of digital skills and the consolidation of joined-up systems of government. As such, there is a strategic drive that works in favour of the Interoperability Academy's mission.

However, the Interoperability Academy team keeps in mind that the actual content of this strategic alignment continues evolving, and so they have to adjust to periodical changes in the policy framework such as the transition from ISA^2 to the Digital Europe Programme, or the new editions of the EIF that may be released. Each of these changes in the policy background, have to be considered as inputs in the strategic definitions of how the Academy will develop in order to make it sustainable and adapted to new realities. It is in the transitions period that sometimes an insufficient alignment is perceived as hindering the performance and sustainability of the initiative.

Some team members also mention that beyond this political and managerial commitment towards European interoperability, there are still some challenges in terms of financial support and distribution of responsibilities.

In terms of financial support, some interviewees mention the lack of sufficient resources to be more ambitious and advance faster in the development of the Academy. However, here the issue appears to be also a matter of scope and level of complexity the Academy intends to reach. Even though, at the start of the project, the Interoperability Academy may have evaluated the possibility of creating its own platform, by the second year of the project the decision was made to use what they already had, namely the European Commission's EU Academy eLearning platform which is managed by an entirely different team from the Joint Research Centre (JRC). This implied that the Interoperability Academy would not receive the funding to create an independent platform, as it was originally thought off. Further analysis on the implications of having to adjust to using the EU Academy platform will be addressed in **6.2.8 Other factors**.

Furthermore, the lack of sufficient resources also impacts the Interoperability Academy in the sense that it has to aim for establishing partnerships and collaborations with other EU programmes, DG, ISA^2 action owners and MS public administrations. As was emphasised by different team members, the budgetary constraints determine that responsibilities have to be clearly allocated within these partnerships in order to distribute the load of invested resources in terms of time, effort and monetary costs. This is particularly more evident whenever the scope of the e-learning resources (courses, events

or materials) expands beyond the predetermined offer of the Interoperability Academy. Instances when this has happened are, for example, when a course owner requests for the course to be translated/dubbed, or for some material to be professionally edited. As such, the distribution of responsibilities within these partnerships can be challenging and generate interdependencies that sometimes add complexity to the operational dynamics of developing, managing and promoting the courses on the platform.

6.2.2 Knowledge management

Many team members felt unsure about how to refer to this factor and requested clarification about its meaning. The common answer was that they have not yet encountered issues concerning knowledge management practices and capacities. Since everything on the platform is open source, intellectual property is not an issue the Interoperability Academy has to deal with. Also, since the platform is in an infant stage, they are still mainly focused on transforming existing ISA^2 resources into courses. As such, ISA^2 action owners have been the main sources of courses so far and, usually, the experience has proved that they have the knowledge resources ready and sufficiently formalised to be easily shared with others. What these course owners mainly need is some pedagogical guidance to properly transform the resources into an e-learning activity and this, they seek to get from the Interoperability Academy. This has proven to be also sometimes challenging as the Interoperability Academy does not have the expert knowledge to simply receive the resources and create the courses by itself. Thus, the dynamic has been more like a co-creation process where the Academy also relies on the communication and pedagogical skills of course owners (further on this will be addressed in the **6.2.5 Human resources** sub-section). Back and forth interactions are maintained so the Academy can guide the process of course creation, suggest pedagogical improvements and assess the quality of the overall e-learning material.

One aspect, however, that was mentioned as influencing the readiness of potential course owners to share knowledge, was the general dependency on contractors. Public administrations, both in MS and at the EU level, rely quite extensively on different teams of contractors. This also includes the Interoperability Academy, where more than half of the team is composed of external consultants. As pointed out by the interviewees, this general dependency on external contractors can add difficulties to processes of knowledge creation, accumulation and sharing within public administrations. Public procurement contracts usually establish clear delimitations on what kind of deliverables should result from the contractual relationship and expanding these outcomes can imply a considerable amount of bureaucratic procedures and subsequent delays, to make available additional resources. As such, the creation of courses for the Interoperability

Academy can fall within these internal negotiations between public administration stakeholders and their contractors, acting as a potential inhibitor for knowledge sharing. In turn, from the perspective of public administrations, this dependency on external contractors can delimit their capacities to create and accumulate knowledge as they may find themselves without the experience or the resources to perform these processes independently.

In addition to this, it was also mentioned the reluctance of public servants, especially in higher levels, to share knowledge. Even though this unwillingness to share knowledge may have not been encountered yet in practice, it is mentioned by the interviewees as one of the key factors that the Interoperability Academy has to consider and foresee as a potential risk. Since the Academy is still mainly focused on ISA^2 action owners for the development of courses, this factor has remained unsurfaced. However, members of the team foresee that it may become an issue in later stages when the main focus for course creation shifts towards MS public administrations, be they central or local.

As for the users of the courses, the Academy is in the initial stages where the background organisational dynamics are not being considered yet. As such, the Interoperability Academy is not looking at the organisational learning dynamics of organisations, nor the state of revision of their human resources in terms of their skills and competences. Comparing with other academies that do offer customised training to specific organisations, the Interoperability Academy is not yet offering these services, mostly because they are still focused on populating the platform with courses and organising these courses into a proper curriculum that individual users can follow.

6.2.3 Cultural

Cultural factors appear to be highly relevant for the Interoperability Academy's daily work. As it is mentioned by some of its members, cultural factors are considered whenever they interact with different MS public administrations, as different communicational approaches have to be deployed. Aligning organisational cultures is considered a big challenge for interoperability in general, but rather a crucial aspect to tackle to ensure better knowledge exchange between public sector organisations and catalyse synergies between different teams.

Language requirements are a big concern when developing courses for MS public administrations, as some of them may want for their courses to be completely done in their language, instead of English which is what the Interoperability Academy offers. As such, the Academy has had to consider the service of translation to incorporate subtitles in other official EU languages in an attempt to accommodate the requests of MS public

administrations. However, requests on making the complete course dubbed in the MS's language cannot -currently- be met because of the considerable extra financial costs this implies. Additionally, the concern from the Interoperability Academy's perspective is that these dubbed courses would have a more limited target audience (i.e., mainly public servants from the MS that has created the course) and, hence, there is greater uncertainty regarding how many users will be taking the course. In other words, there is a cost-benefit analysis in this regard that influences the decision of the Academy not to offer dubbing courses.

6.2.4 Legal

In terms of legal factors, the most common response from the interviewees was that the harmonization of legislation and regulations that apply to the different organisations or public administrations has not been an issue for the Interoperability Academy's work. Since it is an open virtual Academy, all the resources that course owners upload are, from the start, open resources. As such, whoever wants to register, either as a course owner or as a user, has to register using EU Login and accepting terms and conditions according to the General Data Protection Regulation (GDPR).

6.2.5 Human resources

Human resources have been at the centre of considerations for the Interoperability Academy. As one of the interviewee's mentions, the human factor is considered crucial for organisational interoperability, as it relies not only on the alignment between processes but also between people and teams of different organisations.

In line with this, when building the specifications for the Interoperability Academy, the first aspect that was studied was the people who would be using it. This was the process of developing learning profiles and learning paths that was described in the previous chapter. Here, the main finding was that there is a real spread of different role types that could be potential users of the platform, some of them more technical, while other more managerial and related to policymaking. As such, it was inferred that the learning motivations and requirements for these roles would be different, considering that technical roles would want training focused more on skills, while non-technical roles would be more interested in acquiring general knowledge on interoperability.

Besides the skills and knowledge of the users of the platform, be they learners or course owners, there is another human-resource-related factor raised through the interviews, which is the awareness about the relevance of interoperability. If we go back to the EFISC, 'demonstrate the added value of interoperability' and 'demonstrate consciousness

about the relevance of interoperability' are considered two important values for interoperability in the public sector (Casiano Flores et al., 2021). It can be assumed that it is important for public servants to have and develop these values. The interviews revealed that, in terms of awareness, the Interoperability Academy faces a lot of work to be done to raise awareness in certain policy sectors and government levels where the relevance of interoperability is not yet fully understood. To face this challenge, the Interoperability Academy team decided to incorporate awareness-raising types of courses in the sense of introductory courses to interoperability, suitable for a broader spectrum of users and focused on explaining exactly what it is and why it is important.

All of these factors which involve the skills and competences of public servants for interoperability are influencing the process of developing a curriculum for the Interoperability Academy. This curriculum will provide a structure for all the resources available in the platform based on the above-mentioned requirements, as well as based on the level of proficiency of the learners. As for how the levels of proficiency will be determined, the interviewees say that the courses should go through regular rounds of testing that would provide feedback about their level of difficulty. However, for this, increased engagement and enrolment is needed to gather feedback from diverse learner profiles.

Finally, the skills and competences of course owners are also a challenging matter for the Interoperability Academy. As it was anticipated in the knowledge management sub-section, course owners may know about interoperability, but they lack the pedagogical knowledge and/or the skills to create e-learning resources. As one of the interviewees points out, "just creating a presentation about the content is not enough to call it an e-learning course". In a similar sense, course owners may have project management skills, but they lack IT skills or specialised knowledge on interoperability. To tackle this problem, the role of the Interoperability Academy in testing the courses with students and providing pedagogical advice has been essential. Additionally, since the Interoperability Academy team has also adjusted to work with an externally provided platform (the EU Academy), the development of guidelines to formalise the process of course creation, management and testing proved to be necessary, not only for the team but also to support potential course owners.

6.2.6 Process

Process-related factors is another category that spurred fruitful conversation during the interviews. Process-related factors were considered by some of the team members as the most important ones in terms of how they influence the Interoperability Academy's work.

As it was already mentioned in the **6.2.1 Strategic** factors sub-section, the Interoperability Academy's work depends considerably on establishing partnerships for collaboration with other organisations. These collaborations imply the need to clearly distributing time, effort and budgetary investments from different teams which, in turn, may generate operational interdependencies between them. To operate efficiently and effectively, basic processes, such as the processes for course creation, management and assessment need to be streamlined and formalised. With this, a common understanding of what implies publishing a course on the Interoperability Academy is built. The Interoperability Academy has done this by publishing a set of resources for course creation, management and deployment (see Interoperability Academy, 2021b).

However, process alignment proves to be challenging anyway because of the different organisational structures and work methods that characterise each course owner. This is particularly evident whenever a public administration institution from a MS is in the role of a course owner. As it was commented by different team members of the Interoperability Academy, interoperability in MS is many times a shared responsibility between different ministries and governmental agencies. Similarly, training for public administration can be a responsibility of different ministries, agencies or academies depending on the subject. Sometimes digital training for public servants of MS relies on independent digital academies, while traditional training for public servants is a responsibility of ministries of interior and human resource departments. In addition, federal countries may distribute these responsibilities into different governmental levels, introducing more variations to be considered at the regional or local level.

All of these considerations imply that, sometimes, the Interoperability Academy has to interact with many different contact points to co-create one course with a MS public administration. As such, coordination, availability and readiness to work can be challenging.

6.2.7 Data

As for data-related factors, the perception of all team members is that no such factors are influencing the work of the Interoperability Academy. Since the platform does not enable data exchange, nor is the intention of the Interoperability Academy to facilitate the exchange of data between different organisations or individuals, this is not considered a relevant category. The only way data is being considered in the knowledge sharing activities fostered by the Interoperability Academy, is as an area of knowledge for public servants training according to the semantic layer of interoperability represented in the 2017 EIF (see **Figure 1**).

6.2.8 Other factors: Technology

As previously mentioned, by the second year of the project it had already been determined that the Interoperability Academy would work hosted in the EU corporate e-learning platform, namely the EU Academy platform. This platform was in the process of being developed as a result of the cooperation between the European Commission's JRC and DIGIT. The beta version of the platform was released in April 2020 defined as an EU-owned online environment for the provision of e-learning resources produced by EU institutions and intended for external audiences (Interoperability Academy, 2020d). The EU Academy has, therefore, a broader target audience than the Interoperability Academy, going beyond public servants and, at the same time, has a stronger focus on EU institutions, while the Interoperability Academy also involves knowledge on interoperability produced by MS public administrations.

Beyond these differences in management, scope and target audience, the Interoperability Academy had to adjust to the way the EU Academy platform was designed. The design of the platform has implied some limitations on what the Interoperability Academy team can do, especially now that the team is in the process of designing a curriculum to structure all the courses on the platform.

Currently, the EU Academy platform works with 16 broad categories of topics to classify courses produced by different EU institutions, among which the Interoperability Academy is mainly producing courses for the topic 'public sector leadership, innovation and knowledge sharing' alongside other institutions and actions that may be producing content for the same category. To create a distinguishing brand for the Interoperability Academy courses, the team created a digital banner to place on the platform as well as a certificate that states it is awarded by the Interoperability Academy. However, beyond these distinguishing features, the Interoperability Academy has little space to introduce sub-categories for its courses and establish learning paths.

Working around these limitations, the Interoperability Academy team is currently designing a system of tags according to levels of proficiency and interoperability-topic areas to implement its curriculum and learning paths. This is seen as a first-phase solution; however, the Interoperability Academy maintains regular meetings with the EU Academy team to understand how to better use the functionalities of the platform and, at the same time, provide suggestions on how to improve it according to users' feedback and the specific requirements of the Interoperability Academy. In turn, the EU Academy releases periodical updates of the beta version of the platform that incorporate this feedback, although the times on which these happen do not always adjust to the Interoperability Academy's roadmap and timetable. On the positive side, however, being hosted within

the EU Academy platform is seen as an opportunity to gain visibility and reach broader audiences. Thus, the potential of this platform could be leveraged to increase users' engagement with the Interoperability Academy's courses.

6.3 Dynamic capabilities and knowledge interoperability

This section covers all the results gathered for the predefined categories of knowledge-based dynamic capabilities that are involved in e-government knowledge interoperability development.

6.3.1 Knowledge acquisition capability

As stated in section **3.3 Theoretical framework**, the knowledge acquisition capability has been defined as the ability "the [organisation's] ability to identify and acquire useful external knowledge", implying the processes of "searching and strategic sense-making" (Zheng et al., 2011, p. 1038). Intimately connected to the sensing capability proposed by Teece (2007, 2018), this capability is all about sensing opportunities and defining a strategy to acquire knowledge that can be useful for the organisation.

In this case, the Interoperability Academy deploys different processes through which the organisation makes strategic decisions to acquire knowledge that can be useful for providing training resources to improve the knowledge and skills on interoperability of public servants across Europe.

Considering this, the collected information reveals that the Interoperability Academy deploys this capability through five different processes: top-down policy alignment; reuse of existing knowledge; R&D; organisational learning; collection of feedback from end-users. In what follows, each of these processes will be explained.

First, because of contract obligations, the Interoperability Academy priorities are strictly aligned with the European Commission. As such, the Interoperability Academy does not require forecasting mechanisms to anticipate changes in the political environment, because it gets informed of new policy developments directly through top-down official communication channels. This reveals that one very important way the Interoperability Academy makes strategic decisions on how to acquire knowledge is by following political-strategic guidelines that have a strong influence on the scope and long-term planning of the Academy's activities. One example of this was the decision to include the building blocks from CEF within the scope of potential course owners and e-learning resources. As such, these political guidelines have determined that the Interoperability

Academy's training priorities are mainly focused on the EIF, mature ISA^2 interoperability solutions and CEF's building blocks.

Second, the Interoperability Academy's knowledge acquisition capability -at least in its first years- is strongly marked by the imperative of reusing knowledge that already exists within the ISA^2 Programme as well as CEF and transferring it to the EU Academy as e-learning resources. Sense-making on knowledge acquisition is delimited by the scope of the action, which is about interoperability and training on what the EU does concerning interoperability. As such, the primary aim of the Interoperability Academy is to produce training and tutorials on off-the-shelf interoperability solutions and tools that already exist. As expressed by one of the interviewees, the idea is to become "like a one-stop-shop for training on mature interoperability solutions".

A third way the Interoperability Academy makes strategic decisions on how and what knowledge to acquire is through internal R&D processes. This is mostly evidenced by the activities implied in the development of the learner profiles, learning paths, the EFISC and the Interoperability Academy's curriculum. All of these final products (also called deliverables) implied extensive research aimed at having direct applications on the platform. The frameworks resulting from these research processes guide the work of the Interoperability Academy, by helping to establish priorities and focus areas on what kind of knowledge the Interoperability Academy should acquire to translate into courses.

The fourth process through which the Interoperability Academy makes strategic decisions on knowledge acquisition is via mapping and exchange of bets practices with other digital or public administration academies. The incorporation of best practices from this particular set of stakeholders reflects on the organisational learning ability of the Interoperability Academy as well as on the Academy's ability to position itself on the map with a distinctive offer.

Finally, a fifth process that characterises the strategic sense-making of the Interoperability Academy is the collection of feedback from end-users. As expressed by one of the interviewees, the feedback collected from end-users has a strong influence on how the Interoperability Academy tailors future activities for knowledge acquisition and course creation. The Academy has already in place different mechanisms through which it collects this kind of feedback, the most frequent of which is through workshops, webinars and meetings with groups of end-users of the platform. Additionally, the EU Academy platform allows collecting information about participation, enrolment and completion rates via data analytics. This provides knowledge on what courses generate more interest from end-users. Finally, the Interoperability Academy also is planning to organise targeted and open consultations to ask different stakeholders which topic areas and type

of courses they think are most important. This consultation will serve two purposes; first, to collect more inputs to delineate the first version of the curriculum and, second, to attract more people to the platform. The latter purpose is very important for the Interoperability Academy's knowledge acquisition capability, as well as its knowledge generation capability, which will be further addressed in the coming sub-section.

6.3.2 Knowledge generation capability

The knowledge generation capability has been defined as an organisation's "ability to develop and refine the activities and processes that facilitate creating/generating new knowledge" (Zheng et al., 2011, p. 1039). Aligned with Teece (2007, 2018) this capability also expresses in the way an organisation captures value through innovations in terms of business models, products, processes, or services.

In this case, the Interoperability Academy deploys different routines through which the organisation refines processes to create new valuable knowledge on interoperability. The collected information reveals that the Interoperability Academy deploys this capability through three different processes: course co-creation; rounds of testing and validation; and leveraging partnerships.

First, as has already been explained, the Interoperability Academy engages in a process of co-creation with potential course owners. Concerning this, the Interoperability Academy plays a triple role of guidance, support and assessment. The Academy is providing guidance with the establishment of a clear step-by-step roadmap on how to create an e-learning course or resource to upload on the EU Academy platform. This roadmap consists of six steps that provide potential course owners with all the information they need in order to choose a format for their course; develop their course according to pedagogical, technical, functional and accessibility requirements; and finally test a pilot of their course before deployment in the public environment of the EU Academy platform (see Interoperability Academy, 2021b). The resources that provide orientation on pedagogical, technical, functional and accessibility requirements, complement the support the Interoperability Academy provides through regular meetings with course owners on these same aspects, throughout the development process. Finally, the Interoperability Academy supports the final stages of piloting, dissemination and continued assessment. In order to test the pilot course, the Interoperability Academy team uploads the content of the course into the pre-production environment of the EU Academy, thus making it available for testing by members of the course owner team. After the pilot course has passed all the testing stages, the course is migrated by the Interoperability Academy team to the production (public) environment of the EU Academy platform. Once published, the Interoperability Academy team supports the

dissemination of the course to engage participants, as well as in the continued assessment of the course performance.

The second course of action through which the Interoperability Academy refines its internal processes for course creation is through periodical rounds of testing and validation. This process applies to courses and e-learning resources already published in the EU Academy platform, as well as to the products developed through internal research. On the one hand, as mentioned before, the Interoperability Academy team supports the continued assessment of course performance by collecting feedback from end-users and monitoring a course's key performance indicators through platform analytics. This process ensures that the courses remain updated and responsive to users' feedback the whole time they stay publicly available on the EU Academy platform. On the other hand, the Interoperability Academy also intends to submit its R&D products to periodical rounds of validation. This involves the learner profiles, learning paths, the EFISC and the soon to be published first version of the curriculum. The intention behind this is to keep these products updated and to strengthen their validity against user requirements. As such, for example, the first version of the curriculum is planned to be subject to an open consultation process, where not only experts, but every person interested in the topic of interoperability can provide their feedback. This is also intended to increase awareness about the Interoperability Academy, as well as to attract more course owners and users to the platform. Throughout the interviews, it is many times mentioned that these products are considered "living frameworks", which means that the team assumes they should flexible and adaptable to changes in the political, technological and user requirements, even though changes are not considered to happen that often.

Finally, a third process through which the Interoperability Academy deploys the knowledge generation capability is by leveraging partnerships. On this subject, one very important partnership for the Interoperability Academy is the one the team has with the EU Academy team. Establishing a close collaboration, with regular meetings and communication exchanges with the EU Academy team has enabled the Interoperability Academy team to work around the limitations of the platform. In other words, whenever the Interoperability Academy team faces a difficulty with the platform (e.g., technical or functional issues), these are communicated to the EU Academy team, which in turn provides alternatives to mitigate the problem or directly takes notes of the problem to solve it in the current or future versions of the platform. Considering that the EU Academy platform is still on its beta version, these exchanges may also be considered highly valuable for the platform's improvement. Another key partnership hold by the Interoperability Academy is with NIFO action, in this case, also within the ISA^2 Programme. As pointed out by one of the interviewees, NIFO can provide valuable

information regarding how interoperability in MS public administrations has been improving since the Interoperability Academy was introduced. As such, the Interoperability Academy is aiming to leverage a stronger partnership with this action in the future. Finally, another partnership that the Interoperability Academy is aiming to strengthen to leverage synergies is with the Innovative Public Services Observatory created in the framework of the Innovative Public Services action of the EU ISA² Programme. As expressed by one of the interviewees, a closer partnership with this action could provide valuable information to the Interoperability Academy regarding the adoption of emerging and disruptive technologies by the public sector across Europe. Having this information would enable the Interoperability Academy to better adapt to changes in the technological environment within MS and the region.

6.3.3 Knowledge combination capability

The last dynamic capability analysed in the framework of this research corresponds to the knowledge combination capability. This capability has been defined as "the [organisation's] ability to integrate and apply internal and external knowledge" (Zheng et al., 2011, p. 1039), thus implying processes of mixing different sources of knowledge and experimenting new applications. Linked to the transforming/reconfiguring capability of Teece (2007; 2018) it is associated with top management's ability to reconfigure an organisation's resources to keep it agile and, at the same time, sustainable.

The Interoperability Academy deploys different mechanisms to integrate knowledge, explore new applications and reconfigure its internal processes. The collected information reveals that the Interoperability Academy deploys this capability through four different processes: continuous adaptation to stakeholders' feedback; short- and long-term planning; exploring scope synergies; and project review cycles.

The first process through which the knowledge combination capability is deployed corresponds to the continuous adaption to stakeholders' feedback. As previously explained, the Interoperability Academy has different mechanisms in place that combine internally produced knowledge with external knowledge from different sources. We have reviewed already the knowledge that the Interoperability Academy produces as a result of extensive research and how this knowledge is kept alive through periodical rounds of validation with different groups of stakeholders. We have also mentioned the processes of co-creation and testing of courses, where existing external knowledge is combined with knowledge provided by the Interoperability Academy throughout the development and maintenance of the courses. What all of these activities have in common is how the Interoperability Academy has developed different mechanisms to always ensure a continuous adaptation to stakeholders' feedback, be they course owners or end-users of

the platform. As such, fed by processes of the knowledge acquisition and knowledge generation capabilities, the knowledge combination capability of the Interoperability Academy gets expressed in its ability to continuously adapt to stakeholders' feedback through different mechanisms and at different stages.

The next mechanism through which the Interoperability Academy deploys the knowledge combination capability is through short- and long-term planning. A perfect example of how short- and long-term planning enables the integration of knowledge to ensure the Interoperability Academy is agile and, at the same time sustainable, is reflected in the development of the Academy's curriculum. As stated by different interviewees, the strategy adopted for the development of the curriculum is to establish a short and long-term plan. The segmentation of the process in stages leads to the creation of a curriculum that is intrinsically flexible; a framework that can be easily updated either by adding, dividing or amending topic areas. Having short- and long-term plans enables a controlled integration of old and new knowledge that does not put at risk the sustainability of the initiative. This also enables it to be more flexible when facing changes in their political, technological and user requirements because, as it is mentioned by the interviewees, changes in IT policy frameworks are expected to happen more and more frequently.

A third process through which the Interoperability Academy deploys this capability is by exploring scope synergies with other EU programmes. In this regard, some team members mention the possibility of establishing synergies with other EU initiatives and programmes that share a similar scope or target. In doing this, the Interoperability Academy may be exploring an interesting opportunity to expand its available resources and explore new applications of its existing capabilities. However, as a consequence of exploiting these synergies, the action may also have to go through a re-definition of its scope and even its whole identity (e.g., having to change its name and objectives).

Finally, the last process that characterises the Interoperability Academy's knowledge combination capability, consists in the project review cycles. Project review cycles are part of the governance model of the Interoperability Academy, and they are established by formal contract procedures. These cycles are programmed from the beginning of the project, and they determine opportunities for project owners to adjust the scope of it. As examples of when these review cycles have determined changes in the Interoperability Academy project, interviewees mention the decision on including CEF's building blocks within the Catalogue of Educational Training Resources and as potential course owners; the decision to work with the EU Academy platform, instead of an independent platform; and the new guidelines to transition from ISA^2 Programme to work in the framework of the Digital Europe Programme.

7 Discussion

In this chapter, the author discusses the main results obtained from applying the theoretical framework to the empirical case. The purpose is to summarise the most important gathered insights about the factors and dynamic capabilities involved in the development of e-government knowledge interoperability in the EU. As such, the author will first discuss the results obtained concerning the set of factors, to afterwards dedicate some time to the dynamic capabilities. Finally, the author discusses more general connections between the results obtained and the reviewed literature.

First and foremost, it is important to clarify that the Interoperability Academy appeared to be in line with the concept of knowledge interoperability as defined by Chen and Doumeingts (2003). As presented in chapter **6 Results**, the Interoperability Academy's team agrees with the concept of knowledge interoperability and perceive it as applicable to their work and mission - even if only as a long term or ultimate goal. The Interoperability Academy is currently at an early stage of development and therefore, much of the planned work with and between MS public administrations is still yet to be done. However, in line with the definition of knowledge interoperability, the Interoperability Academy aims at levelling the plane field between public administrations in terms of their knowledge on interoperability and their advanced digital skills. As such, the Interoperability Academy initiative acknowledges the importance of developing compatibilities within European public administrations in terms of their knowledge resources and knowledge sharing capabilities and works for their enhancement.

Regarding the set of factors, this research found that six out of the seven initial factor categories were considered relevant for the Interoperability Academy's current work. The original set of factors included in Espadinha-Cruz and Cabrita (2018) framework included: strategic, knowledge management, cultural, legal, human resources, process and data factors. As reviewed in the previous chapter, data factors were not considered applicable to the Interoperability Academy as it is not in their interest or within their scope to facilitate transferences of data between organisations. Instead, a new category of factors was suggested by referring to the importance of the platform that is being used for knowledge sharing. As such, a technology factors category was included in the framework, while the data factors category was removed.

In addition, within each category, it was possible to identify certain factors acting as enablers for knowledge interoperability, while others tend to challenge it. Following Rico-Pinto and Sánchez-Torres's (2019) definitions of what can be considered an enabler and a challenge, this research considers an enabler of knowledge interoperability any factor within Espadinha-Cruz and Cabrita's (2018) categories that promotes or facilitates

developing compatibility of knowledge resources in a network of organisations. In turn, a challenge for knowledge interoperability is a factor within these same categories that inhibits or puts barriers to the development of this compatibility in terms of knowledge. As for how factors can influence interoperability development is highly-context dependent (Rico-Pinto & Sánchez-Torres, 2019), the author of this thesis took basis on the current perspective of the team members of the Interoperability Academy to distinguish between enablers and challenges and grouped the factors described in chapter **6 Results** into these two different classifications. As pointed out by many interviewees, it is however important to state that challenging factors are not necessarily bad for developing compatibilities in terms of knowledge resources between public administrations, as they can also represent opportunities to innovate, adapt and leverage unforeseen enablers.

Furthermore, the case study revealed that the categories of factors were attributed with different levels of relevance. Strategic, human resources and process-related factors play crucial roles, both enabling and challenging, knowledge interoperability development. Cultural and technology-related factors play a relevant role as well, but their influence depends largely on how strategic factors such as financial constraints and governance schemes are addressed. Finally, it was found that legal factors only play an enabling role for knowledge interoperability in the European context, while knowledge management factors were the ones with the least awareness off in the current scenario, but with a perceived high potential impact on the long-term sustainability of the initiative.

In terms of **Strategic factors**, the results show that having supporting policy frameworks, such as the EIF and ISA^2 -or now the Digital Europe Programme-, is favourable for developing compatibilities in terms of skills and knowledge between public administrations in the EU. These multiannual policy frameworks set the basis for a strategic alignment between different stakeholders around common goals concerning interoperability. As such, policy frameworks guarantee a minimum level of political and managerial commitment towards European interoperability. Setting a common horizon around the goal of interoperability enables more possibilities to establish collaborative partnerships that facilitate and promote the exchange of knowledge. All of these represent strategic enablers that work in favour of the Interoperability Academy's mission and, hence, knowledge interoperability.

On the opposite side, challenging the development of knowledge interoperability is the fact that policy frameworks are subject to periodical changes. As technology, users and political will go through changes, policy frameworks should adjust to new times. Change is not something to avoid, but something that needs to be considered when defining which

skills and which knowledge the EU needs to make compatible between public administrations. Policy frameworks also imply different amounts of financial resources available for developing knowledge interoperability, without which more collaborations are required. Budgetary constraints determine that responsibilities have to be clearly allocated within partnerships in order to distribute the load of invested time, effort and monetary costs. In turn, having to establish collaborations with external stakeholders to achieve certain goals, implies a more complex distribution of responsibilities and diffuse governance schemes.

Below, **Table 3** summarises the discussed strategic enablers and challenges influencing knowledge interoperability development in the EU.

Factor	**Enablers**	**Challenges**
Strategic	- Supporting policy frameworks - Strategic goals alignment between different stakeholders - Availability of collaborative partnerships	- Changing policy frameworks - Financial constraints - Complex distribution of responsibilities

Table 3 – Strategic factors influencing knowledge interoperability

As for the **Knowledge management factors**, the results show that there are three main enablers for developing knowledge interoperability in the EU. These enablers consist of using open-source knowledge resources, having knowledge resources sufficiently formalised and co-creating knowledge resources. First, using open-source knowledge resources enables an easier sharing process, without having the concern for intellectual property. Secondly, having knowledge resources sufficiently formalised is indispensable for knowledge sharing readiness, leading to a more streamlined process of transmitting and reusing knowledge. Finally, co-creating knowledge resources also facilitate their shareability. As explained in the previous chapter, the Interoperability Academy maintains back and forth interactions with course owners supporting them in the process of course creation with pedagogical and technical advice.

In turn, e-government knowledge interoperability is challenged by the dependency of public administrations, both in MS and at the EU level, on external contractors and their fixed procurement contracts. This general dependency on external contractors and the constraints of fixed procurement contracts can delimit public administration’s capacities to create, accumulate and share knowledge. Additionally, top management unwillingness

to share knowledge can be another factor related to knowledge management practices in public administrations that can challenge the development of compatibilities in terms of skills and knowledge with other public administrations. These represent relevant challenges for the sustained development of knowledge interoperability and, hence, initiatives such as the Interoperability Academy.

Table 4 summarises the enablers and challenges related to knowledge management that influence knowledge interoperability development in the EU.

Factor	**Enablers**	**Challenges**
Knowledge management	- Open-source knowledge resources - Sufficiently formalised knowledge resources - Co-creation of knowledge resources	- Dependency on external contractors - Unwillingness to share knowledge

Table 4 – Knowledge management factors influencing knowledge interoperability

Concerning **Cultural factors**, the results gathered show that being culturally open and offering to use automatic tools to translate knowledge resources are very important for the Interoperability Academy's daily work and mission. As such, cultural awareness and multilingualism can be considered relevant enablers in the search for developing knowledge interoperability in the EU.

Challenging the development of knowledge compatibilities, the results show that public servants' language skills and public administration's strong linguistic identities can act as barriers. As shown in the results, some MS public administrations may prefer their courses to be completely done in their official languages either because of a lack of English skills among public servants or due to linguistic identity preferences.

Bellow, **Table 5** summarises the cultural enablers and challenges that influence knowledge interoperability development in the EU.

Factor	Enablers	Challenges
Cultural	- Cultural awareness and openness - Multilingualism	- Public servants' language skills - Public administration's linguistic identities

Table 5 – Cultural factors influencing knowledge interoperability

Next to data factors, **Legal factors** were considered the least relevant for the Interoperability Academy's activities and mission. However, some key enablers were mentioned in relation to complying with commonly agreed security and privacy regulations (i.e., GDPR) and basing all knowledge exchange on open-source licences. No challenging factors were identified for the legal category.

Table 6 summarises the legal enablers that influence knowledge interoperability development in the EU.

Factor	Enablers	Challenges
Legal	- Open-source licences - Common data protection regulation	

Table 6 – Legal factors influencing knowledge interoperability

Human resources factors were among the most relevant for interoperability in terms of knowledge and skills. The human factor is considered crucial for organisational interoperability, as it relies on the alignment between processes and also between people of different organisations. Here, having standardised profiles and learning paths, developing a common framework of interoperability skills and competences for public servants (i.e., EFISC) and establishing a common interoperability curriculum, can be considered key enablers for developing e-government knowledge interoperability in the EU. These were the first outcomes produced by the Interoperability Academy and are, in many ways, the basis for their current and future work.

In turn, in terms of challenges, the case shows that targeting a diverse population of public servants within the EU is extremely complex. It is a major challenge for the Interoperability Academy to account for the multiple skills and knowledge requirements of its users, be they learners or course owners. More importantly, these skills and knowledge requirements need to be kept updated and closely monitored for the

Interoperability Academy to adapt to its user's needs. Additionally, another challenging factor is the lack of awareness of interoperability in public servants. When developing e-government knowledge interoperability it is of the utmost importance that public servants understand the value of interoperability for the public sector. Finally, a third challenging factor refers to the insufficient engagement with e-learning activities on the topic of interoperability. Linked to the lack of awareness about the value of interoperability, increased levels of engagement and enrolment in e-learning activities are needed to develop e-government knowledge interoperability.

Bellow, **Table 7** summarises the enablers and challenges related to human resources that influence knowledge interoperability development in the EU.

Factor	**Enablers**	**Challenges**
Human resources	- Standardised learner profiles and learning paths - Common framework of interoperability skills and competences for public servants - Common interoperability curriculum	- Diverse skills and knowledge requirements from users (learners and course owners) - Lack of awareness of the value of interoperability - Lack of engagement on interoperability e-learning activities

Table 7 – Human resources factors influencing knowledge interoperability

Process factors are also considered very important for knowledge interoperability according to this thesis' empirical findings. A major enabler here has been the creation of a standardised roadmap for knowledge sharing between public administrations in the EU mediated by the Interoperability Academy. As explained in chapter **6 Results**, this standardised roadmap explains step-by-step the procedures that are required to create, manage and assess knowledge resources (i.e., courses and events) in the framework of the Interoperability Academy, thus helping to overcome operational difficulties spurred from the multiplicity of stakeholders that have to work in coordination.

Process alignment can be, however, very challenging because of the different organisational structures that characterise each public administration. Interoperability and training for public servants are, on many occasions, shared responsibilities of diverse government levels, ministries and agencies with different degrees of autonomy. Having

to adjust to all these different realities present in the EU can be a major challenge for the development of e-government knowledge interoperability.

Bellow, **Table 8** summarises the process-related enablers and challenges that influence knowledge interoperability development in the EU.

Factor	**Enablers**	**Challenges**
Process	- Standardised roadmap for knowledge sharing	- Diverse organisational structures within public administrations

Table 8 – Process factors influencing knowledge interoperability

As previously mentioned, this research could not identify **Data factors** being relevant for knowledge interoperability in the EU but, instead, a new category of factors was included, namely **Other** factors: Technology **factors**. Regarding the use of technology for supporting knowledge sharing between public administrations in the EU, an important enabler has been to maintain close collaborations with the team responsible for the development of the hosting platform (i.e., the EU Academy). Considering that the Interoperability Academy has no control over the development of the EU Academy platform, it has been essential to work in close collaboration with the EU Academy team of developers.

Maintaining regular meetings with the EU Academy team to understand how to better use the functionalities of the platform and, at the same time, provide feedback, has been crucial to mitigate potential misalignments in terms of scope, timelines and target audience between both initiatives. This collaboration allows to work around the challenges posed by the design of the platform and to gradually improve it by incorporating users' feedback. In return, the knowledge resources produced in the framework of the Interoperability Academy also gain visibility within this platform because of its wider scope, thus enabling it to reach broader and diverse audiences acting as a one-stop digital portal for e-learning resources on mature interoperability solutions.

Table 9 summarises the technology-related enablers and challenges that influence knowledge interoperability development in the EU.

Factor	Enablers	Challenges
Technology	- Close collaboration with platform developers - Visibility as a one-stop digital portal for e-learning on interoperability	- Misalignments in scope, timelines and target audience between teams - Platform design limitations

Table 9 – Technology factors influencing knowledge interoperability

Regarding the involvement of knowledge-based dynamic capabilities on e-government knowledge interoperability, this research revealed three groups of processes through which the Interoperability Academy deploys this kind of capabilities. In what follows, the author will summarise the different groups of processes that manifest each of the knowledge-based dynamic capabilities considered in this thesis' theoretical framework.

First, the **Knowledge acquisition capability** consists of those processes through which the Interoperability Academy makes strategic decisions to acquire knowledge that can be useful for providing training resources to improve the knowledge and skills on interoperability of public servants across Europe. These processes are (see **Figure 10**): top-down policy alignment; reuse of existing knowledge; R&D; organisational learning; collection of feedback from end-users.

Following top-down political guidelines and directions is key to orient the knowledge acquisition efforts and make sure that the knowledge resources being shared are perceived as relevant for the overarching goals that sustain the network. Similarly, the reuse of existing knowledge is another process involved in knowledge acquisition, which prioritises obtaining and sharing knowledge on mature interoperability solutions that have already been thoroughly implemented. Furthermore, R&D (for example on learner requirements) is another process that allows to establish priorities and focus areas on the kind of knowledge that should be acquired and afterwards shared. Organisational learning, in turn, is the process through which knowledge sharing best practices are mapped to learn from them and produce a distinctive offer. Finally, the collection of feedback from end-users allows gaining information about which kind of knowledge triggers more interest and thus, tailor future knowledge acquisition.

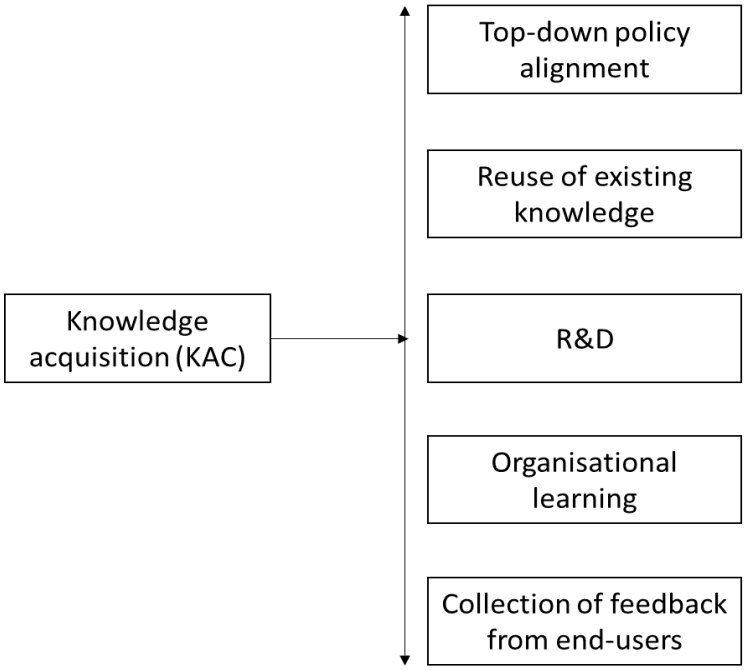

Figure 10 – Interoperability Academy's knowledge acquisition capability

Second, the **Knowledge generation capability** consists of those processes through which the Interoperability Academy refines processes to create new valuable knowledge on interoperability. These processes are (see **Figure 11**): course co-creation; rounds of testing and validation; and leveraging partnerships.

The process of course co-creation refers to all activities that serve to guide, support and assess the creation of knowledge resources to be shared with the network. This involves exchanging viewpoints and expertise so that the produced knowledge resources comply with pedagogical, technical, functional and accessibility requirements, which should make it understandable and applicable by others. The rounds of testing and validation, in turn, imply processes aimed at guaranteeing that the produced knowledge resources are kept updated and responsive to changes in the political, technological and user requirements. Finally, the process of leveraging partnerships allows refining the creation of knowledge resources by collaborating with or incorporating the inputs of key stakeholders. For this case, the partnerships with the EU Academy platform development team, the NIFO team, and the Innovative Public Services Observatory team were considered crucial to innovate with regards to knowledge generation.

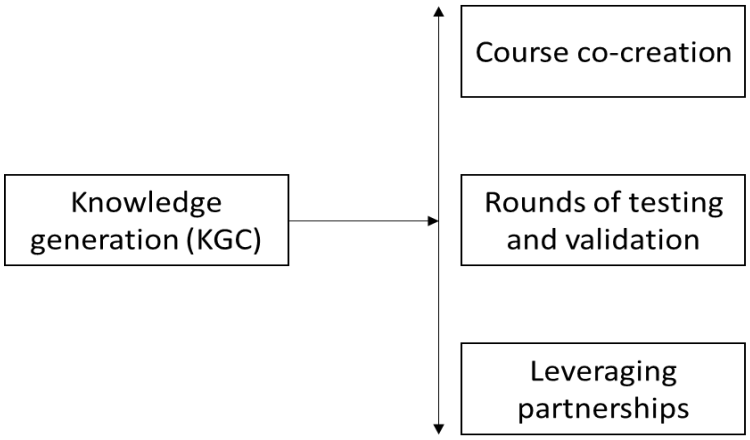

Figure 11 – Interoperability Academy's knowledge generation capability

Finally, the **Knowledge combination capability** consists of those processes through which the Interoperability Academy integrates knowledge, explores new applications and reconfigures its internal processes. These processes are (see **Figure 12**): continuous adaptation to stakeholders' feedback; short- and long-term planning; exploring scope synergies; and project review cycles.

The continuous adaption to stakeholders' feedback involves all processes that, beyond the purposes of knowledge acquisition and knowledge generation, allow the organisation to be agile and sustainable through the integration of internal and external knowledge. Integrating external knowledge means being responsive to stakeholders' requirements, be they course owners or end-users, through continued mechanisms and at different stages. As such, this process is fed by some of the above-mentioned processes of collecting users-feedback, co-creating, and performing rounds of testing and validation.

In turn, the processes involved in having a short and long-term plan enable a controlled combination of old and new knowledge, without putting at risk the sustainability of the initiative. Splitting an initiative into stages also works as a form of experimentation that allows adjusting mid-way in response to obtained outcomes. Moreover, exploring scope synergies refers to the processes through which the Interoperability Academy explores compatibilities with other EU initiatives to expand its available resources and capabilities. Finally, project review cycles involve the processes through which the Interoperability Academy internally decides to reconfigure its scope and resource-base.

Appendix D: Overview of results shows an overview of all the discussed results in this chapter.

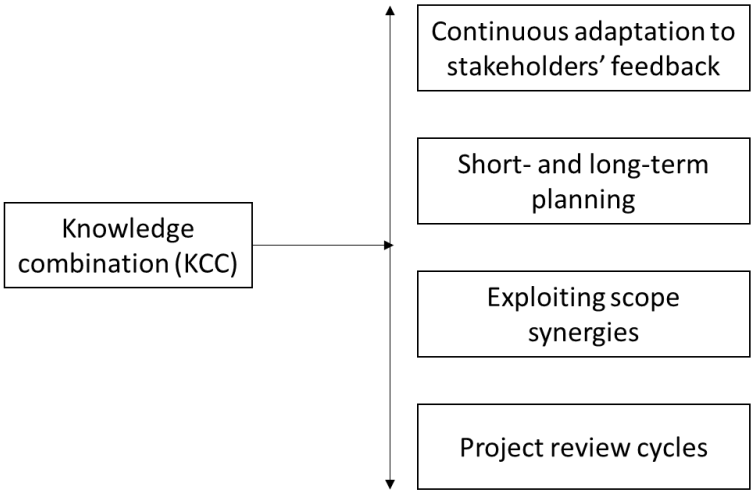

Figure 12 – Interoperability Academy's knowledge combination capability

To close this chapter, in what follows, the author discusses more general connections between the gathered results and the reviewed literature.

Here, it is important to emphasise that the Interoperability Academy is seen as a means towards the fulfilment of broader goals concerning the modernisation of public administrations and the consolidation of a joined-up government in Europe. The connection between this strategic drive and the role of the Interoperability Academy in raising knowledge and awareness about interoperability shows the pertinence of Gottschalk and Solli-Saether's (2008) organisational interoperability model (see **Figure 2**). As this model highlights, establishing knowledge sharing practices is key to creating added value in networks of organisations and for harmonizing business process alignment with strategic alignment. Concerning this, the Interoperability Academy's case reveals that even if cross-organisational or cross-boundary processes already exist, they can only reach a limited implementation if the knowledge about how these processes were built and their importance for the common goals is not shared. In other words, for best practices to become common practices, they need to be identified and shared.

Based on this research, it can be argued that the Interoperability Academy is actively tackling this problem by improving public organisations' capacities to share knowledge through collaborative and co-creative processes and raising awareness about the value of interoperability. In line with Vernadat (2010), by producing e-learning resources through co-creation, the Interoperability Academy enhances the value of the generated knowledge by not only making it available but also understandable to other organisations within the EU. Additionally, the Interoperability Academy is fostering organisational learning by identifying best practices and collecting them in the Catalogue of Educational and Training Resources to eventually transform them into educational activities or courses.

Agreeing with Espadinha-Cruz and Cabrita's (2018) propositions, the results show how the Interoperability Academy is bridging knowledge gaps by supporting public administrations' capacities to learn and share knowledge and by building a knowledge-sharing network within the EU.

The relative relevance of the different categories of factors situates knowledge interoperability as a sub-layer of organisational interoperability mostly concerned with strategic, human resources and process-related factors, and the relationships between them. In line with what the literature on organisational interoperability points out (e.g., Pardo & Burke, 2008; Pardo et al., 2012; Rico-Pinto & Sánchez-Torres, 2019; Tripathi et al., 2013; Vernadat, 2010), having qualified human resources, as well as compatible work processes, knowledge management practices, organisational cultures and managerial leadership towards common goals are key aspects for interoperability development.

Acknowledging that every potential course owner may exhibit different characteristics, the Interoperability Academy's experience shows how it has had to adapt to different EU institutions and MS public administrations in order to develop knowledge compatibilities at the EU level. Matching what some of the reviewed authors (Cresswell et al., 2005; Pardo & Burke, 2008) argue, the Interoperability Academy does not work under the assumption that every public sector organisation has -or should have- the same capacities or characteristics, but rather by leveraging the knowledge and capacities that already exist among the sharing entities. As such, it could be argued that the Interoperability Academy approaches knowledge interoperability development as a highly context-dependent process that needs to consider the different organisational capacities of the stakeholders involved in the network. For this, the establishment of co-creation processes and continuous feedback loops has become central to the initiative. Regarding how the evolution of organisational interoperability in terms of knowledge compatibilities could be monitored, the Interoperability Academy's curriculum and the impact assessment of its training resources, open an interesting door for future research.

Additionally, the application of the proposed theoretical framework reveals the relationship between knowledge interoperability as a sub-layer of organisational interoperability with other layers of it, namely the legal, semantic and technological layers as represented in the 2017 EIF (see **Figure 1**). Interestingly, this case revealed that legal factors only had an enabling influence on the Interoperability Academy's work. One could venture that this is due to the level of development of legal interoperability in the EU, where much of the needed agreements that could impact knowledge sharing practices between public administrations have already been settled. Data or semantic factors, in turn, proved to have no impact on the Interoperability Academy's activities, indicating

that knowledge and data sharing practices do not necessarily implicate one another. Instead, semantic interoperability -as the other layers- is only relevant as a knowledge area for the interoperability curriculum and course development. Finally, technological factors were identified as relevant for the Interoperability Academy's activities in the sense that much of the knowledge sharing activities developed by the initiative depend on the use of a specific e-learning platform (i.e., the EU Academy). Besides the already discussed challenges experienced by the Interoperability Academy -which are specific to this case- it could be argued that creating a common platform for knowledge sharing which enables educational content co-creation, curriculum organisation, user feedback collection and learning assessment, is key for developing knowledge interoperability. As expressed by one of the interviewees, such a platform has the potential of becoming a one-stop-shop accessible by all members of the network for gaining knowledge about mature interoperability solutions and, at the same time, for sharing knowledge with guaranteed broader visibility and, possibly, a greater impact for the whole network. Hence, the incorporation of technological factors in the proposed theoretical framework represents another key result gathered by this thesis which goes in line with the perspective of interoperability as a multidimensional innovation (Cresswell et al., 2005; Scholl & Klischewski, 2007; Pardo et al., 2012; Malinauskienė, 2013; Tripathi, Gupta, & Bhattacharya, 2013).

As a final remark, the author highlights the applicability of the dynamic capabilities' categories to understand how the Interoperability Academy fulfils its mission while adapting to external changes and responding to its different stakeholders' requirements. The above-mentioned processes through which each dynamic capability gets deployed, reveal that developing knowledge interoperability is an endeavour that requires processes of "repeatable, continuous adaptation" (Vial, 2019, p. 133). As such, efforts for acquiring, generating and combining valuable knowledge need to be sustained and improved through time as new opportunities unfold. Collaborative and agile forms of management (see Mergel, 2016), are terms that are not unfamiliar to the Interoperability Academy team but still represent difficulties because of the different challenging factors that have been identified. The current scenario of e-government knowledge interoperability development in the EU is not yet conformed by a constellation of public organisations that are capable of sharing knowledge and learning in order to lead the phenomenon of digital transformation (see Kattel & Mazzucato 2018; Mazzucato et al., 2020). However, this case shows that knowledge-related processes are gaining importance to improve the technical and evolutionary fitness (Teece, 2007) of public sector organisations and that networked forms of government are a fruitful context to deploy knowledge-based dynamic capabilities in the public sector.

8 Limitations

This research is not exempt from limitations. First, regarding the literature review, it is important to clarify that the collected sources were initially filtered by the use of a single database (i.e., Scopus). Even though this is a renowned database for scientific literature, compliant with the highest standards of quality, it may still lead to a limited selection. Nevertheless, in an attempt to mitigate this limitation, the selection was expanded to literature gathered from other databases (i.e., Google Scholar, Web of Science) with the process of back and forward search (Webster & Watson, 2002).

Another limitation refers to the developed **3.3 Theoretical framework**. The chosen frameworks and their constructs were adapted from the business management literature to be used in the e-government and public administration field of research. As acknowledged in Piening (2013), it has been argued that approaches such as the dynamic capabilities theory have limited applicability for public sector organisations. This is because of the differences between public and private managers, and because this approach refers strongly to an environment ruled by market forces (Piening, 2013). Similarly, the theoretical framework used to conceptualise knowledge interoperability was taken from literature on B2B interoperability. However, the choice of using these constructs responded to the impossibility to find homologous ones coming from the e-government field of research.

Acknowledging this limitation, the author adapted the constructs incorporated in the **3.3 Theoretical framework** before applying them to an e-government interoperability context. This adaptation was done by suggesting stipulative definitions of the knowledge interoperability factors, based on Rico-Pinto and Sánchez-Torres's (2019) characterisation of G2G interoperability factors. Additionally, Zheng et al.'s (2011) definitions of the three knowledge-based dynamic capabilities were broadened to consider any kind of organisation, instead of just firms or companies. In doing so, this thesis aligns with a recent trend in research that is exploring the applicability of the dynamic capability approach to the analysis of organisational routines in the public sector.

A third form of limitation arises from the choice of conducting a single case study. Case study research has been criticized for being prone to incur in biases and for not leading to generalizable conclusions (Yin, 2018). The author of this thesis addressed the first concern by clearly reporting all evidence and methodological procedures followed throughout this research. Additionally, several sources of evidence were approached to triangulate information (e.g., six interviewees), as well as different methods were implemented to collect it (i.e., documentation, participatory observation, semi-structured interviews). These forms of triangulation allowed the author to apply a corroboratory

strategy that strengthens the accuracy and validity of the results. As for the second concern, the author of this thesis argues that the results obtained from this case study "are generalizable to theoretical propositions and not to populations or universes" (Yin, 2018, p. 53). As such, this thesis proposes analytic generalizations regarding how theory on e-government knowledge interoperability can be approached in the European context.

Forth, in conducting semi-structured interviews it is important to acknowledge that open-ended questions may lead to forms of bias and concerns about reliability (Saunders et al., 2009). In this type of non-standardised interview, the researcher may omit some questions or alter the order of the themes covered depending on the flow of the conversation, the context or the particular interviewee (Saunders et al., 2009). To address this source of limitations, the author of this thesis argues that not only the responses of six different interviewees were compared and contrasted, but also the author used its experiential knowledge about the organisation to gain the interviewees' trust and mitigate any response bias.

Another limitation is linked to the selection of interviewees. As mentioned in sub-section **4.3.3 Semi-structured interviews**, the author of this thesis only approached the team members of the Interoperability Academy. Because of time and scope constraints, the author decided to not include the external perspective of users of the platform or course owners. As such, this thesis is focused only on the internal viewpoint of the Interoperability Academy team. Since much of this team's work depends on establishing cooperative relations with other EU initiatives and MS public administrations, this thesis's conclusion could greatly benefit from exploring their perspectives with regards to knowledge interoperability. Studying the learner's perspective could greatly contribute to improve the users' experience and delineate the Interoperability Academy's curriculum. To address this limitation, the author encourages future studies that incorporate these perspectives in order to complement this thesis' conclusions.

Finally, an interpretative approach was adopted to explore and understand practices within the chosen case study. This implies that the researcher participated in the world of the research subjects and assumed an empathetic attitude aiming to understand their practices and situations from their unique points of view (Saunders et al., 2009). The researcher was part of what was being researched and, therefore, subjective meanings were considered as acceptable knowledge for this thesis (Saunders et al., 2009). To mitigate any possible bias derived from how the researcher interacted with the interviewees, extra efforts were invested into collecting detailed and comprehensive sets of data that could be corroborated against different sources.

9 Conclusions

Defined as "the compatibility of the skills, competencies, and knowledge assets of an enterprise with those of other enterprises" (Chen & Doumeingts, 2003, p. 159), knowledge interoperability has been identified as a key sub-layer within organisational interoperability (Espadinha-Cruz & Cabrita, 2018; Gottschalk & Solli-Saether, 2008). Intimately linked to the organisational capability to share knowledge resources, knowledge interoperability has been recognized as crucial for establishing cross-organisational business processes, bridging knowledge gaps between organisations and for them to know how to act based on shared information (Espadinha-Cruz & Cabrita, 2018; Rhazale & Bounabat, 2018).

To understand this rather unexplored aspect of the organisational dimension of interoperability, this research conducted an extensive literature review on the current state of the art in organisational interoperability and dynamic capabilities, identifying constructs and frameworks that could help conceptualise the sub-layer of knowledge interoperability. This process addressed this thesis' first research sub-question, namely: *What theoretical constructs can help us conceptualise knowledge interoperability?*

Based on this review, a theoretical framework for e-government knowledge interoperability was developed involving a set of factors and knowledge-based dynamic capabilities. For this, the constructs proposed by Espadinha-Cruz and Cabrita's (2018) knowledge interoperability framework and Zeng et al.'s (2011) knowledge-based dynamic capabilities were adapted. Aiming to use these constructs in the e-government field of studies, the adaptation was done by proposing stipulative definitions of the knowledge interoperability factors, based on Rico-Pinto and Sánchez-Torres's (2019) G2G interoperability factors, and broadening Zheng et al.'s (2011) definitions of the three knowledge-based dynamic capabilities to include public sector organisations. As a result, this process answered this thesis' second research sub-question, namely: *What theoretical framework can be used to study e-government knowledge interoperability?*

The developed theoretical framework was then applied to the EU's e-government reality by conducting a single case study of the European Commission's initiative that is addressing interoperability from a perspective of knowledge and skills: the Interoperability Academy. For this, different data collection techniques were implemented in order to triangulate methods and sources (i.e., document analysis, participant observation, semi-structured interviews). By applying the theoretical framework to the work conducted by the Interoperability Academy, the researcher was able to extract some empirical insights about the factors and dynamic capabilities involved in the development of e-government knowledge interoperability in the EU. In

doing so, the author was also able to adjust the constructs in the framework, after realizing that some elements were not considered relevant in the particular context under research.

Starting from the premise that the way factors influence knowledge interoperability is highly context-dependent (Rico-Pinto & Sánchez-Torres, 2019), this research examined how a set of factors influence knowledge interoperability development in the EU, from the internal perspective of the Interoperability Academy. As such, enabling and challenging factors were identified. In addition, the processes representing the deployment of knowledge-based dynamic capabilities were identified in relation to the knowledge interoperability development in the EU. Overall, the application of the suggested theoretical framework to this case study allowed the author to answer this thesis' third research sub-question, namely: *How does this framework apply to e-government knowledge interoperability development in the EU?*

To conclude this thesis, what follows in this chapter is dedicated to answering the overarching research question posed by this thesis, namely: *What factors enable and challenge e-government knowledge interoperability development in the European context and what dynamic capabilities are involved in this process?* In addition, lines for future research are identified.

This research provides two key results to answer this main research question. First, this thesis contributes to the e-government interoperability field of research with a theoretical framework for e-government knowledge interoperability. Secondly, by applying this theoretical framework to the work conducted by the Interoperability Academy, this research has identified the dynamic processes involved in knowledge interoperability development in the European e-government context, as well as the factors both enabling and challenging its development.

Regarding the dynamic processes, this research concludes that there are three groups of processes through which knowledge-based dynamic capabilities involved in knowledge interoperability development get deployed in the European context. The knowledge acquisition capability expresses in five different processes that contribute to strategically sense what knowledge is needed to improve the knowledge and skills on interoperability of public servants across Europe. The knowledge generation capability consists of three different processes that refine the creation of valuable knowledge on interoperability to be shared across Europe. Lastly, the knowledge combination capability involves four different processes that integrate different sources of knowledge and reconfigure the Interoperability Academy's internal processes of knowledge acquisition and generation to make the whole initiative towards knowledge interoperability sustainable and agile.

As for the factors, this research concludes that there are seven categories of factors influencing e-government knowledge interoperability development in the EU. These categories correspond to strategic, knowledge management, cultural, legal, human resources, processes and technology factors. The case study also revealed that the categories of factors were attributed with different levels of relevance as, for example, data factors were not considered influential. In addition, within each category, it was possible to identify enabling and challenging factors for e-government knowledge interoperability in the EU. Here, it is possible to conclude that strategic, human resources and process-related factors have a higher relevance, both enabling and challenging, knowledge interoperability development. In turn, the influence of cultural and technology factors is also considered relevant but largely contingent on how challenging strategic factors are addressed (e.g., financial constraints). The incorporation of technological factors in the proposed theoretical framework represents another key result gathered by this thesis, as it reveals interconnections between layers of interoperability and the importance of using a single digital portal to streamline knowledge sharing between the members of a network. Finally, it was also found that legal factors only play an enabling role for knowledge interoperability in the European context, while knowledge management factors were the ones with the least awareness-off in the current scenario, but with a perceived high potential impact on the long-term sustainability of the initiative.

As a general conclusion, this thesis gathers that e-government knowledge interoperability is a topic of theoretical and practical interest in the European context. Interoperability has become a central topic within EU's Digital Agendas and the Interoperability Academy initiative goes in line with the most recent developments in Europe aimed at modernising public administrations (see European Commission, 2016a). Recent policies indicate that in order to increase the reuse of interoperable solutions, interoperability needs to be addressed in a holistic and sustained way (see European Commission, 2017c; European Commission, 2018b) by fostering user-driven approaches which, in turn, require enhancing digital capacities and skills in the public sector (see Council of the European Union, 2020; European Commission, 2021a; 2021b). Tackling this problem and aiming to raise awareness about interoperability, the Interoperability Academy's emergence reveals the current practical relevance of bridging skills and knowledge gaps between public administrations in the EU. As such, this case study demonstrates how the concept of knowledge interoperability applies to concrete initiatives and practices currently in place in the European e-government context.

Moreover, this research represents the first application of these constructs in the e-government field of practice and research, thus setting the grounds to explore the sub-layer of knowledge interoperability as an e-government topic of research, while

contributing to the conceptualisation of interoperability as a dynamic, multidimensional and context-dependent capability. In this regard, this research revealed how knowledge interoperability development involves a set of dynamic processes in order to make it a sustainable and agile endeavour. The perspective of interoperability as a multidimensional innovation was supported, by showing the interrelations between knowledge interoperability and other layers of this construct. Finally, this case revealed how interoperability is approached as context-dependent e-government capability, as it requires taking into account the different knowledge resources and capacities of the sharing entities. Hence, this thesis possesses theoretical relevance and indirectly supports interoperability practice by providing clarity around the human and knowledge aspects involved when transforming public administrations into interoperable organisations.

Future research could follow up on these results and explore how e-government knowledge interoperability develops in the coming years in the European context. As such, these studies could explore how the influence of the identified set of factors develops over time or analyse whether the relative relevance of the different categories of factors changes as the Interoperability Academy evolves. Similarly, new studies could track how the Interoperability Academy's dynamic capabilities evolve and get expressed in new kinds of processes. This could be done with a longitudinal and in-depth approach, attempting to replicate the conditions of this research.

Furthermore, the implementation of the Interoperability Academy's curriculum and the long-term impact assessment of its training, represent interesting areas to focus on in future studies concerned with monitoring knowledge interoperability development. These studies could incorporate the external viewpoints of users of the platform (i.e., learners) and course owners, and complement it with the internal perspective of the Interoperability Academy team. The analysis of these external perspectives could greatly contribute to improve the platform's users' experience, adjust the Interoperability Academy's curriculum and enhance the Interoperability Academy's dynamic capabilities.

Finally, future research could also explore the applications of the suggested e-government knowledge interoperability framework in other scenarios, either inside or outside the EU. The reality of particular countries and their digital academies could be investigated, studying whether this concept applies to other initiatives aligned with the concept of knowledge interoperability. For this, the operationalised categories of factors could be applied to other cases, thus strengthening their validity and generalisability. Likewise, multiple case study research could compare other initiatives where the concept of knowledge interoperability is applicable and determine whether similar dynamic processes take place in them.

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Appendix

A Literature review conceptual matrix

#	Authors/Year	Title	Methods	Summary of content	Dynamic Capabilities	Organisational interoperability	Public sector	e-Government	Knowledge sharing	Knowledge resources
Organisational interoperability literature										
1	Abatecola et al., 2016	Darwinism, organisational evolution and survival: Key challenges for future research	Narrative literature review	It reviews main themes in the field of research on organisational evolution and co-evolutionary theory.	x				x	x
2	Almeida Prado Cestari et al., 2020	A capability model for public administration interoperability	Theory building and case study application.	It proposes a Public Administration Interoperability Capability Model (PAICM) that allowed to identify barriers affecting organisational performance and to diagnose the interoperability in a public administration scenario.	x	x	x	x	x	x
3	Bouallouche et al., 2017	Organisational interoperability between public and private actors in an extended administration	Narrative literature review	It presents a framework to help manage interoperability between public and private organisations in an extended administration and to evaluate network performance.		x	x	x		
4	Casalino et al., 2014	Defining a model for effective e-government services and inter-organisational cooperation in public sector	Literature review and single case study	It focuses on the subject of interoperability between European public administrations information systems by studying the Italian case and the ELGI project. It identifies the main aspects regarding the field of interoperability, analysing its barriers, organisational issues, success and risk factors related to IS for public sector organisations.	x	x	x	x	x	x

#	Authors/Year	Title	Methods	Summary of content	Dynamic Capabilities	Organisational interoperability	Public sector	e-Government	Knowledge sharing	Knowledge resources
5	Chen and Doumeingts, 2003	European initiatives to develop interoperability of enterprise applications – basic concepts, frameworks and roadmap	Literature review and gap analysis	It argues that it is necessary to involve research on knowledge and competencies for all layers of interoperability and proposes a roadmap for future work on interoperability development as a multidisciplinary endeavour.	x	x	x	x	x	x
6	Cresswell et al., 2005	Sharing justice information: A capability assessment toolkit	Validated through multiple case studies in the US.	Provides a toolkit/self-assessment tool designed for justice professionals to use when planning a justice information-sharing initiative. It allows to identify gaps in capabilities both within and across organisations.	x	x	x	x	x	x
7	Cresswell et al., 2008	A Multi-dimensional approach to digital government capability assessment	Literature review and validation by expert groups	It explains the rationale and approach used for the development of assessment toolkits for the capability assessment of different digital government initiatives, including justice information interoperability projects.	x	x	x	x	x	x
8	Espadinha-Cruz and Cabrita, 2018	Integrating knowledge management and business interoperability: a scenario framework	Narrative literature review	It proposes a conceptual framework to develop the concept of knowledge interoperability at the organisational level. It argues the integration of knowledge management into Business Interoperability.	x	x			x	x
9	Gottschalk and Solli-Saether, 2009	Stages of e-government interoperability	Narrative literature review	Develops and present a four-stage model for e-government interoperability: work process, knowledge sharing, value creation, strategy alignment.		x	x	x	x	x

#	Authors/Year	Title	Methods	Summary of content	Dynamic Capabilities	Organisational interoperability	Public sector	e-Government	Knowledge sharing	Knowledge resources
10	Henning, 2018	A theoretical framework on the determinants of organisational adoption of interoperability standards in Government Information Networks	Literature review and two case studies in the Netherlands.	It develops a theoretical framework of determinants for the adoption of interoperability adoption by organisations in Government Information Networks.		x	x	x	x	
11	Kompella, 2016	Enablers for improving organisational interoperability in e-governance systems	Multiple case study	The paper identifies enablers for improving organisational interoperability between public-private partnerships in e-governance systems.	x	x	x	x		
12	Layne and Lee, 2001	Developing fully functional e-government: A four stage model	Narrative literature review plus observations of an e-gov case in the US.	Suggests a four -stage growth model of e-government development: cataloguing, transaction, vertical integration, and horizontal integration. They also reveal three main issues that need to me addressed to achieve successful citizen-oriented e-government.		x	x	x	x	
13	Mačinković and Aničić, 2016	The systems development life cycle to facilitate progression towards semantic and organisational interoperability for healthcare system	Single case study	It proposes life cycles of semantic web services and of business process interoperability applied to a specific case in healthcare. The objective is to facilitate the understanding of common business processes.		x	x	x	x	

#	Authors/Year	Title	Methods	Summary of content	Dynamic Capabilities	Organisational interoperability	Public sector	e-Government	Knowledge sharing	Knowledge resources
14	Maheswari and Janssen, 2012	Measuring organisational interoperability in practice: The case study of population welfare department of Government of Sindh, Pakistan	Literature review	Investigates interoperability maturity models and frameworks to identify assessment dimensions and propose a measurement instrument to assess the organisational layer of interoperability. They validate the instrument by conducting a case study at a particular Pakistan public organisation.	x	x	x	x		x
15	Malinauskienė, 2013	Conceptual framework for context-based e-government interoperability development	Literature review and comparative analysis.	It analyses the development of e-government interoperability as a dynamic, multidimensional and context-based capability and proposes a conceptual framework that highlights the importance of contextual factors for interoperability research and practice.	x	x	x	x	x	x
16	Nada and Ali, 2014	Integrated interoperability capability model for adaptative and sustainable SMEs	Literature review and questionnaire sent to 100 SMEs in Denmark.	It develops an effective and integrated interoperability model for sustainable and adaptable SMEs. They validate the model with the case of Danish SMEs and reveal that there is a strong positive relation between interoperability capability and adaptative capabilities in SMEs.	x	x	x	x		x
17	Otjacques et al., 2007	Interoperability of e-government information systems: Issues of identification and data sharing	Survey oriented to experts in each of the 25 EU countries	It explores the way public organisations manage identity-related fata and the sharing of such data. It analyses the differences between European public administrations and draws conclusions on the current European state of identity-management in cross-border contexts.		x	x	x		

#	Authors/Year	Title	Methods	Summary of content	Dynamic Capabilities	Organisational interoperability	Public sector	e-Government	Knowledge sharing	Knowledge resources
18	Pardo and Burke, 2008	Improving government interoperability: A capability framework for government managers	Narrative literature review	Develop a Government Interoperability Framework comprised of capability dimensions and three interoperability maturity levels. They also suggest two approaches to apply the framework, either focusing on a specific policy domain or level of government or focusing on a specific initiative.	x	x	x	x	x	x
19	Pardo et al., 2012	E-Government Interoperability: Interaction of policy, management, and technology dimensions	Narrative literature review	Draws on previous theories and research in different fields, to propose a framework of e-government interoperability capabilities, composed of 16 dimensions or categories.	x	x	x	x	x	x
20	Rhazale and Bounabat, 2018	A review of the government information systems of organisational interoperability	Literature review and comparison.	It reviews different approaches to address organisational interoperability, it compares them, highlighting common aspects and common flaws.		x	x	x	x	x
21	Rico-Pinto and Sanchez-Torres, 2018	Characterization of G2G interoperability factors	Systematic literature review	It collects and categorises a set of 25 factors that may influence G2G-IOP, positively or negatively depending on the context.		x	x	x		
22	Scholl and Klischewski, 2007	E-Government integration and interoperability: Framing the research agenda	Narrative literature review	Develop and suggest a research framework to guide further lines of inquiry in the field of e-government integration and interoperability, particularly regarding its purposes, limitations, processes and outcomes.		x	x	x	x	x

#	Authors/Year	Title	Methods	Summary of content	Dynamic Capabilities	Organisational interoperability	Public sector	e-Government	Knowledge sharing	Knowledge resources
23	Sharma and Panigrahi, 2015	Developing a roadmap for planning and implementation of interoperability capability in e-government	Phenomenographic interpretative approach	It identifies a roadmap for uniform implementation of interoperability capability in e-government, validated for the case of India.	x	x	x	x	x	
24	Sta, 2018	Organisational structure for the e-government coordination and interoperability framework: a case study of Tunisia	Case study of Tunisia	It describes the case study under research and the processes by which the organisations agreed to interact with each other. It suggests a possible institutional framework for e-government development in Tunisia and describes its organisational set-up.		x	x	x		x
25	Tripathi et al., 2013	Effect of organisational factors on interoperability adoption for Indian portals	Questionnaire from 300 portals of Indian government departments	It focuses on improving the level of interoperability in Indian government portals and provides insights on organisational factors that may affect it. They suggest a framework to help government officials deal with these factors.		x	x	x	x	
26	Valdes et al., 2008	Identifying relevant national e-government implementations for an emerging country: A selective survey	Quantitative – Survey over a sample of ten countries	Identified best practices concerning national interoperability frameworks, enterprise architecture frameworks and reference models, identifying goals and strategies behind them.		x	x	x		
27	Vernadat, 2010	Technical, semantic and organisational issues of enterprise interoperability and networking	Narrative literature review	Based on the 2010 EIF the paper discusses aspects of enterprise interoperability at the different layers and reveals open issues that have not been properly addressed, specially in international contexts.		x	x	x	x	

#	Authors/Year	Title	Methods	Summary of content	Dynamic Capabilities	Organisational interoperability	Public sector	e-Government	Knowledge sharing	Knowledge resources
Dynamic capabilities literature										
1	Barney, 1991	Firm Resources and Sustained Competitive Advantage	Narrative literature review	Defines key concepts used by the Resource Based View and suggests a framework of attributes to assess resources as sources of competitive advantage.	x		x	x		x
2	Denford, 2013	Building knowledge: developing a knowledge-based dynamic capabilities typology	Systematic literature review	Identifies uses and frameworks of knowledge-based dynamic capabilities and suggests an integrated typology of eight knowledge-based dynamic capabilities.	x				x	x
3	Eisenhardt and Martin, 2000	Dynamic capabilities: What are they?	Narrative literature review	Explores the characteristics and RBV-roots of dynamic capabilities as a construct, in order to conclude with a more theoretically valid and empirically accurate definition.	x		x	x		x
4	Ferreira et al., 2020	Dynamic capabilities, creativity and innovation capability and their impact on competitive advantage and firm performance: The moderating role of entrepreneurial orientation	Survey of 387 enterprises in Portugal	It researches to what extent dynamic capabilities affect performance and how the entrepreneurial orientation acts as a moderator in this relation. They show that dynamic capabilities have an indirect effect on performance of firms by enhancing their creativity and innovativeness.	x		x	x		x
5	Grant, 1996	Prospering in Dynamically-Competitive Environments: Organizational Capability as Knowledge Integration	Narrative literature review	It argues in favour of knowledge as the most strategically relevant resource for organisational performance and develops a knowledge-based theory of organisational capability, based on the knowledge-based view.	x				x	x

#	Authors/Year	Title	Methods	Summary of content	Dynamic Capabilities	Organisational interoperability	Public sector	e-Government	Knowledge sharing	Knowledge resources
6	Gupta et al., 2017	Towards a capabilities approach to smart city management	Systematic literature review	It identifies dynamic, cultural, operational and management capabilities of smart city management, as a framework that should help understand how city-level decision makers reconfigure their resources and processes.	x		x	x	x	x
7	Helfat and Peteraf, 2003	The dynamic resource-based view: capability lifecycles	Narrative literature review	Introduces the concept of capability lifecycle (CLC) which aims to explain in a structured manner the evolution (founding, development, and maturity) of organizational capabilities.	x		x		x	x
8	Helfat and Peteraf, 2009	Understanding dynamic capabilities: progress along a developmental path.	Narrative literature review	Reviews the development of dynamic capabilities research, addressing its theoretical basis, as well as its main critiques.	x				x	x
9	Hung et al., 2010	Dynamic capability: Impact of process alignment and organisational learning culture on performance	Systematic literature review	It proposes a framework of digital transformation articulated across eight building blocks and proposes three lines for a future research agenda, one of which involves examining the role of dynamic capabilities in digital transformation.	x				x	x
10	Kattel and Mazzucato, 2018	Mission-oriented innovation policy and dynamic capabilities in the public sector	Narrative literature review	Provides a historical overview of mission-oriented policies. It argues the need for a new generation of innovation policies that can tackle the so-called ‘grand societal challenges’ and presents the key public sector dynamic capabilities that are required.	x					
11	Kattel et al., 2019	Innovation bureaucracies: How agile stability creates the entrepreneurial state.	Narrative literature review	Define the concept of an entrepreneurial state, meaning states characterised by innovation bureaucracies or, in other words, configurations of public organisations that are capable of being agile while also maintaining stability.	x		x	x		x

#	Authors/Year	Title	Methods	Summary of content	Dynamic Capabilities	Organisational interoperability	Public sector	e-Government	Knowledge sharing	Knowledge resources
12	Kattel, 2015	What would Max Weber say about Public Sector Innovation?	Narrative literature review	Gives an overview of contemporary definitions of public sector innovation and contrasts them with classical definitions of innovation (by Tocqueville, Weber, and Schumpeter). Highlights aspects to recover from classical definitions.	x		x	x		
13	Klievink and Janssen, 2009	Realizing joined-up government – Dynamic capabilities and stage models for transformation	Qualitative – Interviews with security agencies in the Netherlands and session with 30 government strategists.	Develop and validate a five-stage model to achieve a joined-up government, that considers the dynamic capabilities needed for realising each stage.	x		x	x	x	
14	Luna-Reyes et al., 2020	Exploring the relationships between dynamic capabilities and IT-governance: Implications for local governments	Grounded theory based on three workshops involving 34 CIOs from Mexican municipalities	It contributes insights on how IT governance principles enhance innovative capabilities in the public sector and argues how contextual factors may affect this correlation.	x		x	x	x	x
16	Mazzucato et al., 2020	Challenge-driven innovation policy: Towards a new policy toolkit	Narrative literature review	Discusses how states can provide direction for growth based on innovation so that investments are made on solutions that tackle the desired societal goals (e.g., SDGs). They suggest a policy framework ("ROAR").	x		x	x	x	
17	Mergel, 2016	Agile innovation management in government: A research agenda	Process tracing approach and interviews with practitioners	It researches the extent to which existing policies are implementing agile innovation management approaches and the characteristics of this implementation. It also suggests a research framework with suggested lines for future research in the field of agile innovation in government.	x		x	x		x

#	Authors/Year	Title	Methods	Summary of content	Dynamic Capabilities	Organisational interoperability	Public sector	e-Government	Knowledge sharing	Knowledge resources
18	Nelson and Winter, 2002	Evolutionary theorizing in economics	Narrative literature review with anecdotical cases	Reviews the history and characteristics of economic evolutionary theory, highlighting its recent renaissance and how it has led to two different interdisciplinary strands of research, one of which is dynamic capabilities.	x				x	x
19	Pablo et al., 2007	Identifying, enabling, and managing dynamic capabilities in the public sector	Grounded theory based on observations, 75 semi-structured interviews, and archival research.	Exploration in-depth of a public organisation that showed a strategic approach based on a dynamic capability (i.e., learning through experimenting).	x		x	x	x	x
20	Pedersen, 2017	Transforming government service: The importance of dynamic capabilities	Literature review and multiple case study.	It compares a successful and a less successful case of e-government by identifying the differences between them in terms of dynamic capabilities. It uses the categories of dynamic capabilities suggested by Klievink and Janssen (2009).	x		x	x	x	
21	Piening, 2013	Dynamic capabilities in public organisations: A literature review and research agenda	Systematic literature review	It reviews and synthesises the existent literature on dynamic capabilities theory applied to public sector organisations. It suggests an analytical model consistent of antecedents, microfoundations and effects of dynamic capabilities in public organisations.	x		x		x	x
22	Teece et al., 1997	Dynamic capabilities and strategic management	Narrative literature review	Presents the dynamic capabilities framework and defines its main components.	x		x	x		x
23	Teece, 2007	Explicating dynamic capabilities: The nature and micro foundations of (sustainable) enterprise performance.	Narrative literature review	Explains the micro foundations of dynamic capabilities.	x		x		x	x

#	Authors/Year	Title	Methods	Summary of content	Dynamic Capabilities	Organisational interoperability	Public sector	e-Government	Knowledge sharing	Knowledge resources
24	Teece, 2016	Dynamic capabilities and entrepreneurial management in large organizations: towards a theory of the (entrepreneurial) firm.	Narrative literature review	Explains firm heterogeneity and the role of individuals within firms, focusing on the economic, entrepreneurial, and leadership role managers play in a firm's resource allocation under uncertain environments.	x		x	x		
25	Teece, 2018	Business models and dynamic capabilities	Narrative literature review	Explores the interdependencies existent between business models, strategy, and a firm's organizational design.	x				x	x
26	Verona and Ravasi, 2003	Unbundling dynamic capabilities: an exploratory study of continuous product innovation	Case study	Realizes an in-depth analysis of a company in the hearing-aid industry and suggests three categories for dynamic capabilities based on knowledge resources and processes: knowledge creation, knowledge integration, and knowledge reconfiguration.	x				x	x
27	Vial, 2019	Understanding digital transformation: A review and research agenda	Systematic literature review	Proposes a framework of digital transformation composed by eight building blocks and a research agenda highlighting the need of exploring the role of dynamic capabilities on digital transformation.	x		x	x	x	
28	Zahra and George, 2002	Absorptive Capacity: A Review, Reconceptualization, and Extension	Narrative literature review	Identifies dimensions of the absorptive capacity (ACAP) and propose a reconceptualization of ACAP as a dynamic capability in which they distinguish between potential and realised capacity.	x				x	x
29	Zheng et al., 2011	Knowledge-based dynamic capabilities and innovation in networked environments	Survey of 218 Chinese manufacturing firms	Clarifies the categories of knowledge-based dynamic capabilities and explores their relation to innovation performance in networked environments.	x				x	x
30	Zollo and Winter, 2002	Deliberate learning and the evolution of dynamic capabilities	Narrative literature review	Investigates how organisations develop dynamic capabilities, i.e., the learning mechanisms of experience accumulation, knowledge articulation, and knowledge codification.	x				x	x

B Interview outline

This is an interview provided under the framework of Isidora González Rios Master thesis research, for the programme on public sector innovation and e-governance coordinated by the consortium of universities KU Leuven, Munster University and TalTech. The interview should take approximately 30-45' of your time. Thank you very much for your contribution.

If allowed by the interviewee, the audio of the conversation shall be recorded, only for the personal use of the researcher, and not to be divulged or publicly shared. If requested by the interviewee, the interview can be kept anonymous. The comments provided by the interviewee shall be paraphrased by the author of the research and, in case of requiring any direct quotation, the interviewee shall be consulted first for authorisation.

Introduction

1. Could you please introduce yourself, explain your role within the Interoperability Academy project team and tell me since when have you been working in the team? Do you agree to have your name and position disclosed in this thesis?

2. Could you summarise what is the main objective of the Interoperability Academy and at what stage are you in fulfilling that objective?

3. Knowledge interoperability has been defined by literature as a sub-layer of organisational interoperability, referred to the development of compatibilities in terms of skills and knowledge between organisations. Do you think this concept applies to your mission as Interoperability Academy? Why?

4. Could you identify the main stakeholders that you work with and to whom are you orienting most of your training resources and courses?

Knowledge interoperability factors

5. How would you say that the following factors influence the Interoperability Academy's everyday work and mission? Is any of these more important than the others? How do you address the most challenging ones?

- The alignment of strategic interests and goals of different stakeholders

- The knowledge management practices and capacities of public administrations

- The different cultures and traditions of public administrations

- The alignment of legal frameworks

- The different skills and competencies of public servants

- The alignment of processes between heterogeneous organisations

- The alignment of data semantics and formats between heterogeneous organisations

7. Are there any other factors that influence the Interoperability Academy's everyday work and mission?

Knowledge-based dynamic capabilities

8. How do you define priorities for training public servants? Do you have forecasting mechanisms in place? How do you define which knowledge to create or acquire from other sources?

9. What actions are implemented that allow the Interoperability Academy to adapt your training to your user's needs? Do you combine different sources of knowledge?

10. What actions are implemented that allow the Interoperability Academy to adapt and improve your training resources in response to changes in your political, social and technological environment?

11. What actions are implemented that allow the Interoperability Academy to assess the impact of your training resources and courses? Do these assessments impact on the way you define your curriculum?

12. What actions are implemented to ensure the Interoperability Academy is sustainable and agile?

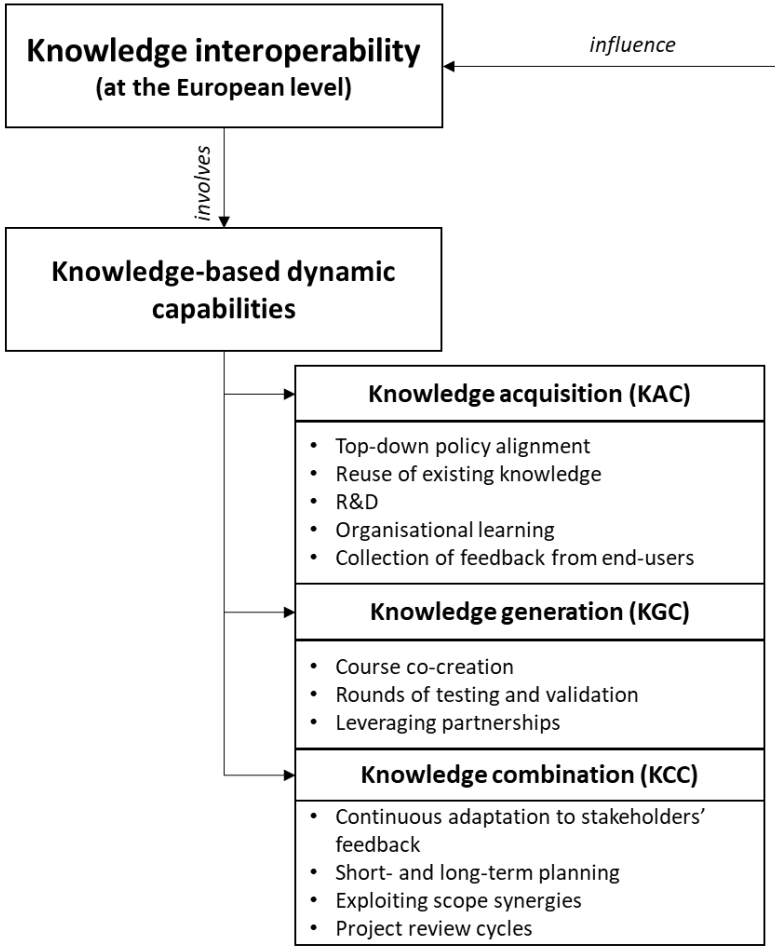
Closure

13. Is there anything you would like to add?

C Codebook

Code	(Stipulative) definitions	N°
Factor – Strategic	Alignment of strategic goals between different stakeholders. Political and managerial commitment (including financial support and leadership). Definition of decision-making schemes, conflict resolution mechanisms and instruments to assign and monitor the fulfilment of responsibilities.	9
Factor – Knowledge management	Management of knowledge resources. Management of intellectual property. State of revision of skills and competencies. Level of formalisation of internal processes. Availability of organisational learning mechanisms.	4
Factor – Cultural	Organisational cultures. Public administration traditions. Language barriers.	5
Factor – Legal	Harmonization of legislation and regulations that apply to the different organisations. Compatibility of security and privacy requirements for data and knowledge exchange.	3
Factor – Human resources	Skills and competences of human resources involved. Skills to create, share and use knowledge. Skills in information and communication technologies. Skills in project management. Attitudes towards sharing knowledge and abiding agreements.	11
Factor – Processes	Alignment of internal processes from different organisations. Compatibility of organisational structures, protocols, and work methods.	6
Factor – Data	Organisations' ability to share data for a common use. Compatibility of data formats, semantics, ontologies, databases' management systems and communication channels.	2
Factor – Other	Undefined	6
Dynamic capability – KAC	Ability of an organisation to sense and acquire useful external knowledge, implying the processes of searching and strategic sense-making (Zheng et al., 2011).	18
Dynamic capability – KGC	Ability of an organisation to refine processes to create new knowledge (Zheng et al., 2011).	15
Dynamic capability – KCC	Ability of an organisation to integrate, old and new, knowledge from different sources and to experiment new applications (Zheng et al., 2011),	12

D Overview of results



FACTORS	ENABLERS	CHALLENGES
Strategic	• Supporting policy frameworks • Strategic goals alignment between different stakeholders • Availability of collaborative partnerships	• Changes in policy framework • Financial constraints • Complex distribution of responsibilities
Knowledge management	• Open-source knowledge resources • Sufficiently formalised knowledge resources • Co-creation of knowledge resources	• Dependency on external contractors • Unwillingness to share knowledge
Cultural	• Cultural awareness and openness • Multilingualism	• Public servant's language skills • Public administration's linguistic identities.
Legal	• Open-source licences • Common data protection regulation	[None]
Human resources	• Standardised learner profiles and learning paths • Common framework of interoperability skills and competences for public servants • Common interoperability curriculum	• Diverse skills and knowledge requirements from users (learners and course owners) • Lack of awareness of the value of interoperability • Lack of engagement on interoperability e-learning activities
Process	• Standardised roadmap for knowledge sharing	• Diverse organisational structures within public administrations
Data	[None]	[None]
Technology	• Close collaboration with platform developers • Visibility as a one-stop digital portal for e-learning on interoperability	• Misalignments in scope, timelines and target audience between teams • Platform design limitations

*Highlighted with darker background are factors with higher relevance.