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Exploring complex matters at the ESS

Creating a Big Science actor
through a legitimising process

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Abstract

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Large-scale infrastructure projects are interwoven into society. Realising these types of projects from their inception towards materialising them are complex feats, involving several actors and interests. This study looks at the legitimising process for creating a Big Science actor in a business network. Creating a Big Science actor requires mobilising resources from a multitude of different types of actors over time, embedding them into a network surrounding the focal actor being created.

The purpose of this study is to analyse the process of creating an actor from idea towards reality in an interorganisational context. To fulfil this purpose, the theoretical chapter draws on the business network approach to develop a model for realising a large-scale endeavour in an interorganisational context involving science, political, and business actors. The model comprises three concepts including mobilising, embedding as well as legitimising refined into technological, sociopolitical, and economic legitimising. Interplay between pairs of concepts include dimensions involving proposed benefits, framing, path dependency, fit, overlapping networks, and emerging context that deepen the model.

This abductively derived model is used to analyse the process of creating an actor. Drawing on insights from systematic combining and a qualitative research strategy, the thesis uses an in-depth single case study to conduct phenomenon-driven research that looks at the process of legitimising the European Spallation Source (ESS). The ESS is an emerging Big Science actor that gradually appeared on the fields outside the Swedish university town Lund, through a legitimising process starting in the mid-1980s as an idea.

The originality of this study introduces a processual model of realising a large-scale endeavour in an interorganisational context in which each phase is viewed as a layer added upon layers involving idea, investment, and actor that includes idea-generating inside a community, broadening and financing as well as materialising. The study also hones the concept of legitimising, complementing IMP scholarship already addressing the concept to shed light on technological, sociopolitical, and economic legitimising. It is concluded that legitimising is an interactive network process in which the actor being created make internal changes to satisfy external interests.

Keywords: business network approach, interorganisational interaction, legitimacy, legitimising, embedding, mobilising, Big Science, process

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1 Introduction

Throughout human history we have endeavoured to push the boundaries by exploring the unknown. Today there is a strand of society exploring the unknown known as Big Science, spearheading scientific exploration within the natural sciences. This thesis tells a story of realising a Big Science endeavour, from inception towards materialising a facility that in the future should enable scientific breakthroughs using neutrons. To accomplish such feats, actors in networks come together by mobilising resources (Håkansson & Snehota, 1995). Realising a large-scale Big Science endeavour is characterised by vast time spans and huge investments that put these facilities in a multi-billion investment category. By being required to include a number of different types of actors, these endeavours also become a matter of satisfying a host of varying interests involving technological, sociopolitical, and economic legitimising. In short, creating a Big Science actor is a complex matter, as different types of actors coalescing towards the joint purpose of realising Big Science is neither simple nor straightforward.

1.1 Big Science

Following the big discovery of the tiny neutron, James Chadwick received the Nobel Prize for Physics in 1935. At the same time, in and around the 1940s, it started becoming increasingly clear that discoveries within the natural sciences would depend on collective effort involving multiple actors to build big scientific facilities. Enquiring into the nature of Big Science depends on whom you ask. The concept of Big Science became widespread in the 1960s, referring to scientific research that needs big investments, big laboratories, big machines, and many people involved (see e.g. de Solla Price, 1963; 1986). Cramer et al. (2020, p. 8) argue that since then the concept has evolved and become “associated with all kinds of things”. For example, additions nowadays also include big impact (Williams & Mauduit, 2020) and big politics.

Most Big Science facilities in Europe are located in Germany, France, or the UK, including but not limited to neutron research facilities. These facilities constitute part of a group of Big Science organisations spread across the

world. This group can be conceived as a fairly tight-knit scientific community moving between facilities, also involved in matters concerning the establishment of new Big Science facilities. They may not know exactly how to realise and materialise these endeavours, but they most certainly know that building Big Science is possible, leaning on the latest achievements in science and technology.

In the second half of the 20th century, two prominent neutron sources emerged in Europe, the Institut Laue-Langevin and the ISIS Neutron and Muon Source. The Institut Laue-Langevin was founded in France in 1967 (ILL, 2026). According to an interviewee, the Institut Laue-Langevin is currently the best-functioning neutron facility in the world. The ISIS Neutron and Muon Source was established in the UK in 1984 (ISIS, 2026), and was later inaugurated in 1985 (Larsson, 2019, p. 98), as the world's most powerful neutron spallation source at the time (Kaiserfeld, 2013, p. 29).

Andersen and Carlile (2016) illustrate how the time needed to realise Big Science facilities has significantly increased. For the Institut Laue-Langevin, it took approximately ten years from proposed idea to realising the facility, and for the ISIS Neutron and Muon Source between fifteen and twenty years. And it will take even longer for more recent additions to the stock of Big Science neutron facilities. As one of the authors of the aforementioned paper states; “[s]o you’ve got to the point now when 70 years after the end of the war it’s taking fifty years to build a project. A lifetime. Whereas in the 1960s it was taking ten years, same kind of project” (Interview Carlile). These expanding timelines can be attributed to increasing project complexity involving, for example, more advanced technology, facilities, and arrangements regarding funding.

As the world slowly moves towards an unknown future, times are changing as various matters have started seeping into Big Science. One such matter concerns the proposed benefits of these facilities as legitimate reasons for different types of actors to spend significant amounts of money, time, and effort on Big Science. These reasons range from a possible monetary return on investment for host and member countries as well as technology transfer to industry and society, to reasons regarding international cooperation between countries, and so on. On one hand, Big Science is purely about science; on the other hand, it is connected to wider society and societal issues.

Rüffin’s (2020, pp. 28–30) summary of Big Science literature spanning several disciplines, such as sociology and political science, found a total of 152 publications, of which roughly 60 address Big Science at European facilities. Over the past two decades, a lot of literature has emerged exploring the socioeconomic effects of Big Science facilities (Håkanson & Kokko, 2022, p.

15). Although Big Science is essentially a scientific pursuit, pursuing it demands more than a good science case; since multiple actors and resources must be mobilised to bring ideas to fruition, interorganisational matters concerning legitimising are foregrounded in realising these facilities. As we shall explore throughout this thesis, the tiny neutron has sparked big interest on the part of a variety of actors to involve themselves in realising Big Science projects.

1.2 Realising a Big Science project

Gazing over the fields of Brunnsög just outside the Swedish university town of Lund, there have been several buildings emerging adjacent to the E22 motorway. This area is gradually transforming into a Big Science facility, representing the biggest research investment that Sweden has ever undertaken (Håkanson & Kokko, 2022, p. 12); the European Spallation Source, also known as the ESS¹. Once finalised, the ESS is envisioned to become the world's most powerful neutron source (ESS, 2021a). The ESS is a relatively recent addition to the stock of Big Science, although discussions of the idea of constructing a facility akin to the ESS were initiated approximately four decades ago. Even though it is now possible to see large stretches of farmland being turned into this large-scale science facility, it has been a long and winding road to reach this stage. Actors in and around an emerging ESS-network become salient in different parts of the process. Throughout this lengthy process, multiple actors each add a piece to the puzzle, including diverse resources such as scientific expertise, technological competence, and money as well as other tangible and intangible resources ranging from know-how to material such as stainless steel or heat-resistant plastics. In realising this huge endeavour, moving from idea towards reality, one of the main drivers throughout the process requires mobilising various different types of actors on this journey by way of legitimising the endeavour.

Seeds for a European spallation source were planted as an idea growing amongst scientists observing a need and sharing a willingness to pursue a next-generation spallation source. The idea of a facility akin to the ESS started gaining traction and legitimacy inside the science community as a desirable way to move forward in neutron research. However, actors involved in generating the idea of a European spallation source stumbled upon a lack of sufficient political support for realising the idea. In due time, it dawned upon actors shepherding the ESS that political support was required to move forward. As

¹ From hereon I use the acronym "ESS" to refer to the European Spallation Source.

such, additional actors had to be incentivised to onboard the ESS journey. What followed was a period of considerable interorganisational interaction, including international, national, and regional political actors as well as other actors. Gradually the idea of the ESS was anchored as a desirable pursuit inside the political sphere by legitimising the ESS as an investment. And eventually the story reaches a climax as there was sufficient agreement amongst relevant actors that Lund is a suitable location for building the ESS. Following a decision to build the ESS in Lund, interorganisational matters continued to expand. Alongside pre-existing actors, a new set of actors, i.e., business actors, emerged, including a wide range of suppliers that control resources required for constructing the facility, including various parts such as its instruments, target, and accelerator.

As a type of factory that uses an accelerator and a target to produce neutrons, the core of the ESS itself interests some actors but not others. However, there are additional aspects connected to the ESS, comprising part of why actors connect to the ESS so as to satisfy their interests. Alongside scientific exploration, these huge investments spark actors' imagination concerning reaping a variety of benefits involved in realising Big Science. What Big Science, and the ESS, is or will become is a matter of perspective. From one perspective, what is envisioned for the ESS is a factory for producing neutrons, using an accelerator and a target. Dismantling the various building blocks by zooming in, it consists of material such as steel and concrete, or even particles. Zooming out, the ESS will comprise several buildings, a campus. Zooming out even further, the ESS is, at the same time, different things for different actors. For a non-science actor, it is not necessarily the ESS as a factory for producing neutrons that piques interest. Rather, actors connect their interests to proposed benefits involved in a process of realising a Big Science facility and thereby become embedded in an emerging and growing ESS-network.

1.3 Theoretical approach

Following the discovery of the tiny neutron almost a century ago, there is today a Big Science community, including vast numbers of actors and interests. In this study, a business network approach (Håkansson & Snehota, 1995) enables us to make sense of the case for creating a Big Science actor, complemented by incorporating the concept of legitimising.

1.3.1 Network

This thesis adopts a network approach, thereby “viewing relationships as part of a broader network structure, rather than as isolated entities” (Håkansson & Snehota, 1995, p. 3). Using a network approach involves fundamental aspects such as recognising interdependencies between actors and connectedness amongst actors (Håkansson & Snehota, 1995) as well as viewing reality as dynamic (Bengtson, Lind & Pahlberg, 2020). As Ford and Håkansson (2006a, pp. 12–13) exclaimed, “[i]t is a case of movements within a moving world!” Ford and Håkansson (2006b) point out that processes between organisations cannot be completely controlled by any single actor, as all actors in the network are active and purposeful, so any action undertaken by a single actor is affected by how the counterpart perceives and reacts to said action. Furthermore, Hermes and Mainela (2022) drive an argument suggesting that legitimation is a dynamic phenomenon that can potentially entail changes to the network.

Interaction is affected by influences from the actor’s other interactions as well as from interactions elsewhere in the network (Ford & Håkansson, 2006a). In this approach, it is also argued that business actors are heterogeneous and particular (Ford & Håkansson, 2006b). Ultimately, realising the ESS requires mobilising many different actors, embedding them into an ESS-network. However, these actors operate in different contexts and have varying interests as well as expectations of what is legitimate. A few previous studies have touched upon ways to mobilise different types of actors (e.g. Ritvala & Salmi, 2010). At the same time, Mehtälä et al. (2025) point out that processes that stimulate and mobilise collective engagement are still insufficiently understood. Understanding this process is important because, to achieve their goals, actors need to mobilise and receive support from other actors in the network (Håkansson & Snehota, 1995).

The nature of an actor

An actor is characterised by controlling resources and performing activities (Håkansson & Snehota, 1995). Nowadays it is widely recognised in research using the network approach that many different types of actors can be included, such as political actors (e.g. governments), science actors (e.g. universities and Big Science), and other miscellaneous actors such as the media, and more². Realising Big Science in a network setting can be viewed as a case

² See e.g. Welch & Wilkinson, 2004; Hadjikhani & Thilenius, 2009; Gebert Persson, Lundberg & Andresen, 2011; Åberg, 2013; Hermes & Mainela, 2014; Ljung, 2014; Åberg & Bengtson, 2015; Leite & Bengtson, 2018; Hadjikhani, Leite & Pahlberg, 2019; Landqvist & Lind, 2019; Leite, 2022; Bengtson, Casales Morici & Lindholm, 2022; Andersen, Åberg & Bujac, 2023.

involving vast amounts of different types of actors working towards the joint task of creating a new Big Science actor. Generally, it is presumed that various types of actors have different interests. The notion of spheres captures that there are elements inside each sphere that connect the different actors that belong to them. For Big Science, serving scientific and societal interests become their aim (Andersen & Åberg, 2017). Political actors, in general terms, pursue endeavours that are beneficial for the public. Political actors differ (e.g. Welch & Wilkinson, 2004) depending on whether they are municipal, regional, or national actors, such as governments, and so on. One way to understand the role of political actors in the network is by acknowledging that they can command economic resources (Welch & Wilkinson, 2004). Furthermore, legitimacy can be achieved for political actors showing economic gains by interacting with business actors (Hadjikhani, Leite & Pahlberg, 2019). Business actors become interesting in the Big Science context since they, on one hand, are crucial as suppliers in building these facilities; on the other hand, in doing so, business actors enable benefits for political actors. Business actors include companies that interact with the ESS, mainly as suppliers. These actors come in all shapes and sizes, ranging from big companies to a number of smaller companies in different industries delivering a variety of products and services.

Different actors take centre stage at different points in time throughout the process of realising the ESS, moving from idea towards reality. Since the ESS requires extensive public funding, it is vital to persuade political actors to fund the endeavour. To build the ESS and its accompanying scientific instruments, they need to rely on business actors. And if they want anybody to actually use the ESS, they have to satisfy science actors to attract users from the scientific community. As this network is heterogeneous, it becomes an issue as actors have different goals as well as possibly conflicting interests (Hermes & Mainela, 2014). Actors belong to various types of systems that have different legitimate grounds (Hadjikhani et al., 2019).

1.3.2 Legitimising

Previous scholars have claimed that there is a need for better theoretical tools with which to understand the interaction between business and non-business actors (Pittaway et al., 2004; Mahoney, McGahan & Pitelis, 2009). Pittaway et al. (2004) and Mahoney, McGahan, and Pitelis (2009) published their reasoning a while ago, prompting scholars to address the matter, although much remains unknown. My study intends to continue expanding the horizon of the business network approach (Thilenius et al., 2016) by participating in discussions that conduct research involving actors from different spheres of society (see e.g. Leite & Bengtson, 2018; Andersen, Åberg & Bujac, 2023). As such,

new terms and concepts emerge, including legitimacy (see e.g. Gebert-Persson & Káptalan-Nagy, 2016).

Legitimacy can be broadly defined as “a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions” (Suchman, 1995, p. 574). Paraphrasing, Kumar and Das (2007, p. 1426) stated that “[a]n organization is said to garner legitimacy if it meets the expectations of its key constituencies in the environment (Suchman, 1995)”.³ Exploring legitimising in a process of realising Big Science is relevant because actors operating in different contexts have varying views of what they deem desirable, proper, or appropriate.

In other streams of literature there has long been the claim that actors require legitimacy to survive. Actors, as they are conceptualised in the network approach, involving interaction with concrete counterparts, also require legitimacy for survival. Kumar and Das (2007, p. 1433) argue that “[t]he quest for legitimacy is motivated by the fundamental need of all actors to garner support from their constituencies”. For a public investment such as the ESS, legitimising is arguably even more pressing than for a company using other sources of funding, such as its own profit. Pragmatic legitimacy “rests on the self-interested calculations of an organization’s most immediate audiences” (Suchman, 1995, p. 578). Interpreted by Kumar and Das (2007, p. 1434), “[p]ragmatic legitimacy occurs when the organization satisfies the interests of its members”. As this thesis will show, a network surrounding the ESS involves a number of counterparts harbouring various interests.

In contrasting legitimacy-as-process to legitimacy-as-property⁴, Suddaby, Bitektine, and Haack (2017, p. 459) state that “legitimacy is not assumed to be a stable condition, but rather is actively and continually negotiated”. During the several-decade time span of the ESS project, involving different types of actors, legitimising in a network over time is relevant. Eloquently formulated as “no organization being able to rest on its laurels”, Kumar and Das (2007, p. 1430) state that the literature concerning legitimacy suggests that it is an ongoing activity, such as continuously being required to maintain legitimacy. Legitimising can be viewed as “a structured set or sets of formal or emergent activities that describe how an actor acquires affiliation with an existing social order or category” (Suddaby et al., 2017, p. 462). Taking the perspective of legitimacy as a process, legitimacy is an ongoing process that involves several participants⁵ (Suddaby et al., 2017).

³ A constituency, as phrased in the paper by Kumar and Das (2007), is similar to an actor counterpart in the business network approach.

⁴ The ‘standard’ way of discussing legitimacy.

⁵ These participants are essentially actors, as conceptualised in the business network approach.

Notwithstanding a few scholarly pieces, many papers in IMP⁶ mention but do not elaborate on legitimacy. There is arguably a lack of fleshing out the process of how legitimacy unfolds over time situated inside a business network approach. In essence, legitimacy as process is “generative, interactive, and dynamic” (Suddaby et al., 2017, p. 462). Conceptualised inside a network approach, pragmatic legitimising rests on satisfying the interests of a focal actor’s most immediate actor ties.

1.4 Purpose of the study

A large-scale Big Science endeavour requires a number of actors and their resources to realise a multi-billion idea in a process that is essentially a matter of creating an actor. Taking into account the extended time spans and multiple types of actors involved throughout the process of realising a Big Science endeavour;

The purpose of this study is to analyse the process of creating an actor from idea towards reality in an interorganisational context. To do so, I ask the following research question: How does the legitimising process for creating a Big Science actor unfold in a business network?

To dig deeper into the legitimising process of creating a Big Science actor, the research question is supported by processes involving mobilising and embedding. It is argued that legitimising expands to mobilise additional actors that subsequently become embedded in a growing network. As such, legitimising, mobilising, and embedding all work together, as well as in pairs. Actors are mobilised as they control crucial resources for realising Big Science, in which a legitimising process help accessing actors’ resources (Håkansson & Snehota, 1995; Suchman, 1995). This can be done via proposed benefits (Ritvala & Salmi, 2011; Hermes & Mainela, 2014) and framing (Fisher et al., 2017; Bengtson, Casales Morici & Lindholm, 2022) so as to satisfy counterparts’ interests (Kumar & Das, 2007). Proposed benefits involve pragmatic legitimising (Suchman, 1995; Kumar & Das, 2007; Gebert Persson, Lundberg & Andresen, 2011; Suddaby et al., 2017) as a way of mobilising counterparts. Framing refers to the presentation of how actors perceive an entity or issue (Fisher et al., 2017) whereby legitimising occurs by framing a problem and its subsequent solution to mobilise actors (Bengtson et al., 2022). As actors are mobilised, they become embedded in an expanding network. Embedding

⁶ The Industrial Marketing and Purchasing Group (IMP) was formed in the mid-1970s and is today an informal and international network of more than 400 researchers. Research in IMP applies a dynamic approach to economic exchange that is empirically driven looking at relationships and networks. For more information, visit <https://impgroup.org/>.

involves actors' relations with, and dependence on, different types of networks (Halinen & Törnroos, 1998). Ventures can garner legitimacy from earlier, helpful in subsequent stages involving other actors (Fisher, Kotha & Lahiri, 2016). Drawing on legitimacy as fitting together with an external environment (DiMaggio & Powell, 1983; Suddaby et al., 2017; Hermes & Mainela, 2022), it is reasoned that embedding by fitting together with an existing and changing whole entails legitimacy.

So what?

There is already ample research in the business network approach that invites different types of actors. Rich descriptions of the process studied in this thesis should be valuable for peers using the business network approach, especially those interested in continuing to expand its horizon (Thilenius et al., 2016); particularly research involving the concept of legitimising and the process of creating an actor. The relevance of this study concerns research on legitimising as process (Suddaby et al., 2017) in general, and specifically using a network approach (Håkansson & Snehota, 1995). The intention is to hone the concept of legitimising, thereby complementing current IMP scholarship already addressing the concept (see e.g. Gebert Persson, 2006; Gebert Persson et al., 2011; Hermes & Mainela, 2014; Gebert-Persson & Káptalan-Nagy, 2016). This entails a quest to reimagine analytical parts of the concept into three forms, including technological (Ruef & Scott, 1998), sociopolitical (Aldrich & Fiol, 1994), and economic (Vaara, 2014) legitimising. This diverges slightly from conventional categorisations of forms of legitimacy. However, the aforementioned conceptualisation of legitimising arguably makes a lot of sense in IMP research, particularly in this study, focusing on practical issues involved in legitimising an endeavour rather than areas such as how legitimacy judgements are made. This should be relevant to scholars interested in research settings involving different types of actors, diverse networks, and realising large-scale endeavours.

The relevance of this study likewise concerns understanding the process of creating an actor and realising large-scale endeavours. Notwithstanding merely Big Science, large-scale infrastructure projects are empirically relevant as they are interwoven into the fabric of society. They often involve multiple actors and interests, affect society on many levels, and cost enormous amounts of money (cf. Flyvbjerg, 2014). In essence, it makes sense from a societal viewpoint to shed additional light on the process of realising large-scale endeavours. However, while empirically important, it is also theoretically relevant as it helps us dig deeper into the process of creating an actor. Alongside activities and resources, actors are a key part of the business

network approach (e.g. Håkansson & Snehota, 1995), yet the process of creating an actor of this scale remains more or less unexplored, although a few scholars have regarded actor creation as new business development, albeit on a slightly smaller scale (cf. Baraldi et al., 2019; La Rocca et al., 2019; Landqvist & Lind, 2019; La Rocca & Snehota, 2021). Furthermore, the process of creating an actor helps flesh out the observation of Håkansson and Snehota (1995) that actors have distinct identities to different counterparts. By doing so, acknowledging that the essence of an entity may change over time, involving a mix of technological, sociopolitical, and economic legitimising, desirable and appropriate by way of satisfying the interests of different counterparts in a diverse network (cf. Suchman, 1995; Kumar & Das, 2007). Moreover, legitimising as an interactive network process involves the actor being created making internal changes to satisfy external interests.

1.5 Outline of the thesis

The remainder of my thesis proceeds as follows. Chapter 2 delineates the theoretical underpinnings of this study as situated inside a business network approach, focusing on literature concerning mobilising, embedding, and legitimising to develop an analytical model. The theoretical chapter has a particular focus on discussing how the concept of legitimising can be incorporated into the business network approach. Chapter 3 covers the study's methodology, including research design, gathering of empirical material, and reflections. Chapters 4 through 6 trace the process of realising the ESS from idea towards reality. As such, Chapter 4 tells a story about how the ESS emerge as an idea, moving gradually towards reality. Chapter 5 continues tracing the emergence of the ESS alongside an expanding interorganisational network surrounding the focal actor. Chapter 6 covers a subset of national suppliers that are part of enabling the physical materialisation of the facility. Chapter 7 then offers an analysis of the case, viewed through the lens of my analytical model. Chapter 8 presents the conclusions of this study, including theoretical contributions and practical considerations as well as suggestions for future research.

2 Theory

To understand how Big Science is realised from idea towards reality, I use the business network approach as a theoretical foundation. On this basis, I focus on interorganisational literature, shedding light on interaction between business and non-business actors as well as on the concepts of mobilising, embedding, and legitimising. This chapter showcases prior scholarly work from the IMP perspective to logically transition towards new horizons. The concept of legitimacy, and legitimising, is presented by elaborating a broader, albeit succinct, picture to give an unfamiliar audience a taste of the concept by introducing its theoretical palette.

2.1 Business network approach

The business network approach rests on several decades of research developed by IMP scholars. IMP began in 1976 as an international research project (Håkansson, 1982; Håkansson & Gadde, 2018). Håkansson and Waluszewski (2002, p. 13) point out that “the IMP network approach rests heavily on dealing with empirical material”. Industrial markets, as conceived by IMP scholars (Håkansson & Snehota, 1995), entail a quest to understand how business is organised in relationships and networks, often by an emphasis on vast case descriptions attempting to capture and describe the realities faced by companies. Indeed, this school of thought has traditionally been particularly interested in the empirical reality of what companies actually do (Mattsson & Johanson, 2006). Fundamental aspects involve viewing reality as dynamic (Bengtson et al., 2020) as well as recognising interdependencies between actors and connectedness amongst actors (Håkansson & Snehota, 1995). Möller and Halinen (2022) emphasise that scholars within this approach are drawn to complexity, whereby its models (e.g. the ARA-model) are tangible tools with which to understand a complex reality. In general, much of the IMP literature tends to emphasise descriptive research (LaPlaca & da Silva, 2016).

Håkansson and Snehota’s (1995) seminal work *Developing Relationships in Business Networks* builds a foundation on which IMP researchers can understand industrial markets. Håkansson and Snehota (1995, p. 3) adopt a

network approach, “viewing relationships as part of a broader network structure, rather than as isolated entities”. A single business relationship is interdependent on other relationships. In turn, this connectedness forms an aggregated structure, a form of organisation that the authors refer to as a “network” (Håkansson & Snehota, 1995, p. 19). Håkansson and Snehota (1995) argue that this “form of organization is peculiar because it does not have a centre, nor does it have clear boundaries” (p. 19), and is dynamic over time (p. 21). The business network approach rests on interdependencies and connectedness, more eloquently expressed as “no business is an island” (Håkansson & Snehota, 1989). This creates so-called chain and net dependencies of (indirectly) connected actors, such as a supplier’s supplier (Håkansson & Snehota, 1995, p. 19).

Interaction is a major part of a company’s existence, and “[i]t is through interaction that a company exists and develops” (Håkansson & Waluszewski, 2002, p. 14). Interaction implies adaptation and mutual commitment (Håkansson & Snehota, 2017, p. 12). According to the business network approach, relationships help to create something jointly that cannot be achieved individually by a single actor (Håkansson & Snehota, 1995, p. 25). A key reason to interact with other actors is to perform activities as well as utilise resources, which may not be possible independently but only interdependently (Håkansson & Snehota, 1995, p. 37). Furthermore, interaction in the network can be viewed as a process that involves resources from distant parts of the network rather than being confined to a small set of actors, such as dyads or triads (Ford & Håkansson, 2006a). According to Ford and Håkansson (2006a), interaction is influenced by an actor’s other interactions, including those elsewhere in the network. The relationship depends on more than the dyadic interaction as it also depends on how third parties, which are directly or indirectly connected to the actors, have been and will be acting (Håkansson & Snehota, 1995, p. 41). Essentially, the assumption of a network (comprising relationships) means that there are ripple effects in the network, as what happens in one relationship affects other relationships, and what is happening in that specific relationship is affected by other relationships (Håkansson & Snehota, 1995, p. 20). These types of ripple effects coming from other distant actors, including third parties, can have significant effects on the relationship. Furthermore, a company, in itself, is both a source as well as recipient of ripple effects in the network (Håkansson & Snehota, 1995, p. 40).

As alluded to, relationships form a network, the parts making up the whole. Relationships are mutually oriented interactions occurring between a pair of reciprocally committed actors (Håkansson & Snehota, 1995, p. 25); over time, mutual commitment creates interdependencies between the actors in a process

of acts and counteracts. According to Håkansson and Snehota (1995, p. 25), “relationships are mutually demanding besides being mutually rewarding”. The authors argue that becoming mutually committed means giving as well as being given some priority. And each relationship offers benefits as well as costs (Håkansson & Snehota, 1995, p. 38).

Håkansson and Snehota (1995, p. 26) state that a way to categorise a relationship is its function (i.e. who is affected by the relationship) and the substance (i.e. what is affected). Although a number of academic fields and disciplines use the notion of a relationship, the beauty of the business network approach is how a relationship (arguably a very abstract phenomenon) can be conceptualised as a tangible substance comprising actor bonds, resource ties, and activity links. Regarding who is affected by the relationship (i.e. its function), this can be conceptualised as function for the company, dyad, or third parties (Håkansson & Snehota, 1995, p. 27).

The relationships that an actor has affect the organisation of the actor’s own enterprise (Håkansson & Snehota, 1995, p. 39). It is argued that the internal parts of the organisation are not entirely controllable by the organisation itself, as the internal structure is affected by (and affects) the various relationships (Ford & Håkansson, 2006b). Additionally, Ford and Håkansson (2006b, p. 254) point out that “[c]ompanies themselves are the outcome of their interactions”. Furthermore, concerning the whole set of relationships that the focal actor has, “[t]here are important synergies in some dimensions and contemporaneously important constraints in other dimensions” (Håkansson & Snehota, 1995, p. 39). The mix of actor, resource, and activity layers in one relationship influences the individual company’s other relationships as well as is affected by, and is influencing, connections to other third parties as part of a whole network (Håkansson & Snehota, 1995, p. 27).

A change anywhere within the network can have multiple reactions, including in a company, in relationships, or throughout the network, reactions that can be expected (wanted) and unexpected (Håkansson & Snehota, 1995, p. 45). An activity link is part of a broader network of activity links (activity pattern), a resource tie is part of a broader network of resource ties (resource constellation) that an actor can mobilise, and an actor bond is part of a broader network of actor bonds (actor web) (Håkansson & Snehota, 1995, p. 44). As such, resources are embedded in resource constellations and actors are embedded in actor webs.

An activity can be broadly defined as “a sequence of acts directed towards a purpose” (Håkansson & Snehota, 1995, p. 52). In their network view of public–private cooperation, Leite and Bengtson (2018, p. 182) synthesise prior literature, stating that “[i]t is commonly assumed that the reason for the

cooperation is the fact that the nature of the required activities cannot be achieved by any single organization, public or private". In terms of activity structures, Håkansson and Snehota (1995, p. 29) show ripple effects in the network quite clearly, since the "[a]ctivities of a sub-supplier can affect those of a supplier which will in turn have effects on those of a buying company which in turn is reflected in those of its customers". The network, on some level, works in terms of ripple effects by acknowledging that what happens in one part of the network has effects on other parts of the network.

Regarding resources, something becomes a resource due to its potential to be used to create value, in combination with other resources (e.g. Penrose, 1959; Håkansson & Waluszewski, 2002, p. 15; Bocconcelli et al., 2020). Succinctly put, Wagrell et al. (2022, p. 421), leaning on aforementioned references, state that "the services that resources provide are determined by how they are combined with other resources (Håkansson & Waluszewski, 2002; Penrose, 1959)". According to Ford and Håkansson (2006a, p. 11), "[r]esources are at the heart of interdependence". Every actor in a network is a provider and user of resources (Cantù, Corsaro & Snehota, 2012). Various actors hold different resources that are sought by other actors. Because there are limits to an actor's own resource collection, the actor becomes dependent on relationships (Ford & Håkansson, 2006b). Bengtson, Casales Morici, and Lindholm (2022, p. 341) point out that "networks are wider resource constellations that the firm can gain access to through its relationships". Tangible resources can include everything from steel and machinery to capital (i.e. money). Slightly more abstractly, Ford and Håkansson (2006b, p. 250) elaborate by stating that "[r]elationships are heavy with their own resources: physical; financial and technological, accumulated over time". One way of understanding business relationships is to acknowledge that there are expectations to gain access to tangible and/or intangible resources (Håkansson & Snehota, 1995, p. 30).

Actor bonds affect actors' identities, for example, influencing how one counterpart is perceived by others. For instance, "[b]eing seen as a 'close friend' to a company known as advanced or powerful helps in other relationships. The perceived identity thus affects the possibilities to act" (Håkansson & Snehota 1995, p. 32). The various relationships of a company in turn affect the resources (potentially) available, and ultimately what the company can do (Håkansson & Snehota, 1995, p. 31). Furthermore, the authors argue that relationships enable an actor to mobilise and access other parties' resources for its own purposes and advantage (Håkansson & Snehota, 1995, p. 31). That is, relationships enable different resources to be mobilised for others (Håkansson & Snehota, 1995, p. 137).

Regarding intangible resources, a relationship (with an actor) can be viewed as an organisational resource, including both strong and weak relationships (see e.g. Håkansson & Snehota, 1995; Håkansson & Waluszewski, 2002, p. 37; Landqvist & Lind, 2019). Relationships can incur “both opportunities and restrictions” (Håkansson & Waluszewski, 2002, p. 37). A relationship is a unique type of resource because it cannot be depleted; instead, using a relationship tends to enhance its value (Håkansson & Snehota, 1995, p. 138). Additionally, Ford and Håkansson (2006b) reason that neither party in a relationship owns, directs, or manages it. In that sense, a relationship is in a way different from other resources, as the relationship cannot be owned by one actor since it is jointly owned (Håkansson & Snehota, 1995, p. 138). Håkansson and Snehota (1995, p. 137) argue that “[n]ovel resource ties tend to emerge in relationships as new uses for resources are discovered and as new resources for actual purposes are developed”; which, if this line of reasoning is extended, could also be viewed as describing how relationships, as a resource, can take on new uses. Håkansson and Snehota (1995, p. 138) shed further light on the matter by reasoning that the value of a relationship is also dependent on its combination with other resources. Continuing to view the relationship as a resource, it is relevant to note that realising large-scale endeavours requires that multiple relationships with actors across different spheres of society be used, or combined, for purposes of realising the endeavour from idea to reality. Furthermore, these types of endeavours tend to be lengthy processes spanning several years. And as Ford and Håkansson (2006b, p. 250) point out, “[r]elationships require action and investment today, but offer the prospect of reward only at some time in the future”.

Zooming out, to the network function, Håkansson and Snehota (1995, p. 40) claim that a third party can react in different ways to change, stemming from another relationship in the network. Håkansson and Snehota (1995, p. 40) write that:

“Any relationship is because of its substance a constituent element of the wider network in which relationships are interconnected. Activity links, resource ties and actor bonds in a relationship are connected, directly or indirectly, to some others. The aggregated structure is an organized web of conscious and goal-seeking actors; it is also an organized pattern of activities as well as an organized constellation of resources.”

The network is sustained because some type of network logic is accepted by a sufficient amount of actors (Håkansson & Snehota, 1995, p. 40).

While greatly influential, an aspect of networks that is largely neglected, albeit hinted at, in Håkansson and Snehota’s (1995) book is non-business actors. Today, however, the story is slightly different. And as such, it seems

relevant to now already acknowledge two important dimensions of networks that was somewhat overlooked. First, there is nowadays a greater emphasis on non-business actors. Companies are interwoven in networks that include other equally important non-business actors (for further discussion, see 2.1.2 *Who is included in the business network?*). Second, non-business actors, similarly to business actors, command resources as well as perform activities (see e.g. Welch & Wilkinson, 2004). Furthermore, some non-business actors, such as governments, likewise handle issues concerning money and are arguably also affected by an economic logic of profit, albeit not necessarily in the same sense as companies are. In such a reality, slightly different perspectives or concepts become worthwhile to explore.

The business network approach, and its language, is eclectic owing to the complexity of industrial markets, which can be understood by incorporating social factors, for example, from other disciplines (Håkansson & Snehota, 1995, p. xiii). Transitioning from a purely business landscape towards a network comprising business and non-business actors, the language, or specifically constructs, used to describe an IMP-reality, must also expand to take into account the dynamics of such a network.

2.1.1 Dynamic interactions in networks

According to Håkansson and Snehota (1995, p. 271), a network is an inherently dynamic structure exhibiting continuous organising processes, and is therefore not a stable structure (cf. Huisman, 2021). Indeed, interactions and networks are dynamic, involving a process of constant change, all the time and everywhere. Hermes and Mainela (2014) point out that the business network approach enables a multi-actor analysis that is not merely restricted to firm level, but also incorporates a view on network dynamics. As an actor is moving closer towards one of its counterparts, the counterpart itself is also moving in relation to other third parties, which are in turn also moving (Ford & Håkansson, 2006a). As Ford and Håkansson (2006a, pp. 12–13) write, “[i]t is a case of movements within a moving world!” Or, slightly more specifically, as per Bengtson, Casales Morici, and Lindholm (2022, p. 341), the network “is dynamic by nature due to the continuous adjustments being made to the relationships among the involved businesses”.

In an interactive view, everything is connected. An action is neither isolated nor independent (Ford & Håkansson, 2006b). A world of interaction means that actors must accept dependence on other actors in order to solve their ‘problems’; conversely, the actor’s counterparts develop dependence in order to solve their own unique ‘problem’ (Ford & Håkansson, 2006a). An individual actor is driven by its own problem-solving and by its own specific views

of its resources and of the surrounding actors with which it is interdependent (Ford & Håkansson, 2006a). Interaction becomes essential as it enables an actor to activate a counterpart's resources in combination with its own resources (Ford & Håkansson, 2006a). Ford and Håkansson (2006b) argue that due to the costs of interaction, investments, and adaptations, the benefits of a relationship can only be gained over time. Furthermore, actors develop interdependencies differently with different actors, including deploying resources differently (Ford & Håkansson, 2006a).

One way to capture the dynamics in a network is to view what is unfolding as a process. According to Ford and Håkansson (2006b), processes amongst organisations cannot be completely controlled by an individual actor since all actors in a network are active and purposeful. As such, any action by a single actor is influenced by how its counterpart perceives and reacts to said action. In turn, I would argue that this creates an unfathomable amount of ripple effects in the network, as a network consists of multiple individual actors all continuously acting, reacting, and re-reacting, painting a picture of a network that is in constant flux due to interaction, as a dynamic network of ripple effects continues ad infinitum.

Regarding dynamic interactions, and consequently dynamic networks, I previously presented an argument showing how the business network approach views relationships and interaction as part of a broader network (Håkansson & Snehota, 1995). A critical part of the business network approach is that it acknowledges that actors interact with one another, which in turn creates connectedness amongst different actors, and that the connections between actors invariably form a type of network. Due to the connectedness of actors, what happens in one part of the network has ripple effects on other parts of the network. Such a network does not necessarily have a focal point or any clear boundaries. Moreover, due to its dynamic nature, it is impossible to understand the network by charting it at any specific point in time, because once it is identified it will have already changed. In a dynamic view of networks, it could be argued that “everything is created in interaction between the involved actors, such as suppliers, customers and others and where the different pieces only have a role in relation to all the others, comprising an interacted structure” (Ford & Håkansson, 2006b, p. 254).

There are different ways (for researchers) to conceptualise the network. Leite (2022, p. 325) defines innovation networks “as loosely coupled systems of autonomous actors engaged in innovation”. Another type of network is strategic nets, which could be regarded as “intentionally governed networks of business actors” (van Bockhaven & Matthyssens, 2017, p. 70) that have some type of purpose. Finally, there is also the notion of an issue network, or

perhaps better termed a ‘loosely formed issue network’, which could be conceptualised as having an “unstable, fluctuating membership with unequal resources and irregular access to political decision-making”, within a political embeddedness context (Welch & Wilkinson, 2004, p. 220). Ritvala and Salmi (2010, p. 898) define an issue network as “a loose, temporary coalition of diverse types of actors that emerges around a common issue to influence existing beliefs and practices through network relations”. All of the aforementioned conceptualisations of networks shed some light on how to approach a network. At the same time, referring to my previous paragraph, and to arguments concerning the uncertainty and unpredictability of a network in constant flux, it seems that there is a continuum of what may be referred to as formalisation of a network. Interaction between business and non-business actors can be viewed as constituting a loose network whereby the position of political actors is not stable, as in earlier conceptualisations of networks (Hadjikhani et al., 2019). Hermes and Mainela (2022) suggest that legitimation is a dynamic phenomenon that may possibly involve changes to the network. Regarding network dynamics, a study with IMP elements, albeit geared towards an international business conceptualisation of the network, looks at actor legitimation as a network-embedded process, finding different dynamics such as the formation of triadic networks, shifting actor positions, and linking of disconnected networks (see Hermes & Mainela, 2022).

Indeed, the conceptualisation of a network is a complicated matter. One way to discuss the network is to acknowledge that it is a subjective depiction of how to descriptively construct the connectedness between individual actors in a type of (reasonably coherent) network connecting actors. Such a network is said to provide only a partial picture. And the view of a network cannot be neutral; instead, it is subjective and relative (Ford & Håkansson, 2006a).

Håkansson and Snehota (1995, p. 33) state that “[a] particular property of the network form of organization is its indeterminateness. The set of actor bonds making up the structure is not given, as it is not related to some overriding purpose for the structure as a whole”. Actor bonds emerge for varying reasons (Håkansson & Snehota, 1995, p. 33). Furthermore, the authors argue that a relationship can be a source of both change and stability in a network. A business network approach conceived this way exhibits constant flux, including the boundaries of the actors that are part of the network (e.g. some join, some leave) as well as their connectedness concerning the substance of the relationships (i.e. actor bonds, resource ties, and activity links), which in turn has ripple effects on other parts in the network.

In such a dynamic network, the individual actor is interesting. The IMP Group challenged the notion of an actor’s independent action directed towards

a passive market, as scholars were observing dynamic interaction (Ford & Håkansson, 2006b). Ford and Håkansson (2006b) question the notion that an actor can develop any type of independent strategy. That is not necessarily to say that actors have zero autonomy; rather, that their autonomy is limited as it hinges on other actors constantly acting and reacting (Ford & Håkansson, 2006b). In such a worldview, realising a large-scale endeavour is interesting considering the process of how the ESS eventually started becoming realised in interaction with different types of other actors, as a matter of managing *in* network rather than managing *the* network.

2.1.2 Who is included in the business network?

The IMP Group entered the academic landscape largely by proposing and formulating theorising around complex and nuanced matters found in the empirical reality of industrial markets (see e.g. Håkansson & Snehota, 2017). Håkansson (1982) challenged the view of industrial markets as an atomistic structure. It is said that business actors are not a homogenous and atomistic constellation, but instead heterogeneous and particular (Ford & Håkansson, 2006b, pp. 249 & 255). Indeed, each (business) actor has its own resources, ways of operating, particular problems, and aims (Ford & Håkansson, 2006a, 2006b). Business network scholars have traditionally theorised about issues involving business actors in networks, as much of the past literature emphasised business actors, typically companies.

As the network is also heterogeneous in terms of business and non-business actors, it is complex as they have different goals and possibly conflicting interests (Hermes & Mainela, 2014). However, they can nonetheless interact to attain mutual benefits (Hadjikhani et al., 2019). A business network approach, including non-business actors, clearly adds additional complexity to the notion of a diverse set of business actors (i.e. companies) and non-business actors (e.g. science and political actors) in actor constellations. My thesis acknowledges the view that actors are interwoven in a network comprising different types of actors from various spheres of society (see e.g. Hadjikhani et al., 2019). As such, actors belong to various types of systems that have different legitimate grounds (Hadjikhani et al., 2019). Extending the horizon of the business network approach (Thilenius et al., 2016) to include actors from different spheres of society, this section highlights what type of actor can be included in a business network approach analysis.

It is nowadays widely recognised and well-received in IMP research that many different types of non-business actors can be included, such as political actors (e.g. government and lobbyists), science actors (e.g. universities, labs, and Big Science), and other miscellaneous actors such as media and non-

governmental organisations (see e.g. Welch & Wilkinson, 2004; Hadjikhani & Thilenius, 2009; Gebert Persson et al., 2011; Åberg, 2013; Hermes & Mainela, 2014; Ljung, 2014; Åberg & Bengtson, 2015; Hadjikhani et al., 2019; Leite & Bengtson, 2018; Landqvist & Lind, 2019; Leite, 2022; Bengtson et al., 2022; Andersen et al., 2023). Interaction between business and non-business actors can be conceptualised in different ways, such as the function of political actors on companies (Hadjikhani & Thilenius, 2009), science–business interaction (Åberg, 2013; Åberg & Bengtson, 2015), or a distinction between the private and public spheres (Leite & Bengtson, 2018), as well as incorporating non-business actors without any clear categorisation defining them. In the remainder of this section, I categorise prior research into socio-political, science, and other types of actors, as well as, in a final section, introducing papers that consider the connectedness between several different types of actors.

2.1.2.1 Socio-political actors

As alluded to, non-business actors have gradually become integrated into the business network approach. In 2004, Welch and Wilkinson (2004) claimed that existing research tended to neglect political actors, either excluding the political actors or merely acknowledging their presence in the network without attempting to explain it. One way to understand the role of political actors in the network is by acknowledging that they are not necessarily only non-economic actors as they can command economic resources (Welch & Wilkinson, 2004). According to Hadjikhani, Leite, and Pahlberg (2019), legitimacy can be achieved for political actors showing economic gains through interacting with business actors (Hadjikhani et al., 2019).

Rather than discussing political actors as a distinct and homogenous group, they can be analytically grouped into, for instance, bureaucrats, government ministers, members of parliament, opposition parties, and interest groups (Welch & Wilkinson, 2004). Drawing inspiration from vertical embeddedness (cf. Halinen & Törnroos, 1998), another possible way to conceptualise political actors is by acknowledging that they can be fruitfully categorised as international, national, regional, and local to derive relevant insights for discussing political actors.

It is reasoned that political actors can be supportive or coercive, which, depending on the type of action, can have positive (strengthening) and negative (weakening) effects on a focal business relationship (Hadjikhani & Thilenius, 2009). One possible way of inviting non-business actors into the business network approach is by looking at the primary functions and the secondary functions (cf. Hadjikhani & Thilenius, 2009). Anderson, Håkansson, and

Johanson (1994, p. 3) state that primary functions “mean the positive and negative effects on the two partner firms of their interaction in a focal dyadic relationship”, whereas the secondary functions (also called network function) “capture the indirect positive and negative effects of a relationship because it is directly or indirectly connected to other relationships”.

Leite and Bengtson (2018, p. 181) state that “[m]ore recently there has also been a growing recognition of the importance of including actors from the sphere of political and civil society in order to understand today’s market conditions”. Leite (2022) has adopted a fairly broad horizon of relevant actors to include companies, government, and society. Social actors refer to non-governmental organisations as well as citizens, and political actors comprise mayors as well as public officials. Similarly to the ESS being ‘sold’ to the Swedish Government, Leite (2022) remarks that political authorities can be viewed as buyers. Ljung (2014) and Leite (2018) argue that actors from different spheres of society differ since they pursue different goals and values. For example, social actors are expected to emphasise social goals instead of necessarily economic goals, although the two goals are often intertwined. Leite and Bengtson (2018) drive an argument to state that the differences in motives are larger compared to motives amongst companies participating in other types of networks.

Public–private cooperation requires the reconciliation of several heterogeneous actors’ interests and abilities to create value (Leite & Bengtson, 2018). Leite and Bengtson (2018, p. 181) show “how resources controlled by actors from different spheres, i.e., public and private are combined to create value”. Moreover, different types of actors become interdependent and rely on one another (Ljung, 2014; Leite, 2018). Socio-political actors are important as they can grant social acceptance of the organisation (Leite, 2018). For actors interacting in a business and non-business initiative, Leite (2022) states that improving the brand image was a central concern for business actors. At the same time, it likewise seems that image is also part of political actors’ motivations as “[t]he political actors were interested in the image that such a project could bring to the city” (Leite, 2022, p. 330). While it could be argued that the motivations in (innovation) network formation of business and non-business actors (e.g. companies, government, and society) vary and differ amongst actors, at a certain point individual and collective motivations may align between business and non-business actors (Leite, 2022). A big reason for business and non-business interaction is the possibility of value creation, for instance, as business actors can help political actors (e.g. governments) to achieve their goals (Leite & Bengtson, 2018).

2.1.2.2 Science actors

The different types of science actors can include universities (e.g. Landqvist & Lind, 2019) and Big Science (e.g. Åberg, 2013; Åberg & Bengtson, 2015; Andersen & Åberg, 2017). A university, including university incubators, can aid R&D as well as help commercialise products from newly started business actors (Landqvist & Lind, 2019). Big Science organisations are complex in regard to the scale of involved activities, resources, and actors (Andersen & Åberg, 2017).

According to Andersen and Åberg (2017, p. 348), Big Science organisations as users are “driven by complex motivations”. The interests of science actors and business actors differ. For Big Science, serving scientific and societal interests becomes their aim (Andersen & Åberg, 2017). At the same time, interacting with suppliers, Big Science organisations can contribute to societal technological advancement (Andersen & Åberg, 2017). Big Science organisations interact with suppliers (Andersen & Åberg, 2017) and can be conceptualised as science actors in the business network approach that, broadly speaking, interact with companies (see e.g. Åberg, 2013).

Big Science organisations can influence business creation and innovation in collaboration with industrial suppliers (Li-Ying et al., 2021). These types of organisations are pushing the boundaries of what is technologically feasible, and “their technological insight and expertise often exceed those of their suppliers” (Andersen & Åberg, 2017, p. 349). Big Science organisations “are also prestigious collaboration partners that help producers to be acknowledged as being at the forefront of technology” (Andersen & Åberg, 2017, p. 345).

2.1.2.3 Other types of actors

Another type of fairly prominent actor in IMP theorising is the media. Hadjikhani and Thilenius (2009) briefly mention that the media can affect a business actor’s market legitimacy, and although not elaborating on the meaning of legitimacy in their paper, they show that media can be part of the business network. The media seem to play an important role in the process of building legitimacy (Bengtson et al., 2022). Furthermore, the media can raise awareness of practices concerning the public (Hermes & Mainela, 2014). Non-business actors can, as shown, have a number of different roles in how they are relevant to business actors or other actors. For instance, non-business actors can work as intermediaries between business and political actors (Hadjikhani et al., 2019).

2.1.2.4 Interdependences between different types of actors

According to Leite and Bengtson (2018, p. 181), “[t]he predominant focus of research on organizations concerns either private or public institutions without much consideration for their interdependence”. There seems to be a lack of research integrating the full variety of actors by acknowledging different types of actors’ interdependencies, which in turn connect the actors inside a (type of) network. Coordinating activities can be cumbersome if there are large differences between actors’ perceptions of how to approach various tasks (Gebert Persson et al., 2011). Hadjikhani, Leite, and Pahlberg (2019) looked into interdependence between public and private interests. A fairly common reason to incorporate non-business actors is due to their influence in foreign market entry (see e.g. Hadjikhani et al., 2019), for instance, concerning legitimacy (Hadjikhani, Lee & Ghauri, 2008). According to Hadjikhani, Leite, and Pahlberg (2019, p. 175), there is a presumption in the literature that political actors influence other actors, which in turn are quite passive, whereas they propose that “actors from different spheres are seen to be actively influencing each other”. Indeed, business, political, and social actors are interconnected (Hadjikhani et al., 2019). Commitment to business, political, and social actors can diffuse and affect relationships within each sphere. At the same time, incorporating an element of ambiguity and vagueness can foster commitment from different types of actors, such as critical provincial, local, and national governments as well as suppliers (Low & Johnston, 2008).

In viewing a network as including business and non-business actors, Hadjikhani, Leite, and Pahlberg (2019, p. 176) write that “contrary to the industrial network, the reciprocity is not necessarily achieved through any direct benefit to one actor over another but may be achieved through an indirect benefit provided by another actor”. This suggests that benefits for one actor (in a dyad) are mediated through a third actor. Hadjikhani, Leite, and Pahlberg (2019) find that for a business actor (an MNE⁷) to become involved in a project, it should propose an agenda as well the ability to use business resources to appeal to political actors and address the needs of society. Business legitimacy primarily concerns connected suppliers and customers but also depends on actors in the non-business context, and political legitimacy is attained by interacting with political actors as well as through how citizens perceive a political actor’s actions (Hadjikhani et al., 2019). Looking at start-ups’ entrepreneurial business formation processes (in a highly regulated industry), Bengtson, Casales Morici, and Lindholm (2022) point to prior research that seems to indicate the necessity of start-ups beginning relationships with actors

⁷ Multinational enterprise.

from the business, political, legal, and professional spheres in part to gain legitimacy.

Leite and Bengtson (2018) argue that the cohesiveness of motives as well as complementarity of resources are vital mechanisms for bridging actors from the private and public sphere. Their case study shows how;

“a common ground was achieved in the cooperation due to the cohesiveness of the motives of the various actors. Even though the parties in the cooperation had different motives and the values reached did not benefit each participant equally, there were enough motives for and value in the project to generate commitment from all participants. Identifying motives that accrue to only one partner will facilitate partners’ assistance to each other in achieving both their individual respective aims and expectations and the overall goal of the cooperation.” (Leite & Bengtson, 2018, p. 187)

This section has so far explored who is included in the business network, capturing business and non-business actors from science, politics, and media. Generally, it is presumed that various types of actors have different interests. Some IMP papers use, or hint at, the notion of spheres. A sphere can be defined as an area of activity, interest, or expertise, a section of society or an aspect of life distinguished and unified by a particular characteristic (Encyclopedia.com, 2026). Building on this train of thought, it could be reasoned that one possible reason that there are different interests amongst different types of actors is because they are embedded inside various contexts that value different things as desirable, proper, or appropriate.

What to make of all this? There are instances of challenges to interaction due to actors belonging to different spheres of society, and, conversely, instances of fruitful interaction due to actors belonging to different spheres. A large-scale business and non-business endeavour such as the ESS entails mobilising different types of actors. It can be expected that different actors connected to Big Science would have varying interests, and that these would differ depending on the type of actor. It could also be presumed that goals sometimes align quite smoothly, whereas other instances of interaction might present various hurdles to satisfying the interests of involved actors.

Regarding the IMP school of thought, focusing on business actors in a business network approach is considered rather given. In the meantime, there seems to be an increasing number of studies that include other actors inside the business network approach. Early studies provide a good stepping-stone for moving towards the integration of non-business actors. However, they do not necessarily acknowledge the relevance of non-business actors to the same extent as do some of the more recently published papers that neatly integrate

a myriad of non-business matters into network theorising, as seen in this section.

To conclude, IMP has developed and refined valuable analytical tools with which to understand actor interaction and business networks (including non-business actors). In one sense, the business network approach is a way to view, or approach, reality (of industrial markets, in particular), which in turn carries assumptions such as interdependence between actors as well as network dynamics. In another sense, it is a school of thought that, by exploring this particular way of viewing reality, in turn means that concepts have been developed and refined over past decades. Two analytical tools that have been widely explored in IMP are mobilisation and embeddedness, which we turn to next.

2.2 Mobilisation and mobilising

For the focal actor to achieve its goals, it needs to mobilise actors and receive support from actors in the network (Håkansson & Snehota, 1995). Ritvala and Salmi (2010, p. 899) acknowledged that “IMP scholars were early to note that to accomplish things a company needs to mobilize its partners”. To some extent a network is a continuously emerging structure, which both limits and/or provides opportunities for actors in the network. Håkansson and Snehota (1995, pp. 5–6) argue that “[r]elationships to others represent, for a company, not only constraints on its operations, but also new possibilities and opportunities to achieve desired goals”. They claim that there are two particularly important issues, including the important issue of mobilising various counterparts (Håkansson & Snehota, 1995, p. 6). For an actor such as the ESS, mobilising various counterparts is important, arguably the most important part of their goal to realise the ESS from idea towards reality. Håkansson and Snehota (1995, p. 4) state that,

“[i]n the network perspective, the more successful the counterparts are, the better it is for the company. The more a company can help its counterparts to develop and become successful, the greater are the chances it will become successful itself.”

It could thus be argued that when attempting to realise a new large-scale endeavour that requires mobilising other actors on which the focal actor is dependent (to varying degrees), it is crucial that success should imbue the entire network and the most relevant counterparts.

The concept of mobilising can be viewed in different ways. An important distinction that is discussed in this section is the notion of mobilising an actor

(dyad level) as well as network mobiliser (network level). These differ in the sense that a single actor can mobilise another actor, for instance, to gain access to that actor's resources. Network mobilisation entails mobilising several actors for some type of reason. That is not to say that network mobilisation does not include dyadic interaction between a focal actor and its counterparts, nor that the focal actor does not want to gain access to other actors' resources. Rather, the view is on a network level, not only the dyadic level.

In terms of dyadic mobilisation, according to Ford and Håkansson (2006a), problems are drivers for interaction. Of note here is that the word 'problem' can be both positive and negative. Another way to understand this is that it is similar to the notion of striving for problem-solving. Due to actors' problems, they interact to benefit from the resources of other actors (Ford & Håkansson, 2006a). Indeed, a common reason for mobilising (actors) is to access resources. Due to the problems of one actor (e.g. a socio-political actor), another actor may be recruited (e.g. a business actor) (Leite, 2022), in a sense mobilising other types of actors harbouring other resources that the focal actor lacks but needs. Most, if not all, actors wield limited resources (Håkansson & Snehota, 1995) in the quest to pursue opportunities, making business and non-business actors in the network relevant from the perspective of acquiring necessary resources outside the focal actor (e.g. Leite & Bengtson, 2018). For example, business actors might require some type of resource to achieve a certain goal, such as legitimacy so as to be able to step into foreign markets, or non-business actors may require monetary resources from other actors, such as science actors being dependent on political actors to pursue science.

Mobilising actors in a vast interorganisational network comprising science, politics, business, and the media is a challenge simply because of the inherent heterogeneity. For instance, heterogeneity stems from different goals as well as conflicting interests (Hermes & Mainela, 2014). Mobilising a network entails assembling various actors, such as aligning interests, and clarifying monetary effects for the actors being targeted in the mobilisation process (Hermes & Mainela, 2014). According to Ford and Håkansson (2006a, p. 9), regarding the aspect of time in interaction, "each actor will have a view of a preferred or probable sequence and will interact today with an eye on subsequent interaction in the future". To some extent, this reasoning can be taken further: an actor attempting to mobilise other actors will have a preferred view of the future; equally, the actors being targets of mobilisation will have preferred views of the future. In such a case, it seems important that there should be a reasonable fit between the different actors' preferred futures.

Leite and Bengtson (2018, p. 188) write that "[p]ublic-private cooperation entails accessing and combining the resources, such as skills and capabilities,

of various parties in order to create new capabilities and to meet a certain goal that cannot be easily attained by any one actor on their own". This, in a sense, points towards the prerequisite or antecedent for mobilising actors across different spheres of society, for the ESS to move from idea towards reality.

2.2.1 Network mobilisation

Ritvala and Salmi (2011) claim that prior business network research argues that mobilisation is more than just dyadic relationships and interactions. Ritvala and Salmi (2011, p. 887) define mobilisation as "a dynamic process of engaging actors on broad fronts to tackle a common issue". Mobilising a diverse set of actors requires network centrality, a position in the network vis-à-vis other actors, and selective mobilising efforts towards those whose contributions can be the largest (Ritvala and Salmi, 2011).

Mouzas and Naudé's (2007) model of a network mobiliser acknowledges that actors are embedded in an existing context, including macro-level externalities, network level, and dyadic relationship level. They theorise five different challenges, including network insight and sustaining mobilisation. Network insight can, for instance, include knowledge concerning the location of capabilities in the network (Mouzas & Naudé, 2007). Mouzas and Naudé (2007) point out that continued network mobilisation is hindered without joint gains.

Ritvala and Salmi (2010) propose a conceptual model of value-based network mobilisation in an issue-based net by drawing on the mobilisation of different types of actors. In doing so, they "broaden the analysis to the societal networks wherein business is embedded" (Ritvala & Salmi, 2010, p. 898). Ritvala and Salmi (2010) also note that a single actor's actions are insufficient unless other actors act upon them. Ritvala and Salmi's (2010) model broadly encompasses network mobilisers (actors, resources, and activities), enabling factors, and target organisations. Network mobilisers can utilise various mechanisms to attract interest from other actors to mobilise their resources (Ritvala & Salmi, 2010). This is relevant as actors need the will and interest to deploy necessary resources (Ritvala & Salmi, 2010). Additionally, Ellegaard and Koch (2012) point out that although other actors (such as suppliers) harbour relevant resources, they must indeed be willing, but also allowed, to deploy them. In terms of suppliers' resource mobilisation, Ellegaard and Koch (2012) note that, in some instances, suppliers are already from the start willing to mobilise resources due to the potential of the customer. According to Ritvala and Salmi (2010), enabling factors for mobilisation include social networks, business benefit, and political will. Furthermore, Ritvala and Salmi (2010, p. 904) mention a type of time lag whereby actor mobilisation precedes resources and

activities as well as pointing out that “the first resource commitments tended to be rather modest and activities, such as the search for new business opportunities, somewhat unfocused”.

One way to view Ritvala and Salmi’s (2010) study is in terms of how Hermes and Mainela (2014) point out that network mobilisation moves from individual, organisational, to a network level. Furthermore, both Ritvala and Salmi (2010) as well as Mouzas and Naudé (2007) conceptualise mobilising as a type of series of enablers of mobilisation (see van Bockhaven & Matthysens, 2017). Leite (2022, p. 334), on the other hand, argues that, in an innovation network, phases do not unfold in a series of sequential events, owing to mobilising resources alongside aligning actors’ diverse interests at different stages, through a non-linear process whereby “finding and enacting a solution is often a complex and dynamic process that may require actors to revisit earlier stages, perhaps multiple times, before a proper solution is identified, developed, and implemented”.

Ritvala and Salmi’s (2011) subsequent study puts an emphasis on business actors as targets of mobilisation activities, arguing that prior literature has focused on the mobiliser rather than the target of mobilising. For business actors, the network enabled the possibility of broadening their own network (Ritvala & Salmi, 2011). Ritvala and Salmi’s (2011) analytical framework is divided into three phases covering antecedents, mobilisation tactics by mobilisers, and potential mobilisation outcomes. As a new issue emerges, the authors point to the interorganisational nature (of business and non-business actors), stating that interaction between actors from unrelated industries becomes crucial, which is aided by a network mobiliser. In terms of factors motivating business actors to heed the mobilising call, Ritvala and Salmi (2011) mention, amongst other things, what could be termed potential, although foreseeable, benefits. Slightly abstracted, the motivational factors are potential benefits, rather than realised benefits, in which various potential benefits seem to be the main factors motivating participation in the initiatives.

Regarding potential mobilisation outcomes, Ritvala and Salmi (2011) shift attention to how mobilisation targets start acting on the mobilisation. They reasoned that business actors act positively if the issue is framed in a loose albeit interesting manner, due to the possibility of integrating the issue with their strategy as well as being able to control resource commitments (Ritvala & Salmi, 2011). Furthermore, they found that continued mobilisation was almost self-evident if the business actor’s core business was closely related to the issue at hand (in their case, pollution of the Baltic Sea). Leaning on Halinen and Törnroos (1998), the notion of closeness could be elaborated to mean geographical embedding, in terms of being spatially close, but also in

terms of the actor's closeness to the specific issue (e.g. using or operating in or near the Baltic Sea).

Hermes and Mainela (2014) look at mobilising crisis management networks. Following their theoretical section, they explicate a processual framework outlining a recursive process of network mobilisation for institutional change including, amongst other things, "means of creating a vision of change and mobilizing economic, social and political allies and resources" (Hermes & Mainela, 2014, p. 969). According to Hermes and Mainela (2014), being a network mobiliser requires legitimacy from several actors. Furthermore, an actor can become a legitimate network mobiliser by connecting actors that require or possess important resources (Hermes & Mainela, 2014). Hermes and Mainela (2014) propose incentivisation as a way to create collaboration, such as monetary motivation as an incentive for collective action. Network mobilisation means developing new as well as changing existing actor relationships (Hermes & Mainela, 2014). Network mobilisers are required to be adaptive; for example, exogenous changes might affect strategy and long-term plans (Hermes & Mainela, 2014).

Situated within the area of strategic nets, van Bockhaven and Matthyssens (2017) point out relevant dimensions to consider for mobilising actors by highlighting the identification of necessary actors, their relevant resources, and approaches to attract actors. Akin to discussions concerning different types of actors (see 2.1.2 *Who is included in the business network?*), van Bockhaven and Matthyssens (2017) consider that mobilising business actors (i.e. for-profit actors) can be challenging since goals, incentives, and interpretations differ between profit and non-profit actors. Mobilising actors entails a comprehensive understanding of different objectives to comprehend how susceptible other actors are to the arguments as well as how their objectives align with the common goal (van Bockhaven & Matthyssens, 2017). It seems relevant to understand that some aspects (e.g. technical and economic) might not resonate with some actors, and that other actors can sometimes interpret technical aspects, including using overly technical vocabulary, as too technical (van Bockhaven & Matthyssens, 2017). The authors also reason that even though the correct arguments for relevant mobilisation targets are known, there is still a question of how to approach these actors.

A network mobilisation process consists of different stages (Mouzas & Naudé, 2007), although they do not necessarily unfold in a linear fashion (see Leite, 2022). Mobilising that includes actors from different spheres of society entails identifying relevant actors (see e.g. van Bockhaven & Matthyssens, 2017; Bengtson et al., 2022). Furthermore, complementarity of resources and activities affects network mobilisation (Hermes & Mainela, 2014), and as

acknowledged previously, these can differ depending on the type of actor (see e.g. Leite & Bengtson, 2018). An actor can be used as a resource in the process of mobilising (van Bockhaven & Matthyssens, 2017). Furthermore, mobilising networks calls for prerequisites and activities (Hermes & Mainela, 2014), including motivational factors such as benefits (Ritvala & Salmi, 2011). Indeed, attracting and enlisting (see e.g. van Bockhaven & Matthyssens, 2017) actors seem to be among the key issues in mobilising actors, issues that tend to be either heavily implied or explicitly mentioned in many of the aforementioned papers in this section. To some extent it also stands to reason that, considering the manifold aspects involved in mobilising business and non-business actors, some actors will value and emphasise one reason for mobilising, while another set of actors will care little or nothing for that reason.

Ford and Håkansson (2006a) argue that a new element in an interaction or network can have several sequential consequences extending in multiple directions. As previously mentioned, a dynamic network view acknowledges a continuous stream of ripple effects propagating throughout the network. Furthermore, it seems that the mobilisation of actors requires a legitimate reason for the counterpart, as a mobilising target, to act. Attempting to realise a new venture through mobilising a variety of business and non-business actors calls for embedding interaction, as a process, into resource constellations and actor webs.

2.3 Embeddedness and embedding

Embeddedness is a concept that has been used in research for many years, both within social science in general as well as within the IMP school of thought. A lot of the early and influential work stems from, and builds on, the research of Granovetter (see e.g. Granovetter, 1985). Uzzi (1997, p. 41) conceptualise ties into arm's-length ties ("market relationships") and embedded ties ("close or special relationships"). Landqvist and Lind (2019, p. 161) stated that viewing "companies as embedded in networks is a key assumption within the industrial network approach".

Anderson, Håkansson, and Johanson (1994) wrote a type of position paper published fairly early in the IMP timeline, arguing for paying more attention to the embedded context of dyadic business relationships. They proposed that a dyadic relationship can have positive or negative effects on the focal actor's network identity. Regarding positive effects, Anderson, Håkansson, and Johanson (1994) proposed a construct referring to the anticipated constructive effects on network identity, influencing how a dyadic relationship with an actor is perceived to affect the focal actor's network identity, for example,

strengthening it, supporting it, or otherwise benefiting it. Furthermore, this construct is analytically divided into three dimensions involving activities, resources, and actors. Regarding actors, specifically anticipated actor-relationship generalisability, it is reasoned that interaction with an actor could have generalisable effects on other actors as it implies that the focal actor is a good (in general terms) cooperation partner. Additionally, drawing on the notion of attractive connectedness, it is reasoned that if a focal actor interacts with another actor, the former can get closer to the latter's other relationships. The authors also point out that interacting with a well-known and prestigious actor can positively affect an actor's network identity (Anderson et al., 1994).

Another oft-cited early paper exploring the concept of embeddedness is that of Halinen and Törnroos (1998), who identify six types of embeddedness. Essentially, the concept of embeddedness, according to Halinen and Törnroos (1998, pp. 188 & 189), refers "to companies' relations with, and dependence on, various types of network". As such, the focal unit seems to refer to a business actor rather than a more encompassing understanding that includes other types of actors as the focal unit (see e.g. Welch & Wilkinson, 2004). A key contribution of Halinen and Törnroos (1998) is to recognise the broader contextual setting that business actors are embedded in (e.g. political context). Halinen and Törnroos (1998, p. 189) elaborate on embeddedness by reasoning that business actors "are connected with each other thus forming business networks. But they are also connected with various other network structures which greatly affect economic actions and their outcomes". Embeddedness denotes the interdependence of actors on each other as well as interdependence in a macronet comprising larger structures. They conceptualise the micronet-macronet of embeddedness in which a micronet involves several actors (not only a dyadic relationship) which is embedded in a macronet of larger network structures, such as other non-business actors (e.g. political) affecting the micronet.

The six types of embeddedness are temporal, spatial, social, political, market, and technological embeddedness (Halinen & Törnroos, 1998). Spatial embeddedness refers to the role of the space and geography in which business actors are embedded, which can also be conceptualised as vertical embeddedness including international, national, regional, and local types of networks (Halinen & Törnroos, 1998). In realising the large-scale Big Science endeavour of the ESS, all of the different vertical embeddedness levels come into play as it gradually moves towards being materialised in Sweden, specifically in the city of Lund in Skåne. Market embeddedness is conceptualised by recognising that (business) actors are embedded in a market comprising products and services as well as clientele. For a Big Science user facility, the

market is its users, which can be from both academia and industry; in addition, broadly speaking, the facility serves societal interests (Andersen & Åberg, 2017).

Halinen and Törnroos (1998) conceptualise political embeddedness by recognising that business is conducted in what they call a politico–social context. Political actors, in part, view Big Science as a financial investment, being mindful of monetary issues (see e.g. Åberg, 2013). Welch and Wilkinson (2004) delve into political embeddedness including political institutions, political actors, political activities of firms, and political resources. Welch and Wilkinson (2004) offer a compelling argument by dividing the evolution of IMP research into three generations. They argue that in the third generation, researchers are revisiting the concept of embeddedness (somewhat similar to the first generation in the interaction model) as well as extending the research agenda to involve a diverse range of relationships. This stream of literature recognises that understanding (dyadic) relationships requires acknowledging other relationships and a broader context in which the relationship and the focal actor reside (Welch & Wilkinson, 2004). For instance, a lack of embeddedness and legitimacy entail obstacles for business actors entering new markets (Hadjikhani et al., 2019).

Subsequent theorising has considerably elaborated on the initial ideas exploring the concept of embeddedness. For instance, actors can reasonably be embedded in multiple contexts as well as interwoven in multifaceted ways. Hadjikhani, Leite, and Pahlberg (2019, p. 176) point out that political actors “themselves are embedded with actors such as the media, voters, unions and people (customers)”. Furthermore, as an actor becomes embedded it can also change the embedded context (Bengtson et al., 2022). Additionally, embedding in different business network settings (cf. Håkansson & Waluszewski, 2007) is not a linear process, and there can be instances when embedding overlap (Landqvist & Lind, 2019).

Embedding an actor in a network, through a legitimisation process, affects the network in both the short and long terms, and moreover legitimisation processes can entail structural changes in the network (Hermes & Mainela, 2022). Hermes and Mainela (2022) suggest that, regarding actor legitimisation processes, a network view is suitable as it enables focus on existing and current dyadic relationships as well as changes in the network. They argue that entering a network entail positioning as well as identifying relevant actors and their complex connections. Such a network view can help us understand actor legitimisation in a network as well as the effects on a network (Hermes & Mainela, 2022). In other words, pointing towards how an actor attempts to become embedded in a network as well as towards the resulting changes on a

pre-existing embedded structure of an actor web in the network, due to the process of actor legitimation in embedding itself in a network. Legitimising can potentially start a process that changes the structure, and another effect on the network is that it can affect, for example, increase or decrease, the legitimacy of the network itself (Low & Johnston, 2008; Hermes & Mainela, 2022). Human and Provan (2000, p. 360) show that “the process of network building, once sufficiently legitimized, can itself contribute to the embeddedness of member firms”.

Somewhat similar to embeddedness within IMP, Suddaby, Bitektine, and Haack (2017) bring forth the notion of categorisation, recognising that actors are embedded in social systems, which entails legitimising at different levels.

2.4 Legitimacy and legitimising

The main departure point of my dissertation is the business network approach, incorporating the concept of legitimising. Essentially, actors require legitimacy to exist and to survive. Kumar and Das (2007, p. 1433) argued that “[t]he quest for legitimacy is motivated by the fundamental need of all actors to garner support from their constituencies”. Indeed, all organisations are confronted with the issue of legitimacy (Kumar & Das, 2007). Human and Provan (2000, p. 363) stated that “[l]egitimacy is critical for the survival of all organizational forms”. Additionally, Low and Johnston (2007) highlighted that a central tenet of institutional theory is that organisations need legitimacy to survive.

The concept of legitimacy has been used in different fields, such as political science and sociology (Suddaby et al., 2017), as well as in business studies (see e.g. Low & Johnston, 2008). The concept also appears in papers published in the information systems field, in domains ranging from interorganisational information systems (Hsu, Lin & Wang, 2015) and digital entrepreneurship (Ingram Bogusz, Teigland & Vaast, 2019) to adoption success (Krell, Matook & Rohde, 2016). An insight regarding how legitimacy is used in information systems research is that, while most papers are guided by the organisational legitimacy concept, they make the concept their own so as to make sense of their respective research endeavours; for instance, Cram and D’Arcy (2023, p. 1397) replace ‘desirable’ in Suchman’s (1995) definition with ‘fair’. Furthermore, the concept of legitimacy has been applied in a wide variety of empirical contexts.

Indeed, the concept of legitimacy has been widely used in academia⁸. Viewed as a double-edged sword, extensive research involving legitimacy has made it into a rich concept, but this also entails an element of ambiguity as it has been used in a huge variety of ways. Management scholars such as Suchman (1995) as well as Suddaby, Bitektine, and Haack (2017) elaborate on different ways of categorising legitimacy. In this section, I elaborate on the aspects of the concept that are particularly relevant to my own thesis. By considering extensive efforts, particularly within organisation studies, to explore, understand, and develop the concept of legitimacy, this section also helps the reader understand some of the broader debates concerning legitimacy.

As such, this section guides the reader through the jungle of legitimacy, as the concept is quite rarely elaborated on within IMP, notwithstanding a few earlier scholarly pieces (see e.g. Gebert-Persson & Káptalan-Nagy, 2016). In an editorial in the journal *Industrial Marketing Management*, Lindgreen et al. (2020) stated that “[t]he construct “imported” from the other discipline should be well-defined, well-measured, and already well-published, making it easier to use in the new context”. The subtext of this quotation is that one should exercise care when applying the concept of legitimising within the business network approach. As previously alluded to, legitimacy is not an entirely new concept within the business network approach, although viewing legitimacy in terms of legitimising, which is a process involving dynamic interaction, is quite novel.

A well-cited definition of legitimacy draws on Suchman’s broad definition:

“Legitimacy is a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions.” (Suchman, 1995, p. 574)

This has been used as a guiding definition of the concept of legitimacy in works by scholars using the business network approach (e.g. Gebert-Persson & Káptalan-Nagy, 2016). Even though legitimacy has been used somewhat differently in different streams of literature, Suchman’s (1995) definition of legitimacy serves as a starting point to discuss and open up the nuances of this concept.

⁸ By most accounts, and as stated by many authors, legitimacy is a concept that has been studied by a variety of scholars in different fields using the concept in various ways. A way to gauge just how much the legitimacy concept has been used is by noting that Suchman’s (1995) paper has received almost 30,000 citations.

2.4.1 Legitimacy in organisation studies

Organisation scholars have extensively researched the concept of legitimacy (Suddaby et al., 2017). Broadly speaking, legitimacy can be divided into strategic legitimacy and institutional legitimacy (Suchman, 1995). One branch of organisation studies is institutional theory. Going back to early work by scholars such as DiMaggio and Powell (1983), it could be argued that institutional theorists view organisations as being like prisoners in a cage. Legitimacy, as a property, is contingent on the external environment (Suddaby et al., 2017). Hermes and Mainela (2022) point towards how a traditional view of legitimacy concerns a ‘fit’ between the actor and its external environment. Having said that, developments within organisation studies point to more agency, such as institutional entrepreneurship (Hermes & Mainela, 2014). Hermes and Mainela (2022) suggest that prior literature on organisational legitimacy has had a tendency to view it as something quite passive, whereas there has recently been acknowledgement that actors are active in influencing legitimacy.

Paraphrasing, Kumar and Das (2007, p. 1426) stated that “[a]n organization is said to garner legitimacy if it meets the expectations of its key constituencies in the environment (Suchman, 1995)”. Kumar and Das (2007, p. 1430) look at interpartner legitimacy, defining it as “the mutual acknowledgment by the alliance partners that their actions are proper in the developmental processes of the alliance”. Suddaby, Bitektine, and Haack (2017) suggest that legitimacy can be viewed as either dichotomous (it exists or does not exist) or continuous, whereby there are different degrees of legitimacy. Kumar and Das (2007) state that not all actors need to agree on the legitimacy of an actor for legitimacy to exist. In that sense, it could be argued that the focal actor requires sufficient legitimacy (on a continuum) from the (most) relevant actors. Having said that, in contrast to viewing legitimacy on a continuum, Suddaby, Bitektine, and Haack (2017, p. 469) contend that legitimacy, as a process, is instead viewed “as growing from a state of no (zero) legitimacy to a tipping point at which legitimacy emerges”. If interpartner legitimacy exists, Kumar and Das (2007) argue that alliance partners are less likely to act in terms of strictly their own self-interests, albeit acknowledging that, while actors are invariably driven by self-interest, it is also important to be sensitive to other actors’ needs. In a multi-actor context, “interpartner legitimacy is related to an actor’s activities being socially accepted within certain contexts” (Gebert Persson et al., 2011, p. 1025).

An endeavour like the ESS, involving actors from different spheres of society, depends on resource support from various audiences, similarly to emerging technology-based ventures (see Fisher et al., 2017). Synthesising literature, such as the work of Aldrich and Fiol (1994), Fisher et al. (2017, p.

52) stated that, “[f]or members of an external audience to provide a new venture with resources and support, they need to perceive the venture as legitimate”. Fisher et al. (2017) leverages an institutional logic lens to partition the different audiences: they argue that emerging (technology-based) ventures confront competing legitimacy demands in seeking resource support from different audiences with differing institutional logics. A new venture should be perceived as legitimate across a range of interests whereby framing influences legitimacy. Discussing prior research concerning framing, Fisher et al. (2017) posits that framing is impactful in influencing the decision-making of other actors, which is particularly relevant in a context of different types of actors⁹. Emphasis on different framings of the endeavour, in a context involving various types of actors, could help in meeting contrasting legitimacy criteria (see Fisher et al., 2017).

2.4.1.1 Analytically examining legitimacy

Regarding different analytical dimensions of legitimacy, generally speaking, papers using the concept of legitimacy have a tendency to categorise legitimacy into further, slightly more precise, analytical forms. Kaganer, Pawlowski, and Wiley-Patton (2010, p. 6) point out that “[s]everal frameworks delineating forms of legitimacy are available in the literature”. Regarding the different forms of legitimacy, Truong, Ackermann, and Klink (2021, p. 3) claim that “[t]he multiple dimensions of legitimacy are not mutually exclusive; rather, they often overlap, as conformance to one dimension will potentially affect the others”. There seems to be a few most often-used ways of analytically delineating legitimacy, including pragmatic legitimacy, but also moral, normative, cognitive, regulative, and sociopolitical legitimacy as well as to some extent technological legitimacy.

Pragmatic legitimacy “rests on the self-interested calculations of an organization’s most immediate audiences” (Suchman, 1995, p. 578). Or, as interpreted by Kumar and Das (2007, p. 1434), “[p]ragmatic legitimacy occurs when the organization satisfies the interests of its members”. Specifying slightly concerning interpartner legitimacy, Kumar and Das (2007, p. 1434) state that “pragmatic interpartner legitimacy means that alliance members see their involvement and contribution as furthering their own interests and the interests of the (larger) alliance”. A positive effect of (interpartner) legitimacy is to promote cooperative behaviour such as implementing solutions that are in all actors’ interests (Kumar & Das, 2007). Indeed, pragmatic (interpartner) legitimacy concerns whether the network (strategic alliance) satisfies the self-interests of other relevant actors (constituents) (Kumar & Das, 2007). Gebert

⁹ In the paper, audiences are understood to be operating under different institutional logics.

Persson, Lundberg, and Andresen (2011, pp. 1028 & 1029) define pragmatic interpartner legitimacy somewhat similarly as “[s]elf-interest — occurs when the network satisfies the interests of its members”. Concerning regional strategic network formation, pragmatic legitimacy can be viewed as agreeing on common goals while enabling the actor to align the overarching goal to benefit its own individual goals (Gebert Persson et al., 2011).

In their conceptual paper, Kumar and Das (2007) reason that pragmatic (interpartner) legitimacy is most crucial during the early stages since it would make little sense to commence and continue interaction if there are no mutual benefits connected to the self-interests of the actors. This line of reasoning makes sense. However, in terms of a vast interorganisational endeavour over a long period of time, starting interaction and mobilising a variety of actors means that, even though the interaction with a specific counterpart has a formation, the focal actor has several initial formation stages with a variety of actors continuously navigating the issue of mutual benefit and satisfying their counterparts’ interests.

Suchman (1995, p. 577) sheds light on institutional and strategic legitimacy, highlighting a distinction by stating that it “is a matter of perspective, with strategic theorists adopting the viewpoint of organizational managers looking “out,” whereas institutional theorists adopt the viewpoint of society looking “in””. Institutional legitimacy can, to some extent, be contrasted to strategic legitimacy in which actors have greater agency to influence legitimacy on a much broader scale (see e.g. Suchman, 1995). Another type of categorisation is to distinguish legitimacy as external or internal, with external legitimacy being conceived as the fit, or acceptance, between the organisation and its environment, whereas internal legitimacy (interpartner legitimacy) concerns internal constituencies (see e.g. Gebert Persson et al., 2011). Gebert-Persson and Káptalan-Nagy (2016, pp. 309–310) point out that “[g]aining legitimacy involves different types of activities. These activities are not something that a manager plans as an effect of trying to conform to a changing environment, yet rather are a question of nursing its relationships and framing the business network context, which is in line with the strategy definition by Håkansson and Snehota (1989)”.

As previously highlighted, the concept of legitimacy can mean slightly different things depending on how it is analytically delineated into various parts. The definition of legitimacy tends to be attributed to Suchman (1995). It is debatable how well-defined the concept is, instead serving as a more general definition. The concept of legitimacy is certainly well-published, not only in organisation studies but also other disciplines. Moving further in this

theoretical chapter, I will specify how legitimising is used in understanding my own case.

2.4.2 Legitimacy as process

Formulated as “no organization being able to rest on its laurels”, Kumar and Das (2007, p. 1430) claim that previous literature on legitimacy suggests that it is an ongoing activity, for instance, requiring constant maintenance. Suddaby, Bitektine, and Haack (2017, p. 459) contrast legitimacy-as-process with legitimacy-as-property (i.e. the ‘standard’ way of discussing legitimacy), stating that “legitimacy is not assumed to be a stable condition, but rather is actively and continually negotiated”. Legitimising, as a process, means that legitimacy is ongoing, including several participants (Suddaby et al., 2017). A consequence of taking this perspective is that the actors have a high degree of agency (Suddaby et al., 2017). Legitimising¹⁰ can be viewed as “a structured set or sets of formal or emergent activities that describe how an actor acquires affiliation with an existing social order or category” (Suddaby et al., 2017, p. 462). For instance, as alluded to concerning embeddedness, how an actor acquires affiliation with a category is somewhat similar to embedding in different spheres of society. Additionally, making such a statement even clearer within IMP theorising, it could be stated that the legitimation process involves acts of justification by continuously seeking other actors’ approval (Kumar & Das, 2007). Low and Johnston (2008, p. 875) state that “justification may be described as manoeuvring processes a firm undertakes, to ensure quality and fit between its legitimacy activities and its acceptance by network constituents”.

Suddaby, Bitektine, and Haack (2017, p. 462) suggest that “there is no single best way of achieving legitimacy”. Legitimacy can exist in interaction with one of the actor’s counterparts but not in others, and dynamic legitimacy exists along a continuum over time. Furthermore, actors need to act to sustain legitimacy, recognising that the legitimation process is a continuous stream of ebbs and flows; as such, there is no room for complacency (Kumar & Das, 2007). Rather, legitimacy is conditional (Kumar & Das, 2007), requiring ongoing legitimising. Evidently, ongoing legitimising involving a myriad of business and non-business actors over long periods of time is challenging. It is suggested that as an actor frequently engages in new interactions, legitimacy is continuously changing (Gebert-Persson & Káptalan-Nagy, 2016, p. 303). In essence, legitimacy as process is “generative, interactive, and dynamic” (Suddaby et al., 2017, p. 462).

¹⁰ Or legitimation.

Legitimacy, as process, is interactive, occurring amongst several (social) actors (Suddaby et al., 2017). Suddaby, Bitektine, and Haack (2017, p. 451) write that,

“[i]n the legitimacy-as-process perspective, researchers adopt a somewhat broader lens that examines legitimacy as the product of interaction of multiple actors (typically organizations) operating largely, but not exclusively, at more macro levels of analysis, such as the organizational field.”

Regarding actors engaging in legitimising, Suddaby, Bitektine, and Haack (2017, p. 451) state that “the key role of actors is typically characterized as a “change agent” whose primary interest is in changing the process by which legitimacy is constructed”. Whereas legitimacy-as-property is congruence with an external environment, legitimacy-as-process is less of an outcome than how such congruence is achieved (Suddaby et al., 2017). In legitimacy as a process, attention is directed towards an actor as a change agent seeking to implement (social) change in how relevant audiences evaluate the object of legitimacy (Suddaby et al., 2017). They argue that legitimacy occurs as consensus between several actors in a (social) field. In that sense, legitimacy involves many different types of actors (Suddaby et al., 2017).

Legitimacy (as process) occurs in interactions between actors each pursuing their self-interests (Suddaby et al., 2017). Suddaby, Bitektine, and Haack (2017, p. 462) argue that “because legitimation is a multiactor and often multilevel process, legitimacy is not the outcome of efforts of a single actor, but rather a socially constructed outcome that emerges as part of the contestation and cocreation of the general social order”.

In their conceptual paper, Fisher, Kotha, and Lahiri (2016) point out that emerging ventures seeking to grow must appeal to expectations from disparate actors¹¹ throughout their evolution. Fisher et al. (2016) assert that legitimacy criteria differ across stages, involving additional resource needs as resource providers have different expectations. Different audiences “operate under different socially constructed institutional conventions” (Fisher et al., 2016, p. 389). Emerging ventures face multiple legitimacy thresholds since additional heterogeneous actors, having certain sets of expectations, introduce new evaluation criteria in each stage (Fisher et al., 2016). In terms of legitimacy buffering, Fisher et al. (2016, p. 398) synthesise prior literature to state that “[l]egitimacy not only is a way to garner resources but, when accumulated, also serves as an important resource in its own right, because it enables a venture to attract other resources”. Legitimacy can also be transferred to other contexts involving different audiences (Fisher et al., 2016). Technological

¹¹ The authors do not discuss actors per se; rather, they refer to audiences.

pro prowess, supportive stakeholder relations, and positive media attention in one context can help in building legitimacy and relations in another context, or setting (Fisher et al., 2016).

2.4.3 Legitimacy in networks

This section focuses on research within, sometimes bordering on, or otherwise related to business network research. Legitimacy can be conceptualised in various ways inside the business network approach.

Access to resources is not necessarily sufficient for survival without legitimacy (Gebert Persson et al., 2011). Additionally, Gebert-Persson and Káptalan-Nagy (2016, p. 302), referring to Sharma (1991), stated that “without legitimacy the network will not be willing to supply resources”. Moreover, legitimacy itself can be viewed as a type of resource, such as an ability to create legitimacy (Bengtson et al., 2022) or a necessary resource for an actor to access resources outside its own organisation (Gebert-Persson & Káptalan-Nagy, 2016, p. 305).

Hadjikhani, Leite, and Pahlberg (2019, p. 176) contend that “[l]egitimacy is defined as the position recognised by the surrounding actors in a business network”, based on the focal actor’s different types of ties (and their strengths) to other actors in the environment. Hadjikhani, Leite, and Pahlberg (2019) reason that legitimacy, affected by interrelated spheres of society (i.e. business, society, and politics), involves ensuring mutual gains. Legitimacy can exert a moderating effect that changes commitment to a relationship (Hadjikhani et al., 2019).

Entering a network requires legitimation for the new actor attempting to become part of the network (Hermes & Mainela, 2022). Furthermore, new organisations are more likely to die due to a lack of legitimacy, including an inability to conform (Low & Johnston, 2008). Low and Johnston (2008) explore the concept of network legitimacy, pointing towards the importance of performing different types of activities (i.e. business, social, and political) jointly with critical network actors. Furthermore, “network legitimacy requires knowledge of how the organization is attracted to, selected by, and becomes member of this network” (Low & Johnston, 2008, p. 874). According to Low and Johnston (2008, p. 874), an actor’s resources and activities can be less important than “their relative attractiveness as perceived by others in the network”, with attractiveness being dependent on other actors in the network valuing the actor’s resources and activities. They argue that activities have to be justified considering that other actors in a network have different needs. An actor’s network legitimacy leads to “economic, social, technical, and political capital” (Low & Johnston, 2008, p. 875). Their study paints a view of reality

in which business, political, and social relationships are inseparable. For instance, a political activity like being member of a technological network to achieve business benefits with business actors (Low & Johnston, 2008). Low and Johnston (2008, p. 878) argue that the focal actor “carefully crafted and developed legitimacy orientations aimed at a host of constituencies needed to acquire legitimacy”. There seems to be more pressure to achieve legitimacy in an ambiguous context. Additionally, establishing legitimacy requires several concurrent activities directed towards multiple actors (Low & Johnston, 2008).

Human and Provan (2000) used a blend of institutional and strategic legitimacy in a comparative study of multilateral networks and their network formation. In terms of network legitimacy, “[t]he interaction process itself had to be legitimized” so that actors would be committed to sustain the network (Human & Provan, 2000, p. 340). Similarly, the authors suggest that interactions need to be legitimized in order to develop embedded ties. Legitimacy for actors being part of the network seems to arise only if the network itself is legitimate (Human & Provan, 2000). Building legitimacy from the inside–out can be more fruitful than initially focusing on external support in the early stages of network formation. In their study, they show that legitimacy is dynamic and that strong internal network legitimacy seems to withstand external legitimacy shocks (Human & Provan, 2000). Indeed, many large projects have been contested (see e.g. van Den Ende & van Marrewijk, 2019) by what could be considered external legitimacy shocks from other actors. Another insight of Human and Provan (2000) concerns the process by which choices made during the initial stages continue to influence the later stages.

Gebert Persson, Lundberg, and Andresen (2011) shed light on legitimating processes at the network level, focusing on interpartner legitimacy in network formation. Thereby contributing to research on a network level, since applying interpartner legitimacy increases our understanding concerning the process of network formation and development. Such a network can involve actors including (local) government, companies, and universities. Internal, or interpartner, legitimacy puts an emphasis on how a focal actor’s legitimacy is bestowed by other counterparts in the network (Gebert Persson et al., 2011). Additionally, interpartner legitimacy can exist as a mutual acknowledgement of expectations before an initiative is initiated (Gebert Persson et al., 2011). It is reasoned in their paper that an actor will be more committed if it believes that the goals of a (regional strategic) network are aligned with its own goals. Common aims build a foundation for pragmatic interpartner legitimacy (Gebert Persson et al., 2011). It is considered that network formation is affected by pragmatic legitimacy, particularly during the early stages, as it is reasoned that

an actor should perceive benefits to become a part in the network (Kumar & Das, 2007; Gebert Persson et al., 2011). Gebert Persson, Lundberg, and Andresen (2011, p. 1026) propose that the concept of legitimacy can,

“identify both the initial processes of negotiations on the rules and norms which influence the future possibilities for interactions and commitment as well as important conditions for the survival and purpose of multi-actor interaction.”

Low pragmatic interpartner legitimacy can be viewed as a hindrance for developing commitment (e.g. to invest time and other resources) due to an inability to identify arguments that benefit the individual actors' self-interest. It is easier to establish pragmatic interpartner legitimacy to find common goals if the involved actors are already aware of each other's competencies and fields of interest (Gebert Persson et al., 2011). Additionally, interpartner legitimacy develops in tandem with network formation (Gebert Persson et al., 2011).

Gebert-Persson and Káptalan-Nagy (2016, p. 309) propose a model with which to understand “legitimacy as processes at different levels where an organisation is subjected to both internal and external pressures”, divided into different levels concerning the firm, relationship, and network (context) level. Gebert-Persson and Káptalan-Nagy (2016, p. 302) argue that legitimacy is formed within interactions, in dynamic networks. Importantly, they “add to previous research by arguing that what constitutes legitimate behaviour is formed during the course of relationship interactions, embedded within business network contexts” (Gebert-Persson & Káptalan-Nagy, 2016, p. 302). Legitimacy is perceived differently depending on the context. Therefore, it should be appreciated that legitimacy in interaction can occur between organisations from different contexts (Gebert-Persson & Káptalan-Nagy, 2016, p. 303). Gebert-Persson and Káptalan-Nagy (2016, p. 304) reason that pragmatic “pressure expects the firm to demonstrate a willingness to satisfy the interests of the stakeholders within their direct and indirect relationships”. A legitimising process could be viewed as the focal actor's understanding of what the network perceives as legitimate and as its actions being aligned with what actors in the network perceive as legitimate (Gebert-Persson & Káptalan-Nagy, 2016, pp. 308–309).

An actor can be legitimised through positive recognition by another well-respected actor (see e.g. Leite & Bengtson, 2018). In network mobilising, affiliating with other actors can mean gaining legitimacy, and in a context comprising a number of actors, it is relevant to point out that this legitimacy might differ between actors as they have different perspectives. Affiliating with

many different actors, joined together in a specific setting, entails a type of collective legitimacy (Hermes & Mainela, 2014). Legitimising can also arise in a triad of actors, as an actor that is seeking legitimacy might require an intermediating actor for another actor to approve it (Hermes & Mainela, 2022), thus using a relationship with one actor to legitimise towards another. Network mobilisers display an element of adaptative behaviour, such as building ad hoc constellations of actors that, at a certain stage in the process, jointly constitute a legitimate constellation able to advance their ultimate aim (Hermes & Mainela, 2014). However, the situation environment might change, in turn requiring new actors to be part of the constellation, meaning a need to establish new actor ties or modify other relationships (Hermes & Mainela, 2014).

A legitimation process of a new actor is embedded in the network (Hermes & Mainela, 2022). Legitimacy spillover from one actor to another can occur as legitimacy is transferred through relationships (Hermes & Mainela, 2022). An actor legitimising to enter a network can affect the network structure in terms of intended and unintended long-term effects. Hermes and Mainela (2022, p. 3) write that “legitimacy is crucial for new members to build and join networked collectives”. Regarding actor legitimation processes, it is stated that networks can be viewed as the means as well as an end of legitimation.

An actor can gain legitimacy and acceptance by communicating the various benefits that it can offer (Bengtson et al., 2022). A way to legitimise, through arguments, is by framing a solution to a perceived problem which is viewed differently by actors from dissimilar spheres of society (Bengtson et al., 2022). One way to approach legitimacy is to view it through the lens of a problem, either as a problem in the IMP sense of interacting to solve problems (e.g. technological benefits for business actors) or in terms of problematisation in which the focal actor can solve a problem. Theorisation, such as abstracting practices into generalised terms, can “usefully initiate change when it both problematizes (i.e., delegitimizes) an existing practice and simultaneously offers a solution (i.e., legitimates)” (Suddaby et al., 2017, p. 461).

Bengtson, Casales Morici, and Lindholm (2022) develop process-focused explanations, and in doing so shed light on arguments (which is related to legitimacy) to find that arguments significantly differ contingent on who is the target, accordingly adapting arguments to fit the targeted actor. Furthermore, this implies that an actor consciously identifies and formulates arguments depending on the target. Additionally, the same argument can be viewed and used differently by other actors (Bengtson et al., 2022). A fairly similar insight, in terms of adhering to various critical actor groups, is how corporate sustainable brand identity work, specifically the process of brand identity

creation, entails versioning the brand narrative towards different groups of stakeholders (Andersen et al., 2023).

The strategic perspective seems a fairly common way to view legitimacy. Furthermore, it seems as if most business network scholars use legitimacy in terms of what Suddaby, Bitektine, and Haack (2017) referred to as legitimacy-as-perception; more eloquently formulated, that legitimacy is in the eye of the beholder (Ashforth & Gibbs, 1990). For my thesis, it is relevant to point out that the process of legitimising acknowledges a perceptual element of legitimacy; however, the process of legitimising is most relevant.

2.5 Towards my own view: A model for analysing the process of realising the ESS

The model below will be used to analyse the process described in the forthcoming empirical chapters, tracing the journey of realising the ESS. In doing so, the model intends to capture the process of creating an actor from idea towards reality in an interorganisational context. As such, it is relevant to acknowledge the broad range of actors typically involved in these kinds of projects. Different types of actors from distinct spheres become salient at various points in time during the processes of generating an idea, attracting financing, and building a facility, as various actors control a variety of resources that need to be mobilised to realise the project. For instance, realising Big Science facilities requires resources including, but not limited to, the user community's expertise, political funding, and suppliers' physical resources. Figure 1 illustrates my model of analysis for legitimising a Big Science facility during its process towards being realised.

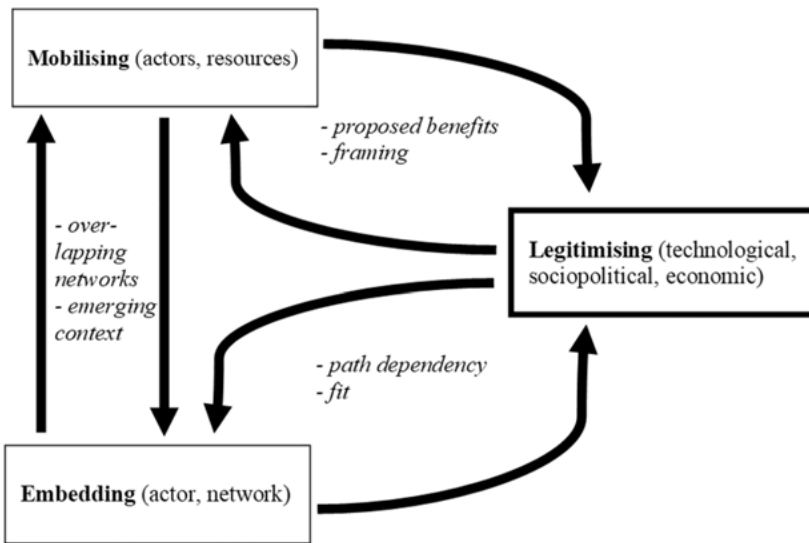


Figure 1 Model of realising a large-scale endeavour in an interorganisational context

In the process shown in Figure 1, legitimising rests on satisfying the interests of the focal actor's most immediate actor ties, involving technological, socio-political, and economic legitimacy (also see Suchman's [1995] broad definition of legitimacy). To shed additional light on the process of realising a large-scale endeavour, the concepts of mobilising and embedding are used as support in understanding the legitimising process. Mobilising refers to a dynamic process of engaging actors on broad fronts in realising a large-scale endeavour, mobilising actors and their resources (see Ritvala & Salmi, 2011). Embedding refers to processes involving actors' relations with, and dependence on, various types of network structures and broader contextual settings over time (see Halinen & Törnroos, 1998). The three concepts interact together as well as in pairs involving legitimising and mobilising and so forth. Each pair contains additional analytical parts, including legitimising and mobilising, which entail proposed benefits and framing. Legitimising and embedding concern path dependency and fit; finally, mobilising and embedding include overlapping networks and emerging context.

2.5.1 The three building blocks involved in realising the ESS

Viewed in terms of the business network approach, the conceptual framework presented in Figure 1 consists of three interrelated concepts, including legitimising, mobilising, and embedding, used to analyse the process of creating an actor from idea towards reality in an interorganisational context. The building

blocks and the interplay between the concepts constituting the model are all viewed as processual.

2.5.1.1 Legitimising

As mentioned previously, legitimacy can be defined as “[a] generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions” (Suchman, 1995, p. 574). There are different ways to analytically delineate the concept of legitimacy into more specific parts, for example, by refining different forms of legitimacy (e.g. pragmatic, moral, or cognitive) or categorising different configurations of legitimacy (e.g. property, process, or perception). According to Suchman (1995, p. 578), “[p]ragmatic legitimacy rests on the self-interested calculations of an organization’s most immediate audiences”. This was interpreted by Kumar and Das (2007, p. 1434) to mean that “[p]ragmatic legitimacy occurs when the organization satisfies the interests of its members”.

Conceptualised within the business network approach, I argue that pragmatic legitimacy rests on satisfying the interests in a focal actor’s most immediate actor ties¹². My study uses the concept of legitimacy, mainly viewed as pragmatic legitimacy¹³, in a process of legitimising¹⁴. To further understand legitimising analytically, it is relevant to draw on its different forms, namely, technological, sociopolitical, and economic legitimising. This means that these forms concern a process that is about satisfying interests of various actors inside distinct spheres of society regarding what is desirable, proper, or appropriate inside their contexts.

The aforementioned distinction amongst different forms of legitimacy diverges slightly from conventional categorisations seeing as there is a fairly taken-for-granted consensus in the legitimacy literature that certain ways of using and categorising the concept are more common than others, such as

¹² The definition of legitimacy is derived from organisation studies. Furthermore, a distinct difference between institutional theory and the business network approach concerns the field vis-à-vis counterparts, which are conceptually different between the two streams of literature, although referring to something external to the focal actor. In institutional theory, the field tends to be quite abstract, whereas in the business network approach, there is direct and indirect actor interaction that connects actors (see e.g. Anderson et al., 1994; Hadjikhani & Thilenius, 2009). Essentially, regarding legitimising, the ‘audience’ (cf. Suchman, 1995) in my case refers to connected actors.

¹³ Specifying that it is mainly, albeit not solely, pragmatic legitimacy means that processes of technological, sociopolitical, and economic legitimising are encapsulated by satisfying a focal actor’s most immediate actor ties. This means that legitimising as satisfying a focal actor’s most immediate actor ties is most prominent relative to other types of legitimacy (e.g. moral or cognitive).

¹⁴ This means that the focus is the process of legitimising, although there are elements of legitimacy as a perception.

pragmatic, moral, and cognitive legitimacy (see e.g. Suchman, 1995)¹⁵. At the same time, legitimacy is a broad concept that includes many insights. Focusing on technological, sociopolitical, and economic legitimising makes theoretical sense, since these different perspectives are captured in the legitimacy literature¹⁶, although my categorisation of legitimising into these three forms is quite rare. Furthermore, distinguishing legitimising as technological, sociopolitical, and economic makes a lot of sense in IMP terms, and particularly within the present study, as I focus on practical issues involved in legitimising an endeavour rather than on questions such as how legitimacy judgements are made (for a similar type of reasoning, see Fisher et al., 2017).

The three forms of legitimising pertain to counterparts' varying interests, not necessarily to any specific type of actor. Ford and Håkansson (2006a, 2006b) claimed that each actor is unique, although IMP scholars also highlight that networks consist of different types of actors. Even though each and every actor is unique, legitimising in a network involving actors from different spheres of society entails a mix of technological, sociopolitical, and economic legitimacy that can work together to satisfy a variety of counterparts' different interests. It may also be that all three forms coexist to varying degrees, zooming in on specific counterparts.

All three forms of legitimising are involved throughout the process, which includes all spheres of society. Technological legitimising entails a process involving sufficient amounts of relevant actors in the network finding the focal actor's technology desirable and appropriate. Sociopolitical legitimising entails a process involving sufficient numbers of relevant (authoritative) actors finding the actor desirable and appropriate. And economic legitimising entails a process involving sufficient amounts of relevant actors in the network finding the economic viability desirable and appropriate for interaction.

Technological legitimising

Technological legitimising refers to technology used in the creation of the ESS as desirable or appropriate to serve counterparts' interests providing various benefits relevant inside their contexts. Technical legitimacy could be viewed as focusing on aspects of core technology (Ruef & Scott, 1998)¹⁷. Technological legitimacy can be achieved by accounts of technical superiority alongside demonstrating familiarity as similar to old technology (Suddaby et al., 2017).

¹⁵ Similar types of taken-for-granted categorisations have also been used in other research borrowing the concept of legitimacy, for example, in information studies and to some extent in IMP research.

¹⁶ This is more so regarding sociopolitical legitimacy, especially vis-à-vis the literature concerning economic legitimacy.

¹⁷ Ruef and Scott (1998) put an emphasis on normative legitimacy.

The plausibility of a technology is relevant at early stages, as actors need confidence that associated challenges can be resolved (Fisher et al., 2016). Technological legitimising concerns whether an idea is technologically feasible and doable¹⁸. Furthermore, technological legitimising involves technical claims such as statements concerning technological breakthroughs and contributing to knowledge advancement (see Fisher et al., 2017). This can also include technical expertise and being on the frontier of technology (Fisher et al., 2017). Even though they do not explicitly discuss technological legitimising, Fisher, Kotha, and Lahiri (2016, p. 391) argue that “[r]esource providers embedded in the academic community favor ventures that have the potential for technological breakthroughs or scientific advances that serve the larger public interest”. Reasons for funding a technological venture can include job creation or knowledge spillover stimulating economic growth (Fisher et al., 2016).

For the ESS, an example of technological legitimising is arguing that the facility, due to its technological superiority, will enable breakthroughs in science (that will serve the common good). As a complex technological endeavour, it is relevant for counterparts to gauge the plausibility of the endeavour being realised. As a process of legitimising, it is not sufficient to merely propose a desirable and appropriate idea, as the idea also needs to be concretised (e.g. in design studies) and constructed. The ESS involves a variety of advanced technology, designed and built by science actors, to be used by scientists. In this context, technology and science are quite intertwined. However, the technological side of the ESS is partly distinct from the science side, which is instead used in legitimising the ESS as its technology could spark scientific breakthroughs.

Sociopolitical legitimising

Sociopolitical legitimising refers to satisfying sociopolitical interests as to what can be accepted as appropriate and right given existing norms and laws. Sociopolitical legitimising can be defined as “the process by which key stakeholders, the general public, key opinion leaders, or government officials accept a venture as appropriate and right, given existing norms and laws” (Aldrich & Fiol, 1994, p. 648)^{19,20}. Fisher et al. (2017) argue that grant

¹⁸ In my study, feasible and doable are set within the context of constructing Big Science, as such projects tend to be technological achievements in and of themselves.

¹⁹ Suddaby et al. (2017, p. 454) drew on Aldrich and Fiol (1994) as well as Scott (1994) to write that “[s]ociopolitical legitimacy refers to a degree of congruence between a focal organization’s characteristics or behaviors and the normative expectations in the cultural meaning system of the other organizations that surround it (Aldrich & Fiol, 1994; Scott, 1994)”.

²⁰ Aldrich and Fiol (1994) discuss cognitive and sociopolitical strategies in terms of four levels of analysis: organisational, intraindustry, interindustry, and institutional. Although the

administrators distributing governmental research funds use a state logic focusing on knowledge advancement and knowledge for the public good. A way to view sociopolitical legitimacy is as the “extent to which a new form conforms to recognized principles or accepted rules and standards” (Aldrich & Fiol, 1994, p. 646). A new endeavour might have trouble gaining government agencies’ approval as activities and long-term consequences are less understood (Aldrich & Fiol, 1994).

For the ESS, an illustration of sociopolitical legitimising is arguing that the ESS will enable Europe to remain at the leading edge of neutron science, as is appropriate and right given existing norms. A sign of sociopolitical approval could be various governments’ decisions to invest in the ESS, viewed as an appropriate and right course of action given their norms and laws (cf. Aldrich & Fiol, 1994). Realising the ESS from idea towards reality involves different types of sociopolitical actors, for example, regional and national political actors as well as the general public (see also Halinen & Törnroos, 1998; Welch & Wilkinson, 2004; Hadjikhani et al., 2019).

Economic legitimising

Economic legitimising refers to satisfying counterparts’ economic interests involving desirable and appropriate benefits increasing monetary profits or reducing costs. In elaborating on the economy of business relationships and networks, Håkansson and Snehota (1995, p. 382) argue it can be presumed actors perceive interactions as economically beneficial. Economic legitimising is not especially salient in the literature, compared to other forms of legitimacy, for example, technological and sociopolitical legitimising introduced earlier. One paper, albeit situated in political science, claims that economic legitimacy as a concept is relatively uncharted (see Ignác, 2024)²¹. Formulating legitimisation strategies, Vaara (2014) mention rationalisations concentrating on economic arguments and numbers (e.g. (un)employment in a country). Moreover, Vaara (2014) point out that calculation estimates for various numbers were often not clearly explained. Connecting economic legitimising to discussions on market logic highlights monetary results and self-interest

conceptualisation of industrial markets involving networks in the business network approach differs from the conceptualisation used in their paper, they share certain aspects with the business network approach, such as discussing a focal actor in relation to other actors, albeit on a quite aggregated scale.

²¹ This is one of few papers that discuss economic legitimacy. However, it is too different to my study to shed much light on economic legitimising. Ignác (2024) bring up that the term could be discussed in relation to distributive justice and fairness. The study establish that economic and political legitimacy are two empirically distinct concepts. The results can be taken as an indication that political institutions might have primacy over economic (Ignác, 2024). However, Ignác (2024) also point out that the empirical evidence should be cautiously interpreted.

underpinning decisions to invest in a focal actor (Thornton, Ocasio & Lounsbury, 2012; Fisher et al., 2017). Investment (and interaction) stems from economic returns or an opportunity to participate in the endeavour (cf. Fisher et al., 2017). Financial investment in a large-scale Big Science endeavour means that static costs are more certain than the potential economic benefits. Furthermore, it is argued that costs and benefits arise at different points in time as costs prelude potential benefits (Håkansson & Snehota, 1995, p. 388). Åberg (2013)²² point to economic utility and financial justifications as part of justifying Big Science. For instance, Åberg (2013, pp. 131–136) discuss potential economic utility (for companies) from Big Science. One characteristic of justification concerns “[e]conomic utility from high-tech contracts” (Åberg, 2013, p. 145). Related to financial justifications, it is reasoned that building a new accelerator at the original site (Åberg, 2013, p. 145) could reduce costs (ibid., p. 130). Åberg (2013, p. 147) suggest that there is a tendency towards more and more financial justifications. The aforementioned study essentially shows that matters related to economic legitimising become relevant for different types of actors to pursue these types of endeavours.

For the ESS, an illustration of economic legitimising is arguing that counterparts can reap proposed economic benefits by interacting with the ESS, such as possible financial gain for the member countries investing in the ESS. Håkansson and Snehota (1995, pp. 383–384) drive an argument related to the economy of networks, stating that resources and their utilisation cannot be considered given, since it depends on how resource utilisation changes and evolves. As process, a counterpart might financially invest in the ESS, but the return is not immediate nor automatic as it depends on dynamic performance of the counterpart, dyad, and third parties in the network so as to gain economic benefits. There might also be economic legitimising in terms of specific numbers (e.g. monetary profit or reduced costs), but if it is in a counterpart’s interests depends on how desirable and appropriate the economic benefit is in relation to the (economic) size of the actor and the perceived relative potential economic gain.

2.5.1.2 Mobilising

Ritvala and Salmi (2011, p. 887) define mobilisation as “a dynamic process of engaging actors on broad fronts to tackle a common issue”. Since actors have limited resources, different types of actors are relevant in order to acquire necessary resources (e.g. Håkansson & Snehota, 1995; Hermes & Mainela, 2014; Leite & Bengtson, 2018). Mobilising science, political, and business

²² This is a study situated in IMP, involving a Big Science facility (i.e. CERN), that, amongst other things, bring up economic utility and financial justification.

actors is challenging due to their heterogeneity, for instance, because they have different goals and conflicting interests (Hermes & Mainela, 2014). At the same time, due to the problems of one type of actor, another type of actor can be recruited (Ford & Håkansson, 2006a; Leite, 2022). Mobilising actors from different spheres entails identifying relevant actors (see e.g. van Bockhaven & Matthyssens, 2017; Bengtson et al., 2022). Furthermore, actors need the will and interest to deploy necessary resources (Ritvala & Salmi, 2010).

In my study, mobilising means attracting and enlisting actors and their resources to the ESS. The ESS requires resources that can only be acquired through other actors. Counterparts choosing to interact with the ESS are sufficiently committed to the idea, investment, or actor as desirable and appropriate. In an interorganisational context of actors from different spheres of society, different types of actors control various types of resources as well as have varying interests in mobilising their resources. Mobilising a resource entails mobilising an actor. However, an actor, in and of itself, can also be part of the mobilising process, making its resources available, which can mean that a mobilised actor in turn is sufficiently committed to invest additional resources in the relationship with the ESS.

2.5.1.3 Embedding

Embeddedness, according to Halinen and Törnroos (1998, pp. 188 & 189), refers “to companies’ relations with, and dependence on, various types of network”. Actors are embedded in broader contextual settings, and connected with various other network structures (Halinen & Törnroos, 1998). Interacting with a counterpart means that an actor can get closer to the counterpart’s other actor relationships (Anderson et al., 1994). Understanding relationships requires acknowledging other relationships and a broader context in which the relationship and focal actor resides (Welch & Wilkinson, 2004). Political actors, for example, are themselves embedded with other actors, including voters (Hadjikhani et al., 2019). As an actor becomes embedded it can also change the embedded context (Bengtson et al., 2022). Furthermore, legitimation processes can entail structural changes in the network (Hermes & Mainela, 2022).

In my study, embedding refers to other actors becoming embedded into a growing ESS-network. As the ESS moves towards being realised, additional actor groups from different spheres become embedded in the ESS-network. This network is continuously expanding (occasionally contracting, as some actors become only temporarily embedded) and therefore changing. Actors involved in the ESS-network gradually become more embedded and committed to realising the ESS. Furthermore, embedded actors, in turn, mobilise third party actors that become embedded in the ESS-network. Additionally, as the

ESS is itself becoming more concrete, so too is the network becoming more concrete.

2.5.2 Interplay between concepts in the process of realising the ESS

This section describes the processual interplay between the aforementioned concepts by focusing on elaborating what happens between the concepts in general as well as analytically specifying each interplay using additional categorisations.

2.5.2.1 Interplay between legitimising and mobilising

Legitimising and mobilising are reciprocally connected. Actors are mobilised because they control resources that are crucial for realising the ESS, in which a process of legitimising helps in accessing actors' resources (Håkansson & Snehota, 1995; Suchman, 1995). In order to mobilise actors and their resources, the focal actor needs to legitimise possible interaction using technological, sociopolitical, and economic legitimising involving various benefits to satisfy the interests of its counterparts. Ritvala and Salmi (2011) noted that actors mobilise due to potential, albeit foreseeable, benefits, which could also be viewed as emphasising motivational factors involving proposed benefits of joining an ESS-network. By mobilising actors, the focal actor and its endeavour becomes more legitimate as mobilised actors enable reaping the proposed benefits. Within an industry²³, Aldrich and Fiol (1994, p. 656) propose that “[i]ndustries in which founders mobilize to take collective action will gain sociopolitical approval more quickly than others”.

Proposed benefits

Legitimising the ESS by formulating proposed benefits mobilises actors. Ritvala and Salmi (2010) are interested in the motivations prompting actors to mobilise towards an issue. I propose that a mobilising mechanism concerns proposed benefits that satisfy the interests of actors inside different spheres of society. Mobilising actors entails targeting specific actors to become mobilised (Ritvala & Salmi, 2011), including targets of legitimation (Hermes & Mainela, 2022). Incentivising is central to mobilising actors (Hermes & Mainela, 2014). Pragmatic legitimising (e.g. Kumar & Das, 2007) by satisfying the interests of an actor's counterparts is a mechanism for mobilising, viewed as proposed benefits. Due to counterparts operating with different interests, legitimising an endeavour might require depicting it in different ways

²³ In their paper, they specifically used the term “intraindustry”.

to various types of actors (cf. Fisher et al., 2017). An actor mobilises (its resources) by heeding a call to connect to the focal actor and a surrounding network, involving the technological, sociopolitical, and economic legitimising of the endeavour. Actors start mobilising towards the ESS in response to a variety of arguments, as proposed benefits, and this dynamic also extends to mobilising third parties.

Framing

Framing has been used in a variety of research, although it appears slightly differently in different research domains. Related to my own thesis, it could be stated that framing involves depicting an entity or issue so as to influence how other actors perceive it (Fisher et al., 2017), thereby legitimising the endeavour by problematising a situation and offering a subsequent solution (see Suddaby et al., 2017). Framing essentially means that legitimising occurs by depicting a problem and its subsequent solution as desirable and appropriate in order to mobilise actors (see Suchman, 1995; Bengtson et al., 2022). Specifically, framing works by problematising a situation (relevant to a specific actor), such as a problem, shortcoming, or improvement, in order to then mobilise actors to connect to, in this case, the ESS. Moreover, the mobilised actors likewise problematise the situation, in turn sparking additional mobilisation of actors and resources.

Ritvala and Salmi (2011) reason that if an issue is framed in a loose albeit interesting manner, actors will act positively as there is room to integrate the issue with their strategies. Emphasis frames involves framing the ESS by pointing to certain aspects of it that are desirable and appropriate for relevant counterparts (Suchman, 1995; Fisher et al., 2017) so that they will mobilise. Fisher et al. (2017) point to emphasis frames, essentially framing a venture by emphasising certain aspects relevant to the target audience. They argue that if the venture does not enact different emphasis frames related to various audiences, it might be perceived as unfamiliar and unrecognisable. Different parts of an actor can have distinct identities to different counterparts (see Håkansson & Snehota, 1995, p. 196). Garnering legitimacy does not necessarily entail a one-size-fits-all approach as an actor distinguishes its various audiences depending on their interests.

2.5.2.2 Interplay between legitimising and embedding

Legitimising and embedding relate insofar as embedding actors into a growing ESS-network requires legitimising, and is also legitimising the ESS. It is argued that a process of legitimising might entail changes in the network (Hermes & Mainela, 2022). As an ESS-network expands to include additional actors, this increases legitimacy (cf. Aldrich & Fiol, 1994). As a new endeavour

interacting with different spheres of society, it is possible for the ESS to gain legitimacy if sufficient amounts of actors join to build the reputation of an ESS-network as a taken-for-granted entrant within a bigger community (cf. Aldrich & Fiol, 1994).

An embedded counterpart that finds the ESS highly desirable in terms of satisfying its own interests will become more committed to a process of legitimising the ESS. Positive recognition and relationships with well-respected actors can legitimise the ESS as an endeavour (Anderson et al., 1994; Leite & Bengtson, 2018). Furthermore, third party actors in embedded counterparts' networks become part of the process of legitimising the ESS. Through network effects, third parties are legitimising the ESS towards actors inside their own network. Moreover, third party actors become relevant as the ESS is being legitimised towards, for instance, political actors using arguments that essentially require involving business actors.

Path dependency

The legitimising arguments citing proposed benefits affect the path dependency of the focal actor and other actors in the surrounding network. As such, in a process, preceding phases become points of departure for subsequent phases involving phases building on each other as layer is added upon layers. For instance, as actors acknowledge the need to involve political actors, the ESS is being legitimised as an investment, whereby realising the ESS as an actor involves counterparts attempting to reap said benefits, for example, by starting new initiatives. Lock-in effects from initial interactions affect the ESS in later parts of the process (cf. Håkansson & Waluszewski, 2002).

Fisher et al. (2016) proposes the notion of legitimacy buffering, meaning that ventures build legitimacy as they garner it from earlier stages, which is helpful in encountering new sets of actors in subsequent stages. Fisher et al. (2016, p. 402) argue that “[t]he notion of legitimacy buffering helps explain how new venture legitimation can be path dependent even when different audiences use distinctive legitimacy criteria”. Building legitimacy concerning science actors could possibly help later in the process when both science and political actors are involved.

Fit

Embedding as fitting together with a pre-existing and ever-changing whole entails legitimacy. This draws on the notion of legitimacy as an entity fitting into an external environment (e.g. DiMaggio & Powell, 1983; Suddaby et al., 2017; Hermes & Mainela, 2022). In my study, this concerns different forms of legitimising (i.e. technological, sociopolitical, and economic), depending on what is being legitimised. In IMP, external legitimacy can be viewed as fit

or acceptance between a focal actor and its environment, whereas internal legitimacy involves internal constituencies (Gebert Persson et al., 2011). According to Suddaby, Bitektine, and Haack (2017, p. 462), legitimising can be understood as “how an actor acquires affiliation with an existing social order or category”. This is related to embedding, as an actor acquires affiliation and congruence with a pre-existing and ever-changing whole. Fit is also understood as aligning interests as well as acceptance by network constituents (Low & Johnston, 2008; Hermes & Mainela, 2014).

Enhancing legitimacy suggests a fit (Fisher et al., 2017), such as fostering legitimacy through a fit involving technological, sociopolitical, and economic contexts. Additionally, it is likely that an emerging endeavour like the ESS, involving different types of actors, will attempt to appeal to certain types of actors at different points in time (Fisher et al., 2016; Fisher et al., 2017). It could also be argued that legitimising is aided by a widespread understanding of how the ESS and the ESS-network fits into a community (cf. Aldrich & Fiol, 1994), a matter that could involve aligning interests (Hermes & Mainela, 2014).

2.5.2.3 Interplay between mobilising and embedding

Mobilising and embedding are related, because successfully mobilising actors and resources leads to embedding in the network, and mobilising by embedding actors in turn changes the network in which they are being embedded. Network mobilisation entails developing new as well as changing existing actor relationships (Hermes & Mainela, 2014).

Engaging in interaction not perceived as beneficial (i.e. low pragmatic legitimacy) is expected to incur low commitment (Kumar & Das, 2007; Gebert Persson et al., 2011). Conversely, it could be reasoned that high pragmatic legitimacy leads to strong commitment. If actors believe that interaction will satisfy their own interests, it will increase commitment. Such a commitment could extend to involving additional interaction amongst third party actors.

Overlapping networks

Actors are embedded in each of their various networks. The notion of overlapping networks takes into account that counterparts are embedded inside various other networks (e.g. Håkansson & Snehota, 1995). Actors that are embedded in pre-existing networks need to take their other counterparts into consideration in the mobilisation process. This particularly applies to political actors embedded in networks, for example, consisting of citizens (cf. Hadjikhani et al., 2019), which affects the process of realising the ESS by impacting the focal actor and its other counterparts. In my study, embedded actors are mobilising third party actors on behalf of the focal actor. In terms of resources,

counterparts are mobilising third parties inside their own network, on behalf of the focal actor, to make resources available to the ESS.

Emerging context

Realising a large-scale endeavour such as the ESS involves a continuously emerging context. Håkansson and Snehota (1995) argue that an actor is part of a context that it can influence all the while it is also influenced by the context. In a way, the ESS springs out of an emerging context, as the whole is changing by realising a need for a new neutron facility in which the emerging context gradually evolves throughout the process. In order to move the process forward, there is a need for change in an embedded context (Bengtson & Håkansson, 2008), thereby mobilising additional actors and resources; the mobilised actors and resources in turn changes embeddedness inside a context that is constantly changing (see Tsoukas & Chia, 2002). For instance, the context changes by mobilising new actors and resources, in turn changing the network surrounding the ESS (Hermes & Mainela, 2022). The network context of the ESS as it is realised is thus never set, but is emerging and changing continuously over time.

2.6 Summary

In this chapter, the business network approach was outlined, followed by a discussion of dynamic networks and different types of actors. We then zoomed in on the concepts of mobilising, embedding, and legitimising, subsequently deriving a model of analysis. The business network approach means that actors are interdependent and connected, forming networks that are dynamic over time (Håkansson & Snehota, 1995). Prior emphasis on business actors has gradually shifted towards including non-business actors, such as socio-political, science, and other types of actors like the media. The theoretical chapter elaborated on the concepts of mobilising, embedding, and legitimising, with an emphasis on actors. The concepts of mobilising and embedding are two analytical tools that are relatively more researched in IMP than is legitimising, which is less developed and refined in this stream of literature. Drawing on legitimacy literature from other fields as well as elaborating on insights derived from using the concept in network studies, the theoretical chapter also discusses insights into legitimising as process (e.g. Suddaby et al., 2017) involving actors. Moving towards my own view, legitimising is refined into three forms, namely technological, sociopolitical, and economic legitimising. It is argued that legitimising is supported by processes involving mobilising and embedding in a model that connects the three concepts, both

altogether and in pairs that are analytically specified by including additional dimensions.

Ultimately, “the IMP network approach rests heavily on dealing with empirical material” (Håkansson & Waluszewski, 2002, p. 13). To capture issues such as interdependencies and connectedness (Håkansson & Snehota, 1995) in a dynamic reality (Bengtson et al., 2020), my study builds on an IMP tradition of rich case descriptions of the business network landscape (Halinen & Törnroos, 2005). The following chapter shows how this study makes sense of a vast empirical reality so as to analyse the process of creating an actor from idea towards reality in an interorganisational context.

3 Methodology

This chapter presents the methodology, describing my research process and discussing the implications of various methodological decisions, including reflections on methodological choices.

3.1 Research design

Van de Ven (2007, p. 36) remind us of the philosophies of science that underpin research, such as ontology (i.e. nature of the studied phenomenon) and epistemology (i.e. methods to understand the phenomenon). In simple terms, ontology can be described as how one views the world and epistemology as how one can obtain knowledge about the world²⁴. This thesis adopts social constructivism²⁵, which suggests that it is the way that my phenomenon is perceived by involved actors that is of interest. Håkansson and Snehota (2017, p. 14) eloquently claimed that a challenge in IMP research “appears to be generalizing uniqueness”. Moreover, “[t]he challenge for researchers is to find approaches and methods to theorize and research the interactive effects in their uniqueness” (Håkansson & Snehota, 2017, p. 14).

The purpose of my study is to analyse the process of creating an actor from idea towards reality in an interorganisational context. This study uses a process perspective to understanding legitimising, whereby the unit of analysis concerns creating a Big Science actor in a business network. Additionally, I adopt many of the methodological choices common within an IMP approach, such as following abductive reasoning, drawing on insights from systematic combining (Dubois & Gadde, 2002, 2014), a qualitative research strategy (e.g. Möller & Halinen, 2022), and using an in-depth single-case study (e.g. Dubois

²⁴ The two most common ontologies in business network research are realist, or critical realism, and (moderate) social constructivism (see Guercini & Medlin, 2020).

²⁵ Regarding ontology and epistemology, these are the leanings in my thesis. However, I likewise recognise the value of other perspectives within the philosophy of science, as each, arguably, has its own time and place. Although what constitutes the “best” or most “legitimate” ontology and epistemology has been a point of debate since time immemorial, it seems that researchers, in general, have settled on some common ground by acknowledging that each perspective can be more/less suitable depending on the specific research and also has a few implications for the research endeavour.

& Gadde, 2002; Halinen & Törnroos, 2005; Dubois & Gadde, 2014). I have done this in conducting phenomenon-driven research (e.g. Håkansson & Snehota, 2017) into the retrospective and real-time process (Bizzi & Langley, 2012) of legitimising the ESS. Data collected from interviews and documents were analysed as a process using a combination of a narrative strategy and temporal bracketing (see Langley, 1999).

IMP research tends to be empirically driven, producing descriptive theories to conceptualise the business world (Håkansson & Snehota, 2017, p. 15). Inductive reasoning and abductive reasoning represent the most common ways to approach reality, usually aiming towards some type of theory development²⁶. A commonly used approach in IMP studies is systematic combining, which, according to its originators “can be described as a nonlinear, path-dependent process of combining efforts with the ultimate objective of matching theory and reality”, particularly useful for theory development (Dubois & Gadde, 2002, p. 556). Dubois and Gadde (2002) posit that systematic combining is grounded in an abductive logic. The “abductive approach is fruitful if the researcher’s objective is to discover new things”, such as generating new concepts (Dubois & Gadde, 2002, p. 559). In doing so, the quest for theory development by generalising a study’s relevance and implications tends to draw on, and elaborate, analytical inferences²⁷ to make a contribution to the IMP literature.

The nature of abductive reasoning in the systematic combining approach is not surprising given its emphasis on constant movement between the empirical and theoretical worlds as a main characteristic (Dubois & Gadde, 2002). Moreover, Langley (1999, p. 694), elaborating on the use of sensemaking, point out that theorising (in a processual study) may iterate between data and theory, arguing that “[r]igid adherence to purely deductive or purely inductive strategies seems unnecessarily stultifying”. In systematic combining, the “theoretical framework, empirical fieldwork, and case analysis evolve simultaneously” (Dubois & Gadde, 2002, p. 554), which occurs continuously. Theory development in my thesis involves all three elements (i.e. theory, data, and analysis) via a constant process of attempting to match theory and reality, thereby gradually homing in on a satisfactory answer to “What is this a case of?” In this approach, one way to view the relevance of theory is that it situates the empirical material inside some type of relevant conceptual boundary, rather than building theory from a virtually non-existent theoretical framework.

²⁶ Asserting that an IMP study contributes to ‘theory development’ seems to be more common than referring to ‘theory generating’ (associated with inductive reasoning), whereas ‘theory testing’ tends to shine in its absence, although there are certainly important IMP contributions drawing on deductive reasoning (see e.g. Hadjikhani & Thilenius, 2009).

²⁷ Compared with statistical inferences, common in deduction.

Indeed, a continuously evolving theoretical framework gives direction to the search for empirical data (Dubois & Gadde, 2002), and additional empirical data likewise inform the evolving theoretical framework.

In general, induction tends to be concerned with theory building (new theories) and deduction with theory testing (existing theories), whereas abduction concerns theory development, meaning that it is used in building or refining theories. Legitimacy is a concept that is used in several theories, such as institutional theory as well as, to some extent, in IMP. My intention in this thesis is to make a contribution to the business network approach by situating the concept of legitimising inside research concerning interorganisational contexts. Thus, the theory development conducted here concerns elaborating on legitimising, incorporating it into IMP research.

3.1.1 Using a process perspective

This section presents and discusses some of the basic tenets of a process philosophy, including various implications of adopting a process perspective. A fitting description of process, for my thesis, is found by referring to Bizzi and Langley (2012, p. 225), who paraphrased Langley, stating that “[p]rocess research involves the study of how and why some significant temporally evolving phenomenon unfolds over time (Langley, 2009a)”²⁸.

Cloutier and Langley (2020) point out that scholars have produced many different conceptualisations of process theorising. Following the basic tenets of process, the main thrust of a process study is to pay particular attention to the notion of time and its unfolding (see e.g. Langley, 1999; Van de Ven, 2007), involving “activity, temporality and flow” (Cloutier & Langley, 2020, p. 3). Process data concern “what happened and who did what when” in chronological order (Langley, 1999, p. 692). Another common feature is to theorise in terms of events. Van de Ven (2007) writes that it is useful to distinguish between incidents and events, stating that “[i]ncidents are operational empirical observations, while events are abstract concepts of bracketed or coded sets of incidents” (p. 217), whereby incidents refer to observations and events to unobserved constructs (p. 195). Conceptualising an event entails some ambiguity as to what constitutes an event, which, drawing on Langley’s (1999) examples, can include a handshake or a merger, both of which can be

²⁸ There are other definitions of process in the literature. For instance, Van de Ven and Poole (1995, p. 512) “refer to process as the progression (i.e., the order and sequence) of events in an organizational entity’s existence over time”.

conceptualised as events, yet significantly differ (e.g. impact on the phenomenon or its scale²⁹).

Although temporality can be analytically divided into discrete events, Langley and Tsoukas (2016) remind us that the continuity of experience (or phenomena) is relevant. For instance, a process of legitimising is ongoing, involving some temporal continuity across each phase throughout the process. However, such a temporal process can also be analytically divided into phases, which display continuity within and discontinuity amongst them. Moreover, Van de Ven (2007, p. 217) state that “[e]vents may be embedded within different types of events of a larger scope”. As such, there are additional, fine-grained temporal events and activities. A passage from Langley and Tsoukas (2016, p. 9) illustrates this quite well: “[a]s process philosopher Rescher (1996: 29) argues, ‘the idea of discrete “events” dissolves into a manifold of processes which themselves dissolve into further processes.’”

Process studies acknowledge “explicit chains of events, activity and interactions” (Cloutier & Langley, 2020, p. 5). A process study can be retrospective or in real-time (e.g. Bizzi & Langley, 2012). Bizzi and Langley (2012, p. 227) argue that “[r]etrospective research designs are particularly useful to study network processes and network evolution over large windows of time”, such as uncovering substantial network changes. Langley and Tsoukas (2016, p. 12) categorise two types of (retrospective) after-the-fact process studies that differ depending on whether studying processes from the outside or inside. Developmental studies involve studying processes from the outside and after the fact, whereby “[t]he researcher stands outside the process and seeks to understand its contour backwards. The underlying image of process is that of motion” (Langley & Tsoukas, 2016, p. 12). At the same time, Langley and Tsoukas (2016, p. 14) pointed out that the distinction represents ideal types, which in prior (empirical) research have been combined.

Langley (1999, p. 692) state that process data can be challenging as they can “involve multiple levels and units of analysis whose boundaries are ambiguous”. An overarching benefit of using a qualitative process approach is that it enables the context to be taken into account (see e.g. Langley, 1999). The business network approach acknowledges three levels of analysis, including the firm, dyad, and network levels, which are conceptualised as so-called functions (see e.g. Håkansson & Snehota, 1995). As alluded to, Langley (1999) suggests that it can sometimes be cumbersome to separate different levels of analysis in process studies. This issue arguably becomes particularly pressing in business network research, seeing as it is indeed possible to

²⁹ Having said that, it is, of course, equally possible that the event of a handshake can have a bigger impact on the process than the unfolding of a merger, so it is not black or white.

analytically distinguish the level of analysis as the firm, dyad, or the whole network, while it is recognised that all three levels exist and interplay. Homing in on the phenomenon, delineating the boundary and level(s) of analysis becomes challenging since legitimising permeates the ESS, its relationships, as well as actors in the network. To this end, it is important to be aware of boundaries in order to, in some sense, isolate the phenomenon (i.e. legitimising) while paying attention to the relevance of context and the interplay between levels of analyses. According to Dubois and Gadde (2002, p. 554) “[t]he interaction between a phenomenon and its context is best understood through in-depth case studies”.

3.2 Case study

Using case studies is common in IMP (see e.g. Dubois & Gadde, 2002; Dubois & Araujo, 2004; Halinen & Törnroos, 2005). At the same time, Dubois and Araujo (2004, p. 208) point out that “[t]he notion of case research is in many ways unclear and diffuse”. Paraphrasing, Halinen and Törnroos (2005, p. 1286) stated that “case studies offer depth and comprehensiveness for understanding the specific phenomenon (Easton, 1995, p. 475)”. A benefit of case studies is that they provide what scholars commonly refer to as rich descriptions (e.g. Halinen & Törnroos, 2005). Halinen and Törnroos (2005, p. 1286) state that IMP “has been active in providing rich descriptions of how business networks function” as well as in creating fresh views of reality. Case studies, perhaps particularly in IMP research, concern a sampling trade-off between depth versus breadth (Bizzi & Langley, 2012). It is argued that “[i]n-depth single case studies tend to produce rich understanding of specific contexts, but there is a risk of generating rather idiosyncratic stories where general lessons are hard to draw” (Bizzi & Langley, 2012, p. 228).

As alluded to, IMP research is empirically driven whereby its early foundation to theorise about an interaction model (Håkansson, 1982) and the ARA-model (Håkansson & Snehota, 1995) were based on empirical insights derived from large case studies and phenomenon-driven research (Håkansson & Snehota, 2017). Case studies are common not least in regard to theory development. A case study is appropriate if there is limited research on the phenomenon (e.g. Halinen & Törnroos, 2005). As previously highlighted in the theoretical chapter, there is indeed some research concerning legitimacy in IMP, and certainly in other streams of literature such as organisation studies. Nevertheless, the phenomenon of legitimising, as conceptualised here (e.g. concerning different spheres of society and drawing on the three forms of

legitimising), provides a basis for conducting case research simply because it is a phenomenon that lacks significant previous research in IMP.

3.2.1 Case selection

Halinen and Törnroos (2005, p. 1287) posit that “[t]he complexity formed by structure and embeddedness creates important problems for a researcher. It is not simple to describe a network”. In my thesis, specifically regarding case selection, decisions concerning spatial and temporal boundary setting are of utmost relevance. Halinen and Törnroos (2005, p. 1286) discuss the nature of IMP research within the area of conducting case studies, for example, stating that the temporal dimension cannot be ignored and pointing out that “business networks are often viewed as embedded in different spatial, social, political, technological and market structures, which makes each network somewhat unique and context specific”. I study the legitimising process for creating a Big Science actor in a business network, illustrating a setting of interorganisational interaction between actors from different spheres of society.

Due to the major investment in the ESS, spanning several decades, realising the ESS provides a particularly fruitful context in which to explore legitimising because of its distinctiveness relating to the vast interorganisational interaction and huge costs funded by public actors. Interorganisational interaction surrounding the ESS involves several different spheres of society, more so than in many other contexts, including business, science, politics, and more. Such legitimising that involves different spheres of society offers a suitable case for theory development about legitimising in an interorganisational context. The former Director General of the ESS, Womersley, eloquently illustrates how the massive costs of ESS matter:

“ESS is a 3 billion Euro investment by the time you include the first couple of years of operation. And that means its subject to a much greater scrutiny than an individual research grant to an individual university, or even the annual budget of the research council. To address big problems on a multidecade timescale requires big investments on a multidecade timescale. And that means they are politically visible and they have to be compared with other multibillion political investments. Not just with other science projects.” (Interview Womersley)

This also highlights the complexities of legitimising compared to a single company that is not as reliant on public funding and vast interorganisational interaction. As such, looking at legitimising surrounding the ESS, which involves different spheres of society comprising business, science, politics, and

the media, offers a suitable case for theory development about how the legitimising process for creating a Big Science actor unfolds in a business network.

My research emphasises a focal actor perspective (i.e. the ESS), whereby the network is depicted in terms of the actors that interact with the focal actor. The boundaries that delimit the case entails a fairly broad depiction of the network, both in actual numbers of relevant actors and concerning the different types of actors. The ESS interacts with a myriad of actors from different spheres of society. Furthermore, although the focal actor interacts with actors such as the media and various political actors, my study also acknowledges that actors in the network interact with each other and in doing so, in terms of legitimising, the focal actor is indirectly involved.

Moreover, a case requires formulating boundaries in time and space. Dubois and Gadde (2002) acknowledge that a process goes as far back in time as the researcher sees fit, with the starting point of the process being a deliberate choice. For the ESS, there is a fairly clear starting point, which is when the idea of a facility akin to the ESS started emerging, which is, however, less clear in terms of specifying an event or a date other than somewhat ambiguously stating that the idea emerged sometime in the mid-1980s. At the other end of the process, Dubois and Gadde (2002) likewise acknowledged that a process has to come to an end, at least in the research endeavour (even as the process continues ‘in the real world’).

In the case of legitimising Big Science, in my thesis, the focal actor and the surrounding network cannot necessarily be separated from each other, since legitimising refers to making interaction with the focal actor desirable, proper, or appropriate for other relevant actors such as political actors (e.g. to fund the ESS) and by involving business actors (e.g. to build the ESS). Arguably, gaining some insight (albeit limited) into other actors enables a fairly good, but by no means exhaustive, picture of other key actors in the depicted network (e.g. Big Science Sweden) by using interviews and documents to explore other actors’ viewpoints.

The sheer scale of matters surrounding the ESS has been challenging to grasp, particularly considering the vast number of involved individuals and actors. This has been taken into consideration by continuously trying to pinpoint a relevant and specific case throughout the abductive process of matching. In other words, I have had to think carefully about the question: “What is this a case of?” It is indeed possible that some important actors who have had a relatively great influence have been overlooked. At the same time, although a few of the important actors might have been overlooked, it is still possible to discern the legitimising process of creating a Big Science actor in a business network.

3.2.2 The empirical setting

The ESS is envisioned to become the world's most powerful neutron source. Today, we can see how large stretches of farmland outside the town of Lund, Sweden, are being transformed into a large-scale science facility³⁰. However, discussions of the idea of constructing a facility akin to the ESS were initiated almost four decades ago. Figure 2 below showcases critical events in materialising the ESS (presented in three empirical chapters covering the mid-1980s to 2009; 2009 to 2023; and the suppliers).

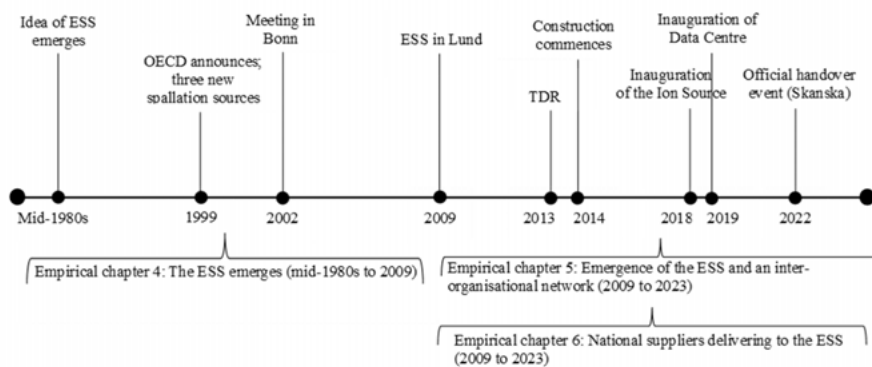


Figure 2 Timeline of realising the ESS

From one perspective, what is envisioned is that the ESS will be a factory for producing neutrons using an accelerator and a target. However, aside from a purely technical and scientific description, answering the question of what we are actually looking at requires many different lenses. Such huge investments likewise spark the imagination of other actors who hope to reap a variety of benefits involved in materialising Big Science facilities. In the case of something like the ESS, many different types of actors have an interest in reaping a broad range of proposed benefits. Interaction occurs on the basis of reaping the proposed benefits connected to the attributes of a Big Science facility, which are encapsulated within the idea of the ESS. Figure 3 below shows the focal actor and a network of relevant actors.

³⁰ There is also a Data Management and Software Centre (DMSC), located in Copenhagen, Denmark, attached to the ESS.

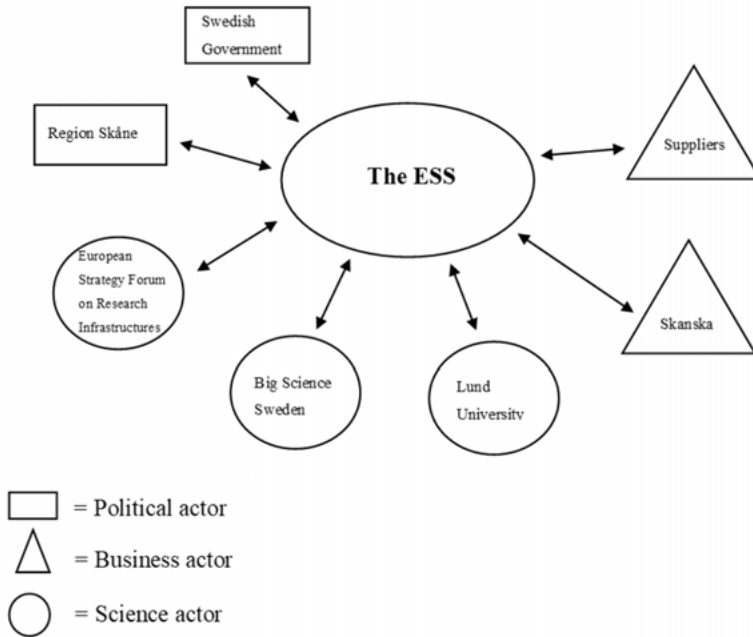


Figure 3 The focal actor and other relevant actors divided into different types of actors signified by the different shapes

3.2.3 Unit of analysis

Looking at the process of creating the ESS involves considering how the legitimising of Big Science unfolds over time. Legitimacy, often studied as a static substance, is instead “approached as situated sequences of activities and complexes of processes unfolding in time” (Langley & Tsoukas, 2016, p. 24), in interaction between actors situated within an IMP framework involving assumptions such as interdependence and connectedness (see Håkansson & Snehota, 1995). Indeed, whereas legitimacy, as a rather static concept, can be studied as a type of state or stable condition (Suddaby et al., 2017), legitimising is a dynamic process. Suddaby, Bitektine, and Haack (2017, p. 459) write that “[t]he unit of analysis, thus, is not the outcome of this process, but rather is focused on the process itself”. A process perspective illuminates various nuances of legitimising and how the phenomenon evolves, to thereby “consider the dynamic unfolding of phenomena over time” (Cloutier & Langley, 2020, p. 1).

My thesis intends to analyse the process of creating an actor from idea towards reality in an interorganisational context. Bizzi and Langley (2012) point out that setting boundaries in network research can be challenging, to also problematise what is (and is not) part of the process. Langley (1999) hint that periods can be considered units of analysis (see the three sections in my analytical chapter). In this study, the main unit of analysis is the entire process of creating an actor from idea towards reality in an interorganisational context, bracketed into three distinct phases.

Realising the ESS started in the mid-1980s, extending to cover the entire process leading towards the final stages of construction in 2023. Setting the mid-1980s as a starting point was motivated by reasoning that, at the time, there were informal discussions in Europe about building a spallation source akin to the ESS. The process of realising the ESS from idea towards reality started as an idea during which it was vital to motivate why the ESS should be built, why it should be located in Lund, and why the Swedish Government should consider hosting it. In 2009, it was decided that the ESS would be located in Lund, Sweden. At this time, there was a big spike in the number of newspaper articles published in Sweden mentioning the European Spallation Source (see *Figure 4* in 3.3.2 *Newspaper articles*). In 2014, construction of the ESS facility commenced, and it started become materialised into reality. As in 2009, there was a huge spike in the number of published newspaper articles in 2014 (see *Figure 4* in 3.3.2 *Newspaper articles*).

Although my research follows the ESS in real time, starting in year 2020, there is an obvious element of conducting retrospective research to understand the process prior to 2020, all the way back to the mid-1980s. The first empirical chapter predominantly uses documents³¹ to explore and understand the earliest stages of the legitimising process, whereas around the turn of the century the chapters increasingly start including a larger element of interviewees' retrospective accounts. The retrospective element of the study imposes a limitation in the sense that the early part of the timeline starting in the mid-1980s, it can be argued, is less fine-grained than the timeline is in later years that use both interviews and documents (of which there were also more published documents). This has been handled by using archival records to understand the early stages of the ESS. Moreover, although relatively few relevant newspaper articles were published in Sweden in the early 2000s, they are helpful in painting a fuller picture of realising the ESS, especially since they are somewhat less technical than other documents.

³¹ Various reports and other accounts (books) cover the early stages of the ESS.

Furthermore, critical events such as a decision in 2009 to place the ESS in Lund³² had already taken place prior to my study. Therefore, at the time of the interviews, individuals already knew that the ESS would end up in Lund. This requires awareness in terms of understanding their accounts and recollections of what happened prior to 2009. Having said that, documents offer a glimpse into reality at that time as they are unaffected by awareness of future events that would eventually lead to the decision in 2009. Additionally, this puts a challenge on me as a researcher, since I have to be aware of my own biases, knowing that the ESS would eventually end up in Lund. A similar line of reasoning applies to other critical events that took place prior to the beginning of my study, such as the start of construction of the facility in 2014.

At the time of writing, some parts of the ESS are currently completed whereas others remain under construction. If everything goes according to plan, the ESS is scheduled to be completed in 2027, postponed from its previous completion date in 2025. However, the ESS has room for additional instruments to accompany its current instrument suite, meaning that the process of materialising the ESS will, in some sense, continue long after the scheduled completion date.

One aspect in my study concerns what some process scholars term an ‘outcome’. Specifically, as Cloutier and Langley (2020, p. 5) eloquently put it, “the open-endedness of outcomes”. Legitimising as a process means that legitimacy is not determined once and for all as it is ongoing. This problematises one part of my retrospective research, since some of the retrospection involves stepping back in time, whereas other parts of the process are, as yet, unknown, which means that I can trace the process in view of my knowledge of an outcome (Bizzi & Langley, 2012), yet recognise that the scheduled completion of the ESS is not the ultimate outcome as such. Having said that, I do recognise that it is, empirically speaking, a goal (and vision) for many of the individuals involved in the process³³.

3.3 Data collection

Using both interviews and documents is a common type of data collection in IMP research. Bizzi and Langley (2012) argue that because of the complexity of studying networks, it is suitable to use several methods as a way to understand the process. Moreover, within the context of research about Big Science,

³² Prior to the decision, potentialities included placing the ESS elsewhere, or not proceed to build it all, and so on.

³³ Other actors, such as the Swedish Government, have different perspectives as they arguably are prioritising and pursuing a range of other goals, alongside the ESS.

or large-scale research infrastructure, Ruffin (2020, p. 31) pointed out that interviews and documents represent the most common means of data collection. A narrative approach can be viewed as “expressed in the recollections and reconstructions of individuals and groups” (Langley & Tsoukas, 2016, p. 15), using interviews which is complemented using documents. Moreover, documents (e.g. archival records) are beneficial for chronologically charting key events (e.g. Bizzi & Langley, 2012). The data in my study mainly comprise semi-structured interviews and documents, most of which are newspaper articles. I also attended a few ESS-related conferences hosted by Big Science Sweden as well as made a site visit to the European Spallation Source.

Qualitative (process) data can shed light on “why and how certain decisions or choices are made, at specific moments in time” (Cloutier & Langley, 2020, p. 5). Using both interviews and documents enabled data triangulation. From a social constructivism point of view, this means that the data sources reveal different stories related to the legitimising process of creating a Big Science actor in a business network. Additionally, hindsight bias³⁴, as “unwitting rationalization of past events so that they seem more linear than they really were” (Bizzi & Langley, 2012, p. 227), and arguably somewhat fuzzy memories of events that happened a decade or so previously, can be corroborated using documents. Importantly, the documents offer a glimpse into reality as it appeared at that time. This adds richness to understanding the process of legitimising. That is to say, data triangulation has helped me gather additional facets of the story, and ultimately create a fuller picture.

Halinen and Törnroos (2005), amongst others, have addressed the practicalities of conducting case research using qualitative data from interviews involving issues such as access. In my research, access has not proven to be a particularly salient problem (although there were a few instances of unsuccessful interview requests). Rather, perhaps, the main hurdle has been in deciding who to talk to and why (see 3.3.1 *Interviews*). Access to documents has likewise been quite straightforward³⁵ since many public documents are published online. The Retriever Research database from which I gathered newspaper articles covers a wide range of published articles.

³⁴ Halinen and Törnroos (2005, p. 1291) stated that “[r]econstructing historical events is another option for grasping change processes in network development, but it represents a kind of a post-rationalization of events by managers in interview situations, which can also be questioned”.

³⁵ However, there are some documents, especially from the early stages of the ESS, that have not been accessed that might be relevant to creating a fuller picture.

3.3.1 Interviews

My thesis includes 48 interviews, which took place from 2019³⁶ to year 2024. The interviews lasted an average of approximately 84 minutes. The interviews were conducted with individuals who could be categorised as science, political, or business actors, who have in one way or another been involved in the process of realising the ESS. I conducted 18 interviews by myself, 18 interviews together with my supervisor, and 12 interviews were conducted by my two supervisors within their own project. For an overview of the interviews, see Appendix 1. My interviews were conducted in intervals that were fairly spread out, rather than setting specific time periods in which to carry out most of the interviews (see Appendix 1).

The interviewees were identified in different ways, depending mainly on what categorisation they belonged to (i.e. science, politics, or business). Initially, when reading about the ESS, it became quite clear who the most prominent politicians and scientists were within this context. And as my knowledge of the ESS grew, the list of potential interviewees also grew. However, it is equally important, in this case, to think about who was relevant to interview and why, due to the abundance of individuals involved in matters surrounding the ESS. One way was through snowball sampling. Usually the interviewees were asked to recommend potentially relevant suppliers, people working at the ESS, other people related to the ESS, and anyone else who might be relevant to talk to. Regarding politicians and scientists, the snowball sampling usually tended to confirm the notion of who to talk to, seeing as several recommendations had already been identified as potentially relevant interviewees. Having said that, a few new names were identified solely through snowball sampling.

Suppliers were mostly identified from *The Swedish Guide*, an annual document published by Big Science Sweden that contains many Swedish Big Science suppliers. The two main criteria for suppliers were that they should be located in Sweden and that the supplier had in one way or another been interacting with the ESS (e.g. partaking in procurement or delivering products or services).

To give the reader a better understanding of the interviewees, the initial categorisation was broadly categorised into science, political, and business actors. Science actors mainly include scientists who work at, or with, the ESS. Political actors mainly include politicians who have been involved in the ESS in different ways. Business actors mainly include suppliers, generally companies who supply products or services to the ESS. At the same time, there is a

³⁶ The first interview was conducted by my supervisors. I began conducting my own interviews starting in year 2021 (see Appendix 1).

certain overlap between the categories in this empirical context. For example, the organisation Big Science Sweden is an actor that aims to connect suppliers to Big Science organisations. Big Science Sweden is funded by the Swedish Research Council and Vinnova as a public science–political initiative, driven and populated by several scientists who work with suppliers. Hence, it is a type of hybrid of a science, political, and business actor. Moreover, scientific actors, within this context, are also interesting seeing as several scientists have augmented their role and become part of the political landscape. Furthermore, individuals belonging to this category have had several different roles surrounding the ESS. For example, the former Director General of the ESS, Carlile, had previously worked as the Director General at another similar Big Science organisation, then joined ESS Scandinavia, then became Director General of the ESS, later holding a position at Science Village Scandinavia³⁷. There are many other examples of similar trajectories. That is, same people involved in different roles in different initiatives at different stages of the ESS. This is perhaps best explained by the European neutron and Big Science community being a relatively tight-knit group. Having said this, there is no point in an overly strict categorisation of the actors, seeing as the main emphasis is on the legitimising process for creating a Big Science actor in a business network. It is nonetheless worth noting that attempting to categorise the interviewees highlights one of the many peculiarities of this empirical context.

Interviewees categorised as suppliers range from CEOs to sales managers, and so on. CEOs tend to have a more comprehensive picture of their company, whereas non-CEO interviewees tend to know more about the relationship with the ESS. In many instances, however, especially in smaller companies, it is the CEO who has worked directly with the ESS. Some interviewees know a great deal not only about the ESS, but also about Big Science in general, whereas others have less insight into the ESS and simply view it as yet another customer.

All interview guides were designed for semi-structured interviews, with individual questions divided into overarching themes. The interview guides were slightly different for different actor groups and individuals, although the interview guides that were used for interviews with suppliers tended to follow a relatively generic template (see Appendix 2 for an interview guide including examples of questions for business actors). For example, for suppliers, themes such as “the company”, “the customers”, “Big Science customers”, and “ESS as a customer” were addressed. For instance, asking about their other customers in order to contextualise the ESS as a customer, and to better understand

³⁷ ESS Scandinavia and Science Village Scandinavia are elaborated on in the empirical chapters.

their company. While the interview guides designed for interviews with suppliers followed a relatively generic template, the interview guides for other actors from the political and science spheres tended to be heavily customised for the specific individual being interviewed. There were, of course, a few similarities between all of these interview guides as well, such as an emphasis on the ESS and generic questions pertaining to Big Science in general (see Appendix 2). However, usually both the themes and the specific questions differed. For example, when talking to individuals who were involved during the early stages of the ESS, it was important to step into their reality to know what to ask them about. This entailed doing enough research to understand what questions were relevant to ask particular persons, and thereby formulate appropriate questions pertaining to the interviewee's reality. Moreover, even though I had a relatively clear understanding of several interviewees prior to the actual interviews, it was equally important to be flexible and not follow the interview guide too strictly. Rather, it was important to allow the interviewee to elaborate on their own story in terms of what they deemed most important to communicate regarding their role in relation to the ESS.

In general, the interviews were conducted via Zoom. Usually there were two interviewers present, although I conducted 18 interviews by myself. My skill as an interviewer has improved as my PhD studies have progressed. My supervisor has guided me on how to conduct interviews, including insights into, for example, balancing a semi-structured interview guide between structure and open-endedness, how to focus on the themes in the interview guide, and how to formulate questions appropriately. This resulted in considerable knowledge transfer that gradually improved the quality of each interview. Usually, in my co-conducted interviews, one interviewer took the lead, such as leading the conversation and asking the questions, whereas the other interviewer ensured that we had asked most of our questions and asked complementary questions of their own every now and then. As mentioned previously, the interviews were mainly conducted via Zoom, with a few exceptions. This was partly due to the pandemic and partly due to the geographical distances. Due to the recent pandemic and its restrictions, the interviewees seemed quite comfortable using online video-conferencing software.

3.3.2 Newspaper articles

Newspaper articles were identified and downloaded from Retriever Research (Mediearkivet), a database containing Swedish newspaper articles going back approximately 25 years for some newspapers (Uppsala universitetsbibliotek, 2023). The Retriever Research database contains newspapers ranging from *Aftonbladet* to *Sydsvenskan* and more niche newspapers. *Aftonbladet* is one of

the biggest newspapers in Sweden, whereas *Sydsvenskan* is the main regional newspaper in the area of Scania (Skåne), and the niche newspapers range from topic based (e.g. life sciences) to locally based (e.g. *Ystads Allehanda*). That is to say, the database includes a range of newspaper articles, written about various topics to different audiences.

To my surprise, there was much more written about the ESS than I had anticipated. The analysis of the newspaper articles was not done by strictly coding the material, although I did loosely speaking identify possible themes, including dividing arguments into categories (e.g. value, money, competition, technical, environment, industry, and location). A benefit of using the newspaper articles concerned chronologically sorting my data, and being able to set specific dates for material from interviewees' accounts, as they did not always specify when certain topics or events occurred. The articles also permitted a fuller understanding of the topics or events. The collection of the newspaper articles was done in different stages.

The search term was simple and straightforward, 'European Spallation Source'. The database allows for changing a few settings, such as choosing what dates to include in the search. For each year, the dates 20xx-01-01 to 20xx-12-31 was chosen (e.g. 2000-01-01 to 2000-12-31). The database then also allows the option of sorting the newspaper articles chronologically, which helped me when initially skimming through each and every article, as it helped inform me about various topics in a coherent sequence, illustrated how topics unfolded chronologically, and built a general understanding of the wider narrative, prior to commencing the data analysis. Then, after skimming through each article in a specific year, the relevant articles were all downloaded as individual Word documents. The different Word documents include all the relevant newspaper articles for each year (e.g. 2000, 2001, 2002, etc.), which are chronologically structured, including a table of contents giving an overview including the titles of the articles and their publication dates.

Seeing as a total of 6,572 newspaper articles were identified using the search term 'European Spallation Source', and not all have been included in this study, this paragraph explains how the included articles were selected. Many of the omitted articles were duplicates, which the database automatically detects. From my understanding of the database, duplicates mean that several other newspapers publish either exactly the same text or only slightly different versions (e.g. changing a specific word or adding/omitting a sentence). This is usually the case for big and more general events (e.g. Skanska receiving a contract for the ESS). The number of duplicates increased over the years as more newspapers started writing about the ESS, especially small-scale locally based newspapers (mainly in the region of Skåne, such as *Ystads*

Allehanda). This partly explains why not all articles have been downloaded out of a total of 6,572. Usually, the duplicate newspaper articles that were saved were from the relevant newspapers, including either the big ones in Sweden such as *Svenska Dagbladet*, *Aftonbladet*, and *Metro*, or *Sydsvenskan*, as this newspaper was of particular relevance regarding the ESS, or *Uppsala Nya Tidning* since it was interesting to see what Uppsala (the “rival” university town) had to say about the ESS.

Another criterion for discarding articles was that included articles should preferably contain more than 70 words, although some articles containing fewer than 70 words were included since they shed light on the ESS. The reason for discarding articles with fewer than 70 words is that these were usually factual reports of certain events or happenings, were published in relatively small or niche newspapers, and/or related to events that several other newspaper articles had written about (similar to almost being a duplicate). Notwithstanding the exclusion of articles that contain fewer than 70 words, it is also relevant to point out that in some articles that do contain more than 70 words, the ESS is merely a background topic specifically addressed in fewer than 70 words. That is to say, some articles contain fewer than 70 words specifically about the ESS, but write about another matter to which the ESS is relevant. For example, articles about MAX IV, a nearby large-scale research facility, might briefly mention the ESS, and such articles have been included.

The toughest choice was when the newspaper articles were very similar, yet slightly different. While some newspaper articles were obviously duplicated word for word, usually derived from TT Nyhetsbyrå³⁸, other ‘duplicates’ that were not detected arose when newspapers wrote about similar events but in slightly different ways, and usually these articles have been included. Another issue is that some articles may cover a similar issue, but be published in very niche newspapers that likely have very limited readerships. In this case it was a balancing act whether or not to include the newspaper articles. They were usually included, but since there was no obvious way of drawing a clear line, some of them were discarded. This should not impose any limitation, and seeing as the collection of newspaper articles started after I had acquired a good grasp of the ESS, it was quite easy to recognise if a specific newspaper was presenting a new topic about an unknown event or was simply reiterating what other newspapers had already written.

See Figure 4 below for more information about the newspaper articles.

³⁸ TT Nyhetsbyrå is the largest news agency in the Nordic countries.

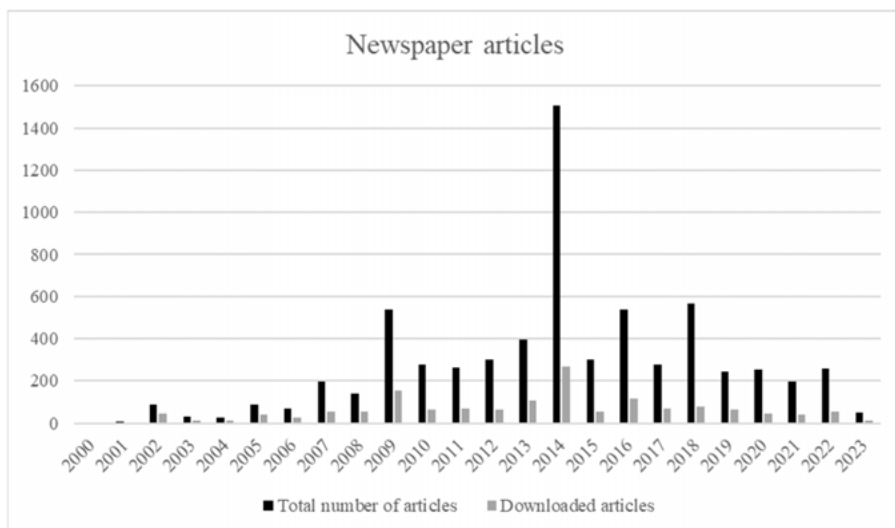


Figure 4 Total number of identified and downloaded articles, from Retriever Research database

There are two main spikes that stand out, a huge spike in 2014 and another big spike early in 2009. Year 2009 is when the decision was made to situate the ESS in Lund, while 2014 is when construction started at the ESS. Years 2016 and 2018 also stand out, whereas 2017, the year between, is average in terms of number of articles. Hence, the spikes in 2016 and 2018 are interesting to note, but it is also interesting that there was no spike in 2017. The figure shows that since about year 2010, with a few exceptions, there have been around 200–300 newspaper articles annually containing the search term ‘European Spallation Source’. Looking at the number of downloaded articles as a proportion of the total number of identified articles, during the initial years up to 2005, there were relatively more downloaded articles, but the proportion then decreased over the ensuing years. One reason, perhaps the main reason, is that a vast range of newspapers started to publish the same articles about the ESS, usually emanating from TT Nyhetsbyrån, and these were considered duplicates. Therefore, although the total number of articles might be quite high, it should be noted that many of these are duplicates.

3.3.3 Other sources

Other sources, such as videos and other documents, were identified in different ways. Mainly through a type of snowball sampling in terms of various documents referring to earlier written texts. Another way to find potentially relevant sources was to utilise the world’s biggest search engine, by Googling ‘European Spallation Source’ and adding other keywords (e.g. ‘VR’ or

‘samhällsnyttan’, or a Boolean search). I also used the biggest search engine for video content, YouTube, to find relevant videos. Another way was through interviewees who mentioned various issues or initiatives that were recognised as related to certain documents or by interviewees recommending certain documents. It is important to note that this was not a systematic search for other material. Rather, I spent some time trying to find as much information about the ESS as possible, which led to new sources and to including new search terms combined with ‘European Spallation Source’. This dispersed set of sources is most evident in Appendix 3, which covers everything from the technical design of the ESS and a TedX Talk about neutrons and the ESS to governmental documents. Far from all the documents listed in Appendix 3 are cited in this dissertation, nor do the documents in Appendix 3 constitute an exhaustive list of all documents related to the ESS. Nor is it a complete list of everything that I have read in recent years, as I have most likely forgotten, or forgotten to include, some of what I have read. However, seeing as these sources have developed my overarching understanding and view of the ESS, from different perspectives, the intention is to signal to the reader that I have a relatively good grasp of the ESS and matters surrounding it, albeit predominantly issues related to the national context. In addition to this, the documents helped me identify who the important actors were and what initiatives they were involved in. They also gave me an overall understanding of the interviewees’ contexts and an overarching understanding of the ESS, which helped during interviews, since I somewhat understood what they were talking about.

3.3.3.1 Documents

The documents included for this dissertation mainly constitute newspaper articles (see 3.3.2 *Newspaper articles*). Other documents are archival records regarding political decisions in relation to both the ESS itself as well as other various initiatives (e.g. Teknikparksfunktionen). Other documents also include books (e.g. Larsson, 2019). One aspect concerning the ESS is its close relation to science, seeing as several social scientists are interested in Big Science. For example, Cramer and Hallonsten (2020) wrote a book more broadly about the topic of Big Science. And some books have been written specifically about the ESS (e.g. Kaiserfeld & O’Dell, 2013). Moreover, a few scientists involved in the ESS have shared their stories in their own published articles (e.g. Thomasson & Carlile, 2017). Another aspect concerning documents, such as the one published by Håkanson and Kokko (2022), is that they are indeed separate documents addressing matters bordering on my own area of study but are in and of themselves documents that shed light on legitimising surrounding the ESS and thus are part of legitimising the ESS.

3.3.3.2 Videos

The relevant videos mainly cover conferences, talks, panel debates, or other similar events that have been recorded and published online. For instance, various people working at the ESS were recorded presenting the facility, and a former ESS employee talked about neutrons and ESS (see Appendix 3, document number 21). Some of these events are international with an international audience. Other events, however, are focused on Sweden. For example, some videos cover Swedish politics, in which the best example of this is when the ESS was discussed at the Almedalen Week, a major annual political event in Sweden. The video recordings have not been transcribed.

3.4 Data analysis

My data analysis is primarily based on systematic combining. According to Dubois and Gadde (2014, p. 1279), “[i]n systematic combining one of the cornerstones of the research process is ‘matching’”. Matching resembles an abductive approach, constantly going back and forth between theory, data, and analysis (Dubois & Gadde, 2002, 2014). In my thesis, I have gradually moved from the broader contours, using an interactive approach between theory and data to understand what I am looking at, thereby becoming increasingly specific in relation to what my study is a case of. Thus, the evolving framework and the evolving case are constantly confronted with the matching of theory and data.

Furthermore, as per Langley’s (1999) advice, I have ordered the data chronologically, writing a case narrative using time and critical events to unfold the story of the ESS (e.g. Langley & Tsoukas, 2016). Alongside systematic combining (Dubois & Gadde, 2002), the temporal ordering of the data into a chronological narrative was one of the initial methodological choices in my study. Moreover, my narrative was analytically partitioned by using temporal bracketing to divide the process into successive phases (see Langley, 1999). Throughout my research, the narrative has become progressively full, rich, and in-depth as my research has proceeded, moving from the broader contours of a process towards realising the ESS to bracketing the process into three phases.

The matching and process, described above, contributed to my phenomenon-driven study (Håkansson & Snehota, 2017) shedding light on a legitimising process in creating an actor from idea towards reality in an interorganisational context. As already alluded to, my process started wide, an overarching chronological narrative that progressively became fuller, richer, and deeper. Theoretically and empirically, legitimising emerged as a useful lens. Later, a conceptual framework consisting of the concepts of mobilising, embedding,

and legitimising was constructed and used to home in on my case. To deepen the analysis, each pair of the aforementioned concepts was supplemented by additional analytical parts. Additionally, by matching theory and data, three specific forms of legitimising emerged. These allowed more specific understanding of the phenomenon of legitimising in order to analyse the process of creating an actor from idea towards reality in an interorganisational context. In this section, I shed further light on how my data analysis has been carried out by emphasising and elaborating the most important steps of my research process, to derive the insights in the analytical chapter.

At the outset of my research, two broad boundaries appeared when situating the thesis within the IMP framework, thereby using the lens of a business network approach (and thus following a certain set of assumptions), and somehow relating it to the ESS. Broadly, I was looking at the ESS using a business network lens. Early on there was a recognition that interorganisational interaction involving different types of business and non-business actors could be relevant. However, the specifics of how remained open. At this stage, my reply to ‘What is this a case of?’, in its broadest sense, related to the different types of actors involved in the ESS. Later, while going through material related to the ESS and conducting a few initial interviews, I discovered the legitimising aspect as something both empirically and theoretically interesting to investigate further.

As such, the phenomenon and concept of legitimacy arrived quite early in my study. I also had a prior theoretical understanding of the concept of institutional legitimacy before the outset of my project. In a very broad sense, focusing on legitimacy provided another type of initial boundary and a way to make sense of my empirical material. As such, the notion of legitimacy was inductively derived from my material. However, interviewees and various documents seldom used the specific word, legitimacy, although as a researcher I could, at this stage, by being research-centric, recognise that legitimacy would be relevant in this setting, although the specifics remained unclear.

Furthermore, the temporal boundary progressively became clearer. Halinen and Törnroos (2005, p. 1290) state that “[i]n a processual case study analysis, the task of the researcher is to search for patterns in the process”. An aim, albeit quite general, was, at this point in time, to look at the entire process of materialising the ESS. And I was to do so by incorporating the wide variety of actors involved in this process. A narrative strategy essentially “involves construction of a detailed story from the raw data” (Langley, 1999, p. 695). According to Van de Ven (2007, p. 155), discerning central subjects is relevant to process studies. In my study, the central subject as an individual entity³⁹

³⁹ As phrased by Van de Ven (2007, p. 155).

concerns a focal actor⁴⁰, the ESS, and an emerging network surrounding it, “around which the narrative is woven” (Van de Ven, 2007, p. 155).

Broadening to include other relevant actors, depth in terms of an understanding of legitimising, arguably deepens in a case study that involves a broad range of actors from different spheres of society. Digging into the literature, the concept of legitimacy has been delineated, refined, and studied in a variety of ways by scholars⁴¹. Drawing on the notion of pragmatic legitimising became one way for me to specify legitimacy in my project.

As alluded to, the contours of my chronologically structured process including critical events and key actors had been gradually emerging from a quite early stage, in which my descriptive narrative (Langley, 1999) became fuller, richer, and deeper. I then carried out a type of empirical analysis of my material, meaning that I used a lens of legitimising to conduct an analysis. In doing so, I did not use a strictly theoretical lens (of legitimising) but rather viewed the empirical material through a legitimising lens, which could also be described as having an understanding of the meaning of legitimising to thereby view the phenomenon (rather than theoretical concept) in my analysis. Although using a fairly research-centric lens (i.e. the phenomenon of legitimising), I made “efforts to give voice to the informants” (Gioia, Corley & Hamilton, 2013, p. 17).

Empirical Chapter 4 shows how the ESS emerges (from the mid-1980s to 2009), focusing on the dimensions of interorganisational interaction and legitimising with an emphasis on making the ESS desirable mainly inside the science community. During this stage, the ESS is an idea. Chapter 5 concerns how an interorganisational network around the ESS emerges (from 2009 to 2023), focusing on the dimensions of interorganisational interaction and legitimising with an emphasis on anchoring the ESS within a local landscape as a proper and appropriate actor. During this stage, the ESS idea is materialising into something concrete. Empirical Chapter 6 is about (a subset of) national suppliers that enable the physical materialisation of the ESS, focusing on the dimensions of interorganisational interaction and legitimising. These chapters are connected chronologically (mainly Chapters 4 and 5), contextually (within the confines of the ESS story), show interorganisational interaction across different spheres of society, and emphasise the theoretical and empirical phenomenon of legitimising.

⁴⁰ As commonly phrased in IMP.

⁴¹ For example, as per Suddaby et al. (2017), legitimacy can be viewed in terms of a property, process, or perception. Furthermore, legitimacy is a concept that has been analytically refined into more specific parts such as pragmatic, moral, and cognitive legitimacy (see Suchman, 1995) as well as other types of legitimacy.

This then provided ground for elaborating an emerging conceptual framework by understanding how the analysis relates to relevant specific concepts inside IMP. As such, a conceptual framework including mobilising and embedding was developed as support for understanding the process of legitimising. I analysed the material by thinking in terms of the level of informants (i.e. empirical) and the theoretical level in tandem (cf. Gioia et al., 2013). For example, the empirical analysis made it clear that legitimising is used as a way to mobilise actors from different spheres of society and that mobilised actors in turn are legitimising the ESS. Furthermore, it also became quite clear that there were what could be termed aggregated interdependencies in the network, whereby embeddedness seemed reasonable in order to further understand the legitimising process.

3.4.1 Temporal bracketing

The empirical processual lens was analysed further by explicitly using temporal bracketing in tandem with a narrative approach (see Langley, 1999)⁴². In doing so, using these two strategies was “based on a desire to capture and express the experience of temporality, flow, activity and emergence in concrete terms” (Langley & Tsoukas, 2016, p. 14). Temporal bracketing is a type of temporal decomposition into finer-grained analytical phases ordered sequentially, implying that there is some commonality, or continuity, within each period, while there is some type of discontinuity, or difference, between the periods (Langley, 1999). In essence, it is a matter of comparing distinct time periods (Bizzi & Langley, 2012). Langley (1999, p. 703) elaborate, stating that this “enables the explicit examination of how actions of one period lead to changes in the context that will affect action in subsequent periods.” Changes and events in one period subsequently become the point of departure for the following phase (e.g. Bizzi & Langley, 2012). In terms of the ESS, the changes and events leading up to the meeting in 2002 in Bonn were characterised by insufficient political support. This in turn gave rise to a point of departure for the following phase of anchoring the ESS on a political level to ultimately reach a decision allowing construction of the ESS to begin, in turn leading to a new point of departure as the ESS start being materialised in Lund, leading to new sets of actors emerging within the ESS story. In the process of realising the ESS from idea towards reality, the three phases are connected by the phenomenon of legitimising, yet separated in terms of dimensions such as

⁴² It is relevant to note that, in my process of matching, the thesis incorporated a process approach from a fairly early stage. The difference is that it became fuller, making it gradually possible to further understand the process of legitimising (which, likewise, had been part of my research from a fairly early stage).

mobilising actors and embedding, which, alongside legitimising, differs in each phase.

Different actor groups are clearly salient at different points in time. That is to say, science actors were initially salient, then science and political actors, and finally science, political, and business actors. This realisation arose from a mixture of empirical material and theory, since it became clearer from the empirical analysis using an informant-centric and empirical legitimising lens that different actors were mobilised and mobilising at different points in time. Theoretical concepts concerning mobilising and embedding as supporting legitimising helped me understand continuity within and discontinuity between different phases (Langley, 1999). In refining my temporal bracketing, the analytical structure, as a process, became divided into “Idea-generating inside the science sphere”, “Broadening to the political sphere to ensure support”, and “Materialising by involving science, political, and business spheres”.

The temporal bracketing and narrative as well as the conceptual framework gradually emerged in tandem. At this stage, I had a workable conceptual framework that I started to use as a stricter lens to analyse each phase that had been temporally bracketed. This round of data analysis resulted in an abstract conceptualisation of the narrative to understand what occurred within and across the phases. In other words, I was applying a strict theoretical lens at this time, using the concepts and conceptual framework to understand the process of legitimising Big Science on a more aggregate level. For instance, in each separate phase, it was relevant to mobilise specific actors to move forward in realising the ESS, which was done using specific arguments adhering the interests of actors embedded in different spheres of society. However, while the specifics look different in each phase (e.g. mobilising different actors), a coherent process of legitimising, on an abstract level, occurs across the phases since realising Big Science requires continuous embedding, mobilising, and legitimising from an idea towards reality.

As a next step, a table was developed and elaborated on that provided a succinct overview of the empirical material related to each analytical phase (for its final version, see *Table 1 Empirical overview*). The table focused on aspects such as what is being legitimised, the involved spheres, and who is legitimising to whom. In this round of data analysis, the conceptual framework was analytically deepened by including dimensions between pairs of concepts. At this stage, it was not entirely clear what dimensions of the model should be included as there were a few different options. The dimensions in each pair of concepts, although abductively derived, related quite heavily to theory. Analytically deepening the understanding of my case also involved three forms of legitimising. The dimensions and three forms involved a heavy element of

matching, derived from the empirical material whilst having theory in mind. The three forms of legitimising were slightly more inductively derived, particularly as the combination of three forms related more to the empirical material in my study than to taken-for-granted categorisations of the concept⁴³.

In this step, after having decided on the model of analysis, including various dimensions and forms of legitimising (see *Figure 1* in the theory chapter), I began the most time-consuming and effortful part of the analysis as I started to zoom in on each aspect, using the model to elaborate on what each aspect meant in my case (for a succinct overview, see *Table 2 A summary of phases 1, 2, and 3 using the model of analysis in Chapter 7: Analysis*). In going through the empirical material for each temporally bracketed phase, I made use of tables to elaborate on the dimensions as well as the three forms of legitimising. In doing so, the analytical chapter provides a detailed account of the matching between the empirical material and each interplay between concepts as well as their dimensions. The different dimensions were elaborated on as my data analysis proceeded. It was recognised that proposed benefits and framing constitute a cornerstone for recruiting actors and their resources towards the journey of realising the ESS, depicted in the interplay between legitimising and mobilising. For instance, proposed benefits of a technological, sociopolitical, and economic nature incentivised various types of actors towards mobilising, and framing provided rationale for actors to mobilise towards realising the ESS. Regarding legitimising and embedding, actors become embedded into a growing ESS-network that involve more and more actors throughout phases one to three, meaning that path dependency and fit include matters such as lock-in effects from mobilising actors in earlier phases through legitimising, which, in turn, affect later parts of the process. Mobilising and embedding were deepened by including dimensions of overlapping networks and emerging context, which means that actors in overlapping networks affect the process of creating the ESS in a continuously emerging context. Furthermore, each additional phase includes an increasing amount of matters related to each phase, in part because more actors, and thus matters, become involved in the process.

3.4.2 Creating a processual model

As a final step, drawing on *Figure 1 Model of realising a large-scale endeavour in an interorganisational context*, what is being legitimised in each phase, and my analysis in Chapter 7, a processual model of realising a large-scale

⁴³ There are also theoretical elements involved, seeing as previous research has used technological and sociopolitical legitimacy, albeit less so economic legitimising.

endeavour in an interorganisational context was created, thus updating the aforementioned model in Figure 1. As a processual model, the temporally bracketed phases from earlier in my data analysis remain, but informed by a deeper analytical understanding of continuous legitimising, mobilising, and embedding involving six dimensions and three forms of legitimising. Using the model, legitimising expanded for mobilising additional actors that subsequently became embedded in a growing network surrounding the ESS. The endeavour transitioned between phases by a need for mobilising additional sets of actors and their resources, and in doing so, embedding additional actors in an expanding network. As a processual model involving three temporally bracketed phases, three concepts including mobilising, embedding as well as legitimising further refined into technological, sociopolitical, and economic legitimising as well as six dimensions between pairs of concepts, preceding phases become points of departure for subsequent phases as a process that involve phases building on each other as layer added upon layers.

3.5 Ethical considerations

The ethical considerations in my study are mainly guided by Vetenskapsrådet's report from 2017⁴⁴. In Heading 4, in the aforementioned report by Vetenskapsrådet (2017, p. 39), they state that it is important to 'think before you act'⁴⁵. Therefore, it seems fitting to disclose relevant ethical considerations that were established prior to commencing my interviews.

In the e-mails that I sent to the interviewees, I briefly presented myself, my research and who was funding my research project, the purpose of the research albeit as a preliminary version (i.e. looking at interorganisational interaction at ESS from a business and industrial marketing point of view), and the purpose of asking for an interview. During the interviews, I once more presented my project and the purpose of the interview (i.e. to use it as qualitative data for a research project). I also asked if the interviewees had any questions, either in general or about the project. I then proceeded to the administrative points where I asked if I could record the interview and that I would tell them when I turned on the recording, I asked if it was fine to transcribe the interview and if it was possible to share the transcript with my two supervisors. The interviewees were also given the opportunity to read through the transcript in case they wanted to check that everything was correct and/or if they wanted to exclude certain parts that they did not feel comfortable with. I then asked if

⁴⁴ Vetenskapsrådet (2024) published a new version in 2024.

⁴⁵ In Swedish, att tänka efter före.

they had any further queries or questions, and emphasised that they should feel comfortable. Ultimately, I wanted to show respect to the interviewees.

Besides the initial six interviews, I did not ask the interviewees if they would prefer anonymity⁴⁶. Moreover, in some instances, if I were to use pseudonyms, it would require tremendous effort to maintain the anonymity of some of the interviewees, seeing as a few could be regarded as prominent public figures within the Big Science sphere or in Sweden. Neither did I promise confidentiality. However, even though I did not promise confidentiality, I strove for it by not disclosing unnecessary information about the interviews and interviewees unless it was warranted, as a way to respect their privacy. To sum up, I feel it is important to respect the interviewees and to ensure that they know what they are getting themselves into. As it might not be possible to promise anonymity and confidentiality, I did not promise either of those, but I did strive to respect their privacy.

There is no conflict of interest between me and the ESS, they are not funding my project. However, it feels appropriate to disclose two aspects of my research that I have been reflecting on, related to the nature of the ESS as a scientific endeavour. First, as with almost any megaproject, there have been voices critical of the ESS, in particular from other scientists in Sweden who have expressed a sense of worry that it will channel funding away from other areas of research. Therefore, it might be appropriate to ask how I, as a social scientist, navigated this dimension of the ESS, seeing as I am part of this research landscape that could potentially experience decreased funding because of the ESS. The answer is that it has not affected my own research significantly, other than being aware that the topic of the ESS might occasionally stir up critical voices. Second, there is the possibility that I might view the ESS from an overly positive perspective, losing a sense of objectivity due to my amazement of the project. I have indeed enjoyed the opportunity to study the ESS, and I am in awe of the facility and its potential future scientific value. Although I do, on a personal level, support most scientific endeavours, and especially such huge investments in science such as the ESS, I have tried to maintain a certain level of objectivity. These are two issues where I have tried to practice reflexivity, by trying to maintain my role as an independent researcher conducting my own scientific research project. Ultimately, however, instead of highlighting potential issues and briefly reflecting on them, I hope that my professionalism towards these areas is something that shines through in my dissertation.

⁴⁶ However, none of the initial six interviewees wanted to be anonymous.

4 The ESS emerges (mid-1980s to 2009)

This chapter is the story of how an ambitious endeavour, the ESS, emerge as an idea and how the idea moves towards becoming a reality. In doing so, we explore the process by paying particular attention to dimensions of interorganisational interaction and legitimising. For example, interaction amongst science actors and political actors (e.g. national governments) to legitimise the idea of the ESS as desirable for the host country, such as return on investment and other claimed benefits of hosting a Big Science facility. Or, to Europe, at large, both politically and scientifically, as a desirable idea drawing on the notion that several neutron reactors are being decommissioned or otherwise becoming unusable, and if Europe wants to remain world-leading, it would be wise to invest in a neutron facility. In other words, how the ESS, and actors involved in and around ESS, attempt to make the idea desirable to other actors that are important for realising the idea of the ESS (e.g. political actors). As such, the emergence of the ESS is affected by interorganisational interaction between a variety of actors from different spheres of society, in particular, legitimising the idea as desirable through interaction with actors.

The following story looks at the ESS. Since Sweden became host country of the ESS in 2009, the perspective, starting around the years 2000–2002, emphasises the host country's point of view to a larger extent than in prior phases. For example, interorganisational interaction between ESS Scandinavia and political actors in legitimising the ESS as desirable. However, the idea of the ESS did not start in Sweden, but rather as a European concept to preliminarily be placed in Germany.

4.1 The idea of a facility akin to the ESS emerges

In 1986, it seems that the idea of building a big European spallation source emerges within the scientific community, coming out of Germany and being advocated by scientists affiliated with Forschungszentrum Jülich proposing how to build the facility such as technical aspects. Other national laboratories show interest in pursuing this idea, such as Risø National Laboratory. Moreover, in 1986, the Commission of the European Communities (CEC) Large

Facilities Panel recommends a study of exploring future spallation sources in Europe (Kaiserfeld, 2013, p. 29).

The idea, or project, of a facility akin to the ESS is simmering during the 1990s. The originally proposed concept goes through several iterations. In 1990, the Neutron Study Panel suggests in a report, a detailed design study, as a way for Europe to maintain neutron science at the forefront (Kaiserfeld, 2013, p. 29, referring to Taylor, 1995). Clausen (2001, p. 27) point out that;

“[i]n the Large Facilities Report to the Commission of the European Community (CEC) in 1990, the Neutron Study Panel underlined the continuing need for neutron scattering and recognised that a major initiative was necessary to secure an effective ongoing neutron science programme in Europe for the year 2000 and beyond.”

This is followed by a series of meetings over the next two years, exploring the possibilities of a facility akin to the ESS.

The first meeting takes place at Simonskall in September, 1991 (Taylor & Lander, 1992). During this point in time, the original proposal is to locate the ESS at Simonskall (Andersen & Carlile, 2016), a small German town about 50 minutes by car from Jülich. Half a year later, in February, 1992, yet another meeting, the second in a series of meetings, takes place at the Paul Scherrer Institute⁴⁷ (Taylor & Lander, 1992). A third meeting takes place, also in February, the same month as the meeting at PSI, in which roughly 70 experts in condensed matter science gathers to discuss the idea of the European Spallation Source, including topics such as the accelerator and the target (Interview Lefmann; Interview Carlsson; Taylor & Lander, 1992).

By mid-1993 the ESS starts taking shape, as it is now that the ESS Council is formed with representatives consisting of European countries (Kaiserfeld, 2013, p. 29). Having said that, the ESS Council, in 1993, is perhaps most suitably described as the embryo of the organisation eventually leading to a more formalised ESS organisation during the next few decades. Furthermore, during this period, the European Neutron Scattering Association, ENSA, starts *“to advocate for what would be the most ambitious and broad-based spallation source in the world, ESS”* (ESS, 2021b). ENSA is an actor that gathers scientists using neutron sources in their research (ENSA, 2026). According to Hallonsten (2020, p. 89), a reason for forming ENSA relate to the ESS plan, including a mission to materialise the ESS through support and lobbying.

Regarding the future of neutron scattering, there is a meeting at Risø National Laboratory in 1993 consisting of representatives of 18 countries, and

⁴⁷ Also known by the acronym PSI.

later a follow-up meeting in 1994 at the Oak Ridge National Laboratory (Richter & Springer, 1998, p. 7). According to a report (from 1998);

“[m]any of the discussions centered on the question of how nations could deal in a coordinated way with the threatened “neutron gap” – a foreseen decline in the supply of neutrons caused by the shutdowns of research reactors at the end of their normal period of exploitation.” (Richter & Springer, 1998, p. 7)

The issue of a foreseen ‘neutron gap’, mentioned in the aforementioned report, resurface in the ESS story a few times, as both science and political actors deem it important to bridge this gap (see e.g. Larsson, 2005), albeit for various reasons.

Around this time, Hallonsten (2020, p. 89) point out an important aspect of the ESS project, stating that *“in spite of all these endorsements, not much progress was made on a political level”*. In about 1996, a feasibility study is produced examining the possibilities for building the different parts of the facility, considering, for example, how it would be possible to manage the material and the neutrons, and so on (Interview Carlsson). The first phase of the project is about establishing a scientific case and the technical feasibility of a next-generation European neutron source (Clausen, 2001, p. 27). According to Clausen (2001, p. 30), the first phase of the ESS design study is completed in November 1996.

It is during this time, in early 1997, that *ESS – A next generation Neutron Source for Europe* is published, comprising three volumes: *European Spallation Source* (vol. 1), *Scientific Case* (vol. 2), and *ESS Technical Study* (vol. 3) (see e.g. Clausen, 2001, p. 27). Hallonsten (2020, p. 89) point out that the ESS Council three-volume report published in early 1997 and the R&D phase were driven by scientific interests rather than political interests (e.g. funding and location of the facility). Hence, a political decision-making process is not necessarily being pursued at this point in time by the ESS Council.

Regarding the number of potentially relevant scientists who could benefit from a spallation source, and to show how many scientists potentially have an interest in building the ESS at this time, Hallonsten (2020, p. 89), referring to a report by ENSA from 1998, write that the organisation currently consists of roughly 4,400 European members. Moreover, as an additional way to gauge the extent of interest from the community, a report by Richter and Springer⁴⁸ (1998, p. 9) published in November, 1998, state that *“[a]n ever-growing scientific community (currently of the order of 6000 scientists) uses neutrons for*

⁴⁸ It is not entirely clear if this number (i.e. 6,000 scientists) refers to a European or worldwide total, although an excerpt on page 10 of the report by Richter and Springer (1998) seems to indicate that it concerns the wider neutron scattering community.

research in physics and chemistry and, more recently, in materials science, engineering, earth sciences and biology". Alongside the number of potentially interested scientists, this also showcases the number of potentially relevant fields.

The aforementioned report by Richter and Springer (1998, p. 38) is summarised by stating that the study predicts a "*very significant decline of neutron scattering capabilities*" within the next two decades, in all of the OECD. Moreover, this poses a threat to neutron scattering, including so-called new growth areas comprising materials science, engineering, earth sciences, and biology (Richter & Springer, 1998, p. 38). In essence, there is an urgent need concerning future neutron sources (Richter & Springer, 1998, p. 39). The OECD's Megascience Forum announces in 1999 that three neutron spallation sources should be built, one in North America, one in the Asia-Pacific area, and one in Europe (see e.g. Larsson, 2005). The OECD's Megascience Forum is an intergovernmental organisation bringing together senior government science policy officials such as discussing large science projects (Richter & Springer, 1998, p. 7). The Megascience Forum is international in its scope and therefore includes other topics besides those that are of solely European interest. In a sense, this actor paves the way for continuing the efforts to see the ESS to fruition, as the Megascience Forum could be regarded as a key actor. According to Hallonsten (2020, pp. 91–92) this announcement "*has come to be regarded as decisive not only for the eventual successful launch of the ESS, but for the construction of spallation sources elsewhere*".

4.1.1 Scandinavian researchers get involved

Around the turn of the century, Scandinavian researchers become more involved in the idea of the ESS. During this time, the ESS takes in proposals for where to put the ESS. In the early 2000s, researchers at Risø National Laboratory discusses situating it close by. However, according to an interviewee, this is not possible due to the political winds in Denmark at the time, wanting to get rid of anything that produces radioactive waste. And instead reason that a good location for the ESS is just across the newly opened Öresund Bridge that links Denmark and Sweden. At the same time, the other European partners are not impressed with this suggestion (Interview Lefmann). Instead, the idea of the ESS, gradually starting to become more of a reality, and less of merely an idea or technical concept, is being championed by Germany and the UK. Furthermore, around this time, Hallonsten (2020, pp. 92–93), referring to an interview with Peter Tindemans⁴⁹, write that "[t]echnically and scientifically,

⁴⁹ Chair of the OECD Megascience Forum, year 1992 to 1999 (Hallonsten, 2020, p. 93).

and with regard to budget and timetable, the ESS project was well-equipped, but the main hurdle was to get it through the national and European politics”.

Around year 2000, reactors are closing down or are about to close down, reaching the end of their technical lifespan. This means that there eventually might not be enough research facilities for the community to carry out research.

Scandinavian scientists using neutrons congregate at the Gamla Biskopshuset⁵⁰ in Lund in October, 2000. This is a critical event that will, arguably, influence the entire trajectory of the ESS. A grassroots meeting where representatives of the neutron scattering community from Denmark, Norway, and Sweden assemble. They had early on seen this as a chance for Lund, noting a lack of progress, not in design, but in moving the ESS to the point where it could start construction. This meeting, amongst other things, includes the scientific case for the ESS (Hallonsten, 2020, p. 101). Moreover, and perhaps as vital as the meeting itself, this is the inaugural meeting of the ESS Scandinavia Initiative. At this time, the Board of ESS Scandinavia consists of Lars Börjesson, Börje Johansson, Kim Lefmann, Robert McGreevy, Kell Mortensen, and Martin Vigild (Hallonsten, 2020, p. 102). According to Hallonsten (2020, p. 100), ESS Scandinavia wants to achieve a strong presence related to the ESS and to declare its support to the project. As ESS Scandinavia starts its operations, from hereon my dissertation moves towards a greater emphasis on the ESS from a Scandinavian perspective, as this is the trajectory that the ESS would eventually follow as it becomes materialised in Lund, a town in Sweden, Scandinavia⁵¹.

Even though ESS Scandinavia, at this point in time, is fairly small, and eventually evolves, a telling detail about ESS Scandinavia is shedding light on some of its key figures (especially from 2006 onwards) which include Colin Carlile, Allan Larsson, and Patrik Carlsson, amongst others such as Lars Börjesson who Larsson (2019; Interview Larsson) refers to as the mastermind. Carlile, the previous Director General of the Institut Laue-Langevin, has an understanding of running Big Science organisations alongside a vast scientific network. Larsson is a well-respected politician and former Swedish Minister of Finance with a vast political network who had spent five years in the European Commission. Carlsson, although one of the younger members of ESS Scandinavia, is knowledgeable about the science and technical design of the ESS. Hence, a group containing a mix of scientific and political expertise. Another junior member who joins ESS Scandinavia after the aforementioned

⁵⁰ Gamla Biskopshuset is owned by Lund University and is being used as a centre.

⁵¹ While not neglecting other narratives that either connect to the ESS story or are important regarding the ESS in general, such as the Hungarian and Spanish ESS contingent, which will be introduced later in this chapter.

meeting in October is Aleksandar Matic, who starts to prepare documents directed towards various actors such as municipalities in Skåne⁵², universities in Sweden, and the Swedish Research Council⁵³ (Hallonsten, 2020, p. 102), and is mentioned in Larsson's (2019, p. 182) book as contributing greatly to the business case that ESS Scandinavia presented for hosting the facility.

Sydsvenskan, the most widespread regional newspaper in Skåne, publishes one of the first Swedish newspaper articles covering the ESS. Sydsvenskan mentions the group ESS Scandinavia alongside a fairly long description of neutron science and of the fact that both Japan and the USA have already taken steps towards similar Big Science facilities. According to Professor Börje Johansson, one of the initiators of ESS Scandinavia, in an interview published in Sydsvenskan, “[i]t shows that, internationally, material research is considered something to pursue. This is a technology-driven field of research, so it is important that we in Europe do not get sidetracked due to political heaviness”⁵⁴ (Ljunggren, 2000).

There is an official call saying, if you want to propose yourself as a site, raise your hand now. Returning to the idea of the ESS, the two main contenders are the UK and Germany, unsurprisingly, as these types of European Big Science organisations tend to be located in Germany, France, or the UK, although a few exceptions exist. The UK scientists who are running the ISIS facility, sharing several similarities to the ESS, says that it would be possible to simply upgrade ISIS, which would also be much cheaper. The Jülich scientists, on the other hand, instead argue that they are the biggest centre for neutron scattering, and already have a lot of expertise, and are also running their own reactor.

At this time, the ESS question emerges locally in Skåne. According to an interviewee, several little towns in Skåne propose themselves with a lot of ideas (Interview Lefmann). And, around this time, Region Skåne, a public organisation that acts as the regional council of Skåne, arranges a meeting including all the region's mayors to discuss the ESS. Questions and issues surrounding the ESS at this time, about 2000–2001, relates to regional matters, so Region Skåne becomes involved. Around this time, according to Lefmann, “*the local authorities did everything right, at the time*” (Interview Lefmann).

An ESS proposal is discussed in a report from 2001 (Clausen, 2001). In some sense it could be argued that this report shows that the idea of the ESS is alive and well, for instance, formulating various milestones such as a proposal for submission to funding agencies by June 2003 (Clausen, 2001, p. 27

⁵² Another name for Skåne in English is Scania.

⁵³ In Swedish, Vetenskapsrådet.

⁵⁴ Translated by author.

& p. 31). The report is quite technical, covering instrumentation, target station, and accelerator activities. Amongst other things, it is stated that “[t]he instrumentation group will also evaluate the potential of ESS for applications other than neutron scattering: fundamental physics, nuclear physics, muon-resonance, radiography, tomography, irradiation, etc.” (Clausen, 2001, p. 29).

At the end of 2001, Sydsvenskan announces that Skåne is amongst the hottest candidates, and that a handful of municipalities (e.g. Lund) have already signalled their interest in the ‘super facility’, as phrased in the article referring to the ESS (Widing, 2001). Indeed, briefly stepping away from the discussions within the scientific community and amongst other relevant actors, looking instead at how newspaper articles at the time write about the ESS sheds additional light on how the idea of the ESS is being portrayed.

Another regional newspaper sheds light on some of the fairly common lines of reasoning perpetuated in media accounts. Helsingborgs Dagblad publishes an article at the beginning of 2002 that features an investment promoter⁵⁵ from Region Skåne. The article arguably depicts the ESS and Skåne in quite a favourable light. In the article, the investment promoter says, “[i]n terms of research, it will mean an awful lot and also in terms of marketing. It will be a frontline for research and it will be towards this facility that the whole world will turn its eyes”⁵⁶. At the same time, the article points out that it is not what happens inside the walls that entices the municipalities the most, rather that “[t]he ESS facility will be a new workplace for 400 people. In addition, the facility will host 4 000 visiting researchers annually, which will undoubtedly mean good days for hotels, restaurants and airlines”⁵⁷. Furthermore, the investment promoter from Region Skåne argue that this type of facility will attract different types of conferences, and it is also speculated that the ESS might attract several other new facilities. From the other side of the coin, the investment promoter from Region Skåne is optimistic about the possibility that the facility will end up in Skåne;

“[a] concrete advantage is that we are incredibly close to everything, he says. We have twelve universities and colleges within 100 kilometres, very well-developed communications, close to the big city, the countryside and to the major Kastrup airport of course.”⁵⁸ (Helsingborgs Dagblad, 2002)

Another article published the same day by Sydsvenskan quotes an interviewee saying that “[e]ven though this is a project for us physicists and material scientists, I am convinced that other disciplines such as biology and medicine

⁵⁵ In Swedish, investeringsfrämjare.

⁵⁶ Translated by author.

⁵⁷ Translated by author.

⁵⁸ Translated by author.

and in the long run also industry will benefit from the spallation research”⁵⁹ (Fagerström, 2002). This newspaper article also highlights a running theme up to the decision on siting the ESS, namely competition. As per the title of the newspaper article published in *Sydsvenskan*, the competition between municipalities, and the newspapers also tend to emphasise competition between countries.

It seems that the idea of locating the ESS in Skåne is gaining increased traction at the time. The ESS Scandinavia Consortium is formally inaugurated in Denmark in March, 2002 (Aobadia, 2002a). According to *Sydsvenskan*, “[t]he goal is to bring this decade’s perhaps biggest European research effort to Scandinavia”⁶⁰ (Aobadia, 2002a), specifically, to present an expression of interest in hosting the ESS at a forthcoming, and significant, meeting. A number of actors sign the ESS Scandinavia Consortium agreement, including several universities such as the University of Lund, University of Copenhagen, University of Oslo, University of Linköping, DTU (in Denmark), Chalmers, KTH, and the Norwegian University of Science and Technology. Other academic actors such as the Danish, Norwegian, and Swedish neutron scattering associations, MAX-lab, Risø National Laboratory, Kjeller, Studsvik, and Svedberg Lab also sign. Political actors signing include the City of Lund and Region Skåne, and other miscellaneous actors include Øresund University, the Medicon Valley Academy, the Øresund Science Region, the Øresund Committee, and Copenhagen Capacity (Hallonsten, 2020, p. 103).

There is also a so-called ‘OS group’ formed. A group with clear connection to ESS Scandinavia, consisting of local and regional political supporters, for politicians to discuss political strategies for promoting ESS Scandinavia on the local, regional, and national levels (Hallonsten, 2020, p. 104).

On 16 and 17 May, 2002, there is an ENSA users’ meeting in Bonn (Hallonsten, 2020, p. 93) where five contenders present their proposals for where to locate the ESS, two from Germany, two from the UK, and one from Scandinavia. At this meeting it is to be decided where to locate the ESS, proposing the ESS idea to politicians. The meeting is attended by 900 participants, including 750 scientists and various other European participants such as politicians, industrialists, and journalists (Hallonsten, 2020, p. 94). In this meeting, the different sites present their expressions of interest. However, the meeting in Bonn did not go well. For instance, one of the aforementioned main contenders, Germany, decide that they want to pursue the X-ray Free-Electron Laser, unable to host more than one Big Science facility. According to Lefmann (Interview);

⁵⁹ Translated by author.

⁶⁰ Translated by author.

“[t]hen the Germans in Jülich got extremely upset, and more or less pulled out of it. And then there was this, although only thing that was said was that Germany cannot host it, it was like, everybody pulled out immediately. Except Skåne. It was the only place, and an organisation was, the organisation was maintained. So there was a temporary organisation, up to the Bonn meeting.”

Moreover, Hallonsten (2020, pp. 94–95) describe how the meeting, and specifically meeting participants, lacked political awareness.

The idea of the ESS seems to be dead in the water, nothing but a concept and a dream for the European science community. However, the time has come for ESS Scandinavia to shine, gaining increasing momentum. A golden opportunity with little chances of success⁶¹ (Larsson, 2019). ESS Scandinavia begins gathering actors to support its endeavour to build the ESS in Lund. In 2002, ESS Scandinavia starts gathering a consortium of regional actors to propose locating the ESS in Lund, in what was essentially political lobbying. Alongside the intention to get the Swedish Government’s support to host the ESS, they also sought support from other actors in Europe.

4.2 The ESS becomes anchored on a political level

“Here everything could have gone down the drain. Between 2002 and 2006. Because nobody believed in it. Just nobody. I mean, everybody believed in it scientifically, but politically they said this couldn’t fly. But Lund was just persistent. It was amazing.” (Interview Lefmann)

Succeeding the failed meeting in Bonn, the ESS starts to become anchored on the local level in Lund. Later in the year, Sydsvenskan publishes a newspaper article stating that 66% of the Lund population are positive to placing the ESS in Lund, while 21% are undecided and the remaining 12% says no (Aobadia, 2002b). This implies that the local population has awareness of the ESS, which is perhaps not entirely unfounded, as more and more newspaper articles start to crop up including descriptions of the ESS in layman’s terms.

At the beginning of 2003, the European Strategy Forum on Research Infrastructures (ESFRI) publishes a report. Referring to an interview with Peter Tindemans, Hallonsten (2020, p. 97) write that the report “*contributed strongly to the abandoning of the original and very ambitious ESS design, and the common conclusion that if the ESS had a future at all, it would be in a scaled down and significantly cheaper version*”. In some sense, 2003 was also a turning point for the ESS, technically and scientifically, but also

⁶¹ As per the title of a chapter in Allan Larsson’s biography, a key figure for ESS Scandinavia.

“[p]olitically, the strategy of keeping scientific ambitions high, but lowering the costs, obviously made sense” (Hallonsten, 2020, p. 97).

During the same period, Svenska Dagbladet (2003) publishes a newspaper article entitled: ‘Unique opportunity for research’⁶². Svenska Dagbladet is one of Sweden’s biggest newspaper agencies, and its publications are disseminated throughout the country, albeit fairly concentrated to the region surrounding Sweden’s capital city, Stockholm. The article states that the ESS will constitute a tool for thousands of European researchers, and is, in short, a unique opportunity for the country that hosts the facility to become a centre of European research with huge possibilities for research and industry development. The newspaper article ends with a type of call to action, urging the Swedish Government and industry to seize this opportunity, stating that this would secure Europe’s leading position in a number of core technical areas in the coming century while developing the knowledge that exists in this area in Scandinavia. In short, “ESS would give fantastic possibilities for expansion and growth”⁶³ (Svenska Dagbladet, 2003).

Referring back to the quotation introducing this section, Physics Today publishes a short article entitled ‘European Spallation Source: Dead or Alive?’ It discusses the possibility of the ESS as well as mentioning that other countries are building new spallation sources (i.e. Japan and the USA) and that the ESS is important for Europe’s long-held leadership in neutron science (Feder, 2003).

An interesting actor in the ESS story is Kreab, a Swedish PR company. Kreab is supposed to help ESS Scandinavia with contacts, for example, on the European level, with Swedish industry, and with investment banks, as well as monitoring what political processes the ESS project should try to influence. However, in the middle of 2003 it is decided to reduce Kreab’s efforts, mainly due to issues of expenses. Karl-Fredrik Berggren, Project Leader at ESS Scandinavia since the turn of the year, says that “[w]e are cutting back on Kreab because we are short of money. But also because the nature of the work has changed. We do not need them as much now as we did in the initial phase”⁶⁴. Rather, efforts are now about trying to convince the Swedish ministries about the ESS, especially the Ministry of Education and Research as well as the Ministry of Enterprise (Bernhardsson, 2003).

ESS Scandinavia starts using tax revenues from electricity usage as an argument for the Ministry of Enterprise to work more actively to locate the ESS in Sweden. Indeed, electricity taxes worth 400 million Swedish kronor

⁶² Translated by author.

⁶³ Translated by author.

⁶⁴ Translated by author.

(SEK)⁶⁵ should induce the Ministry of Enterprise to work actively for a facility, writes *Sydsvenskan*. The number refers to an estimate concerning the amount of electricity that the ESS might use. A telling detail of ESS Scandinavia's work using arguments in favour of the ESS is found in a quotation from the newspaper article; “[i]t is a shame that we have not found this brilliant argument sooner”⁶⁶ as stated by Karl-Fredrik Berggren, who furthermore also points out that “[t]he tax revenues is a very good argument to get the State to work for the ESS-facility to be built in Sweden”⁶⁷. The newspaper article writes that until now it has mainly been Lund Municipality, Lund University, and several other stakeholders that had striven to locate the ESS in Sweden. To that point, the interest from the Swedish State has been lukewarm (Samuelsson, 2004).

An important milestone in the ESS story, especially in the process leading up to finally locating the ESS in Sweden, is in June, 2004, when the Swedish Government gives an assignment to Allan Larsson to explore the possibilities of placing the ESS in Sweden. At the time, Allan Larsson is working as Chairman of the Board at Lund University⁶⁸ (see e.g. Tofft, 2004), and has previously been Sweden's Minister of Finance. Larsson will eventually become one of the most prominent individuals in the ESS story, being awarded the title of ‘This year's lobbyist’ in 2009, albeit pointing out that he does not want to call himself a lobbyist instead saying that he is a negotiator (Resumé, 2009). Nonetheless, the award showcases the amount of time and effort that Larsson devoted to the ESS. Regarding the aforementioned assignment, it is based on the proposition from ESS Scandinavia with an aim to investigate the interest from researchers and industry for such an endeavour (Larsson, 2005, p. 13). Indeed, getting the Swedish Government to promote the facility has long been regarded as a milestone in the journey (Tofft, 2004). The results of this investigation will be presented later, in year 2005.

It is relevant to reiterate that there are other countries interested in the opportunity to host the ESS, such as Germany and the UK, already mentioned. In July, 2004, there is a first mention of Hungary⁶⁹ in Swedish newspaper articles as a contender for hosting the ESS (Tofft, 2004). In June, 2005, the newspaper *Ny Teknik* (2005) mention Spain as a contender for hosting the ESS, although Hallonsten (2020, p. 99) write that “*Spain joined the game for real in 2006*”.

⁶⁵ To help the reader put the Swedish currency into perspective, SEK 10 is roughly equal to Euro 1, although the exact conversion depends on factors such as fluctuating exchange rates.

⁶⁶ Translated by author.

⁶⁷ Translated by author.

⁶⁸ In Swedish, Lunds universitets styrelseordförande.

⁶⁹ This is corroborated by Hallonsten (2020, p. 99), who said that Hungary joined in 2004.

The results of the aforementioned assignment to explore the possibilities of placing the ESS in Sweden is published in June, 2005, presenting six recommendations (Larsson, 2005, pp. 9–12)⁷⁰, as follows: In 2005, the Government should present a letter of intent stating that Sweden is preparing an offer to host the ESS, thereby clarifying the circumstances for Sweden to do so (pp. 9–10); the Government should also clarify the research and industry policy motives, as well as the principles of financing, for Sweden hosting the ESS (p. 10); the ESS and MAX IV should be co-localised to create strong synergies within research and industry (pp. 10–11); plan for ESS in a regional scientific development context (p. 11); develop the ESS project as a partnership between the State and industry (pp. 11–12); and establish a managing organisation for international negotiations and national preparations (p. 12).

This report is situated within a political context. Larsson (2005, p. 14) points out that Europe risks losing its world-leading position in neutron research to Japan and the USA. The report highlights some of the reasons for building the ESS that have been stated in previous documents. For instance, the report emphasises that a number of neutron facilities will be or have been shut down (Larsson, 2005, p. 14). Amongst other things, the report states that from a European research point of view, the ESS is a matter of scientific capacity. There will be a need for new capacity, and capacity for research on a higher scientific level than is possible using today's neutron sources. Moreover, the report argues for big potential socioeconomic gains, while pointing out that an important conclusion is that the gains will not automatically be realised (Larsson, 2005, pp. 19–20).

Sydsvenskan publishes a newspaper article commenting on Larsson's (2005) report, stating, amongst other things, that the report does not take the environment into consideration, as per the headline of the article. The article furthermore points out that there are no arguments against the facility. Moreover, Sydsvenskan points out that local environmental opinions are not mentioned in the report (Samuelsson, 2005a).

ESS Scandinavia announces a decision in Sydsvenskan to focus on only building a long-pulse accelerator, rather than the initial proposal to build both a short- and long-pulse accelerator. Behind the decision are tactical and economic reasons, for example, that there are already similar facilities with short-pulse, in which a long-pulse would complement these facilities. Furthermore, funding is pointed out, as it is not enough that the Swedish Government approves construction of the ESS, it is also necessary to get several European countries onboard with the idea of a facility in Lund. At the time, nobody

⁷⁰ These are bolded subheadings in Larsson's (2005, pp. 9–12) report that have been translated into English.

knows with certainty what wishes they have or what requirements they will impose (Samuelsson, 2005b).

Another event in 2006 is the ESFRI Roadmap 2006. The European Strategy Forum on Research Infrastructures (ESFRI), and at the time a fairly recently established organisation,

“is a strategic instrument to develop the scientific integration of Europe and to strengthen its international outreach. The competitive and open access to high quality Research Infrastructures supports and benchmarks the quality of the activities of European scientists, and attracts the best researchers from around the world. ESFRI operates at the forefront of European and global science policy and contributes to its development translating political objectives into concrete advice for RI in Europe.” (ESFRI, 2026)

The ESFRI Roadmap 2006 is for policy-makers, researchers, funders, industry, and society (ESFRI, 2006, p. 18). Notwithstanding the role of ESFRI within the European research landscape, from the other side of the coin, ESFRI is an important actor to interact with in order to build the ESS. As such, ESFRI will resurface in the ESS story a few times in the subsequent period.

Around this time, according to Sydsvenskan, building the ESS in Lund has strong support from the research and university community, from industry, and from politicians on the local, regional, and national levels. However, the article points out the crux, there is still no formal declaration of intent from the Swedish Government that Sweden is ready to host the ESS (Tedin, 2006).

ESS Scandinavia continues to work towards reaching a decision about the ESS. Arguably, ESS Scandinavia has been doing good work up to 2006, especially gathering support from local actors. However, in the autumn of 2006, ESS Scandinavia takes on a different, more ambitious, momentum. In October, 2006, Colin Carlile, the previous Director General of the European Big Science organisation, the Institut Laue-Langevin, joins arms with ESS Scandinavia. As stated previously, ESS Scandinavia was founded in October, 2000, and in the years leading up to October, 2006, had been gathering regional actors and, as illustrated by the newspaper articles, also promoting public interest in materialising the ESS in Lund.

Once Carlile joins ESS Scandinavia, the momentum completely changes, being sustained until the site decision in 2009. Prior to Carlile joining in October, in 2006, Karl-Fredrik Berggren had worked as the Director of ESS Scandinavia together with two other people, all three spending approximately 20% of their time on ESS Scandinavia. Allan Larsson is working as a type of consultant and is very passionate about the ESS. Around this time, a team from ESS Scandinavia travels around Europe, essentially attempting to gain support for a decision to locate the ESS in Lund, meeting Research Ministers, State

Secretaries, and Heads of Research Councils, and so on. According to Carlsson, “*we went around Europe like a traveling circus troupe*”⁷¹ (Interview Carlsson). Key in this is what could be regarded as the support of the Swedish Government, access to Swedish embassies, and the ability to use the embassies. This paragraph elaborates on ESS Scandinavia as it could be argued that, during this time, ESS Scandinavia changes momentum and Carlile joining could be conceived as a critical event for the organisation and the entire ESS story⁷².

ESS Scandinavia works on realising the ESS from idea towards reality on several different levels, gathering regional political support, regional public support, national political support, and support from other European countries, as well as working on a technical design for the ESS. In the following paragraphs it becomes clear how ESFRI, as an authoritative scientific–political organisation in Europe, is yet another actor in addition to the list of aforementioned actors. Indeed, as will become clearer by the end of the next section, what seems to be missing at the time is sufficient support from actors such as ESFRI to locate the ESS in Lund.

Although the ESS, as a Big Science endeavour, is unprecedented in Swedish history, the country boasts one of the most recognised worldwide scientific events, the Nobel Prize. In December, 2006, representatives of ESS Scandinavia and ESFRI meet at the annual Nobel Prize dinner⁷³. The following day they meet again, together with Peter Honeth and the then current Swedish Minister for Higher Education and Research, Lars Leijonborg. Leijonborg will continue to play a vital role as representative of the political actor, the Swedish Government, and more specifically the Ministry of Education. According to Larsson’s (2019, p. 43) account;

*“[j]udging from the anecdotal version that Colin Carlile has given, this was, as you say, a “defining moment” in Lars Leijonborg’s decision-making process. On Lars Leijonborg’s question if it wouldn’t be better to build the ESS in Stockholm, the otherwise timid John Wood raised his voice: “It should be in Lund, if Sweden wants to compete for the facility”.”*⁷⁴

Specifying Lund is relevant, as the report that Larsson (2005) had previously published had been contested by some actors, saying that it might be better to place the ESS closer to the Swedish capital city, Stockholm⁷⁵.

⁷¹ Roughly translated into English from a Swedish expression: “*Vi flängde runt som ett resande cirkussällskap i Europa*”.

⁷² Colin Carlile later received the prestigious Order of the Polar Star (“*Kungliga Nordstjärneorden av kommendörs grad*”), see e.g. Skånska Dagbladet (2013).

⁷³ Colin Carlile of ESS Scandinavia, and John Wood, Chairman of ESFRI at the time.

⁷⁴ Translated by author.

⁷⁵ Stockholm is almost as far from Lund as is Leipzig, Germany.

Where better to end this phase than with the Nobel Prize in December? In the next section we delve deeper into other topics, amongst other things, the so-called competition between Hungary, Spain, and Sweden to host the ESS that heated up in the period preceding the site decision in 2009.

4.3 The conundrum of the ESS in different places

“I was in the neutron community as an observer. And there was, yeah. Basically we went to conferences and there were people from ESS Bilbao, the Hungarian ESS contingent, and the Swedish ESS contingent, all basically saying how good it would be to have a spallation source in their sites.” (Interview Taylor)

Beginning year 2007, newspapers start highlighting the Swedish Government’s support of the ESS, through the Minister for Higher Education and Research, Lars Leijonborg. For instance, clearly exemplified in the title of an article published by TT Nyhetsbyrån, the largest news agency in the Nordic countries, *“Leijonborg hopes to get research village”*⁷⁶. An excerpt from the newspaper article states, *“[w]e expect that the research grants will increase in the future so that this investment will not affect other Swedish research, says Leijonborg.”*⁷⁷ Moreover, one sphere of society that has been somewhat neglected up to this point is industry, which connects to the ESS story in quite different ways. The aforementioned article writes that Leijonborg hopes that, as the facility becomes more and more concrete, the business community will wake up and start investing money (TT Nyhetsbyrån, 2007).

In 2007, media coverage in Sweden starts increasing quite significantly compared to previous years. Another article is published in the regional newspaper Sydsvenskan. This article features a wide range of individuals acting on behalf of a number of organisations, such as ESS Scandinavia, Lund University, the Ministry for Higher Education and Research, and the State Secretary, as well as political party members, including the Director of Lund Municipality, and others. Indeed, many different voices surface in Sydsvenskan’s article. One voice says that if the ESS is located in Lund, it will benefit the entire Öresund Region. The hope is that construction of the ESS will lead to several thousand new jobs⁷⁸. It is stated that when the ESS is finally finished, it is expected that 500 people will be employed at the facility, and yearly about

⁷⁶ Translated by author.

⁷⁷ Translated by author.

⁷⁸ *“Flera tusen nya jobb”*, as formulated in Swedish in Sydsvenskan (Habul, 2007).

4,000–5,000 scientists will visit Lund⁷⁹, and that the service industry might benefit from their presence. A critical voice state that the ESS would cost a lot of money and concern a very niche area, neutron science. Furthermore, the environmental consequences are far from being adequately investigated. Indeed, the ESS has received criticism from the environmental point of view, for instance, from the Swedish Environmental Protection Agency. It is written that, because of this, Karl-Fredrik Berggren emphasises, it is extremely important that there is a thorough environmental evaluation (Habul, 2007).

The Swedish Minister for Higher Education and Research alongside several scientists congregate in Lund for the fourth European conference on neutron scattering in June 2007 (Bosson, 2007; Interview Carlile). The location of these events is decided four years in advance. Depending on perspective, it was a lucky coincidence for ESS Scandinavia that the conference is being held in Lund this time around. It is a big meeting in the scientific community with about 800 people attending, all coming to Lund in the middle of summer, arguably a time when Swedish towns like Lund show their best side. Furthermore, the meeting is well-organised. In summary, the meeting gave visitors positive views of Lund and Sweden. Prior to this conference, Leijonborg had managed to get a commitment from the Swedish Government that Sweden will pay a substantial fraction of the capital cost. Leijonborg then announces this at the conference. According to Carlile (Interview), “*this of course put the fear of God up the rival sites*”.

Making an appearance in *Sydsvenskan*, Karl-Fredrik Berggren says that the ESS is now moving into a new phase, and that the Swedish Government will appoint a new Director of ESS Scandinavia. ESS Scandinavia’s mission is, amongst other things, to plan and analyse the research required to construct the ESS. In collaboration with Lund University, ESS Scandinavia should build competence and recruit scientists and technicians for the facility. Moreover, ESS Scandinavia should investigate the opportunities to build the ESS in accordance with the Swedish Environmental Code as well as Sweden’s strategy for mercury. The international negotiations are handled by the Swedish Government’s appointed ESS negotiator, Allan Larsson, although ESS Scandinavia will also assist during contacts with other countries (Bosson, 2007). Shortly afterwards, in July 2007, Colin Carlile takes over the role from Karl-Fredrik Berggren as the new Director of ESS Scandinavia.

In 2008, there is a press conference at the Hilton Hotel in Kastrup Airport⁸⁰ where the Swedish and the Danish Research Ministers meet to publicly

⁷⁹ Different sources (e.g. various newspapers) use varying estimates, generally ranging between 3,000 to 5,000.

⁸⁰ In Denmark.

declare that Denmark will join Sweden in hosting the ESS. Understandably, after more than 20 years in the making, “*there were quite a few from the Danish ESS group that was there just to see it happen. Because, you know, we had the feeling, we want to see this before we believe it. But they signed and then the offer was on the table*” (Interview Lefmann). Sydsvenskan announces that the Danish Government has officially taken a positive stance on Lund as host of the European particle accelerator, and it is said that the Danish are prepared to contribute financially. At the same time, the article also states that the fact that Denmark advocating for Lund as the main candidate is in itself nothing new, but the official declaration comes at a time when negotiations of where to locate the facility enter their final stages (Ek, 2008).

Danish politicians want to ensure that they receive some of the benefits of co-hosting the ESS. Around this period, ideas surrounding an ESS Data Centre starts becoming a piece in the puzzle, nested within the bigger process of realising the ESS from idea towards reality. As a rule of thumb, approximately 5% of the cost of big scientific facilities needs to be dedicated to supporting computing and data analysis (Interview Womersley). It is envisioned that the Data Centre will be responsible for data management and software pertaining to the ESS, which involves “*the ESS scientific data pipeline, including experiment control, data acquisition, data curation, scientific web applications, data reduction, data analysis and modelling, data systems and data centre operation*” (ESS, 2021c). The aforementioned activities essentially involve data management that allows the users to make sense of their data from their experiments at the ESS. As Denmark decided to co-host and help pay for the ESS, “*the Danish needed something back. So we had negotiations, or some planning meetings, in the Danish Ministry, and it was discussed*” (Interview Lefmann). In these discussions, attendees were figuring out what could be placed in Denmark. Eventually, it turned out to be the Data Centre, and then this idea was pushed forward. The idea of locating the Data Centre in Denmark comes from a political agreement to have Sweden and Denmark as co-hosts for the ESS; a political driver. Moreover, it is reasoned that a big development within the technological field concern data management, and not only data but also visualisation, analysis, and the like, so the Data Centre represent an exciting area for technological development for Danish research and development (Interview Melander).

A distinction between the Danish ESS strategy and the Swedish ESS strategy is that the Danish politicians pursue a less abstract strategy than did Sweden by being more concrete and instead focusing on specifics, such as specific numbers (Interview Melander). A discussion point relating to the ESS Data Centre concerns the number of 60 (future) full-time employees at the Centre.

This number derives from comparison with the data centre at the Spallation Neutron Source⁸¹, a comparable neutron facility in the USA. Estimating the number of employees required for the ESS Data Centre is undertaken through discussions between the head of the data centre at the Spallation Neutron Source (in the USA) and a scientist involved in providing input to the Danish Ministry. Deciding on an estimate, by doubling the number of employees at the Spallation Neutron Source's data centre, it is reasoned that the ESS Data Centre should have 60 employees. This is then presented to the Danish Ministry. According to an interviewee, “[l]ater it has come down as a very important political number, that there has to be 60 persons at the Data Management Centre” (Interview Lefmann).

Moreover, having its main facility in Sweden and its Data Centre in Denmark constitutes a rather unusual set-up for a Big Science organisation. In particular, it is rare to have an international border separating the data centre from the main facility in which the experiments are carried out. According to Rennie (Interview), there has to be recognition that it will not be the same as everywhere else in that respect. However, the rest of the ESS belongs together, as it does not work to produce the neutrons in Sweden and study them in Denmark. On the other hand, it is possible to transport the data to the Data Centre in Copenhagen. Nonetheless, rather than having a data centre right beside the ESS facility in Lund, its future users will have to travel about an hour by train from Lund to Copenhagen; a less than ideal situation, but, politically, a necessary one. Returning to the politics of locating the Data Centre in Copenhagen, “we can put it in another way. What price did we pay to get the Danish contribution? Well they have their part of it there. And so, you know, if it was the difference between not having the facility, you know all of these things...” (Interview Rennie).

An important event is when ESS Scandinavia in 2008 submit their proposal to the ESFRI Working Group on ESS Siting (see Malm et al., 2008). In other words, ESS Scandinavia is attempting to persuade ESFRI. In one interpretation, this report is essentially attempting to shed light on the question: Why should the ESS be located in Lund, Sweden? In the report, this is answered from a slightly more scientific perspective as well as taking the science community into account. The report states that the location of the ESS in Lund is the official policy of the Swedish Government (Malm et al., 2008, p. 4). Structurally, the report covers the following points (Malm et al., 2008, p. 3)⁸²: Political and financial support from the Swedish Government embodied in a

⁸¹ Usually referred to by its acronym SNS, or Oak Ridge (which is where the facility is placed).

⁸² The following text is presented as bullet points (although slightly more elaborated) in the report.

series of decisions at Cabinet level; the ESS Scandinavia Reference Design is fully compatible with the description outlined in the ESFRI European Roadmap for Large Scientific Infrastructures 2006; the ESS in Lund will be a joint European venture; the Swedish Government will pursue a funding model based on generosity and fairness; a solid and reliable organisational base; the location for the ESS in Lund is ideal; ESS in Scandinavia will be integrated into one of the most advanced scientific and innovative environments in Europe; and Sweden has set the goal of making the ESS and MAX IV⁸³ both CO₂ and climate neutral. The document itself goes into more depth compared with the above condensed sentences, which briefly illustrate how the ESS interacts with ESFRI.

Advocating for locating the ESS in Lund, the document could be summed up by an excerpt from its concluding remarks:

“This compact university city offers all the attributes necessary to host a world-leading scientific user facility: political commitment at all levels; surrounded by academic excellence; twinned to the highest brilliance synchrotron radiation source MAX IV; connected on all sides to proven innovation incubators; a human-scale, welcoming community, speaking English and embedded in diverse and beautiful countryside; an excellent communications infrastructure; in close proximity to a capital city; but above all located in the socially advanced society of Scandinavia where respect for the environment and for all people is strived for.” (Malm et al., 2008, p. 55)

These arguments are relevant in that it is envisioned that future users of the ESS will comprise scientists coming and going in large numbers. Therefore, issues such as transportation and communication infrastructure are crucial, including infrastructure such as the Öresund Bridge connecting Denmark and Sweden, the City Tunnel running between the Öresund Bridge and Malmö Central Station, and a tramline constructed from Lund Central Station with the European Spallation Source as its terminus⁸⁴. Additionally, a nearby international airport, Kastrup Airport in Copenhagen, offer several connecting flights. Hence, accommodating fairly easy trips for scientists to come to the ESS, as they can fly into Kastrup Airport, take the train to Lund (over the bridge and through Malmö in tunnels), arrive at Lund Central Station, then directly⁸⁵ take the tram towards the ESS, and walk approximately 100 metres to the gates that allow access to the ESS.

Later in 2008, ESFRI publish its Roadmap 2008 document. This report describes how Sweden, alongside Hungary and Spain, are candidate countries

⁸³ A Swedish large-scale research infrastructure, this actor is presented in section 5.1.3.

⁸⁴ The tramline was completed in 2020 (Skanska, 2025b).

⁸⁵ A walking distance of approximately 50 metres.

for hosting the ESS. The Roadmap states that the ESS is a high priority to ensure that Europe has access to world-leading facilities. A decision on the ESS is said to ensure that Europe's leading role remains and is strengthened regarding neutron scattering. The report reasons that “[i]f a decision on the site of this 5-MW longpulse source is taken in 2008 and construction starts in 2009, the facility may become operational in 2019/20” (ESFRI, 2008, p. 62).

The region continues to be involved. In October, 2008, there is a conference on the topic of the ESS, held by several regional municipalities and Region Skåne and attended by individuals such as Pia Kinhult as the Chair of Region Skåne's Regional Executive Committee and an important individual in the ESS story. The purpose of the conference is to build readiness for action to reap the growth effects that the possibility of the ESS could entail, and to contribute to the vision of Skåne taking advantage of the possibilities of science. A week prior to the conference, the Swedish Government presented its Research Bill in which, according to the text published in *Sydsvenskan* (2008), the Government clearly marked how urgent it is to build MAX IV in Lund. The newspaper article describes how both MAX IV and the ESS will contribute to discoveries and innovations of great significance for society and industry. In *Sydsvenskan* (2008) it is written that the growth effects of establishing the ESS are partly direct effects based on a certain amount of money being invested in Skåne⁸⁶ and partly the longer-term indirect effects emanating from the ESS's significance for innovation climate, technological development, and possible spin-off effects. It is stated that if actors can take advantage of the long-term effects of the ESS, this will, according to the study ‘ESS in Lund – Effects on Regional Development’⁸⁷, mean that the expected accumulated effect on Skåne's gross regional product will be 214 billion Swedish kronor higher during the 2010–2040 period due to the ESS. It is also written that there is a possibility to increase employment by about 700 people per year in Skåne up until 2040 or 23,000 more employees 2040 just as an effect of the ESS. How big the indirect effects will be, however, is dependent on how well MAX IV and the ESS are received and on taking advantage of the long-term effects of the facilities, writes *Sydsvenskan* (2008). Indeed, *Sydsvenskan* (2008) reports that for the ESS and MAX IV to become springboards for future growth and development, active and conscious strategic work is required by several actors in the region. Planning and acting for the two facilities therefore must start now. The article ends with a comparison, stating that MAX IV and the ESS can make the Öresund Region for materials science into what Silicon

⁸⁶ Specifically, 13 billion Swedish kronor, according to *Sydsvenskan* (2008).

⁸⁷ In Swedish, ‘ESS i Lund - Effekter på regional utveckling’.

Valley is for computer and electronics science, a beacon in the international science world (Sydsvenskan, 2008).⁸⁸

To complicate the story further, in this time period a lot seems to be happening on different levels. An interviewee highlights some reasons for Sweden to bid to host the ESS:

“And way back, in 2008, it was clearly understood that there were two big benefits for Sweden to host a major facility like this. Maybe three. But two economic benefits. There’s a short-term benefit, that a big stimulus to the local economic activity will happen. So the Swedish government is contributing 37% of the construction cost of ESS. But a lot more than 37% of the budget is being spent within Sweden. So this investment is pulling in money from other European countries. Paying salaries. 2,000 companies in Sweden have registered as ESS suppliers. 80% of the commercial contracts are placed with Swedish companies. So there’s a very big economic footprint from the construction activity. And not just the immediate spending of the money, but all of the other businesses that have located there to supply, and the impact that it’s had on the local region. The second benefit is much longer term and that comes from the access to a world-leading research capability very close Swedish universities, which are very very good in terms of their individual research profile. But have often based their research on what can be done in the university campus itself. And so investment, first in MAX IV, in high-performance computing capability, in SciLife lab and other national capabilities, and in ESS, is a change in this model. It’s to provide a national focus for research capability that goes beyond what any single university, by itself, can operate. And then that means a change in psychology too. And this is... The areas that ESS facilitates, the areas of research that neutron scattering supports are particularly important for the profile of the Swedish economy.” (Interview Womersley)

Going into 2009, ESS Scandinavia has arguably made a good case, getting several types of critical actors onboard the idea of realising the ESS in Lund.

4.4 The ESS can finally be realised

“Day of joy for Lund: ESS WE CAN!”^{89,90} (Sydsvenskan, 2009)

“Sweden takes charge and dares to think big”⁹¹ (Svenska Dagbladet, 2009)

⁸⁸ To clarify, this paragraph paraphrases excerpts from the newspaper article, showing how Region Skåne, Sydsvenskan, and others portray and reason about the ESS in the regional context.

⁸⁹ “ESS WE CAN” is presumably a play on the words “Yes we can” used during the presidential campaign of Barack Obama, who became the US president in 2009.

⁹⁰ Translated by author.

⁹¹ Translated by author.

The opening quotations hint that efforts to realise the ESS rose in a crescendo leading up to the decision to locate the facility in Lund. However, first a few remarks on what happened in the early months of 2009, prior to the aforementioned decision. In early 2009, work is done on key parts of the design.

At the end of April, 2009, Ny Teknik (2009) report that in a month's time, Leijonborg will have the opportunity to put Sweden on the world scientific map. Furthermore, interesting to note from the newspaper article is that it summarises five common arguments for the ESS that surface here and there every now and then prior to 2009. These are as follows:⁹² Construction work, Sweden only pays 30% of construction costs and gets a European facility worth 13 billion Swedish kronor; operation, Sweden pays 10% of the operation costs of one billion Swedish kronor and gets 500 new qualified jobs in Lund; brain power, Lund will become a magnet for the world's neutron scientists, who will live, eat, and research in Lund at times, and some of whom will move to Lund permanently; new companies, neutron science is an eye into the nano-world, and this research will create new material and spin-off new companies; prestige, the ESS will give Sweden invaluable PR, just as CERN did for Switzerland (Ny Teknik, 2009).

In May, 2009, the research ministers of Europe gather for a meeting over dinner in Brussels at which the ESS is the topic. When asked where to build the ESS, more or less all countries suggest Lund. Hence, at the meeting in Brussels, a number of European government representatives makes the decision that, given that ESS is built at all, Lund will be selected as the ESS site (ESS, 2021b; Hallonsten, 2019)⁹³.

Following several years as a conceptual design and as a mere idea in the minds of scientists and others, the ESS journey reaches a critical moment in the path towards being realised and materialised into reality. After the meeting, ESS Scandinavia immediately starts a collaboration with Spain and Hungary, although this had been initiated previously as they were collaborating on the design. Indeed, the project now changes from being a political project to a planning project, at least in some regards. Political aspects such as funding as well as regional and national politics in terms of creating various national initiatives to reap the proposed benefits of hosting the facility continues through the following years.

⁹² According to the wording in Ny Teknik (2009).

⁹³ For interested readers, Hallonsten (2019, p. 7), in his footnotes, refers to a number of different sources that elaborate on this decision.

5 Emergence of the ESS and an interorganisational network (2009 to 2023)

Once it is decided, in 2009, that the ESS will be located in Lund, the process starts becoming increasingly localised to the Swedish landscape⁹⁴. Alongside the emergence of the ESS itself, an interorganisational network surrounding the ESS starts to emerge during this period. The emerging network consists of actors from several different spheres of society. This chapter highlights the many different types of actors that emerge, such as how they enter the story of the ESS and why they are relevant. Sweden, the host country, starts gearing up its activities, moving it closer towards being a Big Science nation.

The dimensions addressed in this chapter focus on interorganisational matters, as a large number of new actors enter the story, and we can see a lot of interesting actor constellations being formed, particularly within the national landscape. Entirely new actors get involved but also pre-existing actors remain involved, albeit in slightly different ways than previously and to a greater extent than prior to the decision in May, 2009. Many of these actors are in one way or another attempting to reap the proposed benefits used in legitimising the ESS as attractive in the previous phase.

Following the decision in Brussels to locate the ESS in Lund⁹⁵, several Swedish newspaper articles understandably report on what could be viewed as a success. *Sydsvenskan* (2009) reports that construction of the ESS is projected to start around year 2012 and that operation can begin approximately ten years later. The newspaper article further reiterates what could be regarded as some of the key benefits of hosting the ESS, such as how the facility will have 500–600 employees and will be visited by 2,000–3,000 European scientists

⁹⁴ My dissertation delves deeper into the Swedish national perspective because this is where the ESS trajectory takes us as the project is being materialised in Lund. However, this does not mean that other actors did not have an impact on the ESS. Other actors remain involved in various parts of the project that are not elaborated on here, such as ESS Bilbao that instead of hosting the facility deliver equipment for the ESS construction. Indeed, European labs contribute greatly to building the ESS.

⁹⁵ Lund could be referred to as a university town, with a population of about 100,000 inhabitants, in the province of Skåne with about 1,4 million of Sweden's total population of slightly over 10 million citizens. Lund is also embedded within the so-called Öresund Region, which broadly speaking covers southernmost Sweden and northern Denmark, including cities such as Malmö and Copenhagen.

annually. Furthermore, it points out that the real significance of the ESS is in the long term. For example, it states that globalisation has made it harder for Swedish companies to compete with low-wage countries in the traditional manufacturing industry, and that a way to maintain and increase welfare is to move higher up the economic value chain, towards knowledge-intensive production. As such, it is argued, it is ever more important to be at the forefront of science. And a world-leading facility such as the ESS can have crucial significance for Lund's opportunities to keep research-intensive and high-tech companies, to attract new similar enterprises, and to create an environment where new knowledge-companies emerge, grow, and thrive.

However, although it is decided that the ESS would be located in Lund, this did not mean that it was smooth sailing thereafter. Several preparations, alongside the ESS, are required to make the most of the opportunity.

5.1 Preparations are underway

During this period, efforts are devoted to find funding for the ESS as well as to elaborate on its technical aspects, leading up to the Technical Design Report published in 2013. From a regional perspective, it is more about preparing to host the ESS. Indeed, there are a number of initiatives surrounding the ESS that are set up to prepare for the facility.

In October, 2009, ESS Scandinavia's success is acknowledged by the Marketing Association in Malmö, awarding it the 'Marketeer of the year' award;

“for successfully meeting the “dual marketing” challenge of gaining support from Europe for building one of the largest ever research facilities in Sweden, and getting support in Sweden, as well as extensive visibility, for a unique and expensive, but not easily understandable, project.” (ESS, 2010, p. 37)

The ESS continues to adhere to multiple actors in different ways and engages in a stream of matters. For example, in its Activity Report 2009–2010, the ESS is portrayed in terms of how it helps humanity (ESS, 2010). The Activity Report, published annually, can be likened to an annual report, and is a document that is perhaps most tied to the ESS and how the organisation chooses to communicate with other actors⁹⁶.

During this period, a video is published on YouTube (see Uni Huddersfield, 2010) that will subsequently receive over 14,000 views, and thereby a fairly widespread dissemination overshadowing the number of views of any of the

⁹⁶ On the other hand, newspapers arguably serve as a type of mediator between the ESS and the public.

videos posted on the European Spallation Source’s own YouTube channel. In the video, the movie actor Patrick Stewart⁹⁷ makes an appearance on behalf of the University of Huddersfield, describing the ESS in terms of its future potentialities. He captures viewers’ imaginations as to what science and large science facilities, such as the ESS, could contribute to humanity, including the societal benefits. This video also highlights another aspect of the ESS, namely, how the ESS and other actors communicate the science and technical aspects of the facility. Many claim that the ESS is complex and thereby cumbersome to explain. Non-science actors, such as Region Skåne or newspapers, tend to draw the analogy of the ESS as a giant microscope, whereas within Swedish political life the notion of “the tube”⁹⁸ is sometimes used, which was initially coined by Leijonborg as Minister for Higher Education and Research (Leijonborg, 2018, pp. 341–342; Interview Leijonborg).

5.1.1 Organisational transition from ESS Scandinavia into ESS AB

ESS Scandinavia transforms into a public limited company in April 2010 according to its Activity Report (ESS, 2010, p. 9), established by the Swedish Government (Cisionwire, 2010a). In July, Cisionwire (2010a) reports that the transition into the state-owned company European Spallation Source AB is complete, and that the company takes over responsibility for building the facility in Lund together with several European countries. As reported by Cisionwire, Chairman of the Board of ESS AB, Sven Landelius, says: “*I am very happy that ESS AB has gotten a good start. The research environment that we will build in the north of Lund will be as significant as the Öresund Bridge*”⁹⁹ (Cisionwire, 2010a).

In conjunction with the transition into ESS AB, the pursuit of funding from prospective countries continues. The issue of funding is one of the rather more complicated elements of the ESS¹⁰⁰, both for an outsider to understand and for the involved parties themselves to navigate. As mentioned earlier, France, Germany, and the UK are the three big European players in terms of Big Science facilities. And it is these countries, together with significant contributions by the two host countries, Sweden and Denmark, that will contribute the largest sums of money towards the ESS.

⁹⁷ Patrick Stewart is known for playing roles such as the fictional character Captain Picard in the science fiction media franchise Star Trek.

⁹⁸ In Swedish, röret.

⁹⁹ Translated by author.

¹⁰⁰ For the purpose of this dissertation, it suffices to consider funding commitments from other countries at a quite superficial level; for a more in-depth discussion, see e.g. Hallonsten (2020, pp. 223–245).

An article published in *Sydsvenskan* (2010) exemplifies the funding commitments in a simple and fairly straightforward way, while briefly touching upon the complexities;

*“[o]n Friday it became public that Sweden and France entered into an extensive research collaboration worth approximately 625 million [Swedish] kronor. France will deliver equipment to ESS for about 256 million kronor and Sweden will support and participate in French research to a value of approximately 370 million kronor.”*¹⁰¹

This is accompanied by a quotation from the Head of Accelerator at the ESS, Mats Lindroos;

*“I know that the French accelerator labs have a very high level of competence and it will be fun to work with them again. It would have taken ten years to build the same competence in Sweden, with this agreement we will be able to start the work immediately”*¹⁰². (*Sydsvenskan*, 2010)

The newspaper article in *Sydsvenskan* (2010) manages to capture many of the ongoing themes during this time period. Additionally, the illustration of the ESS as a giant microscope surface to describe the ESS. The newspaper article concerns funding from various European nations as well as their scientific expertise in terms of building scientific equipment for the ESS. Moreover, another theme, returning every now and then within the Swedish research landscape, concerns how other scientists with little direct benefit from neutron research view the ESS project. *Sydsvenskan* (2010) succinctly summarises the sentiment, writing that “[t]here has been grumbling within the Swedish Research Council that ESS swallows too much of the Swedish research money”¹⁰³. Furthermore, amplifying the sentiment is an accompanied quotation from Peter Honeth, who says;

*“[w]ell, it’s not that simple that all researchers in Sweden think it’s great that we invest 4,5-5 billion in a facility in Lund. Many researchers have no use whatsoever for ESS or Max IV. It would be strange if there wasn’t that kind of debate.”*¹⁰⁴ (*Sydsvenskan*, 2010)

Later in the autumn, it is reported that Germany has presented a large financial contribution of approximately 200 million Swedish kronor to the ESS project (Cisionwire, 2010b). And, at the end of 2010, Denmark, co-host of the ESS, becomes a partner in ESS AB. TT Nyhetsbyrå (2010) reports;

¹⁰¹ Translated by author.

¹⁰² Translated by author.

¹⁰³ Translated by author.

¹⁰⁴ Translated by author.

*“ESS AB was established in April this year and has been wholly owned by the Swedish state until now. The Danish state buys 26,3 percent of the shares in the company. More European countries are expected to become partners in ESS, which is an investment of approximately 14 billion.”*¹⁰⁵

5.1.2 Preparing the ESS

Entering 2011, before construction of the ESS, and even prior to the Conceptual Design Report, Sydsvenskan (2011a) publishes an article entitled ‘ESS shows the way’¹⁰⁶ reporting that the ESS facility will be first with an energy solution that makes it environmentally sustainable. The article states that, through its unique energy solution, the ESS is taking the lead in setting the agenda for energy use and climate impact in the research world. As such, the ESS can provide guidance internationally for developing other accelerators and research facilities. It is claimed that there is every reason to highlight the development that is currently taking place. Indeed, the Swedish Government wants to profile the country at the forefront of developments within sustainability (Sydsvenskan, 2011a).

In preparing the ESS, additional employees are being recruited to the ESS team in Lund. Carlile, now working as Director of the ESS¹⁰⁷ (see e.g. ESS, 2010), is showcasing the benefits of Lund and Sweden (Sydsvenskan, 2011b). To their help, Carlile and the ESS have used material from Invest Sweden, an agency within the Ministry for Foreign Affairs whose mission is to attract foreign companies and investors to Sweden. The article sets forth various benefits, including that it is free to drive on Swedish motorways, it is free to study at university, it is much cleaner in the cities, and equality has come much further in Sweden than in most other places around the world (Sydsvenskan, 2011b).

The Conceptual Design Report¹⁰⁸ is published in February, 2012 (ESS, 2012a). At over 240 pages, this is one of the first major reports published by the now slightly better-established ESS organisation in Lund. As alluded to above, the organisation is starting to expand from its previous relatively small-scale ESS Scandinavia-group. At this point in time, the ESS is in a rapid growth phase with almost 100 employees (ESS, 2012a, p. 11). This document mainly contains technical matters, leading up to the Technical Design Report¹⁰⁹. However, a few non-technical matters surface throughout the report, which, for example, highlights some key actors involved in matters

¹⁰⁵ Translated by author.

¹⁰⁶ Translated by author.

¹⁰⁷ Rather than ESS Scandinavia.

¹⁰⁸ Also known by its initialism, CDR.

¹⁰⁹ Published in 2013 (ESS, 2013).

surrounding the ESS including “*scientists, politicians, funders, laypeople, et cetera, and be they local, regional, national or international in origin*”, through activities such as “*press releases, web pages, talks, visits, exhibitions, branding, brochures, annual reports and one-to-one interactions*” (ESS, 2012a, p. 9). According to the report, the ESS has “*built up a strong communications culture and this is to be constantly updated, appropriate, attractive and relevant*” (ESS, 2012a, p. 9). In the report’s following paragraph, a similar line of reasoning shows a quite telling detail that, in some sense, encapsulates the ESS and its journey, as “[*i*]t is very important that the project has many supporters, but it is perhaps even more important that it has few enemies. Public acceptance is crucial to success and we put particular effort into this” (ESS, 2012a, p. 9). Another important issue in the report is how to make the best use of the ESS, and what key areas can benefit the most. A few different science areas are said to benefit from the ESS, broadly speaking involving physics, chemistry, and life science (ESS, 2012a, p. 14). In terms of the area of life science, according to the former Minister for Higher Education and Research, Leijonborg, Sweden is a big exporter of both pharmaceuticals and medical technology products (Leijonborg, 2018, p. 332).

Around this time, planning the ESS also means planning the Data Centre. A political dimension permeated the decision to locate the Data Centre in Copenhagen, Denmark (see 4.3 *The conundrum of the ESS in different places*). However, the planning phase of how it will be designed is formulated by acknowledging its future users (i.e. scientists) to a greater extent than before, essentially, to help the user community in managing their data from the ESS. To make the Data Centre with the scope and volume that it has is an attempt to take seriously its role as a data broker for the community and to help the users analyse their data. Once the ESS becomes fully operational, the users from the scientific community will be conducting experiments, acquiring data, doing data processing, data reduction, and data analysis. Practically speaking, it is envisaged that users will come to the ESS, carry out their experiments at its instruments, then return to their home institutions and access the facility’s infrastructure remotely to do data processing. The Data Centre will help the users during this process by managing their data. This is one of the purposes of having the Data Centre, in addition to providing the data and data services for the community when they are conducting their data analysis after their experiment, because most of the analytical work happens after the experiments (Interview Taylor).

The volume of data is only increasing as the number of neutrons increases a little bit but the number of detectors that are detecting the neutrons and the speed at which it is possible to do that detection increases a lot. Not necessarily

referring specifically to neutron data but instead generally to data at a data centre, the argument was, and still is, that a lot of data are wasted because users cannot figure out how to make sense of it (Interview Holm Rod). Indeed, spallation neutron sources have always had a data challenge. The Data Centre believes that the users will acquire 10, 20, 40, 100, maybe even 200 terabytes of data during their experiments at the ESS. The users need access to their data;

“it’s not that they take it home in their rucksack when they leave. Because, in principle, the volume is too big and really we wouldn’t want to put the responsibility of research data management on to the user community because that’s not necessarily their field of expertise.” (Interview Taylor)

Moreover, scientists from various disciplines have in the past had problems using neutron facilities because of a lack of support regarding data, “[a]nd the idea, the very clear idea, is that this is not going to happen at ESS. We will have people that will help the users” (Interview Lefmann). There will be instrument-responsible people at the ESS in Lund, who will help the users when they are carrying out their experiments. In addition to this, there have been discussions related to the Data Centre about having one additional instrument-responsible person, a data scientist dedicated to the data. However, it is unclear whether this will be implemented, or to what extent, although it is a topic and possibility that has been discussed as an additional way to help the users at the ESS manage their data.

Following the Conceptual Design Report, previously highlighted, the ESS publishes its Technical Design Report¹¹⁰ in April, 2013, covering a substantial part of the technical design of the ESS (ESS, 2013). Relative to the approximately 240-page conceptual design published at the beginning of 2012, the Technical Design Report consists of more than 650 pages¹¹¹. The opening sentence shows an emphasis on users from both academia and industry: “ESS, the European Spallation Source, will be a major user facility at which researchers from academia and industry will investigate scientific questions using neutron beams” (ESS, 2013, p. xxi)¹¹². This could be viewed as a politically strategic statement since it seems that in general politicians tend to be the group most concerned with attracting industrial users to these types of Big Science organisations. Industrial users will have to pay to use the ESS, whereas use is already paid for users from academia. Viewed from another perspective, the individual scientists merely pay with their time and even the neutron

¹¹⁰ Also known by its initialism, TDR.

¹¹¹ The numbering of pages in the document starts in Chapter 1.

¹¹² This excerpt appears twice, as the introductory sentence of the Executive Overview (ESS, 2013, p. xxi) and as the opening sentence of Chapter 1 (ESS, 2013, p. 1).

community does not pay the bill; instead, the governments that fund the facility pay the bill, and ultimately the taxpayers. Moreover, another aspect worth elaborating on from the opening sentence concerns that the ESS will be a user facility.

As a user facility, the ESS organisation will not conduct its own research. As such, the ESS is reliant on scientists wanting to use the facility by pondering relevant questions that could be investigated at the ESS. A potential user writes a proposal that is evaluated, and if the proposal is well received, the scientist can then access and use the ESS. It seems that the ESS takes its mission of helping its future users seriously. Aside from striving to build the best facility and instruments, the Communication Officer at the ESS says that the ESS should also make it easier to conduct research at the facility (Interview Eriksson). It should not be necessary to be a neutron scientist to use the instruments at the ESS. Instead, the ESS will provide the users with other scientists who will help them, for example, to use the instruments and with the sample. Ultimately, this will make it easier for the user and increase the pool of potential users. Kinhult¹¹³ says how the ESS will help its users, and also notes that the owners of the ESS have told the organisation to try to increase the level of service somewhat more than is normally the case at such facilities to allow a wider range of scientific disciplines to use the ESS (Interview Kinhult).

The Technical Design Report describes an instrument suite at the ESS that could address a fairly broad range of scientific disciplines, including science drivers involving soft condensed matter research, life science, magnetic and electronic phenomena, chemistry of materials, energy research, engineering materials and geosciences, archaeology and heritage conservation, and, finally, fundamental and particle physics (ESS, 2013, pp. 15–45). It is stated that “[t]he choice of instruments to build will take place as an ongoing process in which a number of concepts are selected every year, starting in 2013” (ESS, 2013, p. 49). Furthermore, evaluation criteria include “*scientific impact, user base and demand, instrument performance, strategy and uniqueness, technical maturity and costing*” (ESS, 2013, p. 49).

The topic of in-kind contributions also surfaces in the Technical Design Report:

“With 17 European partners committed to construct ESS, it is inevitable that a significant source of revenue will be components manufactured and supplied as in-kind contributions. For planning purposes, the ESS organisation has worked under the expectation that 75% of the capital cost will be covered by cash contributions and that 25% will be in-kind. Currently, representatives appointed by the Swedish and Danish governments are engaged in bilateral

¹¹³ Chair of Region Skåne’s Regional Executive Committee as well as later working at the ESS.

discussions with the other partners in order to determine the potential of each country to engage in the construction process starting in 2013. The significant fraction of in-kind contributions brings with it particular challenges. Management of in-kind contributions is the key issue in delivering the ESS on time, to budget and fully operational. The technical risks of managing interfaces need special attention. Additional resources will be required to do this effectively, and 100 M€ is not an unrealistic sum for this purpose.” (ESS, 2013, p. 5)

5.1.3 Preparing the surrounding landscape

In conjunction with the decision to locate the ESS in Lund, a variety of different types of actors are creating and participating in various initiatives in different constellations, particularly within the surrounding landscape. Loosely speaking, they do so to utilise and reap the benefits of the forthcoming ESS.

In their Activity Report 2009–2010, the ESS emphasises the importance of proactive communication and networking, stating that “*ESS is conducting an active public relations work in order to meet the needs of actors within science, the general public, politics and media*” (ESS, 2010, p. 36). Furthermore, the report states that actors are planning how the surrounding community can prepare for the ESS (ESS, 2010, pp. 39–40). The nearby surrounding landscape seems to be particularly interested in the ESS and in reaping various benefits from the decision to locate the facility in Lund. In 2009, a report on behalf of regional actors, by Öhrlings PricewaterhouseCoopers (PwC) is published as a result of work conducted between autumn 2007 and June 2009 (TITA, 2011a, pp. 7–8; TITA, 2011b, p. 17). During much of the time whilst conducting this study, it is undecided where to locate the ESS¹¹⁴. The purpose of the study is to provide knowledge to increase readiness for action in the region prior to the establishment of the ESS (TITA, 2011b, p. 17).

TITA, an acronym comprising two parts, TI (i.e. growth and innovation) and TA (i.e. accessibility and attractiveness), is a regional project that starts in 2010, initiated jointly by Region Skåne and 42 other public actors in the nearby region (TITA, 2013a, p. 13). TITA is co-financed by the European Union (TITA, 2013a, p. 13). Amongst other things, TITA mobilise actors inside the region (Sandberg et al., 2022, p. 2) and strive to “*see how regional stakeholders can maximise the societal benefits and capture spin-off effects*” generated by the oncoming MAX IV and forthcoming ESS (TITA, 2013b, p. 2).

The project is regional, concerned in regional matters, and thereby takes into account both the ESS and MAX IV, located in the outskirts of Lund approximately 800 metres apart. MAX IV is a nationally funded large-scale research infrastructure and user facility, or, from a natural science perspective,

¹¹⁴ That is, Lund in Sweden, Bilbao in Spain, or Debrecen in Hungary.

a synchrotron laboratory that “*delivers high-quality X-ray light for research in materials and life sciences*” (MAX IV, 2025a, 2025b). In Larsson’s (2005) report, potential synergies between the ESS and MAX IV are stated as one of the many reasons as to why the Swedish Government should endorse the decision to locate the ESS in Lund. In November, 2010, the MAX IV construction site opens, and the facility is finally inaugurated in the summer of 2016 in an event attended by the Swedish Prime Minister and the King of Sweden (MAX IV, 2025c).

Starting already in 2010, the TITA-project is quick to mobilise actors inside the region (Sandberg et al., 2022, p. 2), a few years prior to starting the construction of the ESS. During the spring of 2010, work at TITA commences, including spreading information, and in June there is a kick-off (TITA, 2011a, p. 14). The TITA-project consists of different groups and sub-projects. In total, the project is divided into nine sub-projects, with TI 1 to TI 6 concerning matters related to growth and innovation and TA 1 to TA 3 concerning accessibility and attractiveness (TITA, 2013a, pp. 16–18). In other words, there are six sub-projects broadly relating to reaping benefits connected to growth and innovation and three regarding accessibility and attractiveness. According to a report, that is published in 2011, some of these sub-projects are very concrete (e.g. TA 2), whereas other sub-projects have long-term goals and are more unclear in their design (e.g. TI 4) (TITA, 2011a, p. 26). In general, it could be stated that the TITA-project, in my own words, is somewhat messy since it comprises a myriad of studies in different sub-projects, a vision of future issues, and involves a number of different actors. Tying the TITA-project together is the Steering Group headed by the Chair of Region Skåne’s Regional Executive Committee, Pia Kinhult (TITA, 2011a; Sandberg et al., 2022).

Concluding the TITA-project is a final report published in 2012¹¹⁵ that, amongst other things, formulates five strategies for reaping the benefits of the ESS and MAX IV, summarised as follows¹¹⁶: build a region strong in education; create dynamic research environments; increase accessibility throughout the region; develop the international attractiveness of the region; and enhance the competitiveness and innovative capacity of the business sector (TITA, 2013b, pp. 18–19). Furthermore, in their own words, the TITA-project “*has helped the region’s stakeholders acquire new knowledge and models for collaboration*” (TITA, 2013b, p. 18). At the beginning of the (short version) report, TITA presents three general conclusions, one of which is that “*growth*

¹¹⁵ The report in Swedish was published in 2012 whereas the report translated into English was published in 2013.

¹¹⁶ The following text refers to the headings of the respective strategies.

will not happen by itself”, recognising the need for proactive efforts from actors representing a variety of interests (TITA, 2013b, pp. 5–6).

Sydsvenskan (2012) publishes an article on a meeting of approximately 400 people at Luftkastellet in Malmö marking the TITA-project’s concluding conference, albeit pointing out that it is equally the start of ongoing work to ensure that all parts of society receive benefit from Lund becoming a research hub. Sydsvenskan (2012) reports that almost every speaker emphasises that there needs to be ongoing collaboration to maximise the effects of this unique research investment, that industry needs support to know when and how procurement happens, and that Skåne needs to strengthen its attractiveness regarding accommodation, public transport, and education, on all levels. The article also presents a quotation from Pia Kinhult, saying that “[n]ow that the project is complete, it is important that everyone incorporates the continuation into the daily work, otherwise there is a big risk that nothing will happen”¹¹⁷ (Sydsvenskan, 2012).

In 2020, Hallonsten (2020), a social scientist in Sweden, knowledgeable about Big Science in general and the ESS in particular, bring up TITA’s final report from 2012, commenting, amongst other things, that it is unclear what TITA achieved, stating that “[t]he message – that a lot has been learned but that nothing happens by itself and a lot of concrete work remains – is repeated in the final report, which lists a number of actions that will be taken” (Hallonsten, 2020, p. 263). While the TITA-project was concluded in 2012, ten years later there is a follow-up evaluation (see Sandberg et al., 2022). The evaluation mentions short-term effects of TITA such as improved knowledge of the ESS (and MAX IV) as well as enhanced collaboration within the region, particularly between municipalities. Furthermore;

“[t]here is evidence that the TITA-project also strengthened the region’s attractiveness in many respects. However, the hopes were too high for “quick results” in terms of investments, new establishments, and increased business for companies.” (Sandberg et al., 2022, p. 4)

5.1.3.1 Piecing together a complex jigsaw puzzle

“The ESS facility is a huge and highly complex jigsaw puzzle” (ESS, 2025).

The metaphor of a jigsaw puzzle provides a suitable mental image depicting all of the different bits and pieces that have to fit together to construct the ESS. Several different types of suppliers deliver a broad range of products and

¹¹⁷ Translated by author.

services to the ESS. The above quotation is from the ESS's own website and concerns In-Kind Contributions (see ESS, 2025).

In-Kind is a funding model meaning that instead of contributing by paying cash towards funding the ESS, the other member countries opt to deliver products and services¹¹⁸. By 2009, it was understood that the ESS would be built as some type of collaboration, although nobody at the ESS had done this previously (Interview Lindroos). Until the site decision in May 2009, ESS Scandinavia mainly acted as a lobbying organisation. In-Kind was discussed in conjunction with IKON's first meeting in 2011 (ESS, 2012b). Other member countries, acting as In-Kind partners, deliver high-tech products through their various institutes, such as Forschungszentrum Jülich in Germany or ISIS Neutron and Muon Source in England. Various parts of the ESS are constructed across different locations, whereby products are subsequently transported to Lund. Broadly speaking, the ESS uses two types of suppliers to build the facility, commercial suppliers and In-Kind partners. In-Kind partners are permitted to use commercial suppliers, sub-suppliers, and so on.

In-Kind deliveries are used for several different parts of the ESS, including the accelerator, target, and various instruments. The more specialised the product is, the greater the likelihood that it will be delivered as In-Kind (Interview Lagerblad). To ensure the success of In-Kind, it is crucial to build a consortium and to be able to cooperate (Interview Lindroos). As such, in comparison to a commercial supplier in a commercial consortium, the suppliers view themselves just as much as owners of the ESS (Interview Lindroos). The In-Kind model is a collaborative project in which all parties collaborate to ensure ESS's success, rather than a model of simply ordering products from various suppliers in industry (Interview Lindroos).

Building the ESS using In-Kind contributions is partly a technical necessity. The ESS is somewhat of an engineering feat, a highly complex next-generation spallation source that pushes not only scientific boundaries but also technological boundaries. The ESS is a novel undertaking, yet it builds on previous expertise. Indeed, several highly complex Big Science organisations already exist, such as other neutron spallation sources (e.g. Spallation Neutron Source). Although the ESS is a new, one-of-a-kind effort, its construction builds on the expertise from previous, related projects. The In-Kind model is one way to make use of previous experiences, by utilising the competencies scattered across different locations. A former Director General at the ESS says that In-Kind is a;

¹¹⁸ Sweden is paying 'In Cash' (e.g. towards Skanska constructing the facility); see section 5.4 for more information about when Sweden can contribute In-Kind.

“[t]echnical necessity because in Lund the skills do not exist to build a 5 megawatt proton accelerator or to design power modulators to power it. Those skills exist in other laboratories, in France, in Germany, in Italy. And it’s much better to take advantage of those capabilities than try to duplicate them.” (Interview Womersley)

Essentially, to build a facility such as the ESS, it is not entirely feasible to do everything in Lund. In 2013, TT Nyhetsbyrå reports on the topic of In-Kind hinting at how it is also used as a political instrument for other countries to support the ESS:

*“According to Peter Honeth, Germany and France have made far-reaching commitments and Great Britain has announced a strong interest. The lifeline for several of the countries – for example crisis-stricken Italy and Spain – is that as an alternative to money, instead contribute to the ESS with equipment and expertise, so-called in kind-contributions.”*¹¹⁹ (TT Nyhetsbyrå, 2013)

*“It greatly facilitates for some of these countries. The in kind-contributions means that they actually pay to their own industry and their own universities, says Honeth.”*¹²⁰ (TT Nyhetsbyrå, 2013)

The In-Kind model is also a political necessity considering that the countries that choose to join the ESS want to know that their own scientists and engineers can contribute intellectually, and that their own companies can contribute and benefit (Interview Womersley). The best way to build the ESS would arguably be by politicians contributing a huge pot of money that the ESS can spend. However, Carlile argues that this is not politically acceptable nowadays (Interview Carlile). The ESS costs a lot of money, towards which several European governments contribute large sums of money. In-Kind makes it somewhat easier for member countries to defend why they are using taxpayer money to the benefit of another country. Using the In-Kind model, a lot of activity remains inside the borders of each member country, which in turn makes it easier for the governments to explain why they are making this type of investment across national borders (Interview Kinhult). In the words of Womersley:

“I mentioned already, the contributions, In-Kind, as an important part of the, maybe marketing is too strong a word, of the, preparing the case for investments from other European countries, because they wanted to see some of these same economic benefits flow to them. And if the facility is located in Sweden, what is the benefit for France, what is the benefit for Germany. They want to see some of that spend occurring within their own national borders and within their own industry.” (Interview Womersley)

¹¹⁹ Translated by author.

¹²⁰ Translated by author.

A lot of the advanced systems for the ESS are made in other countries. The host country, Sweden, has a fairly small portion of the big contracts concerning advanced systems (Interview Carlsson). As a result, Swedish suppliers tend to be involved in construction of the civil facility by Skanska or as sub-suppliers to various In-Kind partners. For this reason, Sweden and Swedish industry are perhaps less involved than some individuals would have liked. Indeed, there is criticism (within Sweden) of the agreement that Sweden should pay in cash whereas other countries contribute In-Kind to engage their own industry.

Furthermore, the In-Kind model poses a project management challenge, not least evident in the voices of people who work at the ESS. There are complex agreements on who is supposed to spend how much money (Interview Oksanen). And in certain instances, the instruments are built by two or more In-Kind partners who contribute different parts but do not communicate sufficiently (Interview Lundmark). An illustrative, albeit hypothetical, example of how the funds of a project manager are locked in would be that X amount of money has to be spent in France, Y amount of money can only be spent in Germany, and Z should be spent in yet another country. This results in a situation concerning who should pay what and how to distribute the costs, as a matter of the right country paying the right amount of money. Complicating this further, sometimes the countries do not have anything to contribute but are nevertheless sitting on part of the budget.

Another problem surrounding the In-Kind model concerns quality control. The In-Kind partners have their own suppliers, and sometimes sub-suppliers, and so on. The ESS has left the responsibility for quality control to the In-Kind partners. In some instances, this works well, especially in large organisations such as the Science and Technology Facilities Council (STFC) in England or the French organisation CEA, as they each have a functioning quality control organisation. However, other organisations do not have their own quality control organisations, which causes some concern surrounding the quality of In-Kind contributions. Furthermore, supply chains can be quite complex. For example, ponder a situation involving an In-Kind partner, such as a university somewhere in Europe. Their delivery to the ESS requires some type of construction. Instead of doing this by themselves, the university outsources parts of the construction to a local company. For example, they buy a mechanical product from a small mechanical firm locally in that country. In such supply chains, the ESS has limited insight to ensure quality. Later, at the end of year 2022, quality problems indeed become an issue (see Sydsvenskan, 2022).

5.2 Construction of the ESS

“we had to make a virtue out of the fact that we were building on a greenfield, I mean completely greenfield.” (Interview Carlile)

An important step towards materialising the ESS is in February, 2013, when Henning Larsen Architects are appointed to design the ESS, after competition with four other architect firms (Aftonbladet, 2013; Interview Hedin). Later, in February, 2014, a collaboration contract is signed between the ESS and the construction company Skanska, in a so-called partnering agreement. Partnering is a type of risk-sharing agreement that takes into consideration whether the project proceeds better, or worse, than initially estimated. The project will be built in successive phases with a separate agreement being signed at the beginning of each stage (Cisionwire, 2015). At the time, the ESS does not know specifically what will be built or in what order (Interview Hedin). Yet, as indicated in, for instance, the Technical Design Report, a lot of design work had already started prior to commencing actual construction (Interview Carlsson).

Appointing Skanska to construct the facility is, however, only one step towards realising the ESS, albeit a big one. In March, 2014, TT Nyhetsbyrån (2014a) reports that the UK declare that it will contribute 10% towards the ESS’s budget. In a press release, Jan Björklund, current Minister of Education in Sweden, says;

*“[t]hat the British Government choose to join as a strong co-financier in the ESS is important for the project and an important success for Sweden. We have been conducting intensive negotiations with the British Government and British research authorities for a long time. The British have highly qualified research and is a heavy science nation”*¹²¹ (TT Nyhetsbyrån, 2014a).

Hence, the major European Big Science countries are, in one way or another, all helping pave the way towards realising the ESS.

Later, in June, the Swedish Environmental Court approves the ESS, as national actors are paving the way for construction to commence (e.g. TT Nyhetsbyrån, 2014b). In July the national newspaper Aftonbladet reports that;

*“[t]he Swedish Radiation Safety Authority approves that the research facility ESS in Lund may conduct activities with ionising radiation. The authority has today decided that the research facility will be given permission to start construction.”*¹²² (Aftonbladet, 2014)

¹²¹ Translated by author.

¹²² Translated by author.

The interaction between the ESS and the Swedish Radiation Safety Authority started some time before 2014 as “[t]he first licence application for the ESS facility was submitted to the Authority in 2012” (Strålsäkerhetsmyndigheten, 2025). In the future, additional permits will be required before operation of the ESS can begin (Aftonbladet, 2014).

The Swedish Radiation Safety Authority makes high demands for radiation safety and documentation. As the ESS is new to the Authority, it is somewhat unclear what the ESS will produce in terms of radioactivity. Crudely speaking, it was understood that the ESS is not the same as a nuclear power plant, but neither is it merely an X-ray division of a hospital. In other words, it is unclear precisely what the ESS is, thereby motivating additional inquiry before permits are given at different stages for the ESS to continue its journey towards materialisation. The Authority visited similar facilities in other countries and talked to their counterparts there. By 2018, it was decided that the ESS is in so-called Category 2 (Interview Kinhult). It is stated on the Authority’s website that the ESS is not a nuclear facility, but that it will create significant amounts of radioactive material; when the target is hit by protons it will release neutrons, and in this process the target becomes radioactive (Strålsäkerhetsmyndigheten, 2023).

Following almost three decades as an idea for a next-generation spallation source, year 2014 marks the start in which construction on the 70-hectare ESS site can finally commence (Skanska, 2025a). To signal that construction is underway, a symbolic gesture takes place as Sweden’s Minister of Education and Vice Prime Minister Jan Björklund, together with the Danish Minister for Education and Research Sofie Carsten Nielsen, break ground in Brunnshög, Lund (e.g. Svenska Dagbladet, 2014). However, as Svenska Dagbladet (2014) highlight, some issues remain unresolved. First, there are concerns regarding money since funding for the ESS is not yet fully finalised. Second, pointing towards national qualms as the Swedish scientific community has not been entirely positive, and that the ESS has been depicted as a prestige project that could jeopardise other research money, which is followed by a comment from the Swedish Minister of Education: “*I believe that large parts of the Swedish scientific community have not yet understood what a positive force this will be for Swedish research*”¹²³ (Svenska Dagbladet, 2014).

In November, it is reported that Skanska has signed a contract with the ESS worth 670 million Swedish kronor to build the first stage of the facility. The work is conducted by Skanska Sweden (75%) in collaboration with Skanska UK (25%). This means that 503 million Swedish kronor is included in the order for Skanska Sweden in the fourth quarter of 2014, and the remaining

¹²³ Translated by author.

part for Skanska UK. The first stage includes excavation work, necessary infrastructure at the workplace, the Accelerator Tunnel, and a number of connected buildings (Cisionwire, 2014).

The Skanska–ESS Collaboration¹²⁴ is led by the ESS Conventional Facilities Division, headed by Kent Hedin acting as Head of Conventional Facilities throughout the project. In a sense, Conventional Facilities orders work from Skanska. Håkanson and Kokko (2022, p. 40) state that “*Skanska has during the years 2015-2020 by far been the biggest supplier to the ESS*”¹²⁵. Conventional facilities refer to “*the spaces required to house research equipment, machines, instruments, and people*” (ESS, 2016, p. 20). In other words, all the buildings required for the ESS to function, totalling 26 buildings ranging from the Accelerator Tunnel to office spaces. In constructing the ESS facility, function takes precedence over design, as in creating a functional facility rather than a beautifully designed building, though beauty of design is also taken into consideration (Interview Hedin). Located in the outskirts of Lund, they are not interested in getting something that looks like a nuclear power plant (Interview Hedin). For example, the ESS has a sombrero-looking rooftop on one of its bigger buildings (see e.g. The Quarantines, 2022¹²⁶).

Skanska describes their assignment on its website:

“Skanska was responsible for planning and building the shell and infrastructure of the research facility together with ESS. The assignment included planning and building an approximately 500 meter long accelerator tunnel, a target station, three instrument halls and service buildings. In addition, Skanska was also responsible for roads, cables, groundwork and plantings.” (Skanska, 2025a)

The seeds for the next phase of the ESS facility are planted in 2015 as Skanska and the ESS sign an agreement to build the second stage of the facility (Cisionwire, 2015). As already mentioned, the project is carried out in different stages. On their website, Skanska (2025a) write that;

“[i]n order to have an efficient construction process and at the same time enable ESS to be built with the latest technology, Skanska and ESS worked in close collaboration where planning was carried out in stages. Separate agreements were made at the beginning of each stage. Skanska contributed with expertise in the planning and project work; ESS contributed with experience in the construction organization.”

¹²⁴ Usually referred to by its acronym, SEC.

¹²⁵ Translated by author.

¹²⁶ Timestamp, approximately 3:14–5:36.

The second stage includes installations in a number of buildings, switchgear and transformers, ground works including pilings, landscape works, and concrete works in the Target Station and Experimental Halls (Cisionwire, 2015; ESS, 2016, p. 22). In the ESS Activity Report 2015, it is reported that there are approximately 340 on-site workers, including almost 200 construction workers (ESS, 2016, p. 20).

In constructing the facility, the ESS is much more dependent on Skanska keeping to the schedule in order to proceed¹²⁷. Moreover, the longer Skanska stays at the ESS, the more it will cost. The ideal situation would be to have everything ready for installation. However, due to time pressure, it is essential to coordinate work, since Skanska and ESS have to wait for each other to finish certain parts. For example, the ESS has to wait for Skanska to finish the Accelerator Tunnel before (some of the) installations inside the tunnel can proceed, or Skanska has to wait for the ESS to specify their requirements before they can start construction on certain parts.

During construction of the ESS, scientists generally tend to want ‘the best of the best’, whereas companies have to be mindful of aspects such as time and cost. The Communication Officer at the ESS illustrates this quite well in the following quotation:

*“a researcher is never finished, that’s the basic premise, and you have to be very aware of that when you start a big project like this, that you have to finally step in and dare to take the drawings out of the person’s hand and say that’s enough. ‘No, no, no, but we only have a little bit left here, we can redo this part here and it will be even better’, ‘that’s enough’.”*¹²⁸ (Interview Eriksson)

Another type of tension arises from distinguishing between must-have and nice-to-have features. A must-have feature could be an installation needed to meet the requirements of the Swedish Radiation Safety Authority. Illustrating a nice-to-have feature would be that somebody needs fume cupboards, perhaps stating that they need 40 fume cupboards whereas 20 might be sufficient, in which case they have to explain why they need so many. This seems to be a fairly common discussion, scientists stating that they require something without necessarily taking other parameters into account.

In the spring of 2016, a cryogenic venting pipe marks the first successful technical installation in the Accelerator (ESS, 2017, p. 70). The component has been constructed and installed in close collaboration between the ESS, Skanska, and the company RFR Solutions’ technical division (Byggindustrin, 2016). It is also reported that the Accelerator Tunnel infrastructure is

¹²⁷ Indeed, Skanska has been able to manage their time efficiently; see the end of this section.

¹²⁸ Translated by author.

completed, consisting of about 16,500 cubic metres of concrete and 2,075 tonnes of reinforcement (ESS, 2017, p. 68; Lokaltidningen Lund, 2016). As work proceeds, Skanska and the ESS sign an agreement at the end of 2016 to build the third stage of the ESS, which includes the Target Station, Experimental Halls, labs, a number of adjacent buildings, and technical installations in several buildings (TT Nyhetsbyrån, 2016).

At the beginning of 2017, Skanska becomes involved in another project, to build the first-ever tramline in the city of Lund. The tramline goes from Lund's train station, meandering through the city of Lund, before reaching its final destination at the European Spallation Source as the terminus. The tramline is eventually completed in the spring of 2020 (Skanska, 2025b). Although not specifically part of the ESS, the tramline will certainly be welcomed by future users as it should enable a smoother journey for the scientists venturing to the ESS. Another crucial preparation for welcoming future users is that, in spring 2017, one of the essential parts of the ESS, the Accelerator Tunnel, is completed, which means that technical installations inside the tunnel can begin on schedule (ESS, 2018, p. 76; ESS, 2021d). In June, 2017, the ESS receives its conditional installation permit¹²⁹ from the Swedish Radiation Safety Authority, as stated in its Activity Report 2017, "*allowing installation processes to move forward in the Klystron Gallery Building, the Accelerator Tunnel and the Target Station*" (ESS, 2018, p. 29). In the future, the ESS will also have to obtain a trial operation permit and a routine operation permit (ESS, 2018, p. 29).

In 2017, Ny Teknik (2017), a Swedish newspaper agency, meets with Jonathan Taylor, then Acting Head of the ESS Data Centre in Copenhagen, to discuss issues pertaining to the Data Centre. In the article, Taylor explains that there is a lack of people with the needed expertise, and that the Data Centre works with many teams at other Big Science facilities across the globe.

During 2018, Skanska and the ESS work on preparations for another project awarded to Skanska, to build the ESS Campus. In a press release from Skanska, the District Manager of Skanska Sweden says that "[t]he ESS Campus will be high profiled. We are building for the future with high-end sustainability goals. We will certify the office building according to BREEAM, level Outstanding, which is the highest level" (Skanska, 2018). Skanska is thus involved in building the ESS Campus, a tramline in Lund, and the ESS conventional facilities.

However, several actors are key to materialising the ESS. In the ESS Activity Report 2018, it is stated that the ESS has an opportunity to learn from other existing facilities (ESS, 2019a, p. 39). The Head of Conventional

¹²⁹ The permit was granted in October (ESS, 2018, p. 29).

Facilities, Hedin, says that he has travelled to look at other science facilities (ESS, 2019a, p. 39). According to Hedin, “*Sweden would never be able to build this on its own, it’s not on the map*”¹³⁰ (Interview Hedin). For instance, J-Parc and Spallation Neutron Source, two comparable facilities, assist in the construction of the ESS. As alluded to previously regarding the In-Kind model, although the ESS is a unique next-generation spallation source, it is not the first time that various actors have joined forces to design and build this type of facility¹³¹. Alongside cooperation with other research facilities, the ESS also points out interaction with the local community, stating that “[f]rom universities to convenient bridge, tunnel, ferry and airport access, we have tremendous support around us” (ESS, 2019a, p. 40).

In 2018, Conventional Facilities reach a peak in design activities, gradually starting to move more towards production (ESS, 2019a, p. 40). A milestone in the ESS construction is the inauguration of the Ion Source, symbolising the first deployment of a major technical component at the ESS (TT Nyhetsbyrån, 2018a). The Ion Source is the so-called origin of the ESS proton beam, located at the opposite end of the Target Station along the accelerator. The Ion Source is provided by the Italian In-Kind partner INFN-LNS¹³². The inauguration is attended by the President of Italy, the King and Queen of Sweden, as well as Sweden’s current Minister for Higher Education, Helene Hellmark Knutsson (TT Nyhetsbyrån, 2018a). This event is, perhaps unsurprisingly, reported throughout the Swedish media landscape, showcasing the success of the ESS construction as well as the glamour and glitz of the high-level attendees.

In December, 2018, construction break ground for the ESS Campus (ESS, 2019a, p. 34). In the ESS Activity Report 2018, the ESS Acting Director General says that “[t]he start of the construction of the ESS Campus is an important milestone on the road to completion of this unique research infrastructure, that will help to address some of the big societal challenges of our time” (ESS, 2019a, p. 34). As already noted, the ESS Activity Report is similar to an annual report. It is a medium for the ESS to communicate to other actors. In such a context, indicating that the ESS will contribute towards society is perhaps unsurprising.

Skanska hands over one of the Experimental Halls, specifically the Long Instrument Hall, to the ESS in September, 2019, marking an important

¹³⁰ Translated by author.

¹³¹ At the same time, it ought to be pointed out that these types of facilities are each and every one of them unique: “*We are de facto building a large prototype, like there is no, there is no facility like this.*” (Interview Hedin. Translated by author.)

¹³² Laboratori Nazionali del Sud (LNS) of the Italian National Institute of Nuclear Physics (INFN).

scientific milestone (ESS, 2019b). The ESS Director General, Womersley, comments that;

“[w]e have moved from construction of the building to the first installations of scientific equipment, working closely with our partners in the member countries who are constructing most of this instrumentation. Together we are strongly determined to make ESS a landmark of European science.” (ESS, 2019b¹³³)

Skanska and the In-Kind partners are contributing to the success of the ESS. In the meantime, we should not forget all the various suppliers involved in the construction project.

A Swedish company that worked on the construction of the ESS facility is AirSon Engineering AB. It is a company that works on installation-dense installations for companies in industries such as pharma and med-tech, food and beverage, and high-tech manufacturing. AirSon is involved in more or less all of the buildings at the ESS facility. As has been alluded to, Skanska and the ESS work very closely together in the construction of the ESS. The person involved on AirSon’s side, referring to the ESS, says that “[t]hey worked in a close collaboration with Skanska, that also worked very well”¹³⁴ (Interview Persson). Moreover, constructing the ESS attracts many different kinds of suppliers. These types of big projects provide an opportunity for suppliers to involve junior employees as a way to learn (Interview Hedin). Swedish suppliers are mostly involved in the construction of the buildings at the ESS. The Communication Officer at the ESS says;

*“I actually think we had a very large proportion of Skåne’s collected excavators out here for a period, and I know they had a really hard time finding, I mean they really vacuumed the market for small one-man firms with an excavator that they could bring here to dig.”*¹³⁵ (Interview Eriksson)

As 2019 comes to an end, Svenska Dagbladet (2019) reports that Skanska wins first prize in the international innovation competition Autodesk AEC Excellence Awards 2019 concerning the design, planning, and project of the ESS. During autumn of 2020, the In-Kind partner ESS Bilbao delivers the Target Monolith vessel (ESS, 2021d). As of December, 2020, 75% of the research facility is complete from Skanska’s point of view (Skanska, 2025a). The remaining buildings to be handed over concerns the Target Station and Instrument Halls (ESS, 2021d).

¹³³ This is also reported by Lokaltidningen Lund (2019).

¹³⁴ Translated by author.

¹³⁵ Translated by author.

Amidst construction of the ESS facility in Lund, its Data Centre in Copenhagen is likewise starting to become materialised. Unlike the ESS facility in Lund, the Data Centre has not built its own building. Before discussing the current state of the Data Centre, it is wise to briefly introduce its evolution leading up to year 2021. The Data Centre initially started small, in stages progressing towards materialising a functioning data centre for the ESS. There was an Interim Director from the University of Copenhagen, two hired staff, and one computer standing in the basement of the Niels Bohr Institute. Later, the previous Director of the data centre at the Spallation Neutron Source in the USA became the new Head of the ESS Data Centre, to start the centre as part of the construction project. During this time, the Data Centre hired additional staff and became more professional. According to an interviewee, “[s]o there was a fairly rapid ramp up of some staff. And that was when we were working to actually start writing the software and designing the systems for the whole facility” (Interview Taylor). Following this period, the Data Centre was doing a lot of low-level design work and starting a lot of collaborations to get In-Kind contributions. This involved discussions with In-Kind partners about what they could contribute, how that would work, and what the partners would get out of it. Regarding the Data Centre, specifically the software, there is the possibility of the In-Kind partners obtaining benefits by being able to apply the software developed for the ESS at their own facilities. Eventually the ESS Data Centre is officially inaugurated, although the current Head of the Data Centre at the time, Taylor, reasons “*that’s, in principle, that’s some kind of public relations communications exercise*” (Interview Taylor).

In 2021, the Head of the Data Centre, Taylor, is responsible for project management, such as budgeting and planning. Within the Data Centre there are different groups, with group leaders responsible for the execution of what needs to be done in terms of the actual work. One group is responsible for the hardware systems, that is, the servers and the network for the data acquisition, data processing, and data analysis systems, in both Lund and Copenhagen. Then there is another group that works on the data processing software frameworks and the data analysis. They do software developments, working on what could be called high-performance software for processing the raw data from the neutron instruments into something that scientists can then analyse. This entails correcting the data collected for the experimental artefacts or experimental occurrences. That group also then develops some data analysis software, such that you can have some model system which you can then convert from the model into what is experimentally observed and do a direct comparison. Since you parameterise the model, you can turn a knob to understand what the data is telling you. There is also another group, part of the ESS

Technical Directorate, although based at the Data Centre, that deals with the data acquisition system. They develop the system which is acquiring and processing the raw data out of detectors, and pushing that data onto disc with all the metadata (Interview Taylor).

Regarding the users' data, the ESS is committed to making the data openly available, which was part of the design mandate for the Data Centre. For the open access to work, the Data Centre needs to have the capacity and make the commitment to store the data and make it available, in alignment with the FAIR principle, which stands for Findable, Accessible, Interoperable, and Re-usable. Moreover, the creation of the European Open Science Cloud, as an EU-funded project, is a way for the ESS to become part of a much larger movement towards open science. For science users carrying out an experiment at the ESS, as part of the agreement that they make to access the facility, the ESS will make those data openly available¹³⁶ after an exclusive access period of three years. The users essentially have three years to extract the scientific benefit themselves, and after that time the data become available to anybody else. The intention is that the ESS will then start to create and populate a large database of material science properties and results, so it will be possible to make comparisons between one experiment and all previous experiments that have looked at similar things. Even people who have not carried out an experiment at the ESS can conduct meta-analyses of generic properties using large datasets of previous experiments (Interview Womersley).

At the time, the Data Centre can be described as a room with power, cooling, and rack space. About three racks are populated, which represents about half a petabyte of fast storage and 6,000 cores with compute. It is possible to fit a lot of hardware in a small space. Regarding the cooling, as for any data centre, there is the necessity of cooling, and the Data Centre made some budget choices to get the most energy-efficient system that it could afford (Interview Taylor).

Returning to the ESS facility in Lund, Skanska hands over all the buildings according to plan in December, 2021. However, other works remain left to do, such as technical installations (SVT Nyheter Skåne, 2021), but the lion's share of the facility is completed. The Head of Conventional Facilities adds saying that “[a] facility like this will always have smaller construction projects, always. Not in this class that we have built now, but you are constantly rebuilding instruments and changing and stuff”¹³⁷ (Interview Hedin).

¹³⁶ The ESS will welcome both scientific and industrial users, in which the European Open Science Cloud does not necessarily apply to industry. According to an interviewee, it is for publicly funded research in which the facilities pay for the beam time that the scientists use (Interview Holm Rod).

¹³⁷ Translated by author.

A few months later, in 2022, there is an official handover event at the ESS, which, for obvious reasons, marks a significant milestone in the ESS's journey towards becoming materialised. Connected to this event, the CEO of Skanska Sweden commented as follows;

“[i]nnovation and sustainability are important to Skanska, not only in how we work but also in what we deliver to our customers and to society. That is why today I am extremely proud to officially hand over the buildings of the world-leading research facility to ESS.” (ESS, 2022)

The ESS highlights, on its website, that construction of the buildings was completed according to plan, despite the issues caused by the Covid-19 pandemic (ESS, 2022). For practical and economic reasons as well as to avoid negative publicity, it was a high priority to, as far as possible, avoid delays and subsequent budget increases (Håkanson & Kokko, 2022, p. 41). This is actually quite a remarkable feat considering the number of somewhat similar facilities that are over budget and behind schedule (e.g. ITER¹³⁸), although other areas of the ESS involving In-Kind partners face similar struggles. Big Science Sweden, an actor that will enter the story in just a short while, had Skanska visit ITER in France to talk about the Skanska–ESS Collaboration as well as a high-level meeting at the Swedish Government Offices to talk about the collaboration (Interview Hall).

In general, the Skanska–ESS Collaboration is regarded in a positive light. Kinhult note that Skanska picked the best from their organisation, both globally and in Sweden, referring to Skanska saying that *“they have put great people here”*¹³⁹ (Interview Kinhult). Whilst discussing the intricacies of the Skanska–ESS Collaboration, another interviewee reiterates the success of the collaboration, succinctly summarising it by stating *“[s]o a fantastic success I think”*¹⁴⁰ (Interview Carlsson). A final comment shows how several people in and around the ESS talk positively about the Skanska–ESS Collaboration; *“they worked so closely together between Skanska and ESS’s people so in that way it became a good collaboration and a good product”*¹⁴¹ (Interview Eriksson).

¹³⁸ According to ITER's website, *“ITER (“The Way” in Latin) is one of the most ambitious energy projects in the world today”* (ITER, 2025).

¹³⁹ Translated by author.

¹⁴⁰ Translated by author.

¹⁴¹ Translated by author.

5.2.1 Organisational transition from ESS AB to ESS ERIC

During the autumn of 2015, ESS AB transitions from a corporation into ESS ERIC, a European Research Infrastructure Consortium (ESS, 2016). According to the ESS Activity Report 2015 (2016, p. 13), an ERIC “*is a type of legal entity created by the European Commission for governing international research facilities*”. The purpose of an ERIC is to enable several countries to, on equal terms, own and operate a research facility that is situated in one of the countries (Håkanson & Kokko, 2022, p. 12). An ERIC is different from a corporation¹⁴² whereby Kinhult describes it from the Swedish perspective as a type of middle ground between a foundation and a publicly traded company. Kinhult, knowledgeable about governmental agencies, tax systems, legislation, and so on, and involved in the transition to an ERIC, says;

*“you regulate the legislation that is common in the EU, then the EU regulations apply, and where you have not advertised in the EU, then the legislation of the country where the ERIC is based applies. And this ERIC is based in Sweden, because you had to decide there. So that, for example in the labour market area Swedish law applies, so we have collective agreements and we like have, follow Swedish normal, so to speak, procedures in that area.”*¹⁴³ (Interview Kinhult)

Sydsvenskan (2015a) reports on the ceremony connected to the ESS becoming an ERIC. One of the attendees is the Director-General of Research and Innovation at the European Commission, Smits, who hands over a plaque to show that the ESS has been elevated to a consortium for European research infrastructures, an ERIC. In a comment quoted in Sydsvenskan (2015a), Smits says: “*I am impressed by how Sweden managed to convince all the decision-makers*”¹⁴⁴, and the newspaper article adds that according to Smits there is a success story awaiting Lund, Skåne, and all of Europe when the ESS is in operation.

5.3 A boost from new initiatives and actors entering the scene

Following the start of construction of the ESS in Lund, an emerging interorganisational network begins to take shape around the ESS, including setting up several national initiatives and involving new actors.

¹⁴² An aktiebolag (AB), in Sweden.

¹⁴³ Translated by author.

¹⁴⁴ Translated by author.

In 2015, *Sydsvenskan* (2015b) publishes an article on how growing research environments create great value. Lund Municipality's enterprise manager¹⁴⁵ Per Persson says that the unique things about Lund are its short distances and how, over the last decade, stable interfaces have been created between academia and industry, such as the Ideon Science Park. In this environment, several business incubators have been created. The newspaper article also mentions Science Village Scandinavia (which will be introduced shortly), writing that it will become an additional dynamic meeting place for idea creators, entrepreneurs, and investors.

Dagens industri (2016), a widely disseminated financial newspaper in Sweden, comments on the Swedish suppliers' engagement, describing a bleak outlook at the start of 2016. According to the article, deliveries for Swedish industry looks to be poor, to say the least, and the Swedish Government receives criticism for not showing greater interest in the ESS project. *Dagens industri* writes that there were considerable expectations on the part of Swedish industry of being able to deliver parts of the technology and various services. An employee at Vinnova says to *Dagens industri* that there has been too little engagement for a long time to earn industrial returns on these types of investments, which will not be solved just because Sweden builds this type of facility on Swedish soil. According to the article, the picture provided by various actors with insight into the project is that the deliveries to a large extent pass Swedish companies by. This is attributed to the nature of the In-Kind arrangement, and yet another explanation according to people that *Dagens industri* talked to is that Sweden's current political rulers are showing a relatively mild interest in the project. Political engagement on the highest level is very important for such projects and Sweden is far behind on this issue, says Krantz, a former Minister for Research and Higher Education, 2009–2010, adding that “[p]oliticians from different colours are not in the habit of promoting national interests in the way that would have been good here. After all, it is a huge investment that is being made, it is important that we are on top of it”¹⁴⁶ (*Dagens industri*, 2016).

5.3.1 Towards a cluster

Science Village Scandinavia, mentioned previously, gets the go-ahead during the summer of 2018 (TT Nyhetsbyrå, 2018b). Science Village Scandinavia AB, a publicly traded company, is owned by Lund University, Region Skåne, and Lund Municipality, situated between the ESS and MAX IV in Brunnshög,

¹⁴⁵ In Swedish, *näringslivschef*.

¹⁴⁶ Translated by author.

Lund. Even though Science Village Scandinavia receives the go-ahead in 2018, the idea of a type of science village located between the ESS and MAX IV has been discussed for a while, albeit conceptualised in different ways.

Carlile, who has been involved in Science Village Scandinavia, says how there was an intention to bring the ESS and the nearby large science infrastructure, MAX IV, closer together (Interview Carlile). The ESS and MAX IV are situated about 800 metres apart. To clarify, the intention was not to expand the facilities to bring them physically closer together, but rather to exploit potential synergies. According to Carlile (Interview), the idea for building a science village stems from a previous idea from his work at the Institut Laue-Langevin, which was to create a centre in the middle for the user community. Initially, the idea was to have local labs to help the scientific community, with expertise in different areas. In other words, to have expertise on the ground comprising of individuals that were experts in a given field. However, as noted above, it seems that the science village has been envisioned in various ways over the years.

According to their website, Science Village Scandinavia has three major tasks. First, to develop and sell the land in central Science Village “*with the goal of creating a vibrant, innovative city district where business, academia, and the public meet in a meaningful way*” (Science Village Scandinavia, 2025). Second, to develop a type of tech park supporting “*both the large scale research infrastructures, the talent in the area, startups, and business to utilize the unique research capabilities and support function in the area*” (Science Village Scandinavia, 2025). Finally, to develop a so-called Science Centre, which “*is going to be an exciting public window into the research going on in the area as well as space for innovation and imagination*” (Science Village Scandinavia, 2025).

The development of the land that Science Village Scandinavia owns is inspired by a variety of other similar initiatives and projects across the world. According to Melander,

“*[s]o there are many different role models for different dimensions of the projects you can build in. And you could also say that we can build things in a little more on the green field, which is an advantage and a disadvantage.*”¹⁴⁷
(Interview Melander)

Moreover, Science Village Scandinavia is intended to provide basic utilities, such as food, hotels, and lodging, all functions necessary for the nearby area. A company that has moved into Science Village is Oatley AB. In 2021,

¹⁴⁷ Translated by author.

Sydsvenskan reports that Oatley AB is planning to move part of its operations to Science Village Scandinavia (Hedberg, 2021), and it later did so in 2023.

5.3.2 Sweden starts gearing up its ILO-function

In 2018, Big Science Sweden is founded (Big Science Sweden, 2023), working as the official Industrial Liaison Officer on behalf of Sweden. Its role as the Industrial Liaison Officer essentially entails efforts to connect national suppliers and Big Science organisations. This entails working closely with both Big Science organisations and with suppliers, as an intermediary between the two spheres of society, a bridge-maker if you will. By year 2019, Big Science Sweden's database comprises more than 140 national suppliers (Big Science Sweden, 2019, p. 3), a number that will increase in the subsequent years.

Big Science Sweden publishes an annual document entitled The Swedish Guide that, amongst other things, includes an overview of the suppliers that are part of Big Science Sweden. In The Swedish Guide, Big Science Sweden offers a fitting description of the organisation, writing that "*Big Science Sweden is the link between Swedish industry and Big Science. We connect Swedish high-tech companies with research facilities, enabling facilities all over the world to find the best suppliers*" (Big Science Sweden, 2019, p. 259). Big Science Sweden has dedicated personnel in Lund, Gothenburg, Uppsala, and Luleå, as well as RISE, and thereby covers most of the geography in Sweden. The Editorial in one of the earliest versions of The Swedish Guide (Big Science Sweden, 2019, p. 3) and, in particular, the Table of Contents (Big Science Sweden, 2019, p. 5) make it somewhat clearer what Big Science Sweden is. On one hand, the organisation wants to attract Big Science organisations to consider using Swedish suppliers, such as emphasising that Sweden is one of the world's most innovative countries (Big Science Sweden, 2019, p. 3). On the other hand, Big Science Sweden also wants to attract national suppliers to consider delivering to Big Science organisations. From a supplier's point of view, Big Science Sweden, amongst other things, assists Swedish companies by finding relevant contracts at Big Science organisations so that suppliers can subsequently submit tenders. In essence, to help Swedish companies win contracts at Big Science organisations.

One of these suppliers is MCT Brattberg, a supplier to the Big Science market since the 1990s. The Sales Manager of MCT Brattberg, referring to Big Science Sweden, gives other potential new suppliers the following advice: "*If you are new and don't know anything, the best option is to contact them because there you get all the information, and you also get help for free and they*

can help finding customers for you. They have very good solutions”¹⁴⁸ (Interview Åfeldt, MCT Brattberg). This quotation is particularly relevant seeing as Sweden is new to hosting Big Science facilities on the ESS scale, and has traditionally had a fairly low industrial involvement of national suppliers in Big Science organisations. Another supplier describes a fairly common, albeit general, point of view from the supplier perspective: “It’s mostly that, well, we have meetings and there Big Science Sweden report a bit about the process of the progress of the infrastructure and then go through the current procurement needs, you could say. And potentially tenders that come out”¹⁴⁹, saying that one piece of advice to suppliers that would like to start delivering to Big Science is to contact Big Science Sweden (Interview Garner, BergmanLabora).

In 2019, most of Big Science Sweden’s activities aim to connect Big Science and suppliers, for example, via ‘Big Science Business Trips’ for Swedish companies to visit Big Science organisations. Other activities include conferences, but also ‘Big Science Morning’ where suppliers can learn more about upcoming developments in Big Science, ‘Big Science Technology Workshops’ to “strengthen the expertise and skills of supplier companies”, and ‘Big Science By Sweden’ described as “a ‘meeting place for meetings’” (Big Science Sweden, 2019, pp. 259–260). These activities are succinctly summarised in The Swedish Guide as: “Seminars, trade fairs, workshops, business trips – Big Science Sweden offers many different ways to generate contacts and exchange knowledge” (Big Science Sweden, 2019, p. 260). Put differently, these represent different types of networking activities. The activity most frequently mentioned in the interviews include Big Science Morning, described by interviewees as a 30-minute meeting looking at recent procurements. Other frequently mentioned activities include workshops such as technical workshops (e.g. for electronics) and small-scale education. The interviewees likewise mention that Big Science Sweden hosts a variety of events, such as the Swedish Big Science Forum. Another event that Big Science Sweden participates in is AIMday, which connects actors from industry and academia. It should be clear to the reader by now that Big Science Sweden is in the business of connecting Big Science and national suppliers, as Sweden’s official Industrial Liaison Officer.

Indeed, most countries that provide funding to Big Science organisations have a dedicated Industrial Liaison Officer, sometimes referred to as an ILO, helping connect national suppliers and Big Science. For example, Denmark, co-host of the ESS, started Big Science Denmark a few years before Big

¹⁴⁸ Translated by author.

¹⁴⁹ Translated by author.

Science Sweden was founded. Having said that, the Swedish ILO-function has existed in some shape or form for a long time.

Around year 2021, Big Science Sweden constitute an organisation with a national geographical spread attempting to cover the entirety of Sweden. Moreover, Big Science Sweden is divided into technical groups organised by technical knowledge. Hall, the Director of Big Science Sweden at the time, says that this means that the Industrial Liaison Officer is responsible for a Big Science organisation, politically and strategically. As such, the ESS ILO¹⁵⁰ says that their role as an Industrial Liaison Officer is to keep in contact with the ESS and to channel their needs to the technical groups.

One part of the ESS that has made particular use of Big Science Sweden is the Vacuum Group. The ESS Vacuum Group Leader says that the Group started to collaborate with Big Science Sweden at a very early stage. From the point of view of the Vacuum Group, because they did not have an interface in Sweden with the vacuum field, they created training for the relevant suppliers in collaboration with Big Science Sweden (Interview Ferreira).

5.3.2.1 Building Sweden as a Big Science nation

Thus far we have learned a bit more about Big Science Sweden, a group of people that constitutes Sweden's official Industrial Liaison Officer. It should be pointed out that Big Science Sweden focuses on the entire Big Science market, not only the ESS.

Big Science Sweden can be regarded as an initiative that is intended to reap the proposed benefits of Big Science, such as improved competencies for suppliers or for Sweden, as a host country, to receive a monetary return on investment. This section discusses Big Science Sweden's role in the journey of the ESS from an idea into reality.

Moreover, Big Science Sweden has taken on a bigger mandate and is involved in the ecosystem surrounding the ESS, playing a role in realising the ESS in the emerging network surrounding ESS. *“We have taken a bigger mandate than what actually this small ILO-role is”*¹⁵¹ to participate in building Sweden as a Big Science nation (Interview Hall).

Another interesting aspect of Big Science Sweden is that the organisation's Director, Hall, says that two key actors in the Swedish scientific-political landscape, the Swedish Research Council and Vinnova, which fund Big Science Sweden, have increasingly collaborated with each other and with Big Science Sweden over the years. Moreover, Big Science Sweden's Advisory

¹⁵⁰ In year 2021, Hall is Big Science Sweden's Director and the ESS ILO. However, the Director does not automatically become the ESS ILO.

¹⁵¹ Translated by author.

group consists of a number of individuals who are, or have been, significantly involved in the ESS's journey from idea towards reality, on behalf of other organisations. For example, Kinhult was previously Chair of Region Skåne's Regional Executive Committee and later working at the ESS, Melander has been involved in the ESS in a few different ways as well as employed at Science Village Scandinavia AB, and Kjell Möller worked as Big Science Sweden's Chair until the end of 2023 and had previously been part of the so-called SAAB-group at the ESS. Another example is Patrik Carlsson, who was part of ESS Scandinavia, already involved in the very early years of the ESS story, and likewise worked at Big Science Sweden. These people have in one way or another been involved in both the ESS and Big Science Sweden journeys. It has previously been acknowledged, or at least claimed, that the international Big Science sphere (e.g. neutron research) is a fairly tight-knit community in various ways. Likewise, it seems, as illustrated by Big Science Sweden, that there is a fairly tight-knit Big Science community within the national context of Sweden.

5.4 Attempts and initiatives continuing to anchor the ESS within a Swedish landscape

The Confederation of Swedish Enterprise, an employer's association, publishes a piece at the end of 2017 stating that the Swedish Government must step up research within industry. It is stated that construction of the ESS can help in solving complex problems within Swedish industry, but that Sweden cannot miss the opportunity. According to the article, the Swedish Government must step up to ensure that the ESS becomes the world-leading hub for research and innovation in the Nordics as was initially intended. The strategies that the Government and its agencies have adopted concerning the ESS need to be translated into action. Furthermore, the opportunities for collaboration amongst academia, industry, and mediator companies must be the very best. All actors are needed to go the whole way. Few actors can accomplish this alone (Görnerup, 2017).

In May 2018, Sydsvenskan reports on how the Swedish Government has laid out a plan to get value from Sweden's investment in the ESS. In the newspaper article, the Swedish Minister for Higher Education and Research, Hellmark Knutsson, says that to get full value it must be ensured that there are coordination efforts that both benefit investments as well as make it known what opportunities exist. The article states that, according to the Government, an ESS office will secure both Swedish and international interests through collaboration. Regarding Sweden's investment in the ESS, the article ends by

pondering whether it will pay off, followed by a quotation from the Minister for Higher Education and Research stating “[i]t is our entire goal that this should both strengthen Swedish research and knowledge development, but also make Sweden more attractive for research and development investments and with that also international investments”¹⁵² (Sydsvenskan, 2018).

Furthermore, a report from the Swedish Government (2018, p. 5) states that:

*“Sweden’s work with the hostship for ESS has gone on for about ten years and undergone several different phases. Focus is now shifted from preparations and construction to forthcoming use. For Sweden to get maximal socio-economic benefit of the enterprise the central question will now be the opportunities for academia and industry to use the facilities.”*¹⁵³

Around this time, SWEbeams is a major national initiative to increase engagement surrounding the ESS (and MAX IV). SWEbeams is financed by the Swedish Research Council and Vinnova (Hollertz, Groth & Ramsten, 2020, p. 12), engaging actors from academia, research institutes, business, public organisations, research funders, and the Government Offices (Vinnova, 2017). In 2018, SWEbeams (2018) present its final report on various ways Sweden can utilise the opportunity that the ESS presents by being located on national soil.

At the start of April, in 2019, Dagens industri publishes an article claiming that criticism of the Government is growing because there is no clear plan for Sweden to earn a return on the money invested in the ESS. Hörstedt, Vice Chancellor at Chalmers University of Technology, leading the SWEbeams initiative, comments that the ESS is a very powerful facility offering big opportunities to increase exports and increase Sweden’s tax base, if it is used correctly. Furthermore, Kinhult, having worked at the ESS for some time now, says to Dagens industri that considering how central the research is for Swedish industry, it is surprising that there is still a lack of a clear plan for how Sweden will nationally earn a return on the ESS, stating that the need for follow-up investments surrounding the facility might have been underestimated. Ernkrans, at the time Sweden’s Minister for Higher Education and Research, one of several individuals who has held the post during the ESS-timeline, comments that “[t]he more I have gotten into the project, the more I realise how complicated it is to get maximum benefit”¹⁵⁴ (Dagens industri, 2019).

In May 2019, the Swedish Government gives Vinnova an assignment to advise on how a national ‘teknikparksfunktion’ could be structured and funded

¹⁵² Translated by author.

¹⁵³ Translated by author.

¹⁵⁴ Translated by author.

(Hollertz et al., 2020; Håkanson & Kokko, 2022, p. 65). ‘Teknikparksfunktion’ could be roughly translated as ‘technology/science park function’. Loosely, a ‘teknikparksfunktion’ is suggested to be a neutral and inclusive arena that serves to catalyse collaboration in the network¹⁵⁵ surrounding the ESS and MAX IV (Hollertz et al., 2020, p. 4). In September, 2019, Vinnova invites to a workshop together with Lund University, Malmö University, Region Skåne, Science Village Scandinavia, MAX IV, the ESS, Big Science Sweden, and RISE to gather key actors and create a dialogue concerning the ‘teknikparksfunktion’ (Hollertz et al., 2020, p. 15). A final report is published at the beginning of 2020 (see Hollertz et al., 2020). This report states, for instance, that to get full value from the investments in the ESS and MAX IV, measures and additional investments are required in several areas (Hollertz et al., 2020, p. 4).

In November, 2020, News Øresund (2020) announces that the MAXESS Industry Arena is launched, funded by Region Skåne, to help companies use the new research facilities in Lund and to simplify the connection between industry and science. MAXESS represents collaboration amongst the ESS, MAX IV, RISE, Science Village Scandinavia, Lund University, and the Centre for X-rays in Swedish Materials Science (MAXESS, 2025). This initiative is, like some of the aforementioned initiatives, focused on both the ESS as well as MAX IV. According to its website:

“MAXESS is an evolving national arena supporting and facilitating industrial use of the large-scale research infrastructures MAX IV and ESS and their ecosystem as well as international infrastructures with Swedish involvement.” (MAXESS, 2025)

As mentioned previously, other member countries deliver In-Kind to the ESS, whereas Sweden contributed money ‘In Cash’ towards the facility¹⁵⁶. Håkanson and Kokko (2022, p. 14) state that;

*“[s]ince Swedish researchers have been given the opportunity to contribute in kind, the Swedish Research Council has created an in-kind programme for the ESS that runs from 2021 to 2025 with a total of SEK 150 million (30 million per year).”*¹⁵⁷

In December 2021, Svenska Dagbladet (2021) reports that the ESS is delayed, with a bill equivalent to 5.6 billion Swedish kronor. The newspaper reports that the problem has not been the construction itself¹⁵⁸, but rather deliveries of

¹⁵⁵ The authors use the word ‘ecosystem’.

¹⁵⁶ See section 5.1.3.1.

¹⁵⁷ Translated by author.

¹⁵⁸ See also section 5.2.

technical components and their installation that have dragged on during the pandemic.

5.4.1 Exploring the socioeconomic effects surrounding the ESS

A running theme throughout the ESS story has been the potential socioeconomic benefits stemming from Sweden's investment in the facility (see e.g. Larsson, 2005). In the autumn of 2021, two professors active at the Copenhagen Business School begin their task of analysing the socioeconomic effects of Swedish investments in the ESS over the period from 2010 to 2020. The assignment is carried out on behalf of the Council of Research Infrastructures of the Swedish Research Council, taking a Swedish perspective on the ESS. The final report is presented to the Council of Research Infrastructures in March, 2022, and is published a month later in April. The foreword to the report states that “[m]onitoring the effects of these investments, not only for research but for society at large, is of utmost importance in order to understand how we can best benefit from Sweden's hosting of the ESS”¹⁵⁹ (Håkanson & Kokko, 2022, p. 5). This is the first major report that retrospectively evaluates the socioeconomic effects of the ESS on such a broad and deep level.

Circling back to Larsson's (2005) report, the socioeconomic effects could be viewed as the proposed benefits for Sweden of hosting the ESS, rather than future-proof predictions. With the benefit of hindsight, Håkanson and Kokko (2022) are able to comment on the socioeconomic effects thus far. A fairly illustrative excerpt is that the arguments presented in their report;

*“gives reason to cautiously tone down expectations of the socioeconomic effects of Sweden's investments in the ESS up to 2021. However, they do not constitute an argument that the Swedish investments have been unsuccessful or that invested resources have not benefited Sweden and the Swedish companies that delivered to the facility.”*¹⁶⁰ (Håkanson & Kokko, 2022, p. 69)

The authors use the term ‘ecosystem’ a number of times throughout the report. They state that existing efforts are spread out across several different organisations that, in turn, work with insufficient funds (Håkanson & Kokko, 2022, p. 65). To create opportunities to maximise the societal benefits of the ESS, there is a need to continue the investments in existing actors within the ecosystem surrounding the ESS (Håkanson & Kokko, 2022). Håkanson and Kokko (2022, p. 65) write that there is a lack of coordination and a joint roadmap for the future, pointing out that this has been known for a long time

¹⁵⁹ Translated by author.

¹⁶⁰ Translated by author.

and that demands for a national effort to strengthen the ecosystem have been recurring in the debate. In the debates surrounding the ESS, there is considerable agreement that efforts should aim to strengthen the current ecosystem of companies, universities, and other stakeholders, including a number of organisations and initiatives created specifically for this purpose (Håkanson & Kokko, 2022, p. 71).

Echoing a long-standing and far-reaching discourse, the report of Håkanson and Kokko (2022) reiterates that the benefits of the ESS do not come automatically. Indeed, throughout the ESS story there have been several corresponding ideas pointing to the importance of collaboration amongst different types of actors (e.g. TITA, ‘Teknikparksfunktionen’, and many more). In June, 2022, a chronicle published in *Universitetsläraren* raises criticism concerning issues surrounding the ESS. In this article, there are no ideas or recommendations for new initiatives. Instead, it expresses what could be viewed as a critical perspective on how the ESS has been handled, mainly by Sweden and Swedish politicians, arguing that “[e]ven amateurs understand that the ESS-facility itself is a very complicated construction. But the question is if it hasn’t been, and still is, even more complicated to create some sort of consensus what Sweden actually wants with the ESS”¹⁶¹ (Samuelsson, 2022). Generally speaking, it seems that Sweden wants to reap potential benefits from the ESS (e.g. return on investment), although it remains somewhat unclear how to do this despite a number of ideas and recommendations.

In a press statement published in November, 2022, the Swedish Government (2022) announces that it proposes in the Budget Bill for 2023 that the ESS should be provided with an additional 356 million Swedish kronor. It is also added that the contribution is expected to be SEK 569 million in 2024 and SEK 528 million in 2025. It is stated that it is urgent to continue work so that the ESS can be in operation as soon as possible so that researchers, business, and society at large can benefit from the research facility. Persson, Sweden’s Minister for Education at the time, says that the ESS would create conditions for Sweden and Swedish research to be an important player over the next 40 years. The Minister also points out that the ESS brings jobs and business opportunities to Swedish companies and strengthen the possibility of Sweden attracting cutting-edge expertise (Swedish Government, 2022).

¹⁶¹ Translated by author.

6 National suppliers delivering to the ESS

This chapter focuses on how suppliers start becoming involved in delivering to the ESS as well as digging deeper into the Swedish suppliers and their interaction with Big Science actors.

6.1 Involving regional suppliers in TITA

Starting in 2010, TITA aims to mobilise regional actors, including suppliers. In spring 2011, there are seminars themed ‘ESS and MAX IV – Business opportunities for you’, attended by approximately 340 companies, including technical companies, transport and construction companies, hotel and restaurant companies, and even florists (TITA, 2011a, p. 30). The different types of companies illustrate the range of interested businesses that could potentially reap benefits from the ESS and MAX IV.

In regard to preparing the suppliers, a compact yet informative document is ‘Business opportunities in the wake of ESS & MAX IV’ (TITA, 2011c). The purpose is to strengthen the information advantage of suppliers located in the nearby region (TITA, 2011c, p. 3). A topic frequently surfacing in connection with Big Science organisations concerns the proposed benefits for nearby companies from delivering to these facilities, as illustrated in a study carried out by TITA investigating the interplay between industry and Big Science (see TITA, 2012). The report, entitled ‘Business opportunities in the wake of ESS & MAX IV’, states that the ESS and MAX IV are of interest to suppliers in the region (TITA, 2011c). Additionally, regarding the future, the report states that facilities like the ESS and MAX IV are continuously being upgraded and improved, and if companies within the region can deliver as suppliers during the facilities’ construction phase, then these companies will be in a good position for future deliveries as well (TITA, 2011c, p. 4).

It ought to be noted, yet again, that the TITA-project concerns both the ESS and MAX IV¹⁶². The aforementioned report highlights four criteria that distinguish the ESS and MAX IV for presumptive suppliers (TITA, 2011c, pp. 6–7). Roughly speaking, MAX IV is funded by national actors whereas the ESS

¹⁶² See also section 5.1.3.

is a pan-European initiative, so the ESS follows different procurement rules than does MAX IV, which follows the Swedish Public Procurement Act¹⁶³. Furthermore, during the time span of the TITA-project, MAX IV starts construction, whereas the ESS has not yet started construction, and the time horizons for the two projects also differ. Finally, the two facilities have different technical requirements, dictating which suppliers have the skills and competence to actually deliver to each of the two facilities. Referring to the ESS, the report states that “[t]he big thing on the procurement side will happen from 2014 onwards, when, amongst other things, conventional construction takes off”¹⁶⁴ (TITA, 2011c, p. 15).

6.2 Cluster for Accelerator Technology

During the TITA-project, another nearby project is running concurrently starting in 2011, the Cluster for Accelerator Technology (CATE). CATE is, for instance, mentioned in a study connected to TITA as “a project that in theory could strengthen companies’ ability to deliver goods and services to the ESS and MAX IV within the technical and scientific equipment segment”¹⁶⁵ (TITA, 2011b, p. 89). These two initiatives are, however, quite different concerning aim, purpose, and funding, although their representatives occasionally join forces when travelling around the region to talk about TITA, ESS, MAX IV, and CATE. According to an interviewee, TITA talked about societal issues, whereas CATE talked about technical issues (Interview M. Fahlander).

At the time there is a lot of talk about the ESS, particularly in the region of Skåne. This is not least evident in the TITA-project, which addresses issues concerning how the region can utilise this opportunity and reason that companies within the region should be able to deliver to the ESS. The EU-funded CATE project is set up as a collaboration project comprising 19 partners (e.g. Region Skåne and the ESS). CATE starts surveying and identifying relevant regional companies as well as educating regional companies in skills so as to be able to deliver high-tech components to Big Science. The region, in this context, refers to large parts of Denmark, southern and south-western Sweden, and southern Norway. As noted previously, the ESS is a greenfield project in Lund, and there is a lack of surrounding infrastructure¹⁶⁶. One intention of the CATE project is to educate and train companies to acquire skills so that they

¹⁶³ In Swedish, Lagen om Offentlig Upphandling (LOU).

¹⁶⁴ Translated by author.

¹⁶⁵ Translated by author.

¹⁶⁶ At least compared to other places, such as the Institut Laue-Langevin (ILL) in Grenoble, France.

can eventually act as suppliers to the ESS. Moreover, it is reasoned that when technical difficulties arise at the fully operational ESS (e.g. breakdown of equipment), nearby local companies will be better suited to help solve the problems at a moment's notice than will faraway non-local companies. Furthermore, an additional aim is to involve companies so as to become more competitive at building accelerator components in general. CATE arranges courses to educate companies in competencies concerning accelerators and accelerator components. As well as organising trips to other Big Science organisations for companies to meet people in person, CATE also launches a website for companies to sign their interest to be part of the CATE project.

According to CATE's Project Manager, Fahlander, the companies that took part in CATE started to collaborate and talk to each other, to make things together (Interview C. Fahlander). One of the companies that received education from CATE state that they have not been able to use the competence due to a lack of insight into what it could be used for. The company thought that they would get something out of it, but claim that they had no use for it.

6.3 Big Science Sweden connecting national suppliers and Big Science

As previously described¹⁶⁷, Big Science Sweden is founded in 2018 as the official Industrial Liaison Officer on behalf of Sweden, which essentially entails working to connect national suppliers and Big Science organisations. In terms of Big Science Sweden's work as Industrial Liaison Officer connecting Swedish suppliers and the ESS in particular, there is one person dedicated to this job. Around 2021, the Industrial Liaison Officer describes their work as the ESS ILO as involving networking, helping find good companies, looking at forthcoming procurements, and matching procurements in order for the ESS to build the best facility possible by receiving as many tenders as possible. The ESS ILO attends two meetings per year, gathering information on how the ESS is proceeding and meeting the people responsible. The ILO also obtains information about current and forthcoming procurements, and in turn suggests suitable suppliers (Interview Hall).

6.3.1 Suppliers describing Big Science Sweden

Many different types of companies are connected to Big Science Sweden. One supplier claim that Big Science Sweden is most suitable for companies within

¹⁶⁷ See section 5.3.2.

the manufacturing industries, for example, delivering tubes used in the vacuum chamber or the particle accelerators. In such cases, Big Science Sweden is a valuable resource as they can guide the supplier to the right people at the various Big Science organisations.

Scanditronix is amongst a few other Swedish companies, such as RFR Solutions, ScandiNova, Examec, and Fagerström Industrikonstult, what could be regarded as major Big Science suppliers that are quite active within this sphere. The CEO of Scanditronix says that the mission of Big Science Sweden is to make Swedish industry aware that Big Science is a big market, and to attract companies that have not previously been delivering to this market to join it. There is a lot of business for all sorts of companies, and this is something that Big Science Sweden is working a lot with. However, Scanditronix is already a supplier to Big Science, and state that the help that they receive from Big Science Sweden is in finding projects that Scanditronix themselves might have missed.

The CEO of RFR Solutions describe Big Science Sweden as an interest organisation. The CEO states that Big Science Sweden works with these Big Science organisations, identifying all the relevant projects and their contact persons, and then works with companies to inform them about what contracts exist and connect different contacts. Big Science Sweden not only connects contacts in the sense of connecting Swedish suppliers to Big Science organisations, but also connects Swedish suppliers with each other. According to the suppliers, another benefit of Big Science Sweden is that it arranges meetings or forums that suppliers can participate in to get to know Big Science organisations. According to its CEO, this is especially important for RFR Solutions, as they are a fairly small company, and these types of things takes too much time and effort from other parts of the company's activities. Instead, Big Science Sweden helps in the process of connecting suppliers and Big Science organisations.

From the suppliers' point of view, the main benefit is that Big Science Sweden connects the suppliers to various Big Science organisations. This is illustrated by the CEO of RFR Solutions, who says that "*Big Science Sweden is a very, in my eyes, a very very good organisation that gathers and creates contacts and works us into these different sites*"¹⁶⁸ (Interview Björkander, RFR Solutions).

In general, many suppliers state that Big Science Sweden are fairly active in its overall communications.

¹⁶⁸ Translated by author.

6.3.2 The Swedish Guide: Some national Big Science suppliers

Big Science Sweden publishes an annual document, called The Swedish Guide, containing a list of suppliers that are members of Big Science Sweden. The Swedish Guide 2019 edition contain 140 suppliers (Big Science Sweden, 2019, p. 3). This total increases by almost a hundred suppliers over the period from 2019 to 2022. In The Swedish Guide 2022 edition, Big Science Sweden consists of 242 Swedish companies (Big Science Sweden, 2022, p. 3). Some of the members of Big Science Sweden actively take part in conferences and so on, whereas others are indeed members but not particularly active. At Big Science Sweden's seminars and meetings, there are usually a dozen of the same companies present every time, according to one supplier.

There is great diversity in terms of the suppliers that are members of Big Science Sweden. The companies cover a range of products and services; they also differ in size, although there are many SMEs. For some companies, the Big Science customer segment accounts for a large part of their revenues, whereas for others it accounts for only a minor part. Some companies have long experience delivering to Big Science, whereas others do not.

Some suppliers deliver to the ESS whereas other suppliers deliver to other Big Science organisations, either pre-existing Big Science organisations (e.g. MAX IV) or facilities under construction (e.g. ITER). Some companies have delivered to Big Science prior to the inception of Big Science Sweden. Other suppliers are part of Big Science Sweden but seem unsuccessful at delivering particularly to the ESS, and some to Big Science in general. Some suppliers have received large contracts with Big Science, whereas others have received several smaller ones. Adding time into the mix, some of these dimensions differ at different points in time, as some companies occasionally receive big contracts, which in turn entails Big Science becoming a significant part of their revenue stream (especially for SMEs). So the importance of Big Science for the suppliers differs at different points in time.

Despite the diversity of suppliers, various themes are nonetheless captured in the interviews with some of the suppliers that are part of Big Science Sweden. A majority of the suppliers in my study deliver to both industry and Big Science organisations. In other words, most of the suppliers that deliver to Big Science also deliver to what could be labelled conventional customers, commonly referred to within this sphere as 'industry' (in contrast to 'Big Science'). Customers that suppliers deliver to tend to include the medical and nuclear industries and other fairly high-level industries that have requirements similar to those of Big Science organisations. Commonalities between these industries, as described by suppliers, include that they have very specific requirements and require unique solutions.

6.4 Surveying the effects on Swedish suppliers

In 2022, Håkanson and Kokko (2022)¹⁶⁹ publish a study on behalf of the Swedish Research Council that sheds light on the effects of the ESS on Swedish suppliers. Therefore, before introducing the findings of my own study, it is relevant to first briefly revisit their study¹⁷⁰. It is stated that, overall, Swedish companies have delivered to a higher value than the Swedish cash contributions towards the ESS (Håkanson & Kokko, 2022, p. 39). Aside from monetary benefits, in terms of benefits such as spill-over effects, the study states that;

“[a] large percentage of the supplies related to standard products and services, generating incomes but no evident spill-over effects in terms of technical development and increased competitiveness. Only a small percentage of the suppliers report such effects. This reflects the fact that Sweden had committed to refrain from competing for in-kind deliveries” (Håkanson & Kokko, 2022, p. 8).

The results of their survey, in terms of benefits for small and medium-sized suppliers, arguably paint a lukewarm picture. For example, most of the surveyed benefits fall below a 3 on a scale of 1–5, ranging from low to high, in which the item concerning improved reputation and brand is the foremost benefit that the ESS contributes to its suppliers, scoring just slightly above 3 (Håkanson & Kokko, 2022, p. 47). A vast majority of the respondents claim that contact with the ESS has not affected their innovative capabilities (Håkanson & Kokko, 2022, p. 48). Håkanson and Kokko (2022, p. 49) discuss how their results differ from previous research and reasons as to why this might be, for instance, in light of the nature of the deliveries from Swedish companies.

6.5 Digging deeper into the Swedish suppliers

In my study, there are some main differences and similarities that suppliers can identify between delivering to industry and to Big Science. Moreover, from a business administration point of view, it should help the reader understand how delivering to Big Science works by contrasting it to what could be termed ‘normal’ business exchange within industry. For example, many suppliers comment on the extensive documentation that is required during the procurement process for delivering to the ESS.

Many of the ESS employees who work with the suppliers are scientists, although not exclusively, as other individuals such as engineers are also fairly

¹⁶⁹ See also Chapter 5, section 5.4.1.

¹⁷⁰ For more depth, the reader is referred to Håkanson and Kokko’s (2022) study.

common. Although there are clearly differences, and similarities, between business and science, or between industry customers and Big Science customers, this section delves deeper into the point of view of the suppliers in regard to their day-to-day business with different types of customers. First, however, it is relevant to point out that not all suppliers share this view, but that the majority of the suppliers state that there are differences between industry customers and Big Science customers.

For example, one supplier points out that timescales are not as clear within the Big Science setting. It is important to be perceptive and very understanding because changes will occur and time schedules will change. There will also be different requirements that could involve a lot of work but that end up not leading to anything. There can also be a lot of discussions, in general but also in terms of the ESS wanting something slightly different. Many of these are fairly common views echoed by many suppliers.

A fair share of suppliers also recognises that delivering to Big Science organisations is usually an intermittent affair, perhaps delivering a few products every third year or so. In contrast, industrial companies, in some cases and for some companies, are recurring customers that buy on a more frequent basis.

Another point is that many suppliers seem to work on projects with the ESS in which the turnover of personnel on the ESS side means that the supplier is collaborating with different individuals from ESS over the timeline of the collaboration. However, this is not surprising, as the ESS is an organisation that transitions from design towards materialisation and thereby requires different types of skills and expertise at different stages in its journey towards finalisation. As some people, both suppliers and personnel at the ESS, point out, the ESS is in and of itself maturing as an organisation, including in its organisational structure. For example, one supplier that started working with the ESS quite early during its construction points out that ESS is evolving. As such, it is relevant to note that different suppliers to the ESS have worked with the organisation at different points in time. Moreover, the newness of the ESS becomes a way to distinguish the ESS from the suppliers' other customers. One supplier says: "*It often differs because it is often like a well-established company with well-established processes of how to work. At ESS it is often that something does not exist or is currently being formed. That I would say is the big difference*"¹⁷¹ (Interview Broomé, nVent Nordic).

Within the Big Science sphere there is the notion that delivering to Big Science organisations is usually a one-time ordeal, on a project-to-project basis, which entails customisation and some type of learning or developing new competencies. Basically, it entails some sort of innovation, as a benefit for the

¹⁷¹ Translated by author.

suppliers and an incentive for suppliers to work with Big Science. For some suppliers this does indeed seem to be the case, in general terms. However, there are of course several exceptions on both sides, as some Big Science customers require little innovation, whereas some industry customers require significant innovation. While the level of innovation could perhaps be described as a difference between an industry customer and a Big Science customer, it also seems that some of the interviewed suppliers reason that the products that they deliver to the ESS can also be sold to other customers. Such products tend to be sold in fairly small quantities, and not mass-produced in the thousands for other customers. On the other hand, some suppliers can use the same product that they sell to other customers but slightly customise it to fit the ESS's needs.

For example, nVent is a company that has delivered racks to the ESS for a value of approximately 40 million Swedish kronor (Interview Broomé, nVent Nordic). The Regional Sales Manager at nVent says that there does not have to be such a distinct difference between Big Science and other customers; *“it is not like there has to be a special product just because it has to fit physics but it could be the same product that is being used in other areas. It is just about placing it in the right place”*¹⁷². In some sense, it depends on the company, such as its products and other customers, but also on what the supplier delivers to the ESS. For instance, nVent delivers products to capsule and protect electricity and electronics, products that are also required by other customers, such as the railway industry and the defence industry. The difference, according to the Regional Sales Manager, is that there are different conditions and requirements.

The CEO of RFR Solutions says that, in their understanding, once work has started, then the Big Science organisations are very helpful and share competence, knowledge, and solutions in a deeper way than is the case with industrial customers. They take responsibility and make sure to help and drive everything forward towards a solution. The Big Science organisations are aware that what they are purchasing is only produced once, at least from their point of view. They are not buying IKEA shelves, which is an example used by the CEO of RFR Solutions. Instead, there are unique designs and specifications, so the customer (i.e. Big Science) has to be deeply involved to help everything come together.

This section has so far highlighted a few noteworthy aspects of the suppliers to the ESS. For one, the studied suppliers are quite different from each other in terms of products, services, other customers, and so on. There are relatively few patterns that connect the different suppliers, except for a few

¹⁷² Translated by author.

(e.g. they usually deliver to fairly high-level industries and are members of Big Science Sweden). As such, different suppliers have different views of what differs between Big Science customers and industry customers. Another noteworthy aspect is that Big Science actors quite often paint a picture of various benefits that the suppliers ought to reap, which may or may not correspond to the suppliers' own experience. A third aspect, as has been mentioned in relation to In-Kind, is that Swedish suppliers were not allowed to be directly involved in In-Kind procurement. Moreover, many Swedish companies are fairly inexperienced in delivering to Big Science. In other words, even though the suppliers are members of Big Science Sweden and deliver what could be termed high-tech products, these suppliers cannot necessarily be discussed in the same way as other suppliers that have long experience delivering to various Big Science organisations.

6.5.1 'Once you're in, you're in. But it's tough to get in'¹⁷³

On one hand, entering the Big Science market as a supplier is tough (i.e. it is tough to get in). On the other hand, suppliers that manage to enter the Big Science market tend to be able to stay and find reoccurring business opportunities within this sphere (i.e. once you are in, you are in). This section will now explore those two aspects, both as separate insights and working in tandem since they are fairly interconnected from the suppliers' point of view.

One supplier that exemplifies the notion illustrated in this section is Carlsson & Möller, whose representative says that it is a tough business. Talking about Big Science, Carlsson & Möller says that the first and most important step is to become famous so people know about the company. The second step is that people know that the company is competent, for example, by having an appointed person with competence. Then the e-mails and phone calls start to come. It is disseminated in that way. It can be tough to become famous as a small company, but it seems vital. According to Carlsson & Möller, it can be done by, for example, attending exhibitions and similar events, which is a required part of delivering to the Big Science market. According to the person responsible for sales for Big Science at Carlsson & Möller, this also means that they have entered the Big Science market and are able to stay there.

Both getting in and staying in requires being proactive, according to many suppliers. Highly experienced companies like Scanditronix know the value of being proactive, by attending conferences and the like to network and be seen.

¹⁷³ At one of the events hosted by Big Science Sweden, I jotted down a comment of one of the participants, "Once you're in, you're in. But it's tough to get in", referring to suppliers to the Big Science market. This notion was reiterated in some shape or form by many of the suppliers during the interviews.

As another illustration, the Regional Sales Manager at nVent says: “*to succeed you have to be active and network. That is perhaps the most important*”¹⁷⁴ (Interview Broomé, nVent Nordic). Some successful suppliers have indeed been proactive in pursuing the ESS. Other companies that have delivered to the ESS share a similar strategy of being proactive, like Gammadata, whose representative says that as soon as the ESS organisation started to become populated, the company immediately tried to understand the roles of these people. For example, Gammadata identified the person responsible for radiation at the ESS as somebody to talk to as soon as possible. Moreover, the Business Unit Manager at Gammadata also illustrates the relevance of being proactive within a wider network by saying that the company was already acquainted with some of the people who eventually started working at the ESS. Although Gammadata, of course, did not know everybody at the ESS, the company was involved early and got to know them.

To enter, it seems important to be proactive, particularly by networking and knowing the right people. Some suppliers mention the procurement rules at the ESS. The framework surrounding procurement at the ESS could potentially be viewed as a hindrance to enter since using social contacts and networking becomes a somewhat restricted tool with which to enter the Big Science market. Another hindrance, potentially exacerbating the effect that it is tough to get in is that one supplier mentions the necessity of already having several years of experience of delivering products to Big Science organisations as a requirement to even enter the procurement process in the first place.

Moreover, companies that have worked within this sphere for a long time tend to be placed in certain boxes and put on various lists, as implied by RFR Solutions. For example, the current CEO of RFR Solutions says that being mentioned on one of these types of lists is one way to enter other unfamiliar places. The CEO elaborates that people move around within this sphere; it is a limited group, so the CEO reasons that these people talk a lot with each other. According to the CEO, they look at suppliers that other Big Science organisations use. In another sense, this might hinder new suppliers attempting to enter the Big Science sphere.

However, once a company has entered this sphere, then it seems that they are in. In other words, suppliers that have already delivered once, or more often, to Big Science tend to find reoccurring business within this market. MCT Brattberg is a fairly small company that has delivered to industries such as the maritime and off-shore but also the nuclear industries, and it had started supplying CERN already in the 1990s. A Sales Manager at MCT Brattberg states that it is a fairly similar albeit complex process for different Big Science

¹⁷⁴ Translated by author.

organisations; it is a cumbersome sphere to enter, but once the company has entered, it gets requests all the time. As such, MCT Brattberg reasons that it is worth all the effort in the long term. This is elaborated on by the Sales Manager, who says that it is tough to enter, but that once you have entered, you are in, because then you also have a product that fits. The more a company becomes entangled within the Big Science sphere, and offers good solutions, the easier it becomes. According to the Sales Manager, then everybody around the world knows about the company, regardless of whether it is big or small; once you have entered the Big Science market, it starts rolling because they buy all the time. Having said that, the Sales Manager also points out that it is vital to have a good product.

As discussed above, as a possible obstacle to enter the Big Science market for new suppliers, but discussed in a new light this time, in terms of suppliers that have already entered the Big Science market, once you have entered the Big Science sphere you are put on a type of shortlist (Interview supplier). Some suppliers get reoccurring requests from the ESS and other Big Science organisations. When somebody at a Big Science organisation needs something, they send a few people to the supplier. Thus, making it somewhat easier for suppliers that have already entered the Big Science market to find new business opportunities within this sphere.

A final, and interesting, aspect is a supplier's supplier in regard to entering the Big Science market. For example, the supplier's supplier can aid in helping companies connect with Big Science. Gammadata provides such an example. The Business Unit Manager at Gammadata says that they work with suppliers that are strong brands. For instance, a scientist could come from abroad, to the ESS (or MAX IV), who needs something. This scientist knows a famous brand of a certain product that is required, and then realises that there is a Swedish supplier that sells this brand. That is to say, by representing companies that are globally well-established it becomes an easier process, as the supplier's supplier helps the company enter the Big Science market in some sense.

In summary, it is tough to enter the Big Science market; it requires a lot of work, time, and effort. The Big Science market is also quite long term in orientation, as many projects at Big Science organisations last several years, and they only reoccur once in a while. It is equally important to have patience, and do some small-scale work in the meantime, and then all of a sudden, a supplier can win a bigger contract. The Big Science market seems quite tough to break into, yet suppliers nonetheless pursue it.

An illustration

Sometime in the 2016–2017 period, a local company starts a small-scale project together with the ESS, a pre-study of measuring temperatures on the target. The CEO of the company says that they then started envisaging new opportunities that could result in a lot of big and interesting projects. However, this did not happen.

The CEO proclaims that the company has spent significant amounts of time trying to enter the ESS, to win contracts to deliver products and services. This supplier, which has so far been unsuccessful in entering the Big Science market, says; “*I feel that I have put so much time on Big Science and ESS and we have received so little*”¹⁷⁵, adding, “[w]hich at the same time is very sad because ESS is of course a prestige company, if we can now call ESS a company, and it is cutting-edge technology and a cool environment in many ways, but it is too hard basically to do it”¹⁷⁶ (Interview CEO, Company X).

The CEO of the company continues listing the reasons for persisting, citing benefits such as cutting-edge technology as well as interesting and meaningful projects and challenges, stating that Big Science organisations are important as they make the world a better place. As to why the company has not been able to win contracts at the ESS is unclear. The CEO mentions the importance of knowing the right people:

*“For me as a CEO, or if we look at it through a business perspective I think that it would be very good to have ESS as a recurring customer. Or I tell myself that if you can only get in there, do a project and get to know the right people, then I think that this will lead to several new projects. Then from what I have understood from the science world, it is its own little pond. These people move around a lot between research facilities, so you work at ESS for a couple of years, and then head off to CERN and work there for a few years, then you go to GSI and work there for a few years. That is what they do, move around. So if you only manage to get in at one of these facilities and become a bit famous, so that ‘if you need one of these, then it is [Company X] you should call, they will solve it, they are really good’. Then all of a sudden you maybe get requests from all of these research facilities, across the world. So there is a huge business potential in working with this. That is why we have put in so much time as we have. If it wasn’t for that, we would have probably become tired much quicker.”*¹⁷⁷ (Interview CEO, Company X)

A similar sentiment seems to be shared by companies surrounding Company X, saying that it takes an endless amount of time to get into the ESS and win contracts. But if there is no return on this time investment, why spend so much time on the ESS when there are other customers?

¹⁷⁵ Translated by author.

¹⁷⁶ Translated by author.

¹⁷⁷ Translated by author.

6.5.2 The ESS as a reference

Many suppliers that have managed to enter the Big Science sphere and deliver to the ESS use it as a reference, either on their websites or in other ways, such as in communication with other actors (e.g. customers). Some suppliers merely show that the ESS is one of their customers, whereas other suppliers illustrate their relation to the ESS by showcasing their work with the ESS.

In terms of posting the ESS as a reference on their website, nVent has published their collaboration with the ESS as news on their website by describing their delivery to the ESS in a fairly in-depth manner. According to a supplier, one must receive permission from the ESS in order to cite it as a reference on one's website. Carlsson & Möller is a company with fewer than a hundred employees that sells different types of plastic, for example, to the medical industry, but also to Big Science. The person responsible for Sales for Big Science at Carlsson & Möller, referring to using this as a reference on their website, says;

“[t]here is a link to ESS. And there is a link to Big Science Sweden. This is from an arrangement, that we can have this so people can see. It is not just something that I say or somebody else says. You can click onto the link from our webpage. So we are respected. You do not, it is not possible to put it up on the webpage if you do not fulfil, you need permission. You need permission to do it.”¹⁷⁸ (Interview Gjerløv Jensen, Carlsson & Möller)

When asked about the potential benefits for the supplier in delivering to the ESS, using the collaboration as a reference is a common answer. The suppliers use words such as ‘prestige’ or ‘high-level customer’ in explaining why they use the ESS as a reference. This is interesting to note, since there is diversity amongst the suppliers in terms of company profiles, as they produce different products or services for different types of customers. Nonetheless, using the ESS as a reference is perceived to be a benefit, regardless of the diversity.

Österby Gjuteri usually sells steel to customers that could be considered traditional heavy industries. At the turn of the century, Österby Gjuteri delivered for a worth of several million Swedish kronor to one of the Big Science organisations. According to the Managing Director and Sales Manager of Österby Gjuteri, this became a PR boost for the company. Even though Österby Gjuteri works in an industry that is fairly different from Big Science, they think that their customers also see the PR value of Österby Gjuteri having worked with Big Science. In particular, the trade association has highlighted Österby Gjuteri as a company that shoulders tough challenges and does special

¹⁷⁸ Translated by author.

things. As such, when the trade association receives requests that are somewhat unique, it often refers these companies to Österby Gjuteri.

One of the suppliers involved in the ESS's conventional facilities says that there is a certain marketing value to having the ESS in one's portfolio of customers. It can be used in marketing towards other customers since the ESS is a big international project that many people know about (Interview Persson, AirSon).

The CEO of RFR Solutions, as mentioned previously, a fairly well-known supplier within the Swedish Big Science sphere, says that one reason to work with the ESS is that it is somewhat exotic to have that type of customer on one's reference list. It is something that the company uses in its business, marketing that it is working on a high level, and many are impressed by this. This last claim of RFR Solutions is quite interesting, considering that relatively few of the interviewed suppliers elaborate on whether or not there is actually any benefit from using the ESS as a reference, instead leaving it implicit that the ESS is a good reference (that in turn generates benefits for the company).

The Regional Sales Manager of MCT Brattberg, in a sense, echoes the reasoning of RFR Solutions as to why they want to work with the ESS, by saying that the ESS is a prestige project, is very famous, and will become even more famous. The ESS is famous within the science sphere and is a good reference for the next step. It is argued that nobody cares if you build a house on a street, but everybody who passes the ESS knows what it is. The Regional Sales Manager of MCT Brattberg says, "*I know that a couple of companies, bigger ones, they almost become happy only for the prestige, that they can be part*"¹⁷⁹ (Interview Åfeldt, MCT Brattberg).

Yet another supplier that uses the ESS as a reference is the company nVent, which was mentioned at the beginning of this section for using the ESS as a reference on their website. The Regional Sales Manager at nVent claims that one of the benefits of working with the ESS is that it gives references to other places, which can be used in procurement involving other customers. It is one way nVent markets itself. The Regional Sales Manager notes another way that the ESS works as a reference by acknowledging that there is a community surrounding these Big Science organisations, and that they meet, talk, and share experiences. If nVent does a good job for the ESS, then word of this will probably spread to other places. This is something that nVent notices in its day-to-day business. There are several companies that deliver subsystems to the ESS. If parts of these subsystems require a solution that nVent is good at, it fairly often gets requests from the company that is delivering subsystem to

¹⁷⁹ Translated by author.

the ESS, asking if nVent could help with certain parts because they know that the ESS likes to use nVent's products and they seem to fit the subsystem.

Low2High Vacuum is a supplier that entered the Big Science sphere quite early, even before the ESS started construction. Low2High Vacuum is a family-owned company with about 12 employees (as of 2022) focusing on, as the name implies, vacuum products. Low2High Vacuum is part of Big Science Sweden but have also been involved in CATE. The Technical Account Manager at Low2High Vacuum tells a story about how its products were pitched at Deutsches Elektronen-Synchrotron (DESY), a Big Science organisation, through a previous collaboration with an individual who moved on to work at DESY. This person recommended Low2High's products to other people at DESY.

MCT Brattberg reasons that these types of facilities have such a big turnover of personnel, meaning that the people that MCT Brattberg work with as counterparts on behalf of the ESS tend to move to other facilities (or other employers), disseminating the knowledge of what MCT Brattberg can do within this sphere.

6.5.3 Other benefits from working with the ESS

Using Big Science as a reference makes it a lucrative customer for suppliers. Another benefit is simply that the ESS is an additional customer that adds to the suppliers' stream of revenue.

Before delving into other benefits, it ought to be recognised that within the Big Science sphere there are quite a number of proposed benefits that are disseminated. For example, during the construction, development, and upgrading of Big Science facilities, the literature states potential benefits such as technological development (Håkanson & Kokko, 2022). The Big Science organisations themselves (e.g. the ESS) communicate various benefits to the suppliers. For example, they conduct a lot of PR and communicate the benefits of working with Big Science, for instance, through seminars that one can sign up for and where they present their different projects. Other nearby actors, such as national Industrial Liaison Officers (e.g. Big Science Sweden), likewise tend to list the benefits of working with Big Science. The benefits are communicated to the suppliers, casting the ESS as a lucrative customer. Some suppliers, however, state that nobody has communicated any benefits to them. Other suppliers were already aware of the benefits even before delivering to Big Science.

Some suppliers agree on the benefits and seem to reap them, whereas others are instead somewhat more sceptical towards the proposed benefits. Regarding the specific suppliers, their profiles in terms of product catalogue, other

customers (e.g. the nuclear industry), and specific contracts delivered to the ESS, it seems that not all of the benefits can be applied to all of the suppliers. Instead, some companies reap some benefits that others do not.

Some companies deliver products that are a one-time thing, customised to the ESS, which means that they may, or may not, benefit from producing a high-level product and thus acquire useful competencies. Other companies deliver the same product to the ESS as to any other customer, and thus the different types of customers do not differ as much, except perhaps in other dimensions (e.g. documentation). Still other companies supply fairly customised and unique products to the ESS, which they can then produce in larger quantities and sell to other customers in industry.

Both Big Science Sweden and some of the suppliers recognise a benefit that relates to funding, distinguishing between Big Science customers and customers in industry. Economic cycles, specifically recessions, seem to have less of an influence on Big Science organisations, as they tend to be funded on longer-term timescales. Industry, on the other hand, depending on the industry, tends to be affected by recessions much more quickly. The previous CEO of RFR Solutions, for example, note that some of their customers are more sensitive to the economic cycles than others. Regarding their focus customers including medtech, energy, food, Big Science, and greentech, the former CEO says;

*“if you look at the palette of focus customers that we have defined, then there are some that are more or less sensitive to the economic cycles, and others are definitely not sensitive to economic cycles. Big Science is definitely not sensitive to economic cycles.”*¹⁸⁰ (Interview Orup, RFR Solutions)

Similarly, Gammadata, which defines customers within the nuclear industry as important, suggested that if industry and science are contrasted at their extremes, then it seems that Big Science customers are less affected by recessions. The Business Unit Manager of Gammadata speculates that this might be because of how funds are allocated in longer-term cycles and thus there is a delay for the recessions to affect the Big Science sphere, compared to industry.

Some of the suppliers that were interviewed mentioned that one of the benefits of being part of Big Science Sweden is to get in touch with other suppliers that are likewise members of Big Science Sweden.

¹⁸⁰ Translated by author.

6.5.4 Suppliers' various frustrations

Many of the suppliers mention documentation as being arduous and complex, as much paperwork needs to be completed. Quite often the issue of extensive documentation is compared to the situation in industry, which tends to require less documentation. However, some industries require almost the same amount of documentation, but it differs from Big Science. For some inexperienced suppliers this poses a problem, since understanding and completing the documentation requires knowledge and takes time. For example, consider a company that specialises in welding; its personnel may be good at their craft but lack knowledge concerning the documentation process. For such a company, the extensive documentation required could be viewed as complex. Even suppliers that have a person dedicated to Big Science state that the documentation is vast and takes time. According to the person responsible for Sales for Big Science at Carlsson & Möller, “[y]ou must write everything in detail. It also takes a lot of time to do”¹⁸¹ (Interview Gjerløv Jensen, Carlsson & Möller).

To submit a tender, it is not sufficient to send in a bid as with many other customers. The Sales Manager of BergmanLabora says that the procurement process is very convoluted, reasoning that this is because several different countries contribute money to the ESS, making for a lot of administration. An interesting analogy is also offered; “*I imagine like Brussels where if they have to buy a screw for like the European Parliament, it would take a very long time and involve a lot of different paperwork. It is almost similar with ESS*”¹⁸² (Interview Garner, BergmanLabora).

Some of the suppliers that deliver to the ESS have experience of working with MAX IV, which follows Swedish law as set forth in the Public Procurement Act. However, the ESS as a European Research Infrastructure Consortium (ERIC) follows slightly different procurement processes. For some suppliers, this is something new and somewhat different.

The In-Kind arrangement also seems to be a source of frustration. This arrangement meant that Sweden was for a long time unable to deliver high-tech equipment, defined as In-Kind, directly to the ESS, although it was possible for a Swedish supplier to deliver equipment as a subcontractor to an In-Kind partner. Having said that, one reason for pursuing an In-Kind model was for the member countries that fund the ESS to see some of the benefits in their own country. One supplier says that this of course means that these countries have a certain interest in trying to get as much as possible from their own country. In other words, an incentive to use national suppliers and subcontractors.

¹⁸¹ Translated by author.

¹⁸² Translated by author.

As described by one supplier, the ESS is funded by countries from all over Europe, and the countries that pay for the ESS would like to get some benefits from it for their industry and research. Sweden, on the other hand, is involved in the construction of the conventional facilities, of the buildings. In that sense, Sweden has received benefits as the ESS is situated in Lund. However, a lot of the high-tech inputs have been procured as In-Kind contributions. According to the supplier, this is a bit sad.

Another frustration refers to how suppliers mention things that imply that the ESS seems somewhat unorganised, for instance, people in projects changing fairly often. It is worth noting, however, as mentioned previously, that different suppliers work with the ESS at different points in the project timeline, so the ESS may appear organisationally different at different times.

6.6 Closing the chapter on the story of the ESS, for now

The ESS started as an idea amongst European scientists to pursue a next-generation spallation source in Europe. This was followed by a series of events to find political support. In particular, significant work from ESS Scandinavia advocating Lund as a site for the ESS. Overcoming a variety of hurdles, such as obtaining permits from local authorities to proceed, construction finally commences in 2014. Skanska starting, and finishing, construction of the facility marks one of the many milestones along the way. Alongside work on materialising the facility, suppliers and In-Kind partners scattered across Europe join arms to start building an accelerator, target, and various instruments. In the meantime, the ESS has been able to maintain support throughout several generations of government. Along this long journey, a host of actors from different spheres of society connect to realise the ESS, as an initial idea in the mid-1980s towards eventually materialising a fully-fledged Big Science facility. In closing the chapter on the story of the ESS, we now step aside and leave its journey, in this thesis, as work in Brunshög continues to see the ESS through to reality.

Since the year 2023, wherein this study closes the chapter on the ESS, construction has continued. Despite Skanska completing the facility and In-Kind partners and suppliers delivering towards other parts of the construction, the ESS is not yet entirely finished for users to venture there to conduct research. Work continues, involving business actors and their resources. For instance, finishing various parts of the facility such as its instruments. It is currently forecasted that the ESS will be able to welcome its users sometime during the

end of this decade. However, despite being finished, the different spheres of actors will continue to remain relevant going forward.

It is remarkable to reflect on the fact that although the many pages constituting the empirical chapters show a journey gradually reaching towards a finishing line, as in opening the ESS to its users, it is, from another perspective, only the beginning. Indeed, as the ESS start its operations, this opens up an entirely new chapter. Particularly for future users, by which the ESS should be able to open doors to conduct ground-breaking research.

7 Analysis

This analysis will show the process of realising the ESS as a process involving legitimising, mobilising, and embedding in a network setting. Spawned as an idea in the science community that was later anchored as an investment¹⁸³ summoning political actors, the ESS eventually started materialising into an actor. This analysis zeroes in on the matter of realising the ESS as a legitimising process involving mobilisation of actors and resources. Mobilised actors subsequently become embedded into a growing ESS-network centred around the ESS. I argue that what is being legitimised refers to the emergence of the ESS, including three phases of the ESS as an idea, an investment, and an actor. For a succinct overview, see Table 1, below.

The ESS starts as an idea, mobilising science actors, involving their support as well as resources such as expertise. It is argued that there is a neutron gap as well as that a facility akin to the ESS will be technologically superior to pre-existing neutron capabilities. In this phase, a number of different science actors become embedded in an ESS-network. As the ESS grows from an idea into an investment, political actors are mobilised so as to access their resources, including funding for the ESS. It is argued that the ESS entail benefits for political actors, for example, proposed industrial benefits. Science actors remain embedded in the ESS-network, which grows by accumulating political actors. In the third phase, the ESS, as an actor, alongside an expanding ESS-network, starts mobilising business actors controlling resources, such as materials and know-how, to enable construction of the ESS facility. As an actor, that was legitimised as an investment involving a variety of proposed benefits, later parts of the process involve additional third party actors mobilised on behalf of the focal actor, as embedded counterparts are attempting to reap proposed benefits.

Table 1, below, provides an empirical overview of each phase. Each column depicts one of the three different phases, divided into phase 1 (mid-1980s to 2002), phase 2 (2002 to 2014), and phase 3 (2014 to 2023). As we can see in the table, as the process progresses, each phase, building upon the previous

¹⁸³ In this study, investment refers to the act of putting effort into something to achieve a result (see Cambridge Dictionary, 2026).

phase, includes additional matters. The table summarises what is being legitimised (i.e. ESS as an idea, investment, and actor), involved spheres, examples of salient actors, critical events, what characterises each phase, and which actor is legitimising to whom.

Table 1 Empirical overview

	Empirical overview		
	<i>Mid-1980s to 2002</i>	<i>2002 to 2014</i>	<i>2014 to 2023</i>
What is being legitimised?	ESS, as an idea	ESS, as an investment	ESS, as an actor
Involved spheres	- Science sphere	- Science sphere - Political sphere	- Science sphere - Political sphere - Business sphere
Examples of salient actors	- ESS Council - Neutron science community - European Neutron Scattering Association - OECD's Megascience Forum - ESS Scandinavia	- ESS Scandinavia - Neutron science community - Swedish Government - Region Skåne (incl. TITA-project) - European Strategy Forum on Research Infrastructures - Member countries (incl. Danish Government) - ESS AB	- ESS AB - ESS ERIC - Neutron science community - Swedish Government - Region Skåne - Member countries (incl. Danish Government) - Various suppliers (incl. Skanska) - Various initiatives (incl. Science Village Scandinavia, Big Science Sweden, 'Teknikparksfunktionen', MAXESS, etc.)
Critical events	- Mid-1980s: Idea emerges, starting a process towards realising ESS - 1999: Megascience Forum announces need to build three spallation sources	- 2002: Meeting in Bonn, sparks political mobilising - 2005: Report to Swedish Government, critical document mobilising Government to pursue ESS - 2009: Decision in Brussels to locate ESS in Lund, increasingly localising mobilisation and embeddedness	- 2014: Construction commences, as business actors start materialising ESS - 2019: Inauguration of Data Centre - 2022: Official handover event, marking finalisation of the civil facility by Skanska
Phase characterised by	- Legitimising ESS as a desirable and appropriate idea inside science sphere	- Mobilising political actors for funding and deciding on a location	- Embedded actors expand ESS-network, separating entities,

	<ul style="list-style-type: none"> - This phase concerns the science sphere (and hints of the political sphere) - Idea-generating 	<ul style="list-style-type: none"> - This phase concerns the science and political spheres (and hints of the business sphere) - Broadening and financing 	<ul style="list-style-type: none"> distinguishing ESS as an actor - Integrating ESS in a regional and national context as well as constructing the ESS facility - This phase concerns the science, political, and business spheres - Materialising
Who is legitimising to whom?	<ul style="list-style-type: none"> - Neutron science actors (e.g. ENSA) legitimising ESS inside the science sphere - OECD's Mega-science Forum to actors in its own networks 	<ul style="list-style-type: none"> - ESS Scandinavia legitimising ESS to the Swedish Government - ESS Scandinavia legitimising ESS to ESFRI - ESS Scandinavia legitimising ESS to Region Skåne - Region Skåne legitimising ESS inside the region - ESS legitimising to its member countries 	<ul style="list-style-type: none"> - ESS legitimising to its member countries - Big Science Sweden legitimising ESS to national suppliers (and legitimising national suppliers to ESS) - Various actors (e.g. the Swedish Government) legitimising various initiatives and actors to interact with ESS as an actor

7.1 First phase: Idea-generating inside the science sphere (mid-1980s to 2002)

The first phase begins in the mid-1980s as seeds for an idea akin to the European Spallation Source start growing inside the science community. The idea emerges and spreads amongst researchers comprising a fairly tight-knit group of European science actors beginning to root the ESS as desirable and appropriate inside a science community (Suchman, 1995), specifically legitimising the idea of the ESS inside the neutron science community. In doing so, legitimising the idea of the ESS from the inside out (cf. Human & Provan, 2000). As an idea, the ESS mostly involves technical aspects surfacing in meetings and published reports, moving fairly quickly towards producing technical designs and feasibility studies. As a process, the ESS, as an idea, starts from little, to no, legitimacy, in which legitimacy gradually emerges (Suddaby et al., 2017) amongst science actors, involving mostly technological legitimising satisfying their interests (Kumar & Das, 2007) making the idea attractive and desirable (Suchman, 1995). At this stage, the idea is shepherded by a variety

of science actors, arguably belonging to neutron scientists, attempting to mobilise support for realising the ESS. Throughout this phase, a number of different science actors eventually become embedded in a growing ESS-network. They harbour knowledge of what it takes to develop and build Big Science facilities, and will ultimately become the ones using the ESS.

The main resources involved throughout the first phase includes scientific expertise, technological competence, and, more generally, support as well as engagement. Resources that essentially concern science actors, in this phase. Indeed, to realise the ESS, science actors and their resources must be mobilised. Scientists understand why and how the idea of the ESS is valuable for the community. They control resources in terms of technological knowledge relevant to formulating technical designs and feasibility studies. Moreover, gaining support from the science community aids moving the process forward towards realising the ESS, and later also helps legitimising the ESS involving other types of actors (Fisher et al., 2016).

7.1.1 Interplay between legitimising and mobilising

Actors are mobilised as they control resources that are crucial for realising the ESS, whereby a process of legitimising helps in accessing actors' resources (Håkansson & Snehota, 1995; Suchman, 1995). This is done by using proposed benefits (e.g. Ritvala & Salmi, 2011; Hermes & Mainela, 2014) and framing (e.g. Fisher et al., 2017; Bengtson et al., 2022) satisfying counterparts' interests (Kumar & Das, 2007). As we recall from earlier, legitimacy is distinguished into three forms involving technological (e.g. Ruef & Scott, 1998), sociopolitical (e.g. Aldrich & Fiol, 1994), and economic (e.g. Vaara, 2014) legitimacy, conceptualised as pragmatic legitimacy in a process of legitimising (Suchman, 1995; Suddaby et al., 2017).

In phase 1, science actors start garnering support, of the ESS, as an idea, from constituencies (Kumar & Das, 2007) inside a scientific landscape, mobilising actors analytically portrayed as part of science, natural science, neutron science, and Big Science. For instance, gathering consensus amongst research institutes, labs, and Big Science organisations, as scientists across Europe congregate at various meetings. It is to some extent the ones proposing and designing the ESS that will later be using the facility¹⁸⁴. Legitimising mechanisms concerning proposed benefits and framing make the ESS an attractive idea that is desirable and appropriate (Suchman, 1995) for different

¹⁸⁴ It should be noted that not everyone involved during idea-generation will later use the ESS, particularly due to the long timeframes (this was, at the same time, perhaps not entirely foreseeable in the early stages of the ESS project).

science actors mobilising to join an ESS-network. Mobilising science actors means proposing benefits such as a technologically superior design as well as discussion of widening the potential user community. From the start, the idea quickly moves towards generating various designs, illustrating an initial emphasis on technological legitimacy. In terms of framing by problematising a situation resolved by realising the ESS, a need for additional European neutron capabilities start mobilising actors. Nearing the end of phase 1, political issues also start seeping into the ESS.

7.1.1.1 Proposed benefits

In terms of mobilising actors, this entails targeting specific actors (Ritvala & Salmi, 2011) involving targets for legitimation (Hermes & Mainela, 2022). Incentivising is key to mobilising actors (e.g. Hermes & Mainela, 2014). Pragmatic legitimising (see Suchman, 1995; Kumar & Das, 2007; Gebert Persson et al., 2011; Suddaby et al., 2017) by satisfying interests of the ESS's counterparts is a mechanism for mobilising, viewed as proposed benefits in this study. The proposed benefits refer to reasons and motivations for actors to decide to mobilise (cf. Ritvala & Salmi, 2010), including legitimising arguments. Due to counterparts' varying interests, legitimising the ESS requires depicting the endeavour in different ways (Fisher et al., 2017). This includes technological, sociopolitical, and economic legitimacy, of which technological legitimising is the most salient during phase 1 involving science actors.

Part of legitimising the ESS as an idea include technological legitimising by formulating a superior technical design. As mentioned in Chapter 4, scientists gather at various meetings to discuss the technical design. This involves a technical design of the ESS including science actors conducting work establishing a scientific case and technical feasibility of a facility akin to the ESS, described in Chapter 4. Science actors discuss matters such as instrumentation, target, and accelerator, thereby concretising the idea. Technological legitimacy permeates this phase, mobilising actors inside the science community, and by involving science actors, partly, demonstrating familiarity of the ESS as similar to current facilities (Suddaby et al., 2017). Moreover, as shown in the empirical chapter, the designs seem to become gradually more concrete, for instance producing a feasibility study. Notwithstanding the technical designs for a superior facility, the conceptual designs also concretise the idea in terms of technological plausibility, which is especially relevant at the beginning by evoking confidence that challenges can be resolved and that the ESS is feasible and doable (Fisher et al., 2016). It is a superior design that is legitimising the idea, sufficiently legitimate for actors in the science community to commit to continue pursuing the idea towards realising the ESS. Furthermore,

it is particularly relevant during the early stages of network formation that actors perceive benefits of becoming part of a network (Kumar & Das, 2007; Gebert Persson et al., 2011).

Throughout this phase, there is talk of attempts to widen the ESS and the range of potentially interested scientists in terms of possibly being able to cater to a wider range of scientific disciplines and interests. Neutron research constitutes only part of the science sphere as a whole. In mobilising actors, it becomes relevant to identify crucial actors and their resources as well as how to approach them (van Bockhaven & Matthyssens, 2017). The ESS as an idea is legitimised inside the science community through talk of broadening the ESS to include larger parts of the science community, such as biology and medicine, or other areas including fundamental physics and nuclear physics. That is, a proposed benefit of the ESS as an idea is that it could cater to a fairly wide range of scientific disciplines and thus science actors. Moreover, the numbers of potentially interested scientists and claims of a growing scientific community also indicate that there would be interest inside the larger science community to build a neutron facility. For instance, as described in Chapter 4, emphasising that an ever-growing community uses neutrons.

Towards the end of this phase, the ESS, as an idea, emerges locally in Skåne. There are proposed benefits involving sociopolitical legitimacy in terms of how the ESS will be at the forefront of research and global attention, alongside rather more economic benefits, including employees at the ESS and visiting researchers benefiting local actors, as described in Chapter 4.

7.1.1.2 Framing

Framing involves presenting the ESS as to how other actors perceive it (Fisher et al., 2017), legitimising the endeavour by problematising a situation and offering a subsequent solution (see Suddaby et al., 2017). Ritvala and Salmi (2011) reason that if an issue is framed in a loose but interesting manner, actors will act positively as there is room to integrate the issue with their strategy. Emphasis frames entails framing the ESS by pointing to certain aspects of it that are desirable and appropriate for relevant counterparts (Suchman, 1995; Fisher et al., 2017) to mobilise. Indeed, the ESS has distinct identities to different counterparts (Håkansson & Snehota, 1995). In this study, framing means that legitimising occurs by framing a problem and subsequent solution to mobilise actors (see Bengtson et al., 2022). Throughout the first phase, framing is used in mobilising actors to connect to the ESS as an idea.

Mobilising actors inside the science sphere entails pointing out that there is a foreseen neutron gap, in which the ESS is a solution to a proposed need for a new European neutron facility. This neutron gap is legitimising the ESS,

making the idea desirable amongst science actors by problematising the current situation as well as proposing a solution (Suddaby et al., 2017; Bengtson et al., 2022). As described in Chapter 4, it is argued that there is a foreseen decline in neutron capabilities. For instance, it is claimed that this is caused by shutdowns of research reactors. The neutron gap concerns framing as there is a problem that there might not be sufficient neutron capabilities for neutron scientists to carry out their research, in which building a facility akin to the ESS will resolve this, thus bridging the neutron gap. As shown in the empirical chapter, the neutron gap continues to be invoked throughout this phase (and also into phase 2).

7.1.2 Interplay between legitimising and embedding

Embeddedness involves actors' relation with, and dependence on, different types of networks (Halinen & Törnroos, 1998). In this study, embeddedness mostly concerns embedding actors into an ESS-network, while also recognising that actors are connected with other network structures and embedded in broader contextual settings (Halinen & Törnroos, 1998). Positive recognition and relationships with well-respected actors legitimise the ESS as an idea (Anderson et al., 1994; Leite & Bengtson, 2018). It is argued that a process of legitimising might entail changes in the network (Hermes & Mainela, 2022). As a new endeavour, in this phase, the ESS may acquire legitimacy if sufficient amounts of actors join to build reputation of an ESS-network as a taken-for-granted entrant within a bigger community (Aldrich & Fiol, 1994). Actors embedded in already existing Big Science networks have fairly good foresight, anticipating a foreseen decline of neutron capabilities.

7.1.2.1 Path dependency

The idea of an ESS emerges from pre-existing networks, garnering technological and sociopolitical legitimacy from an earlier stage (Fisher et al., 2016). The inception of the ESS starts in the mid-1980s, growing out of the Big Science community. Researchers involved in using neutron science gather in meetings at various Big Science organisations to discuss the ESS as an idea. The idea emerges and develops inside pre-existing Big Science networks comprising well-established Big Science organisations (e.g. Paul Scherrer Institute) as well as three prominent Big Science countries (i.e. Germany, France, and the UK) already hosting a large proportion of European Big Science organisations. In these early stages, the idea is gradually rooted in a type of science network comprising Big Science organisations as well as European labs. Despite agreement amongst neutron scientists to pursue a new European

spallation source, there are divides in reaching a consensus regarding a desirable and appropriate location for the facility.

7.1.2.2 Fit

Embedding as fitting together with a pre-existing and ever-changing whole entails legitimacy. This draws on the notion of legitimacy as an entity fitting together with an external environment (e.g. DiMaggio & Powell, 1983; Suddaby et al., 2017; Hermes & Mainela, 2022). In IMP, external legitimacy can be viewed as fit or acceptance between a focal actor and its environment, whereas internal legitimacy involves internal constituencies (Gebert Persson et al., 2011). According to Suddaby, Bitektine, and Haack (2017, p. 462), legitimising can be understood as “how an actor acquires affiliation with an existing social order or category”. In my study, this is related to embedding as an actor acquires affiliation and congruence with a pre-existing and ever-changing whole. Fit is also understood as aligning interests as well as acceptance by network constituents (Low & Johnston, 2008; Hermes & Mainela, 2014). In this phase, fit mainly concerns technological legitimising by attempting to fit together the ESS, as an idea, with Big Science. And, to some extent sociopolitical legitimising, or rather the lack thereof, in terms of fitting together the ESS with political actors’ agendas.

The ESS as an idea, and design, can be viewed in terms of technological fit into the Big Science community regarding how the ESS fits together with pre-existing research infrastructures. As shown in Chapter 4, it was initially argued that it makes legitimate sense to locate the ESS in England by upgrading the ISIS Neutron and Muon Source or in Germany, as Forschungszentrum Jülich harbours a lot of expertise. However, the issue of where to locate the ESS remains unresolved throughout this phase, with its location being influenced by new actors who emerge during the second phase.

One reason why the issue of where to locate the ESS remains unresolved is a lack of sociopolitical fit with specific political actors’ agendas. The ESS as an idea does not align with these actors’ interests (cf. Hermes & Mainela, 2014). For instance, there is a lack of fit in fitting together the ESS with political actors in Denmark due to the political agenda of wanting to get rid of everything that produces radioactive waste, as mentioned in Chapter 4. Similarly, there is a lack of fit in fitting together the ESS with political actors in Germany, who instead decide to pursue other Big Science endeavours, as described in Chapter 4. That is, there is an inability to overcome a legitimacy threshold, partly due to a lack of sociopolitical fit of the ESS with other actors’ embedded contexts.

7.1.3 Interplay between mobilising and embedding

As already described, mobilising and embedding relate as successfully mobilising actors and resources leads to embedding them in the network, and mobilising by embedding actors in turn changes the network in which they are being embedded. This also includes commitment from embedded actors to involve third parties in the process of realising the ESS. It could be argued that interaction perceived as beneficial leads to high commitment (cf. Kumar & Das, 2007; Gebert Persson et al., 2011)¹⁸⁵. In this phase, a nascent ESS-network starts taking shape, mainly involving science actors.

7.1.3.1 Overlapping networks

The notion of overlapping networks takes into account that counterparts are embedded inside various other networks (e.g. Håkansson & Snehota, 1995). As such, they need to consider their embeddedness in pre-existing networks in a mobilising process, including the counterpart's other actor bonds. Moreover, counterparts to the ESS can use their own embeddedness in other networks to mobilise third parties on behalf of the ESS. In this phase, most of the mobilisation is occurring in and amongst science actors. However, third parties become sufficiently committed during the idea-generating phase to recommend exploring future spallation sources.

Political actors are involved by rooting the idea of the ESS inside their own networks. A temporarily embedded third party actor that is legitimising the ESS by sociopolitical legitimacy is OECD's Megascience Forum announcing an international need for new neutron spallation sources. Regarding the OECD, we now start to get a glimpse of the role of third parties involved in the process of realising the ESS, as counterparts are attempting to mobilise actors on behalf of the focal actor. In this instance, building new spallation facilities becomes an international matter. Additionally, the European Neutron Scattering Association (ENSA) is legitimising the idea of the ESS to third parties by advocating through support and lobbying. From a European point of view, it seems that various actors are committed to exploring the ESS, while not necessarily continuing past this stage (despite science actors' efforts to concretise the technical design, for example, by producing a feasibility study).

7.1.3.2 Emerging context

In this study, realising the ESS involving a continuously emerging context means that in order to move the process forward, there is, as already described, a need for change in an embedded context (Bengtson & Håkansson, 2008),

¹⁸⁵ It has been argued that low pragmatic legitimacy leads to low commitment. That is, if there are no benefits for an actor to interact, it will not increase commitment.

mobilising additional actors and resources; mobilised actors and resources in turn changes embeddedness inside a context that is constantly changing (see Tsoukas & Chia, 2002).

To some extent, the entire ESS endeavour arises from an emerging context, as the whole is changing by realising an anticipated gradual decrease in neutron capabilities. In turn, there is a need for change whereby the ESS emerges to make up for a lack of Big Science neutron projects. The context is emerging by means of scientists congregating at various meetings to discuss topics such as the accelerator and the target.

7.1.4 Summarising the first phase

The idea becomes sufficiently legitimate for science actors to commit to pursuing the ESS, sustaining this effort throughout the entirety of this phase. Actors are, in this stage, legitimising the idea of the ESS inside a fairly supportive network, formulating arguments pertaining to the science sphere. For instance, arguments concerning next-generation technical designs and pointing towards a neutron gap. Indeed, it is fairly straightforward mobilising scientific expertise and technological competence as well as support and engagement from various science actors, collaborating to improve the idea and concretise the design and its feasibility. Thereby successfully rooting the idea of an ESS in and amongst themselves, as scientific matters and technological legitimising takes precedence, overshadowing political matters.

Towards the end of the first phase, it is clear that actors shepherding the ESS favoured science actors and neglected to sufficiently mobilise political actors to pursue the idea of the ESS. There are a few faint attempts to elevate the idea of the ESS by involving the political sphere. However, at this stage, political actors mainly endorse the ESS, rather than taking any concrete steps, as they are involved in exploring the idea whilst not making any substantial funding commitments to see the project through to reality. Even though there is fairly strong consensus and mobilisation for collective action within the science community towards realising the ESS, there is a lack of sociopolitical approval (cf. Aldrich & Fiol, 1994), as emphasis framing (Fisher et al., 2017) focuses on technological matters.

The quest for legitimacy by garnering support from other relevant types of actors is not yet sufficient (Kumar & Das, 2007). The crux of the matter for realising something like the ESS is that Big Science requires several different types of relevant actors and interests, all of which are crucial. In terms of legitimising the ESS, rooting the idea inside the science sphere is insufficient if political actors do not sufficiently commit to realising the idea. Ending the first phase, there is an obvious legitimacy threshold that the ESS is unable to

surpass, noticeable following a meeting in Bonn whereby broadening to include political actors becomes a pressing issue, starting a new phase of anchoring the ESS within a political context.

7.2 Second phase: Broadening to the political sphere to ensure support (2002 to 2014)

The second phase starts after the meeting in Bonn, as science actors involved in legitimising the ESS recognise a lack of political support for continuing to pursue the idea. In this phase, the ESS is being legitimised as an investment. Due to the need to mobilise political actors, matters related to investing in and interacting with the ESS emerge. Mainly, legitimising the ESS for political actors to pursue as an investment, most notably governments such as the Swedish Government. Characterising this phase is a need for mobilising sufficient support by anchoring the idea of the ESS as an appropriate investment within a national political context (Suchman, 1995; Halinen & Törnroos, 1998).

The primary resource involved in the process of mobilisation concerns money, essentially various European governments funding the ESS as an investment. And, to some extent, also regional actors providing access to land on which to locate the ESS. During this phase, a number of additional actors become involved, including, but not limited to, actors pursuing a trajectory for siting the ESS in Lund, Sweden. Despite being a fairly small organisation at the outset of this phase, ESS Scandinavia¹⁸⁶ is shepherding the Swedish ESS contingent as a driving force of the process towards legitimising the ESS as an investment. In the first phase, political actors were committed to exploring the ESS as an idea, whereas in this second phase, political actors become committed to funding the ESS as an investment. Following talks in worldwide and European arenas in the first phase, the ESS start becoming increasingly localised as a Scandinavian initiative involving Lund, Skåne, Sweden.

The first phase included a significant element of the ESS as an idea amongst science actors. Science actors are now embedded in an ESS-network, which means that path dependency and fit concerns science actors. Meanwhile, political actors are mobilised involving proposed benefits and framing. The ESS is depicted in a slightly different way in this phase, as legitimising does not entail a one-size-fits-all approach (Fisher et al., 2017) since counterparts operate according to different motives (Leite & Bengtson, 2018) and interests.

¹⁸⁶ As shown in the empirical chapter, shortly before the meeting in Bonn, the ESS Scandinavia Consortium was formally inaugurated. Therefore, at the outset of this phase, ESS Scandinavia was partly embedded in an ESS-network.

In 2009, it is decided that the ESS will be built in Lund, although construction does not start until five years later in 2014. After 2009, two noteworthy changes occur; as described in the empirical chapter, the ESS becomes a planning project alongside a political project, and the process becomes increasingly localised, permeated by local actors¹⁸⁷. It should also be noted that there are instances of mobilising and embedding involving the same actor. For example, in and around 2009, matters regarding mobilising Region Skåne shift towards embedding, including overlapping networks and emerging context as well as path dependency.

7.2.1 Interplay between legitimising and mobilising

Mobilising by legitimising the ESS as an investment is relevant since political actors must be mobilised to continue the process towards realising the endeavour. Essentially, the ESS requires various resources accessed in relationships or networks through its relationships (Ford & Håkansson, 2006b; Bengtson et al., 2022). These resources mainly refer to huge amounts of funding, considering the substantial costs of such facilities, both the initial capital of cost to start construction as well as additional funding during the operational phase. Another reason for mobilising political actors is because they are the ones hosting the facility. That is, the ESS has to be built somewhere, in a country, governed by politicians; as such, the resource required is access to land. A way for actors to access resources is by garnering legitimacy from counterparts, although counterparts might differ in incentives or in what is considered legitimate (Fisher et al., 2016; Gebert-Persson & Káptalan-Nagy, 2016; van Bockhaven & Matthyssens, 2017). This becomes particularly clear during the process of mobilising resources from political actors alongside science actors.

Legitimising the ESS towards political actors involves endorsement from the European Strategy Forum on Research Infrastructures. Mobilising support from ESFRI, for instance, concerns technological legitimising of the ESS involving ESS Scandinavia's proposition being compatible with the description outlined by ESFRI, mentioned in Chapter 4¹⁸⁸. In ESFRI's Roadmap 2008, it is stated that the ESS is a high priority. Legitimising the ESS requires several concurrent activities directed towards multiple actors (Low & Johnston, 2008). Acquiring acceptance and endorsement from ESFRI, in turn, facilitates

¹⁸⁷ Once it is decided, in 2009, that the ESS will be located in Lund, the process of realising the ESS starts becoming increasingly localised in the Swedish landscape.

¹⁸⁸ Mobilising ESFRI to support ESS Scandinavia's proposition is also done by showing how locating the ESS in Lund, Sweden, is a suitable location arguing in terms of a type of appropriate geographical embedding (e.g. good communication links). That is, focusing more on legitimising the location rather than the ESS per se.

in legitimising the ESS as an appropriate investment, thereby increasing the likelihood of actors such as the Swedish Government continuing to pursue the ESS. As such, science actors, aided by ESFRI, actively influence political actors such as European governments (cf. Hadjikhani et al., 2019).

7.2.1.1 Proposed benefits

In this phase, political actors are being mobilised by legitimising the ESS as an investment involving mainly sociopolitical and economic legitimising, proposing an array of different benefits to counterparts. ESS Scandinavia is disseminating proposed benefits connected to the ESS via newspapers as well as transmitting proposed benefits to political actors involving potential member countries including the Swedish Government such as conducting a study to survey various socioeconomic matters connected to hosting the ESS, as elaborated on in Chapter 4.

The Swedish Government is mobilised in this phase involving proposed benefits pertaining to sociopolitical and economic legitimacy. The Government constitutes a critical mobilisation target, gradually becoming mobilised to eventually fund and host the ESS (Ritvala & Salmi, 2010; Bengtson et al., 2022). As seen in the empirical chapters, there is a push to involve the Government during the 2000s. The proposed benefits transmitted to the Government are plentiful and usually, in one way or another, formulated by ESS Scandinavia as type of source. Proposed benefits are direct (e.g. employment) and indirect (e.g. spin-offs) as well as concrete (e.g. quantifying returns) and abstract (e.g. prestige). While keeping these distinctions in mind, the benefits can also be categorised as sociopolitical or economic, less so technological. Moreover, many, if not all, of the proposed benefits are potential, although somewhat foreseeable, benefits (Ritvala & Salmi, 2011) that require proactive efforts to reap.

In terms of sociopolitical legitimising, proposed benefits include that the ESS gives prestige to host country, brain power in terms of a magnet for neutron scientists visiting the ESS, a unique opportunity for the host country to become a centre of European research, or stating possibilities for research and industry development, as described in the empirical chapter. As highlighted throughout the empirical chapters, there are expectations of a number of new qualified jobs in Lund involving highly skilled employees at the ESS, as well as researchers venturing to use the ESS. It is not always elaborated what an influx of visiting researchers entails, although some mention that visiting scientists could benefit the service industry and so on. Furthermore, industrial benefits are also disseminated, such as job opportunities or spin-offs, as described in the empirical chapters. Moreover, it is argued that the ESS is a

matter of scientific capacity, whereby technological benefits of a next-generation spallation source, surfaced in phase 1 mobilising science actors, is echoed for mobilising political actors.

In terms of economic legitimising, there are short- and long-term economic benefits, as pointed out in the empirical chapter, including the short-term benefit of stimulus to local economic activity. Another benefit is that the ESS fits into the Swedish economy. Other economic benefits transmitted to the Government, captured in a report mentioned in the empirical chapter, include quantifiable economic effects. A straightforward illustration of economic legitimising is that ESS Scandinavia points to economic returns on investment from tax revenues from electricity used by the ESS, as described in the empirical chapter. Although the ESS is not a business actor, it can nonetheless entail economic gains for counterparts, akin to political actors commanding economic resources (see Welch & Wilkinson, 2004). Moreover, according to Hadjikhani, Leite, and Pahlberg (2019), legitimacy can be attained for political actors that show economic gains interacting with business actors. Legitimising the ESS shows that economic legitimacy is relevant to science actors. Furthermore, many of the aforementioned benefits legitimising the ESS as an investment entail eventually involving third parties such as business; another third party involved is media.

ESS Scandinavia is a fairly small organisation¹⁸⁹ that leverages the media to mobilise the Government, most notably via the regional newspaper agency *Sydsvenskan*, legitimising the ESS as an investment. However, other newspaper agencies also point to possible benefits of hosting the ESS, for instance, pointing out that the ESS can entail possibilities of expansion and growth. Newspaper articles can be used as an indication that ESS Scandinavia “carefully crafted and developed legitimacy orientations aimed at a host of constituencies needed to acquire legitimacy” (Low & Johnston, 2008, p. 878). A newspaper article has a wide audience, including, but certainly not limited to, politicians, as it for example also includes civil society as a whole (e.g. the populations of Skåne and Sweden). The media can affect an actor’s legitimacy, and using the media plays a role in building legitimacy (e.g. Hadjikhani & Thilenius, 2009; Vaara, 2014; Bengtson et al., 2022). *Sydsvenskan* is proactively, and fairly frequently, publishing articles about the ESS, covering current developments as well as highlighting relevant arguments in favour of the ESS on behalf of ESS Scandinavia.

Part of legitimising the ESS as an investment for member countries concerns the design of the In-Kind model. Using an In-Kind model increases the likelihood that member countries can mobilise their own research institutes

¹⁸⁹ However, ESS Scandinavia grows bigger during the later parts of this phase.

and industry towards constructing the ESS. At this stage, In-Kind is more talk than action, as In-Kind partners start delivering in phase 3. However, formulating an In-Kind arrangement relates to technological, sociopolitical, and economic legitimising of the ESS as an investment mobilising prospective member countries. Regarding technological legitimising, an In-Kind arrangement entails that member countries' own scientists and engineers can be involved in the ESS. In preparing the case for investment in the ESS, as mentioned in the empirical chapter, European countries wanted economic benefits to flow to them and that money is spent inside these countries and benefit their own industry. In terms of economic legitimising, it is stated that delivering In-Kind means that member countries pay to their own industry, as described in the empirical chapter (see TT Nyhetsbyrå, 2013)¹⁹⁰.

7.2.1.2 Framing

Framing means that legitimising occurs by framing a problem and subsequent solution to mobilise actors. As per Bengtson, Casales Morici, and Lindholm (2022), a way to legitimise, through arguments, involves framing a solution to a perceived problem, viewed differently by actors from various spheres of society. In the phase of legitimising the ESS as an investment involving science and political actors, various actors perceive the ESS differently (e.g. Håkansson & Snehota, 1995; Fisher et al., 2017). Framing in the second phase includes two salient elements that involves downsizing the ESS to make it into a more reasonable political investment. And, as other non-European countries start building their own neutron facilities, framing from the first phase is complemented, as it is now argued that since other similar neutron facilities are built, Europe risks losing its world-leading position. In this way, mobilising political actors entails legitimising by framing the ESS as almost a sociopolitical necessity.

Framing the ESS as a legitimate endeavour by referring to a neutron gap is quite similar notwithstanding various audiences as political actors echo the same sentiment (Fisher et al., 2017). However, from a political actor's perspective, the reasoning is slightly different since the problem is that, because scientists cannot conduct world-class science, this, politically speaking, threatens Europe's world-leading position. In phase 1, it was argued that the ESS was needed due to deteriorating neutron capabilities in Europe. In phase 2, Japan and the USA build, and finish, their own neutron facilities. Framing from the first phase, involving deteriorating neutron capabilities, evolves to now include statements about other countries building new neutron facilities.

¹⁹⁰ In-Kind is also a matter of the member country having to answer to its taxpayers for investing in a facility in another country (cf. Hadjikhani et al., 2019).

For instance, this can be seen in a 2005 report to the Swedish Government and also later in 2008 when ESFRI publishes its Roadmap.

Japan and the USA building similar facilities shows how network effects are affecting the ESS. Actors shepherding the ESS frame it to political actors, pointing to sociopolitical legitimacy regarding potential problems arising from not building the ESS, such as losing a world-leading position. As per Hermes and Mainela (2014), exogenous changes affect strategy. Japan and the USA building facilities represent a favourable contingency since they legitimise the ESS as an investment for political actors as appropriate and right given existing norms (Aldrich & Fiol, 1994). Moreover, this is a field in which Europe is traditionally strong, used as a way of legitimising continued efforts to remain strong in neutron science by appealing to tradition (Vaara, 2014).

Framing the ESS as a slightly cheaper investment also constitute an attempt to mobilise political actors. For instance, ESS Scandinavia announces a focus on building only a long-pulse accelerator due to tactical and economic reasons, as described in Chapter 4¹⁹¹. There is an issue involving framing, for mobilising political actors, of the ESS as a legitimate investment, that means less ambitious plans for the ESS, essentially lowering the costs. The issue of downsizing the ESS begins following the meeting in Bonn and then continues throughout this phase, although most obviously in the early 2000s. This mainly involves sociopolitical legitimising by satisfying the wishes of potential funders of the ESS. It also includes an element of economic legitimising, in terms of lowering costs.

Throughout the process of realising the ESS, there are frequently new interactions, as described in the empirical chapters. In the second phase, particularly related to political actors and local interactions. It is suggested that as an actor frequently engages in new interactions, legitimacy is continuously changing (Gebert-Persson & Káptalan-Nagy, 2016, p. 303). An excerpt from the Conceptual Design Report states that it is important for the project to have many supporters but perhaps even more important that it has few enemies, as elaborated on in Chapter 5. It seems that the ESS has achieved this during the second phase as the legitimacy that is continuously changing is, in this case, changing due to a need for mobilising and interacting with different types of new actors rather than a constant ebb and flow (cf. Kumar & Das, 2007) in each specific interaction.

¹⁹¹ While it is politically feasible for lowering costs, it is also scientifically reasonable as it is also argued that a long-pulse accelerator would complement current Big Science organisations.

7.2.2 Interplay between legitimising and embedding

Legitimacy buffering from the first phase regarding science actors affect the second phase concerning political actors funding the ESS as an investment (Fisher et al., 2016), as actors mobilised in the first phase become embedded in an ESS-network. However, some actors, such as the OECD's Megascience Forum, are mobilised but only temporarily embedded.

7.2.2.1 Path dependency

In this part of the process towards realising the ESS, path dependency is salient in two main ways, as the ESS-project moves through the second phase; first, the project becomes political, and second, the trajectory of the ESS moves from international, regional (in Scandinavia), to Lund and Skåne, and then to a national level.

Following path dependency, the ESS endeavour is becoming increasingly localised in different spatial contexts (Halinen & Törnroos, 1998). In phase 1, preceding the meeting in Bonn in 2002, the ESS was mostly a European and international project discussed amongst scientists. Later in phase 1, a group of Scandinavian researchers get involved. In the second phase, the ESS starts becoming increasingly localised to Lund and Skåne, as proponents of hosting the ESS. Up to early 2004, it seems to have been mainly local and regional actors involved in driving the ESS, such as Lund Municipality and Lund University, whereas the Swedish Government's interest at the beginning of phase 2 can be described as lukewarm, as mentioned in the empirical chapter. Around year 2004–2005, notably following Larsson's (2005) report to the Government, interest gradually starts increasing through a fairly drawn-out process towards reaching a final decision. As such, realising the ESS follows a path from the European level to the Scandinavian level, and then to a local level in Lund and Skåne, skipping over the national level coming somewhat later in the process.

In the empirical chapters, it becomes clear that the ESS will eventually become a pan-European endeavour. It is also quite clear how important it is to satisfy interests of member countries. It is described that political actors tend to be quite keen on involving industry as users in Big Science. This entails a type of path dependency whereby reports by the ESS emphasise aspects of the facility as a user facility. As a sign of sociopolitical legitimacy, path dependency by talking about the ESS as a user facility in reports is in part a remnant of the earlier mobilising of member countries.

7.2.2.2 Fit

In terms of fit, there is an element of aligning and combining interests (Hermes & Mainela, 2014; Leite & Bengtson, 2018), such as integrating the ESS with political actors' strategies, as well as an element of mutuality involving how fit is gradually achieved. In the second phase, there is a greater emphasis on fitting together with political actors' agendas compared with the first phase, which mainly appealed to science actors (Fisher et al., 2016; Fisher et al., 2017). For instance, integrating properties connected to the ESS into the host country's other political strategies, for example, emphasising that the ESS fit the profile of the Swedish economy and knowledge-intensive production. Furthermore, there are instances pointing towards sustainability issues, which relates to sociopolitical legitimising as appropriate and right given existing norms (Aldrich & Fiol, 1994). This is illustrated by talk of making the facility environmentally sustainable, which fit the Swedish Government wanting to profile the nation as at the forefront of sustainability.

Moreover, as discussed previously, there are also cost issues involved in legitimising the ESS as an investment. For instance, it is reasoned by ESS Scandinavia that focusing on a long-pulse accelerator complements similar pre-existing facilities, thereby fitting together the project with the Big Science community whilst lowering costs. Thus, fitting together with political actors by making the ESS into a more lucrative investment, as well as scientific actors by focusing on a long-pulse accelerator that complements existing similar facilities.

In terms of the ESS fitting together with the science community, the Conceptual Design Report and Technical Design Report mention a fairly wide range of areas that can benefit from the ESS, including physics, chemistry, and life science, or science drivers such as soft condensed matter research, energy research, and more, as elaborated on in Chapter 5. This is technological legitimising of the technology the ESS can provide, fitting its future users from the science community by addressing a broad range of disciplines.

Fit is also two-way, as in the ESS fitting together with the Danish Government's agenda and political strategy, as well as the Data Centre also fitting the Big Science community (cf. Suddaby et al., 2017). The Data Centre is part of the ESS, albeit located in Denmark. While it could be argued that the ESS and the Data Centre are the same entity, they are also separate in that the Data Centre was located in Denmark as a way of mobilising the Danish Government by legitimising the ESS as an investment (see also Bengtson & Åberg, 2025, for somewhat similar reasoning), for example, employing a certain number of personnel at the Data Centre. Moreover, locating the Data Centre in Denmark helped the Danish Government to legitimise its decision to fund

the ESS to its citizens, in which the Government is embedded (cf. Hadjikhani et al., 2019). As the Danish Government becomes embedded in an ESS-network, the fit starts involving an emphasis on mutuality. This particularly concerns technological legitimising involving the science community, as the Data Centre, amongst other things, will enable users to smoothly access and make sense of data from experiments at the ESS¹⁹², as elaborated in the empirical chapter.

An area of the science sphere that has been somewhat overlooked concerns the broader research community in Sweden. There seems to have been a lack of effort in fitting together the ESS with the overall Swedish research landscape. However, not every actor needs to perceive the ESS as legitimate for it to have legitimacy (Kumar & Das, 2007). In the second phase, legitimising the ESS most notably concerns political actors as well as science actors with an interest in neutron science. Actors shepherding the ESS pay less attention to the wider Swedish research community, likely because the ESS is not as dependent on a network of Swedish science actors (Halinen & Törnroos, 1998)¹⁹³. Mobilising national science actors by fitting together the ESS and the Swedish research landscape does not seem as necessary as appealing to political actors by acquiring sufficient legitimacy for the ESS as a desirable and appropriate investment. Earlier IMP literature reasons about how a lack of embeddedness and legitimacy can be an obstacle to entering new markets (Hadjikhani et al., 2019), while other scholars point out that different types of relationships are vital to become embedded in a network (Landqvist & Lind, 2019). In realising the ESS, including a vast array of actors and interests, it seems that legitimising involving mostly crucial actors is important, notably a type of partnership between political actors, like the Swedish Government, and neutron scientists.

7.2.3 Interplay between mobilising and embedding

As described previously, mobilising and embedding are related, as successfully mobilising actors and resources leads to embedding them in the network, and mobilising by embedding actors in turn changes the network in which it is being embedded. This also includes commitment from embedded actors to involve third parties in the process of realising the ESS. It could be argued that interaction perceived as beneficial incurs strong commitment (cf. Kumar & Das, 2007; Gebert Persson et al., 2011).

¹⁹² Even to the extent that it was discussed to have a third instrument responsible dedicated to data.

¹⁹³ Except Swedish neutron researchers.

7.2.3.1 Overlapping networks

Actors embedded in pre-existing networks need to take its other counterparts into consideration in a mobilisation process. Particularly political actors that are embedded in networks such as consisting of its citizens (Halinen & Törnroos, 1998; Welch & Wilkinson, 2004; Hadjikhani et al., 2019), which impacts the ESS as an investment in this phase.

Counterparts are, in and of themselves, embedded within each of their respective networks (Halinen & Törnroos, 1998). Mobilising a political actor such as the Swedish Government in turn means that an actor embedded in political networks (Welch & Wilkinson, 2004) is recruited into the ESS-network. Mobilising the Government in turn enables the ESS to access this actor's networks (Granovetter, 1985). Powerful and embedded actors, including the Government, can start mobilising third parties on behalf of the ESS. In the instance of heavily invested and committed actors such as the Government, once the actor is mobilised, this type of support, mobilising actors on behalf of the focal actor, continues throughout the process of realising the ESS.

In terms of actors embedded inside each of their own networks, governments must pay attention to their other counterparts. Mobilising governments means that they have to motivate their decisions to invest in the ESS, giving rise to matters such as In-Kind. It can be argued that the embeddedness of governments is a reason for In-Kind, and that the mobilisation of these actors in turn changes the ESS-network, for example, later involving In-Kind partners and their suppliers in mobilising resources for the facility. In this instance, a process of legitimising entail ripple effects and structural changes in the network (Håkansson & Snehota, 1995; Hermes & Mainela, 2022).

The In-Kind model is formulated in this phase, albeit implemented in phase 3. In part, In-Kind concerns inducing potential member countries to invest in the ESS. As actors are embedded in different networks, it becomes relevant for counterparts to balance their interests between the ESS and other actors in their networks. For instance, political actors, specifically various governments, are embedded in networks consisting of citizens to whom they are accountable (cf. Hadjikhani et al., 2019). If a political actor, a government, chooses to interact with the ESS, it becomes a question of benefits for the country and its citizens. Actors' embeddedness in various networks affect interaction with counterparts, and ultimately the ESS itself (Håkansson & Snehota, 1995; Ford & Håkansson, 2006b). As illustrated by In-Kind, member countries want their investments in the ESS to be beneficial for their own countries. The formulation of an In-Kind arrangement subsequently affects the ESS, due to each counterpart's need to legitimise its investment to other relevant actors inside its networks.

Certain actors become heavily committed to the ESS endeavour, most noticeably Region Skåne. Regarding embedded actors mobilising on behalf of the focal actor, Region Skåne is embedded in its own networks, mobilising actors on behalf of the ESS. Political actors differ in referring to a national actor or regional actor such as Region Skåne (e.g. Welch & Wilkinson, 2004). Governmental matters regarding all-encompassing benefits involving a flourishing regional landscape becomes analytically fine-grained in a regional context. Prior to any decision on where to locate the ESS, there is a study on behalf of regional actors to build knowledge and readiness for action, and later, before starting construction, there is yet another initiative concerning readiness for action, as described in the empirical chapter. A likely reason why Region Skåne is so heavily committed is due to its closeness to the ESS (Ritvala & Salmi, 2011). Moreover, it is reasonable that an actor will be more committed if it believes that the goals of a network are aligned with its own goals (Gebert Persson et al., 2011). As a regional actor, close to the ESS, Region Skåne becoming committed can be understood since its goals are aligned with realising the ESS in terms of satisfying Region Skåne's interests (Kumar & Das, 2007; Hermes & Mainela, 2014), such as sociopolitical interest of Lund becoming a research hub. As such, proposed benefits serve Region Skåne's interest in becoming a more attractive region. In turn Region Skåne attempts to legitimise the ESS, creating various initiatives to benefit other actors (e.g. regional companies).

7.2.3.2 Emerging context

The emerging context changes as it was concluded, at the end of the first phase, that the political support was not yet sufficient. As such, there is a need for change in the ESS-network to mobilise political actors to access their resources in terms of funding the ESS. As political actors join the endeavour, various other issues emerge for example, downsizing the ESS to become a more desirable and appropriate investment for member countries. Moreover, making the ESS more lucrative for member countries to invest in changes the ESS itself, at least in terms of talk (as construction starts in the next phase), locating the Data Centre in another country, and adopting its In-Kind model.

The interorganisational network surrounding the ESS is continuously growing and changing. Some actors, including other site contenders, vanish, as alternatives, or take on new roles. For example, ESS Bilbao becomes an In-Kind partner to the ESS. Other actors emerge and connect to the ESS. In turn, the ESS-network starts to grow, expanding to other pockets of (Swedish) society.

7.2.4 Summarising the second phase

Legitimising the ESS as an investment requires various actors in a network. Hadjikhani, Leite, and Pahlberg (2019, p. 175) propose that “actors from different spheres are seen to be actively influencing each other”. In this second phase, science actors actively influence political actors to endorse the ESS. Influencing political actors, such as European governments, is also aided by other actors, such as ESFRI publishing Roadmaps. On the other hand, political actors also actively influence the ESS. Hadjikhani, Leite, and Pahlberg (2019, p. 176) write that “contrary to the industrial network, the reciprocity is not necessarily achieved through any direct benefit to one actor over another but may be achieved through an indirect benefit provided by another actor”, hinting that benefits to one actor in a dyad is mediated through a third actor. In the present case, benefits for a political actor, for example, the Swedish Government, is mediated through third parties in industry. Moreover, throughout this phase, there are instances of actors emphasising that reaping proposed benefits require proactive action, as illustrated by Larsson’s (2005) report to the Swedish Government or by the TITA-project in Region Skåne.

The business sphere becomes relevant for legitimising the ESS as an investment in this phase. One such example is the notion of creating some type of cluster that might benefit actors inside and outside the business sphere. As such, this is not necessarily legitimising targeting the business sphere, but rather legitimising using the business sphere as a vehicle to achieve other benefits targeting political actors. It is not entirely straightforward to state that there is one single recipient, seeing as a return on investment for the Swedish Government would require additional measures such as national business (e.g. suppliers) becoming involved, and that the business actors also benefit from the Government attempting to reap a return on investment.

Even though there are specific arguments directed towards distinct actors, it is possible to satisfy the interests of more than one actor simultaneously. For political actors to reap certain proposed benefits, it becomes necessary to mobilise business actors. Business actors become a part in legitimising the ESS because suppliers and industry enable key arguments directed towards political actors. Indeed, political actors seem adamant on involving industry in Big Science. Legitimising, using the business sphere, in this phase target politicians, using the notion of business actors (as input or output¹⁹⁴) as a way of reaping benefits from the ESS.

¹⁹⁴ Input is understood in terms of suppliers delivering to the ESS, and output in terms of companies using the ESS.

7.3 Third phase: Materialising involving the science, political, and business sphere (2014 to 2023)

In this third phase, 2014 to 2023, the ESS is being legitimised as an actor, controlling resources and performing activities (Håkansson & Snehota, 1995). Following various milestones, buildings start materialising as a facility housing an accelerator, target, and instruments. As the organisation grows, it adopts a new legal framework and an organisational structure similar to the norms of Big Science. As a new actor, the ESS draws on the legacy of Big Science. Moreover, legitimacy buffering from prior phases helps in materialising the ESS (Fisher et al., 2016). This phase also shows a process of gradually being able to discern the ESS as an actor vis-à-vis other actors, albeit interdependent on actors in an ESS-network¹⁹⁵.

Preceding this phase, counterparts became sufficiently committed to mobilise resources and invest in the ESS to thereby cross a legitimacy threshold (e.g. Fisher et al., 2016). Construction commences in 2014 with political actors breaking ground in Brunnsög, marking the beginning of a new phase now including business actors. This phase still includes science and political actors involving resources such as scientific expertise, technological competence, support, engagement, and money. However, this phase poses additional resource mobilisation requirements, foremost suppliers' tangible and intangible resources, ranging from material such as stainless steel and heat-resistant plastics to know-how, enabling construction of the ESS facility.

7.3.1 Interplay between legitimising and mobilising

Legitimising the ESS as an investment involved technological, sociopolitical, and economic legitimising in order to sufficiently satisfy relevant actors' interests, for example, mobilising political actors to invest money. Building on previous phases, the ESS continues mobilising other types of actors harbouring resources that it does not have, but needs (Leite, 2022). Different types of new actors might not necessarily view the ESS as desirable or appropriate for the same reasons satisfying their own interests as legitimising is changing (Kumar & Das, 2007; Gebert-Persson & Káptalan-Nagy, 2016). For instance, in contributing towards materialising the facility, national suppliers delivering physical resources such as stainless steel or heat-resistant plastics may not necessarily care about, for example, different member countries being able to

¹⁹⁵ There are interdependencies in the network. However, the ESS becomes an actor in its own right rather than, for instance, an idea (shepherded by other actors) or an investment (legitimised by, and to, other actors). For example, in the third phase it becomes straightforward to distinctly discern the ESS as one actor and the Government as another.

reap benefits such as industrial returns. However, legitimising earlier in the process involving different counterparts, affect mobilisation in this phase.

Legitimacy from the relationship between the ESS and the Government helps in mobilising business actors, even though political and business actors have different interests (Fisher et al., 2016; Leite & Bengtson, 2018). Legitimacy garnered from the relationship between the ESS and the Government helps mobilising suppliers; for example, Big Science Sweden mobilising suppliers on behalf of the ESS. Legitimacy buffering also helps understand suppliers' seemingly lack of a threshold for deciding to deliver to an entirely new actor and customer (Fisher et al., 2016). Even though the relationship between the ESS and the Government is becoming cemented, the ESS is, nevertheless, an entirely new actor in a new context, and a new customer for suppliers. Mobilising business actors, however, seems fairly straightforward, partly due to previous relationships, but arguably also because the ESS is a Big Science facility.

Emanating as an idea from within Big Science networks characterised by sociopolitical legitimacy, the ESS is legitimate as a member belonging to this category (Suddaby et al., 2017). While belonging to Big Science, the ESS is nevertheless a new actor. Suppliers point out its newness, such as the ESS not having well-established processes, as mentioned in Chapter 6. Despite being a new and somewhat cumbersome customer, the ESS is sufficiently legitimate as an actor for suppliers to start delivering. For instance, in making early commitments to the ESS as a potential customer, Gammadata immediately attempted to understand the various roles of ESS personnel as the organisation became populated. Some companies have not been chosen to deliver, yet keep pushing to do so. The ESS accrued sufficient legitimacy from counterparts in earlier phases to be somewhat taken for granted by suppliers as a potential customer.

7.3.1.1 Proposed benefits

In this phase, the ESS alongside counterparts and third parties propose benefits legitimising the ESS as an actor, for other actors, such as suppliers, to mobilise their resources towards materialising the facility. As described in the empirical chapter, actors such as Big Science Sweden, working as a bridge-maker, legitimise Big Science as a customer to suppliers, thereby mobilising suppliers on behalf of the ESS. The Government, as a single actor expecting benefits, including industrial benefits, is insufficient unless other actors act upon attempting to reap proposed benefits (Ritvala & Salmi, 2010).

Political actors hoping to reap benefits from their investment in Big Science means that industry becomes quite politicised, particularly concerning issues

in legitimising the ESS¹⁹⁶. Suppliers delivering to the ESS enable the Government to reap industrial benefits. Suppliers, including the main contractor Skanska, becomes critical to ensuring benefits for national suppliers from constructing the ESS facility. A political perspective helps understand the broader context involving national suppliers delivering to the ESS, including why using national suppliers is important (e.g. enabling technological development or tax revenues). To some extent, this could be viewed as continued mobilisation, since some of the Government's interests, as a mobilisation target, are closely related and aligned with the ESS (Ritvala & Salmi, 2011; Hermes & Mainela, 2014).

One way to view Big Science Sweden is that it legitimises the ESS as an appropriate actor, controlling resources and performing activities, for suppliers to deliver to it as a customer. Big Science Sweden is legitimising the ESS to business actors inside its networks so that they will interact with the ESS. At Big Science Sweden, the ESS Industrial Liaison Officer keeps in contact with the ESS, channelling their needs to its technical groups, as mentioned in the empirical chapter.

Part of mobilising suppliers to deliver to the ESS entails proposing benefits accruing from interacting with a Big Science customer. In my study, Big Science Sweden plays a crucial role in mobilising suppliers. However, as mentioned in Chapter 6, the ESS itself also conducts public relations by communicating benefits of working with Big Science. In such an instance, the ESS is legitimising itself as a customer for suppliers to deliver to. However, for the most part, in my study, this is done by other actors as well as aided by the discourse surrounding Big Science. There is a range of proposed benefits floating around in the discourse, incentivising suppliers to deliver to Big Science. Common benefits include technological development and innovation (see e.g. Håkanson & Kokko, 2022). The following paragraphs analyse the proposed and realised benefits for suppliers in light of technological, sociopolitical, and economic legitimising.

The technological complexity of a facility such as the ESS might advance suppliers' interests by requiring some type of technological development that is desirable and appropriate inside their context (Suchman, 1995). Although opportunities for technological development may indeed be a reason for a supplier to deliver to Big Science, this is less clear in my study, since many Swedish suppliers are not necessarily involved in high-tech In-Kind deliveries. In terms of economic benefits, as described in Chapter 6, delivering to the ESS

¹⁹⁶ This concerns both the input to and output of the ESS; that is, input in terms of suppliers delivering to the ESS, and output in terms of companies using the ESS. Since the ESS is not yet in operation, there are no companies currently using it; however, industry, as a future user, is part of legitimising the ESS.

adds to the supplier's stream of revenues and creates opportunities to deliver to additional Big Science facilities. This is because delivering to the ESS, it is argued, opens up doors to the entire Big Science market, which is a large market that in turn could increase a supplier's profit.

Suppliers such as nVent and Carlsson & Möller, and more, use the ESS as a reference customer (cf. Åberg, 2013). Using the ESS as a reference in dealing with other companies in the supplier's networks legitimises the ESS as an attractive and appropriate customer to a supplier's current and potential customers and suppliers. Additionally, this shows that suppliers regard the ESS as sufficiently legitimate as a customer that they want to cite it as a reference customer. The ESS is being used as a reference and depicted as a prestige project amongst suppliers.

A number of suppliers depict the ESS in terms of prestige, as elaborated on in the empirical chapter¹⁹⁷. MCT Brattberg, for instance, state they even know of companies that are satisfied delivering to the ESS merely for its prestige. According to Andersen and Åberg (2017), Big Science organisations are argued to be prestigious collaboration partners. Interacting with a prestigious actor can positively affect an actor's network identity (Anderson et al., 1994). For instance, “[b]eing seen as a ‘close friend’ to a company known as advanced or powerful helps in other relationships” (Håkansson & Snehota 1995, p. 32). Descriptions of the ESS as a prestigious counterpart seems to be an important reason for delivering to the ESS. Having said that, it seems taken for granted that prestige is involved in being a counterpart of the ESS. Here, prestige could be viewed as a sign of sociopolitical legitimacy, as the norm amongst some suppliers is that there is prestige involved in delivering to the ESS. In the case of the ESS and Swedish suppliers, prestige seems to be equally, if not more, lucrative than economic or potential technological benefits; for suppliers, perhaps even making up for a lack of technological benefits.

7.3.1.2 Framing

Throughout this phase, counterparts, alongside the ESS, are framing the ESS as an actor, by problematising a situation and a subsequent solution. Framing involves presenting the ESS concerning how other actors perceive it (Fisher et al., 2017). In terms of arguments, the same argument can be viewed and used in different ways by actors (Bengtson et al., 2022), including versioning the ESS for different groups of actors (Andersen et al., 2023). Different parts of the ESS have distinct identities to counterparts (Håkansson & Snehota, 1995), including third party actors. In this phase, counterparts are framing the

¹⁹⁷ Not every supplier uses this specific word, as some use related descriptors (see Chapter 6).

ESS to actors in their own networks, leveraging the relationship to the ESS as an actor.

Skanska leverages its collaboration and relationship with the ESS by legitimising Skanska and the collaboration, and, in effect, the ESS. In terms of technological legitimising, Skanska communicates its collaboration by, for example, making claims of enabling the ESS to be built with the latest technology or depicting the ESS as a world-leading research facility. Thereby, framing the ESS as technologically legitimate, albeit not necessarily towards any specific actor. In terms of a sociopolitically dominant discourse appealing to the norms of political actors and society at large, Skanska uses the collaboration to communicate high sustainability goals, as described throughout the empirical section regarding construction. As such, also framing the ESS as an actor that is sociopolitically legitimate concerning the sustainability issues involved in the construction of its buildings. Using the lens of economic legitimising related to framing, it was conveyed that in the collaboration it was important to avoid delays and budget increases for economic reasons. This, in part, relates to economic legitimising, as the ESS's buildings are completed according to plan. In terms of framing, actors may themselves frame ventures differently to various audiences (Fisher et al., 2017). In the present case, however, as illustrated by the Skanska–ESS collaboration, it is equally a counterpart framing the focal actor as legitimate to other actors, such as implicitly towards science actors by emphasising technological superiority; in turn, the ESS is being legitimised by Skanska by means of affiliation (Hermes & Mainela, 2022).

Another counterpart framing the ESS is the Swedish Government, showing how the endeavour can satisfy its own counterparts' interests. The ESS needs support from its member countries and their governments. These governments, in turn, require their citizens' acceptance of their support to the ESS. Throughout the process described in the empirical chapters, there have been several Swedish ministers at the helm of education and research, sharing some sort of consensus to materialise the ESS. Towards the end of the third phase, it becomes apparent that the ESS requires more money. In a press statement, the Government proposes additional funding injections, pointing towards the urgency of completing the ESS. In this instance, framing the ESS is done by the Government motivating additional monetary support to its citizens, re-emphasising the endeavour's economic legitimacy (cf. Hadjikhani et al., 2019). For instance, restating industrial benefits including additional jobs and attracting talent. The Government's proposed ongoing funding commitments of a fairly substantial nature (several million Swedish kronor spread over three

years) signifies sociopolitical legitimacy, that the relationship is considered sufficiently legitimate as well as the ESS as an actor.

Notwithstanding counterparts legitimising the ESS, the focal actor is also legitimising itself using framing, addressing various challenges (e.g. technical and sociopolitical). It does this most noticeably through recurring Activity Reports published annually for various actors to read. In terms of technological legitimising, demonstrating progress is central at this stage. Earlier phases concerned technological plausibility involving proposed idea and concept, whereas this phase involves demonstrated technological progress in materialising a comparatively vague idea and concept (Fisher et al., 2016). For instance, frequent reporting of the ESS achieving various so-called milestones, and slightly more specific, statements about how, for example, the Accelerator Tunnel is ready for installations to begin. Moreover, as described in the empirical chapter, construction of the facility builds on experiences from other facilities, legitimising the ESS as an actor building on previous knowledge and examining similar pre-existing facilities. This arguably help relevant counterparts (e.g. governments and the science community) to gauge the plausibility of materialising various parts of the ESS project, as they are being built using science actors' expertise. Involving science actors such as research institutes across Europe creates technological legitimacy for the ESS, as the science community appreciates how to design and construct, for instance, various instruments. In terms of sociopolitical legitimising, scattered passages throughout the Activity Reports encapsulate ambitions to be perceived favourably in light of contemporary norms. For instance, the Acting Director General of the ESS framing the ESS in terms of how it will help address big societal challenges, as described in Chapter 5. As mentioned previously, the Activity Reports are not necessarily transmitted to any one specific actor, but instead numerous actors, exemplifying a growing ESS-network.

7.3.2 Interplay between legitimising and embedding

Legitimising the ESS as an idea and investment successfully rooted the ESS in various actors' contexts to continue towards materialising the facility¹⁹⁸. A number of mobilised actors gradually become embedded in an expanding ESS-network, including prestigious counterparts such as various governments (e.g. Swedish and Danish as well as British, French, and German), research institutes (e.g. Science and Technology Facilities Council and

¹⁹⁸ Huge amounts of scientists and politicians have been involved in a process spanning several decades. Scientists involved in idea-generating three decades ago were not necessarily active later in the process. Conversely, politicians active later in the process were not necessarily involved in earlier parts of the process.

Forschungszentrum Jülich), and companies (e.g. Skanska). Positive recognition and relationships with prestigious actors legitimise the ESS as an actor (Anderson et al., 1994; Leite & Bengtson, 2018). Moreover, legitimacy garnered from these actors aid in starting new relationships (Fisher et al., 2016). In my case, legitimacy buffering being accepted by authoritative actors (e.g. governments), in turn, aid mobilising additional actors.

Talk of proposed benefits and framing from earlier in the process legitimised the ESS as an investment. Ford and Håkansson (2006b, p. 250) point out that “[r]elationships require action and investment today, but offer the prospect of reward only at some time in the future”, and in this phase actors start working towards attempting to reap benefits previously proposed in prior phases. In turn, this phase shifts more towards action involving path dependency and fit legitimising the ESS as an actor. Here, mobilisation processes create path dependency and, to some extent, lock-in effects (cf. Håkansson & Waluszewski, 2002), due to actors attempting to satisfy their own interests connected to the proposed benefits. Such as In-Kind, partly a result of path dependency following prior mobilisation of member countries. In terms of fit, actors in the ESS-network undertake action so as to fit proposed benefits to satisfy their own interests. For example, Region Skåne taking action towards fitting proposed benefits inside their context by creating new initiatives. These two examples illustrate embedded actors satisfying their interests, and are also instances of legitimising the ESS as an actor.

7.3.2.1 Path dependency

Illustrating path dependency in realising the ESS, the In-Kind model satisfies counterparts’ interests and, equally, legitimises the ESS as an actor (Håkansson & Snehota, 1995; Suchman, 1995). In this phase, In-Kind partners, using suppliers, start materialising the ESS. As stated earlier, In-Kind was described as a political necessity to mobilise member countries, as they wanted to satisfy their own interests by obtaining proposed benefits from the ESS. This creates path dependency and lock-in effects as member countries committed to the ESS want to involve their own research institutes and suppliers in materialising the facility. To some degree, merely adopting an In-Kind arrangement invokes legitimacy by legitimising the ESS as an actor using research institutes scattered across Europe and ensuring commitment from member countries.

By starting In-Kind deliveries, the ESS is being legitimised as an actor involving all three forms of legitimising. In terms of technological legitimising, In-Kind affects legitimacy of the ESS as an actor since various technical components are built involving scientists. In this case, building the ESS involves

science actors' expertise and knowledge concerning design, construction, and use of the accelerator, target, and instruments. This, in turn, entails confidence in quality that the technology at the ESS is desirable and appropriate to enable ground-breaking science serving future users' interests. On the other hand, using In-Kind also benefits member countries and their scientists as they contribute intellectually. In terms of sociopolitical legitimising, enabling member countries to be involved by using In-Kind partners to build the ESS as a pan-European initiative satisfies interests of European governments, as appropriate and right aligned with existing norms (cf. Aldrich & Fiol, 1994). As well, building parts of the ESS using member countries' research institutes and industry also legitimises governments' decisions to invest in the ESS. This allows them to motivate to their citizens why they are using taxpayers' money to fund a facility located in another country, as described in the empirical chapter. In this context, particularly regarding In-Kind, business, political, and social relationships are inseparable (Low & Johnston, 2008). In terms of economic legitimacy, an In-Kind model increases the likelihood of member countries reaping economic benefits (e.g. industrial benefits involving their suppliers), including the possibility of technological development. This partly means that the governments are paying to their own industries, as mentioned in the empirical chapter. Using In-Kind is legitimising the ESS, as common goals enable actors to align the overarching goal of realising the ESS with advancing their own goals (Gebert Persson et al., 2011).

Using an In-Kind model also affects two other noteworthy areas involved in legitimising the ESS as an actor. First, In-Kind facilitates assembling counterparts to access their resources, despite the ESS being an entirely new actor. Commitment from member countries legitimises the ESS as a new actor and customer, since relationships with governments, in turn, enable involving other actors, such as research institutes that subsequently use various suppliers. However, and second, as elaborated throughout the empirical chapters, using an In-Kind model means that Swedish suppliers were perhaps not as involved in high-tech deliveries as some would have wanted, conveyed as qualms in the national media or individual suppliers stating that it is somewhat sad. Indeed, there is some tension amongst embedded actors due to the adoption of an In-Kind arrangement, whereby the Swedish Government receives criticism from national actors for paying in cash. Nevertheless, the Government is committed to setting up other new initiatives, following path dependency arising from proposed benefits associated with hosting the ESS.

Throughout this phase, several national initiatives start following the path dependency arising from earlier legitimising the ESS as an investment. The Swedish Government invested large amounts of money in the ESS.

Attempting to reap proposed benefits from the investment, the Government commits to starting new initiatives. Indeed, reaping proposed benefits require action; it is not something that happens automatically. To some degree, starting new initiatives show that the ESS is sufficiently legitimate as an actor by counterparts internalising the benefits to increase engagement surrounding the ESS. For instance, SWEbeams is an initiative in and of itself to increase engagement surrounding the ESS, as elaborated on in Chapter 5. This type of commitment, including attempts to increase engagement, can be taken as a sign that the ESS is legitimate (cf. Kumar & Das, 2007). MAXESS is yet another initiative, in my case, essentially geared towards helping companies to use the ESS, thereby legitimising the ESS as an actor that can provide economic and industrial benefits to counterparts (albeit once in operation). Embedding through a legitimation process, in this instance, results in structural changes throughout different networks (cf. Hermes & Mainela, 2022). Compared to earlier, the ESS is now making relatively few substantial changes to satisfy actors in a national context vis-à-vis actors in the context undertaking action to fit and accommodate the ESS and associated benefits.

7.3.2.2 Fit

Fit involves fitting together with a whole as a way of incurring legitimacy. Phases 1 and 2 exhibited an emphasis on the ESS fitting into an external whole (Gebert Persson et al., 2011; Suddaby et al., 2017; Hermes & Mainela, 2022). In this phase, actors embedded in their networks instead undertake increasing action to fit the ESS-network and ESS as an actor. That is, rather than the ESS fitting together with the whole, or external environment, actors make changes to fit the ESS-network and ESS as an actor.

In this phase, embedded actors undertake proactive efforts to fit and accommodate the ESS and associated benefits, in turn legitimising the ESS as an actor. Earlier in the process toward realising the ESS, it was decided that Skåne would host the facility. As described in the empirical chapter, proposed benefits from hosting the ESS include a number of new employees as well as guest scientists, and scenarios such as companies setting up business in the nearby area as well as spin-offs. The ESS is being built on a greenfield in Skåne, situated close to MAX IV, as mentioned in the empirical chapter, so Region Skåne now hosts two large-scale research infrastructures. Yet, despite already hosting MAX IV, the ESS is nonetheless a fairly new endeavour in the region. Hosting two Big Science facilities arguably facilitates additional commitment, such as initiatives involving regional actors. Region Skåne is undertaking proactive efforts to fit and accommodate the ESS in the region, becoming heavily committed to attempting to reap potential benefits from the

ESS¹⁹⁹. Actors that find the ESS highly desirable in terms of satisfying their own interests will become more committed (cf. Kumar & Das, 2007).

Throughout a process of enabling a fertile surrounding regional landscape, Region Skåne satisfies its own interests, in turn legitimising the ESS as an actor²⁰⁰. For example, constructing a tramline that runs through MAX IV, as one of the stops, ending at the ESS as its terminus. The tramline legitimises the ESS as an actor, making it desirable for future users by providing smooth communication and transportation links to the ESS. As described in the empirical chapter, communications infrastructure was stated by ESS Scandinavia as one of the reasons for why ESFRI should endorse locating the ESS in Lund. To be an attractive hotspot for world-class science, a well-developed science environment is arguably important, facilitating the science community's needs. Another example is Science Village Scandinavia, currently being developed, that in part also makes it desirable for future users by providing basic services and accommodation. In developing the Science Village, embedded actors, including Lund University, Region Skåne, and Lund Municipality, jointly interact to satisfy each of their respective interests. These projects involve actors in the ESS-network, rather than being driven specifically by the ESS itself. In this instance, the ESS is both a source as well as recipient of network ripple effects (Håkansson & Snehota, 1995), as committed regional actors are attempting to satisfy their own interests while legitimising the ESS as a desirable and appropriate actor, for example, in the eyes of future users. A growing ESS-network, fitting into a community, makes the ESS and its network legitimate (Aldrich & Fiol, 1994).

Overall, in this phase, embedded counterparts and third parties legitimise the ESS as an actor, both amongst each other and in their own networks. Moreover, as the ESS becomes an actor and as the ESS-network expands, the ESS and its counterparts become slightly more separated as entities. For instance, legitimising the ESS as an investment was strongly connected to member countries and the Swedish Government, rather than the ESS as an actor per se.

7.3.3 Interplay between mobilising and embedding

Earlier in the process of realising the ESS, there was a greater need to mobilise actors from different spheres of society by identifying relevant actors (van Bockhaven & Matthyssens, 2017; Bengtson et al., 2022). In this phase, mobilised actors are, in turn, mobilising third party actors on behalf of the ESS.

¹⁹⁹ This had already started before construction, for example, in the TITA-project.

²⁰⁰ And also satisfying the interests of the Swedish Government, for example, via Science Village Scandinavia enabling industrial benefits.

This phase is less about identifying relevant actors that already exist, and more about embedded counterparts identifying relevant initiatives, and sometimes creating new actors, as counterparts are attempting to reap benefits from the ESS as an actor. The ESS-network grows as mobilised actors become embedded, in turn involving significantly more interaction within the network as well as counterparts' other relationships, thereby including third party actors to a greater extent than previously.

7.3.3.1 Overlapping networks

Throughout this phase, it becomes clear that the embedded counterparts are mobilising actors on behalf of the ESS. For instance, the Swedish Government is embedded inside its own networks, mobilising different types of actors in various constellations in different initiatives. For example, different constellations of actors connected to academia, industry, and the public sphere in initiatives including SWEbeams, teknikparksfunktionen, and more. In this case, counterparts embedded inside their own various networks affect the ESS-network, such as changing existing actor ties into new constellations (Hermes & Mainela, 2014).

As an idea and investment, the ESS was closely integrated with other actors, such as the Swedish Government, whereas overlapping networks in this phase illustrates a process of gradually being able to distinguish the ESS as an actor from other actors. An example of this is how third parties perceive the ESS and counterparts, in this instance specifically the Government. Throughout the third phase, voices in newspaper articles criticise the Swedish Government's engagement in the ESS and in attempting to reap proposed benefits²⁰¹. An example from a newspaper article, elaborated on in the empirical chapter, specifically points out that the Government receives criticism for not showing greater interest in the ESS. And, proposed benefits, such as in terms of industry benefiting by delivering parts of the technology, which, however, to a large extent pass Swedish companies by. In such instances, it is not necessarily the ESS as an actor that is subject to criticism, for example its technological legitimacy or scientific potential, but rather other actors in the ESS-network. Third party actors, not necessarily embedded in an ESS-network, depict the Government and the ESS as separate, yet interdependent, pointing out shortcomings in the Government's efforts to reap the proposed benefits.

²⁰¹ These were the voices of individuals working inside various organisations (i.e. different actors).

7.3.3.2 Emerging context

The emerging context is continuously changing, and in this phase, the context changes to integrate the ESS. For instance, the ESS is being integrated within its regional context and actors are mobilising to develop Science Village Scandinavia, and thereby mobilised actors are changing the emerging context. This also demonstrates the further rooting of the ESS in the regional context, which is relevant from the perspective of regional actors (e.g. Region Skåne). If regional actors want to reap benefits, including possible spin-offs in the nearby area emanating from the ESS, then the region must facilitate this, for example, by creating Science Village Scandinavia. Embedding the ESS in regional networks provides fertile ground for actors to absorb benefits from locating the ESS in Lund. This becomes evident during the third phase as several initiatives emerge. In such instances, it is less about involving regional actors by embedding them into an ESS-network, as it is instead more about a need for change in an embedded context involving regional actors mobilising additional actors and resources, which in turn changes the embeddedness in a constantly changing regional context.

Many of the aforementioned initiatives created throughout this phase signal that the context is changing to cater to the proposed benefits that had mobilised actors in prior phases involving technological, sociopolitical, and economic legitimising. In an emerging context surrounding the ESS as an actor, counterparts such as the Swedish Government proactively take action towards changing the context to accommodate proposed benefits in attempting to satisfy their own interests. An actor is part of the context that it affects but is, in turn, also affected by the context (Håkansson & Snehota, 1995). Previously, mobilisation involved elements of integrating the ESS into relevant counterparts' contexts. ESS Scandinavia attempted to mobilise the Government during the second phase, for example, by proposing benefits to satisfy its interests, including possible returns on investment. Due to a need for change in the emerging context, in the third phase it is rather the context accommodating the ESS. The aforementioned initiatives, involving many different types of actors with varying interests, are attempts from counterparts to change the context to accommodate the ESS and associated benefits proposed earlier in the process. For instance, reaping industrial returns on investment necessitates creating initiatives that enable companies to use the ESS once in operation. The embedded context changes by mobilising additional actors and resources, attempting to reap the proposed benefits, in turn changing the network surrounding the ESS (Hermes & Mainela, 2022).

7.3.4 Summarising the third phase

The complexity involved in realising the ESS increases as the first phase involved scientists essentially discussing an idea and subsequently conducting design work, to later involve a variety of actors with various interests such as governments, and finally also a huge number of suppliers. Due to the problems of science and political actors, another type of actor, the business actors, were recruited to the ESS-network (see Ford & Håkansson, 2006a; Leite, 2022). Political actors and their roles remain similar yet change (Hermes & Mainela, 2014), still involving, for instance, the Swedish Government and Region Skåne, but also evolving to include several new political initiatives and actors in the national context.

This phase concerns a lot of action, alongside talk. In terms of proposed benefits, throughout the second phase the ESS was legitimised as an investment to other actors. This phase is less about talking about proposed benefits, and more about taking action in attempting to reap benefits. Furthermore, other actors are doing a lot of the work, for instance, counterparts building the facility, actors such as Big Science Sweden mobilising suppliers on behalf of the ESS, and the Swedish Government starting initiatives. In this phase, several actors take action, either individually or collectively in various actor constellations, for the most part attempting to reap previously proposed benefits.

Throughout phases 1, 2, and 3, the ESS is never in use by scientists visiting the facility to conduct research, as the timeline of this study covers the development and production setting (Håkansson & Waluszewski, 2007). However, the future use of the ESS affects prior phases leading up to its operation. Moreover, while scientists venturing to use the ESS remain a future matter, there have been several actors involved in taking concrete action. For its counterparts, the ESS is already something concrete that can benefit these actors' interests.

7.4 Summary of phases

Table 2, below, provides a summary of what happens in phases 1, 2, and 3, using the model of analysis from section 2.5 *Towards my own view: A model for analysing the process of realising the ESS* to analytically understand what is happening in each phase. The column to the left concerns the processual interplay amongst the three concepts (legitimising–mobilising, legitimising–embedding, and mobilising–embedding), which is then analysed in finer detail in the column to the right relating to each phase. For instance, in the first phase, spanning the mid-1980s to 2002, the interplay between legitimising and mobilising involved proposed benefits such as formulating a superior

technical design; in terms of the interplay between legitimising and embedding in phase 1, this involved path dependency such as how the ESS emerges from pre-existing science networks. As the process progressed, there was an expansion of matters involved in realising the ESS, as shown in Table 1 (see introduction to chapter 7 *Analysis*). Moreover, Table 1 contextualises Table 2. To illustrate, the involved spheres from Table 1 inform the analytical labels accompanying the processual interplay amongst concepts in the three phases in Table 2. For example, from Table 1, the science sphere is involved in phase 1, which informs what is happening during phase 1 in Table 2, such as formulating a superior technical design.

Table 2 A summary of phases 1, 2, and 3 using the model of analysis in Chapter 7: *Analysis*

				Summary of phases		
				<i>Mid-1980s to 2002</i>	<i>2002 to 2014</i>	<i>2014 to 2023</i>
What is happening in each phase?	Interplay between legitimising and mobilising	<p><u>Proposed benefits</u></p> <ul style="list-style-type: none"> - Formulating superior technical design - Catering to wider range of scientists <p><u>Framing</u></p> <ul style="list-style-type: none"> - ESS solution to need for new European neutron facility 	<p><u>Proposed benefits</u></p> <ul style="list-style-type: none"> - Sociopolitical benefits - Economic benefits - Leveraging media - In-Kind arrangement <p><u>Framing</u></p> <ul style="list-style-type: none"> - Europe risks losing world-leading position - Downsizing ESS into more reasonable investment - Many supporters, few enemies 	<p><u>Proposed benefits</u></p> <ul style="list-style-type: none"> - Counterparts proposing benefits²⁰² - Business actors enabling benefits for political actors - Add to suppliers' revenues - Opening doors - Reference customer - Prestige <p><u>Framing</u></p> <ul style="list-style-type: none"> - Counterparts framing ESS as legitimate to other actors²⁰³ - Counterparts framing ESS as satisfying interests of their own counterparts²⁰⁴ - Addressing technological matters - ESS in terms of big societal challenges 		

²⁰² Such as Big Science Sweden proposing benefits on behalf of Big Science for suppliers to deliver to the ESS.

²⁰³ Such as Skanska framing its relationship with the ESS to legitimise Skanska, in turn legitimising the ESS.

²⁰⁴ Such as the Swedish Government framing the ESS as satisfying the interests of the Government's own counterparts.

<p>Interplay between legitimising and embedding</p>	<p><u>Path dependency</u> - ESS emerges from pre-existing science networks <u>Fit</u> - Technological fit with Big Science community - Lack of sociopolitical fit</p>	<p><u>Path dependency</u> - ESS as political project, moving from regional to national level - Pan-European endeavour - User facility <u>Fit</u> - Integrating with political actors' strategies - Mutuality science and political actors - Wide range of science areas - Lack of fit in national research context</p>	<p><u>Path dependency</u> - Satisfying counterparts' interests legitimising ESS as an actor - Lock-in effects using In-Kind - Ensuring commitment from member countries - New initiatives - Increased engagement surrounding ESS <u>Fit</u> - Proactive counterparts taking action to fit ESS's proposed benefits, in turn legitimising ESS</p>
<p>Interplay between mobilising and embedding</p>	<p><u>Overlapping networks</u> - Temporarily embedded actors <u>Emerging context</u> - ESS springs out of an emerging context</p>	<p><u>Overlapping networks</u> - Powerful actors mobilising on behalf of ESS - Governments taking taxpayers into consideration - Proactive region <u>Emerging context</u> - ESS changes to satisfy actors - Actors change role in network</p>	<p><u>Overlapping networks</u> - Different constellations of actors - Distinguishing ESS as an actor from other actors - Creating new initiatives <u>Emerging context</u> - Context changes to integrate ESS - Vast array of actors emerge - Context changes to accommodate proposed benefits</p>

8 Conclusion

The purpose of this study was to analyse the process of creating an actor from idea towards reality in an interorganisational context. To do so, I looked at the process of creating a large-scale Big Science actor, namely, the ESS, asking the following research question:

How does the legitimising process for creating a Big Science actor unfold in a business network?

In the preceding chapter, I analysed the process of creating an actor in a dynamic network setting over time in which different types of counterparts enable the endeavour to transition from idea, investment, towards finally becoming an actor. A Big Science actor is created by overlapping networks including science, political, and business actors, as realising a large-scale endeavour requires constantly mobilising different types of salient counterparts with varying interests and controlling crucial resources. Doing so is accomplished by satisfying the interests in a focal actor's most immediate actor ties, including technological, sociopolitical, and economic legitimising involving proposed benefits and framing relevant to specific counterparts. As the process proceeds, continuously accumulating additional types of actors, mobilised counterparts become embedded in a network surrounding the focal actor. Actors inside the user community, involved in matters initially related to the endeavour as an idea, such as technological legitimising of a superior technical design, become embedded and, in a subsequent phase, start anchoring the endeavour as an investment that sufficiently fit political actors' interests involving sociopolitical legitimising. Counterparts remain involved in the network, following path dependency, whereby legitimising from earlier phases affects the process of mobilising additional actors. In becoming an actor, mobilised suppliers embark on materialising a facility by delivering to a new and emerging actor. Counterparts and third parties in overlapping networks affect the focal actor, including its resources and activities. The study illustrates that accomplishing a large-scale endeavour by creating an actor constitutes a dynamic process that requires three forms of legitimising engaging different

types of salient actors over extended periods of time connecting to the idea, investment, and actor, thus realising the ESS from idea towards reality.

8.1 A processual model for realising a large-scale endeavour

This section presents and discusses an updated version of my model for analysing the process of realising a large-scale endeavour (see *Figure 5*, below), which can be applied to understand the overarching process alongside each specific phase. As a whole, legitimising (e.g. Suchman, 1995; Suddaby et al., 2017), mobilising (e.g. Ritvala & Salmi, 2010; Hermes & Mainela, 2014), and embedding (e.g. Halinen & Törnroos, 1998) work jointly throughout the process of realising a large-scale endeavour. As a process divided into three temporally bracketed phases (Langley, 1999), what is being legitimised is an entity that emerges as an idea, then investment, finally becoming an actor (see Håkansson & Snehota, 1995).

The process of realising a large-scale endeavour in an interorganisational context requires continuous mobilising constantly legitimising the idea, investment, and actor involving technological (Ruef & Scott, 1998), sociopolitical (Aldrich & Fiol, 1994), and economic (Vaara, 2014) legitimising. Each phase affects the starting conditions of subsequent phases (Bizzi & Langley, 2012), such as who to mobilise and why as well as how (cf. Mouzas & Naudé, 2007; Ritvala & Salmi, 2010; Hermes & Mainela, 2014; Leite, 2022). As an evolving process, different phases build upon each other, incorporating previous phases, as the process continues.

Illustrated by the circles in the updated version of the model in *Figure 5*, preceding phases become points of departure for subsequent phases in a process involving phases building on each other as layer added upon layers. As each phase is a continuation that builds on prior phases, actors involved in the first phase continue to be involved as embedded in later phases. As an illustration, science actors from the user community in phase 1 are embedded in the second and third phases. The second phase involves new matters, satisfying more interests for mobilising additional types of actors that subsequently become embedded in the third phase. Actors that become embedded gradually expand a network surrounding the focal actor.

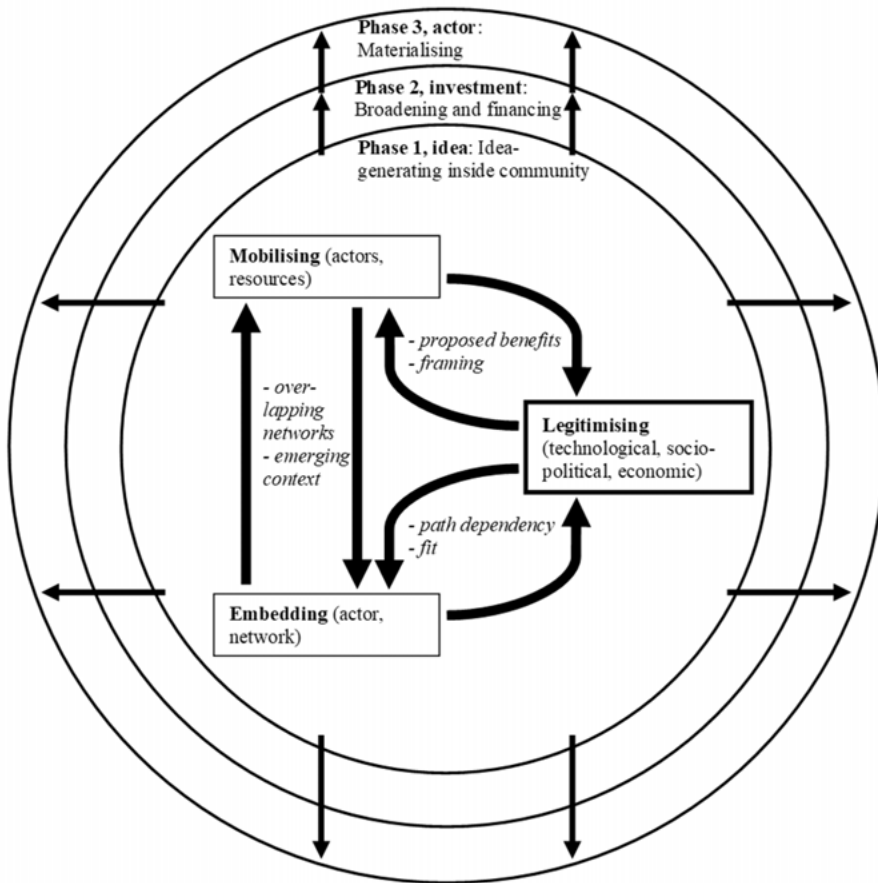


Figure 5 Processual model of realising a large-scale endeavour in an interorganisational context

Regarding the three phases, in the first phase the idea starts inside the user community, which refers to actors that will eventually use what is being developed (cf. Håkansson & Waluszewski, 2007). The idea is legitimised from the inside out (Human & Provan, 2000) amidst idea-generation inside the user community. This is done by legitimising the idea, involving aspects such as framing a problem and its subsequent solution (e.g. Fisher et al., 2017; Bengtson et al., 2022) as well as proposed benefits (Ritvala & Salmi, 2011; Hermes & Mainela, 2014) involving technological (Ruef & Scott, 1998), sociopolitical (Aldrich & Fiol, 1994), and economic (Vaara, 2014) legitimising by satisfying interests relevant to specific counterparts (see also Suchman, 1995; Kumar & Das, 2007; Gebert Persson et al., 2011; Suddaby et al., 2017). In the first phase, benefits may include how the endeavour will cater to the

user community, as in formulating a superior technical design, involving a fairly large element of technological legitimising of the idea. There is also an element of how the new idea fits together with the context of the user community (e.g. DiMaggio & Powell, 1983; Gebert Persson et al., 2011; Suddaby et al., 2017; Hermes & Mainela, 2022). The user community, and specific actors from it, become embedded in a network that is gradually expanding. Support inside the user community enables sustaining sufficient momentum in subsequent phases throughout the process of creating an actor.

The first phase, idea-generating inside the user community, continues into the second phase, now involving embedded actors from the user community attempting to mobilise new sets of actors required to make the idea a reality. In such endeavours, which use substantial amounts of public funding, transitioning beyond idea-generating inside the community entails elevating the idea to include broadening and financing, thereby legitimising it as an investment for political actors. As such, there is a need for mobilising actors from different spheres of society by identifying relevant actors (van Bockhaven & Matthysens, 2017; Bengtson et al., 2022). Political actors, such as governments, control crucial resources, channelling public funds as well as wielding significant decision-making power²⁰⁵. Legitimising from earlier, regarding an idea, involving, for instance, a superior technical design (cf. Fisher et al., 2016; Fisher et al., 2017) or framing a need for the endeavour, remain relevant in a second phase, still involving matters regarding the user community yet also expanding to include political actors. Sociopolitical legitimising becomes salient for mobilising political actors as targets for legitimation (Hermes & Mainela, 2022), making investment desirable and appropriate (Suchman, 1995). This mostly involves proposed benefits, such as industrial benefits (Ritvala & Salmi, 2011), framing the endeavour as inevitable (Vaara, 2014) in emphasising political matters (Fisher et al., 2017), fit by aligning interests integrating the endeavour with political actors' strategies (Hermes & Mainela, 2014), and utilising actors' embeddedness in overlapping networks (Håkansson & Snehota, 1995). The user community begins mobilising actors that use their embeddedness in overlapping networks to mobilise third party actors.

Sufficiently rooted and supported amongst relevant counterparts, actors in a third phase begin materialising the endeavour. The process reaches a legitimacy threshold (e.g. Fisher et al., 2016) whereby actors commit to commencing construction. Materialising the endeavour requires mobilising business

²⁰⁵ Public funding is an important matter for large-scale endeavours, which tend to be very costly. Decision-making power refers to deciding yay or nay for a project to proceed, its scope, and its location.

actors whose resources enable construction of a facility, including tangible (e.g. steel or concrete) and intangible resources (e.g. expertise and know-how). In the case of creating a Big Science actor²⁰⁶, the user community is engaged in construction, involving technological legitimising of a desirable and appropriate (Suchman, 1995) actor by enabling opportunities for technological breakthroughs (Fisher et al., 2017) that can satisfy future users' interests. In this phase, the endeavour is becoming an actor controlling resources and performing activities (Håkansson & Snehota, 1995), alongside materialising a facility and adopting an organisational form akin to other similar organisations. Mobilised counterparts have become embedded in a network surrounding the focal actor comprising science, political, and business actors. Following path dependence from proposed benefits in prior phases, a number of new actors and initiatives emerge as attempts to proactively reap the previously proposed benefits, whereby third parties in overlapping networks start taking a more prominent role in the process.

Regarding the overarching process, matters expand over time. Legitimising expands for mobilising additional actors that subsequently become embedded in a growing network surrounding the focal actor. In my case, the endeavour transitions between phases by an explicit and apparent need to mobilise additional sets of actors and their resources. The idea is being legitimised for mobilising actors inside the community supporting the idea, thereby embedding like-minded actors in a nascent albeit growing network. These types of large-scale projects require huge monetary investments from political actors, as moving from the first to the second phase is fuelled by a recognition that political actors' resources are required, thus spurring a new phase. In a second phase, the investment is being legitimised for mobilising additional actors whose political resources are crucial to begin materialising the facility, thereby embedding political actors in a network growing to now include new actors from additional spheres of society. Moving from the second to the third phase entails mobilising business actors that provide resources enabling construction of a facility. In a third phase, the endeavour, now becoming an actor, is being legitimised for mobilising more actors whose resources are crucial in materialising the facility and, as such, embedding additional actors in an expanding network surrounding the focal actor.

²⁰⁶ Regarding business actors, projects differ considering that some large-scale projects require significant technological expertise for constructing (parts of) the facility. For a Big Science facility such as the ESS, the user community remains quite involved throughout the construction phase, for example, building specific parts of the facility that will later be used by the community.

8.2 Theoretical contributions

This section elaborates on the study's main findings as contributions to theory development. To recall, this thesis emanates from a business network approach (Håkansson & Snehota, 1995) with an intention to continue expanding its horizon (Thilenius et al., 2016) involving interorganisational matters including different types of actors (see e.g. Welch & Wilkinson, 2004; Hadjikhani & Thilenius, 2009; Gebert Persson et al., 2011; Åberg, 2013; Hermes & Mainela, 2014; Ljung, 2014; Åberg & Bengtson, 2015; Hadjikhani et al., 2019; Leite & Bengtson, 2018; Landqvist & Lind, 2019; Leite, 2022; Bengtson et al., 2022; Andersen et al., 2023).

Looking at the process of creating a Big Science actor, my study has honed the concept of legitimising, thereby complementing current scholarship addressing the concept in IMP (see e.g. Gebert Persson, 2006; Gebert Persson et al., 2011; Hermes & Mainela, 2014; Gebert-Persson & Káptalan-Nagy, 2016). In this thesis, legitimising is conceptualised as a process (Suddaby et al., 2017) comprising three phases (Langley, 1999), mainly involving pragmatic legitimacy (Suchman, 1995), as satisfying the interests in a focal actor's most immediate actor ties (e.g. Kumar & Das, 2007) including technological (Ruef & Scott, 1998), sociopolitical (Aldrich & Fiol, 1994), and economic (Vaara, 2014) legitimising.

8.2.1 Process involving technological, sociopolitical, and economic legitimising

In the process of creating an actor, as explicated in the analysis, technological, sociopolitical, and economic legitimising represent three forms of legitimising. This constitutes a core contribution complementing prior research (e.g. Gebert Persson, 2006; Gebert Persson et al., 2011; Hermes & Mainela, 2014; Gebert-Persson & Káptalan-Nagy, 2016). Combining the three forms of legitimising in this study represents the most empirically driven part of the above model (see *Figure 5*). Prior research on the three forms exists in other streams of literature, but is mostly scattered, rather than conceptualised as a tripartite combined form constituting legitimising²⁰⁷. In line with IMP, it is relevant to acknowledge that specific actors view the focal actor as sufficiently legitimate, satisfying their respective interests involving a mix of technological, sociopolitical, and economic legitimising that is desirable and appropriate for relevant counterparts in a network (cf. Suchman, 1995; Kumar & Das, 2007).

²⁰⁷ See discussion in section 2.5.

From the analysis it becomes possible to discern three layers, including function for the focal actor, its counterparts, and network (see Håkansson & Snehota, 1995), all of which are affected by as well as affect technological, sociopolitical, and economic legitimising. Regarding the three forms of legitimising concerning the focal actor, starting with the basics, technological, sociopolitical, and economic legitimising are all present to drive a process towards creating a Big Science actor. Technological, sociopolitical, and economic legitimising are relevant both as a group and in their individual forms. In realising a large-scale endeavour, such as creating a Big Science actor, technological legitimising is most relevant at the beginning of the process (*vis-à-vis* sociopolitical and economic legitimising). Moreover, technological legitimising, starting at the beginning, remains equally relevant to continuing the process of legitimising the endeavour. These forms of legitimising, including specific aspects such as proposed benefits and framing, do not necessarily vanish by fulfilling their purpose as they remain throughout the process.

Regarding a focal actor's counterparts, the three forms are intertwined as technological, sociopolitical, and economic legitimising do not necessarily adhere to any specific type of actor and counterpart. In my case, mobilising political actors involved all three forms of legitimising in formulating In-Kind. At the same time, the three different forms of legitimising and various types of actors can be mixed, such as a science actor engaged in economic legitimising towards a political actor. Finally, regarding counterparts, they themselves embark on legitimising, as counterparts are legitimising the endeavour such as political actors using technical content to legitimise their decisions. In terms of technological, sociopolitical, and economic legitimising unfolding in a network, legitimising can target a specific actor, which, in turn, requires a network involving additional types of actors. For instance, legitimising an endeavour by proposing industrial benefits to political actors in turn requires business actors. Additionally, in a network there is tension amongst the three forms of legitimising, such as technological and sociopolitical legitimising, as political actors tend to be more mindful of costs than science actors pursuing a technologically superior facility.

Alongside interplay between the three forms of legitimising concerning the three functions (i.e. actor, counterpart, and network), there is also interplay between past, present, and future. In terms of technological legitimising, what constitutes technological legitimacy changes over time (cf. Fisher et al., 2017) depending on whether one is referring to idea, investment, or actor. In the beginning, technological legitimising of an idea amongst scientists in the user community becomes prerequisite for starting a process towards realising the project, such as demonstrating familiarity as similar to old technology

(Suddaby et al., 2017) alongside accounts of technical superiority. Technological legitimising of an idea involves comparatively vague conceptualisations and designs concerning future matters. Later in the process, technological feasibility is legitimised using expertise from the user community in an ongoing balancing act of locking in certain parts of a design that may or may not be technologically possible under the current paradigm. Moreover, technological legitimising is required in order to later involve additional actors. Framing the endeavour as a reasonable investment towards actors controlling monetary resources, however, puts strain on technological legitimising by downsizing the project whilst complementing current technology and the need for new technology. Once starting to materialise, legitimising continues by concretising the technology, involving expertise from the user community so as to satisfy interests of future users by enabling scientific breakthroughs. It makes little sense to refer to Big Science facilities as technologically legitimate if the designs are legitimate yet materialise into something less desirable. Moreover, designs perceived as novel, albeit feasible, at the beginning of the process may be rendered obsolete due to new breakthroughs as the process proceeds. Taking a processual view, legitimising, including technological legitimising, changes depending on time and context.

8.2.2 Legitimising is an interactive network process that involves the actor being created making changes to satisfy interests

Early in the timeline of IMP research, Håkansson and Snehota (1995) stated that actor bonds mould the identity of an organisation. The process of realising a large-scale endeavour involves constantly forming new actor bonds due to mobilising and embedding different types of counterparts with varying interests. Pragmatic legitimacy is crucial during the early stages of interaction (Kumar & Das, 2007). Gebert-Persson and Káptalan-Nagy (2016, p. 304) argue that pragmatic “pressure expects the firm to demonstrate a willingness to satisfy the interests of the stakeholders within their direct and indirect relationships”. A process constituting a need for technological, sociopolitical, and economic legitimising involving a variety of different types of counterparts and interests, in turn, affects the ESS, making changes to satisfy interests. For instance, the focal actor and its enterprise are influenced by adopting and adapting initiatives to satisfy and align interests of actors in the network (cf. Hermes & Mainela, 2014).

In my case, creating an actor is heavily affected by counterparts and third parties, influencing its resources and activities and, ultimately, the ESS itself.

Such matters enter during different phases of the process involving the idea, investment, and actor, as additional issues emerge from mobilising and embedding more actors, which in turn have new varying interests. In particular, technological, sociopolitical, and economic legitimising involving proposed benefits. For instance, in an idea-generating phase, technological legitimising within a user community involves elaborate technical designs. At this stage, bonds with various science actors influence the endeavour. However, new actor bonds in turn impact the process as the idea is adapted into a more lucrative investment due to being required to mobilise additional resources from new actors with different interests, such as political actors that command economic resources (Welch & Wilkinson, 2004). This in turn affects the process of materialising an actor in the subsequent phase. In a process of creating an actor, there is path dependence throughout the phases arising from satisfying different salient actors' various interests, in turn, influencing the endeavour of becoming an actor. The relationships that an actor has affect the organisation of its own enterprise (Håkansson & Snehota, 1995), which impacts and is impacted by the various relationships (Ford & Håkansson, 2006b). In creating an actor, there is a need for mobilising and embedding counterparts with varying interests pertaining to technological, sociopolitical, and economic legitimising, in turn affecting its relationships which ultimately, in the present case, impact the ESS. Here, legitimising is a two-way process involving the ESS (as idea, investment, and actor) and actors in the network.

Legitimising as an interactive network process that involves a focal unit making changes to satisfy interests also impacts actors in the surrounding network, including third parties. An actor is both a source as well as recipient of ripple effects in the network (Håkansson & Snehota, 1995). Mobilising actors puts pressure on the process of creating an actor, as a recipient of the ripple effects of different networks. Drawing on the ESS, legitimising the idea in turn influences the level of investment, whereby legitimising the investment creates lock-in effects, such as using In-Kind (in turn, In-Kind affects the instruments later available to the science community). Third party actors influence the process of creating an actor, such as member countries needing to legitimise investing in the ESS inside their own networks, since governments are embedded inside their own contexts (Halinen & Törnroos, 1998; Hadjikhani et al., 2019). Specifically, the ESS adopting In-Kind is technologically, sociopolitically, and economically desirable and appropriate (Suchman, 1995) for member countries' governments. Adopting this type of initiative enables the process to proceed, making changes to the ESS by way of

satisfying counterparts' interests due to legitimising pressures from network actors²⁰⁸.

In a view of actors inside networks, Håkansson and Snehota (1995) drive an argument that the organisation itself is affected by its counterparts. Moreover, as pointed out by Tsoukas and Chia (2002, p. 577), “organization aims at stemming change but in the process of doing so it is generated by it”. An actor is part of the context that it affects but is in turn also affected by the context (Håkansson & Snehota, 1995, p. 195). While the legitimising process requires the ESS to make changes, it also involves counterparts in networks making changes as interests gradually become aligned (cf. Hermes & Mainela, 2014; Leite, 2022). Håkansson and Snehota (1995, p. 197) state that “[a] relationship entails interdependence, a more or less vague expectation of certain outcomes from reciprocal interaction”. This process is incremental, evident in my case in regional actors' attempts to reap proposed benefits from creating an actor, starting new initiatives in turn legitimising the ESS. The process of legitimising involves an incremental process towards matching interests, as the ESS and counterparts change to satisfy their respective interests in the endeavour.

8.2.3 Legitimising as a process comprising different actors' varying perceptions

An actor is viewed differently by various counterparts. Realising a large-scale endeavour involves multiple counterparts over time. Due to involving multiple counterparts with different perceptions, the actor is viewed in many different ways. This requires legitimising efforts involving different counterparts' perceptions of what is desirable and appropriate to satisfy their interests. In short, legitimising is a process involving different actors' varying perceptions.

All actors are different, and it is argued that each actor has its own resources, ways of operating, particular problems, and aims (see Ford & Håkansson, 2006a; Ford & Håkansson, 2006b) as well as perceptions. A large-scale endeavour, involving several types of actors, has distinct identities to different counterparts (Håkansson & Snehota, 1995) that vary over time. Throughout the process of creating a Big Science actor, it is viewed differently by counterparts, illustrated in the case by how the science actors view it as a Big Science facility, political actors more as an investment, and suppliers as a

²⁰⁸ Counterparts putting various pressures on the actor to change is likely more common in the case of creating an actor that is heavily dependent on mobilising counterparts as well as more malleable than existing actors.

customer. As an actor frequently engages in new interactions, legitimacy is continuously changing (Gebert-Persson & Káptalan-Nagy, 2016, p. 303).

Hadjikhani, Leite, and Pahlberg (2019) reason that actors belong to various systems that have different legitimate grounds. Legitimising does not entail a one-size-fits-all approach, as an actor distinguishes its various audiences related to their interests. Due to counterparts operating with varying interests, legitimising an endeavour requires depicting it in different ways to various types of actors (Fisher et al., 2017). Drawing on the actors in my case, for a science actor, the focal actor is a desirable and appropriate Big Science facility that they can eventually use to conduct research. For a political actor, it is viewed as a desirable and appropriate investment. And, for a business actor, as in suppliers, a customer that is sufficiently legitimate for suppliers to start delivering to.

Legitimacy as a perception (e.g. Suddaby et al., 2017) means that legitimacy is in the eye of the beholder (Ashforth & Gibbs, 1990). In realising a large-scale endeavour, legitimacy is bestowed by counterparts (Gebert Persson et al., 2011) in a process of legitimising involving different types of counterparts with varying interests and perceptions, each viewing the focal actor somewhat differently. Legitimising is unlocked in interaction with other actors as it is they who perceive the focal actor as legitimate. This is influenced by the way an actor affects how relevant audiences evaluate the object of legitimacy (Suddaby et al., 2017), which evolves contingent on the endeavour as an idea, investment, and actor. Evaluation involves forms of legitimacy that satisfy the counterpart's interests (Suchman, 1995; Kumar & Das, 2007), including technological, sociopolitical, and economic legitimising. For instance, legitimising the endeavour as an idea satisfying science actors' interests concerns technology to conduct ground-breaking research, making it a desirable and appropriate Big Science actor. For political actors, the endeavour concerns sociopolitical interests such as prestige and industrial benefits, making it a desirable and appropriate investment. For business actors, yet other aspects satisfy suppliers' interests, such as using it as a reference customer or increasing revenues, making it a desirable and appropriate customer. In the process of creating an actor, it is viewed as sufficiently legitimate for mobilising counterparts to start interaction, depending on what identity they give the actor that satisfies their interests.

8.2.4 Network effects in a legitimising process involve synergies and tensions between individual and joint interests

Based on prior research, a process of realising a large-scale endeavour in a diverse network including different goals, motives, and interests (cf. Ritvala & Salmi, 2011; Hermes & Mainela, 2014; Leite & Bengtson, 2018; Hadjikhani et al., 2019; Leite, 2022) involving interplay between actors and networks (e.g. Gebert Persson et al., 2011) can be expected to give rise to both synergies and tensions. Acknowledging network effects in a legitimising process involving synergies and tensions between individual and joint interests, as a premise, this section delves deeper into what this looks like, which usually derives from an ongoing need for legitimising in a network setting including different types of actors.

Regarding network effects in a process of realising a large-scale endeavour, this involves individual actors and a network surrounding the focal actor. The process is affected by individual goals and common goals. Actors with individual interests act purposefully to collectively create an actor. It is reasoned that an actor will be more committed if it believes that the goals of a network are aligned with its own goals (Gebert Persson et al., 2011). During the process, some actors become strongly committed, which is understandable because their goals and interests are closely aligned with the emerging network surrounding the actor that is being created. In my case, regional actors illustrate strongly committed counterparts whose goals and interests are closely aligned with an emerging network surrounding the ESS. Moreover, different types of counterparts that are approached and mobilised become embedded in a network surrounding the focal actor, starting to interact collectively due to joint synergies amongst separate actors attempting to individually reap proposed benefits that legitimised the endeavour earlier in the process. Again, drawing on regional actors, to illustrate how previously mobilised actors that become embedded can jointly interact with each other, a triad comprising a university, region, and municipality interact in creating and developing a Science Village in attempting to satisfy each of their three respective interests (cf. Hermes & Mainela, 2022).

As illustrated throughout this thesis, this is a case characterised by several different types of actors harbouring disparate interests; science actors' interests are different from those of business actors, and so on. Sometimes interests align in quite peculiar ways due to various ripple effects in the network over time. For instance, due to legitimising, ripple effects and synergies arise from initially attempting to mobilise a powerful political actor, which in turn affects additional counterparts that benefit various actors in the network surrounding

the actor that is being created. To exemplify, drawing on the ESS, over time ESS Scandinavia managed to mobilise the Swedish Government to fund and host the ESS, in part because of proposed benefits for industry and suppliers. Later, Big Science Sweden mobilise suppliers on behalf of the ESS. This facilitates the Government in attempting to reap industrial and socioeconomic benefits, via suppliers, in part mobilised by Big Science Sweden on behalf of the ESS. Additionally, suppliers benefit from delivering to the ESS, for example, by using them as a reference customer. Notwithstanding potential synergies, network effects in the process of realising a large-scale endeavour also gives rise to clashes between actors' interests. Throughout the process, there is a type of ongoing tension between embedded actors' interests in mobilising new actors. For instance, embedded science actors emphasise interests involving technical designs, whereas mobilising political actors require other proposed benefits that may or may not align between actors. For instance, mobilising political actors by means of sociopolitical and economic legitimising to fund Big Science in turn creates tension affecting science actors, such as the level of funding and imposing various demands²⁰⁹.

There may also be clashes, or at least tensions, amongst technological, sociopolitical, and economic legitimising per se, throughout realising a large-scale endeavour involving different types of actors. This is particularly since different types of specific actors emphasise certain parts of the three forms of legitimising. A straightforward example of this is how it is presumed that science actors want the best technology available so as to conduct ground-breaking research, whereas mobilising other types of actors requires being mindful of costs. Differences in the emphasis on technological, sociopolitical, or economic legitimising stems from, or is affected by, the different types of actors that are mobilised as the different spheres of society have different, and at times, at least partly disparate interests. However, the three forms of legitimising can also be complementary, working jointly in specific cases without too much friction. In-Kind is an example of technological, sociopolitical, and economic legitimising being complementary, working jointly, satisfying several interests of many different types of actors. Continuing on with In-Kind, a finer-grained picture also shows that while proposed industrial benefits may be reaped by member countries using In-Kind, there is tension within the spheres as each political actor pursues its own interests.

²⁰⁹ For instance, in my case, locating the ESS Data Centre across the national border in another country.

8.3 Considerations for research managers and practitioners

This section presents considerations directed towards research managers and practitioners, including policy-makers and suppliers. The intention is to point out useful food for thought as well as clear-cut advice emanating from my thesis. On an overarching level, a personal insight from using a network approach to understand the process of creating an actor concerns the significant role that counterparts play in realising large-scale endeavours such as Big Science. As alluded to throughout the many pages of this thesis, it could even be argued that the ESS *is* other actors. I believe this insight is also relevant to practitioners so as to acknowledge that creating an actor akin to the ESS is not an isolated endeavour, as it encompasses huge numbers of actors over time each putting their mark on the facility. In line with the IMP research tradition, rather than viewing the ESS as an island, it can be regarded as strongly influenced by actors in various networks. These actors, in turn, have varying interests that strongly affect the process from idea towards realising the project, ultimately influencing what type of science is made possible. Essentially, this line of reasoning underscores that research managers, and other practitioners involved in Big Science, must carefully assess relationships and network effects due to their seemingly great impact on such projects.

8.3.1 Considerations for creating Big Science actors

This section concerns research managers as well as politicians involved in policy-making. Realising large-scale Big Science endeavours from initial idea towards materialising a facility can be a long, consuming, and arduous journey, evident in the case of creating the ESS. Various actors will become salient at certain points in time throughout such a process, usually spanning many decades. Moreover, Andersen and Carlile (2016) illustrated how the time from conceiving an idea to realising Big Science facilities is only increasing. In the journey towards creating a Big Science actor, legitimising from within the user community is important for sustaining momentum over long periods of time by also anchoring the idea across a wide spectrum of actors and interests. Legitimising the idea, but also legitimising the investment and actor, over time enables mobilising counterparts to continue their efforts towards creating an actor. Organisations and individuals alike will inevitably come and go, salient at different points in time, whereby the endeavour itself, as an entity, has to garner sufficient support for actors to believe in it, analytically conceptualised as an idea, investment, and actor. Scientists involved in idea-generating and design during inception might not be involved in building and later using the

facility. Other actors, such as political actors, may emerge much later in the process, yet remain steadfast in their commitment to materialising the technical design as a facility²¹⁰. Being a desirable and appropriate idea inside the user community as well as anchoring the endeavour across a wide spectrum of actors involving technological, sociopolitical, and economic legitimising by way of satisfying interests of relevant counterparts enables the process to continue towards realising Big Science, evident in creating the ESS.

Another consideration for research managers concerns acknowledging that legitimising can be viewed as a continuum and that not all actors need to perceive an endeavour as legitimate for it to be so (Kumar & Das, 2007; Suddaby et al., 2017). It could be reasoned that despite being somewhat contested within certain pockets of society (cf. megaprojects as treated by van Den Ende & van Marrewijk, 2019), the ESS garnered sufficiently strong internal legitimacy (Human & Provan, 2000) to assemble support amongst relevant actors to continue towards realising the endeavour. The idea, investment, and actor should be sufficiently legitimate for relevant counterparts to mobilise towards the project, making it desirable and appropriate for science, political, and business actors²¹¹.

For politicians, particularly regarding policy-making, it is relevant to consider the magnitude of actors and their interests in these types of endeavours. Pursuing Big Science nowadays encompasses much more than just science. Over the past few decades, Big Science has emerged as something that can potentially benefit various types of actors and interests. However, reaping the proposed benefits might require significant work, thus investing in the investment and, in doing so, involving third parties or creating additional actors and initiatives. Particularly first-time hosts of Big Science, of this scale, should be aware that it may not be entirely straightforward to reap proposed benefits. For a new host, benefits do not accrue automatically since reaping the benefits requires being proactive. For organisations such as the European Strategy Forum on Research Infrastructures, alongside investigating potential benefits, it would be relevant to acknowledge that the case of locating the ESS in Sweden provides valuable insights by shedding light on the process behind reaping the benefits; first, to acknowledge that it will likely look different compared to experienced Big Science countries and, second, recognising that there might be a need for additional investments.

²¹⁰ Big Science involves generations of governments. Regarding the Swedish Government, there have been several ministers from various political parties at the helm of education and research.

²¹¹ Specifically, in the case of the ESS, gaining sufficient legitimacy from actors such as ESS Scandinavia, the Swedish Government, and Skanska to involve themselves in the process.

8.3.2 Considerations for potential and existing suppliers to Big Science facilities

This section presents considerations for potential and existing suppliers to Big Science facilities. Before doing so a few caveats are necessary, since the insights draw on suppliers to the ESS. First, it should be noted that while the suggestions below can apply to most Big Science facilities, they are most relevant for delivering to facilities under construction. These facilities may be experiencing a more rapidly evolving organisational structure. Counterparts to the supplier can change as employees move amongst divisions in a maturing organisation. There might also be a lack of well-established processes, already put in place at other Big Science organisations. Second, facilities under construction differ amongst themselves, for example, having different technological demands and time horizons. Third, and finally, the suggestions could be taken into consideration by all sorts of potential and existing suppliers as the suppliers in my study are fairly dissimilar, albeit usually quite small companies already inside the Big Science system that often also delivers to industries with similar characteristics. My study identifies possible benefits for suppliers delivering to the ESS and Big Science, including increasing their revenues, opening doors, prestige, and the possibility of using the collaboration as a reference customer.

Using the ESS as a reference customer is the most salient benefit voiced by suppliers, which is echoed despite their diversity. Being able to use the ESS, and Big Science, as a reference customer should be taken into consideration by all potential and existing suppliers. Other scholars have acknowledged similar findings, including how suppliers use Big Science as a reference customer (Åberg, 2013), which in my case tends to be because Big Science organisations are considered prestigious customers (Andersen & Åberg, 2017). Using the ESS as a reference customer is perhaps unsurprising as it could be categorised within a legitimate Big Science group (Suddaby et al., 2017). It is also theorised that legitimacy can be transferred between relationships (Hermes & Mainela, 2022) and to other contexts involving different audiences (Fisher et al., 2016). Additionally, being perceived as close to an actor viewed as advanced or powerful becomes helpful in other relationships (Håkansson & Snehota, 1995), and an actor's network identity can be positively influenced by interacting with a prestigious actor (Anderson et al., 1994). As such, it makes perfect sense for existing suppliers to use the ESS, and Big Science, as a reference customer, as well as for potential suppliers to consider delivering to such facilities. However, it should also be noted that it is not entirely clear-cut how using the ESS as a reference influences suppliers' business. It might be wise for potential as well as existing suppliers using or thinking about using

the ESS as a reference to further reflect upon the benefits of using Big Science as a reference customer. While suppliers do indeed regard it as a benefit, my study is unable to shed further light on how this might be the case, for instance, how other counterparts in the network perceive the reference customer.

Next follow considerations divided between existing suppliers and potential suppliers thinking about delivering to the ESS and Big Science. Suppliers already delivering to the ESS should consider that this may open doors for delivering to other Big Science facilities. Moreover, it is reasoned by suppliers that products delivered to the ESS could be sold to other customers. Regarding being a supplier to Big Science, remaining one requires continuous networking and staying proactive, to show that the company exists and to highlight its competencies. It is equally relevant to have patience as business may occur on a less frequent basis. In times of recession, Big Science could prove a valuable customer, as it is reasoned that it is differently affected by economic cycles. Complex documentation in the procurement process can be handled by appointing a specific employee to take on this task. It might even be reasonable to have a dedicated person to do business with Big Science (cf. Li-Ying et al., 2021). In a similar vein, it is also good to contact other suppliers, the Big Science facility, or an Industrial Liaison Officer (an ILO) for help regarding documentation. Suppliers can also receive help from their ILO to find other relevant projects and information about contracts, which is particularly relevant to smaller companies lacking time to do so themselves.

For potential suppliers to Big Science, it is essential to understand that entering this market is tough. This should be folded into the thought process from the beginning. Moreover, heeding advice from people assigned to market Big Science, citing benefits such as potential technological development, ought to be taken with a grain of salt as this may or may not happen. Such benefits depend on factors such as the type of company and contract. Regardless of potential technological benefits, Big Science is perceived as a lucrative customer by using it as a reference customer. Moreover, it is reasoned amongst suppliers that Big Science organisations tend to be helpful, for example, sharing competence, knowledge, and solutions. If a supplier finds Big Science a viable customer and market, the transition might be easier if already delivering to types of industries that require similar documentation and unique high-tech solutions. A good first step is to contact the ILO responsible for connecting suppliers and Big Science, to be guided to the right people. Finally, a first-time supplier to Big Science should not be disheartened if the first delivery proves more cumbersome than expected, as it seems to become easier over time by continuing to deliver to Big Science.

To end, companies should be aware that business is quite politicised in Big Science. There might be politically motivated arrangements that affect how the supplier can interact with the Big Science facility. Even though the above considerations are essentially geared towards suppliers, they are equally relevant to research managers, policy-makers, and ILOs wishing to gain insight into the world of Big Science suppliers.

8.4 Future research

My thesis is part of a continuum of past, present, and future research, rather than an isolated endeavour. Three future research avenues warrant further exploration as interesting and relevant to pursue within IMP.

8.4.1 Refining the processual model for realising other large-scale endeavours

Other large-scale endeavours and big infrastructure projects represent interesting research settings in which to apply and refine my model presented in *Figure 5 Processual model of realising a large-scale endeavour in an inter-organisational context*. Large-scale endeavours and big infrastructure projects include a great deal of actors and interests, affect society on many levels, and cost huge amounts of money (cf. Flyvbjerg, 2014). Slightly smaller in scale, other big infrastructure projects involve equal amounts of complexity. Indeed, there are many large-scale projects, and a reader can surely list several empirical examples. These projects have in common that they use expensive inputs, are complex as processes, and potentially have big impact as their output. From a societal viewpoint, it would therefore be relevant to shed further light to help us understand the process of realising large-scale endeavours.

My thesis presents a processual model for realising large-scale endeavours. The model takes into account different types of actors, including science, political, and business actors as well as to some extent the media, involves the three concepts of mobilising, embedding, as well as legitimising, further refined into technological, sociopolitical, and economic legitimising. Interplay between pairs of concepts includes dimensions involving proposed benefits, framing, path dependency, fit, overlapping networks, and emerging context. The processual model involves three phases; idea, investment, and actor, as idea-generating inside a community, broadening and financing, and materialising. Conceived as a stepping-stone towards understanding the process of creating an actor in a business network, all parts of the model can be modified, refined, or elaborated on and other parts can be added. For instance, the

dimensions in each interplay can be elaborated on or additional phases can be added or zoomed in on to paint a finer picture.

Essentially, it would be relevant and interesting to use the model in other large-scale endeavour contexts. Certain parts of the model will differ in contexts outside the ESS and Big Science, specifically, the user(s) and the user community in the first phase of idea-generating as well as technological legitimising. The user might differ in terms of including another type of user or less involvement from the user community during the first phase, which may also require less technological development and technological legitimising. In a Big Science project, specifically the ESS, these are intertwined. I believe there are two fruitful avenues where the model can be used to draw additional insights, involving two different types of contexts that would complement insights into the ESS, namely, large-scale endeavours in which the user community is not as clearly involved during initial stages as well as large-scale endeavours that require less technological development.

The ESS could, in some sense, be regarded as a bottom-up initiative initiated amongst scientists constituting the community that will later also use the ESS. In other cases, it might look different, with the matter of the user being slightly more complex. Moreover, regarding the first phase of idea-generating, in other contexts this phase might not be same or as clear as it was in the case of creating the ESS. For instance, when does the user community become involved, and who is the user? These types of questions could be addressed in a future study. Phases 1 and 2 might be reimaged in other settings. That is, one research avenue essentially concerns the user, as it would be interesting to either look at cases in which the user community is involved in realising an endeavour they will later use, or to look at more complex situations in which users and politicians intermix.

Furthermore, it should be pointed out that Big Science represents highly complex technological endeavours (Andersen & Åberg, 2017). As such, the technological element is pronounced in my study. It would be relevant, using the model, to understand other less technologically salient settings where technological legitimising might look different or involve another form of legitimising. For instance, the creation of schools or universities could be interesting settings. Herein a conundrum, as mentioned above, arises regarding the user, as it in part involves pupils and students and so on (e.g. society at large). Furthermore, pupils and students are unlikely to initiate the process of creating a school, instead other actors are salient. It should be noted that there is much for me to learn about new potential settings; I merely propose that they constitute interesting research settings for reasons connected to refining the

processual model, specifically the user, the first phase, and technological legitimising as these likely differ between large-scale endeavours.

Methodologically speaking, case selection is obviously an important element to consider in future research. This would involve a balancing act between the value for research of refining the model, on one hand, and access, on the other (see Halinen & Törnroos, 2005). Rather than suggesting a specific research setting, it could include a wide range of possible large-scale endeavours, for instance; a research setting involving a multinational megaproject, public or private endeavours or both, and projects initiated by a single company or a consortium of companies. Considering that digitalisation is only becoming more and more prevalent in society, it would be particularly interesting to use the model in the context of creating large-scale digital endeavours.

8.4.2 Looking deeper into the media as an actor

The media permeate society and business, influencing actors and networks. Actors can leverage the media, for example, for garnering support or facilitating the process of mobilising actors. My study shows that media influences the process of legitimising, and other studies acknowledge that media can affect a business actor's market legitimacy (Hadjikhani & Thilenius, 2009) or influence the process of building legitimacy (Bengtson et al., 2022). Insights from the aforementioned studies make it reasonable to query whether the media, such as newspapers, are merely sources of data or whether they also constitute actors in their own right that affect the network, including processes such as legitimising. Looking deeper into the media as an actor would require acknowledging their presence in the network and understanding their role as an actor. Essentially, rather than relegating the media to the background or viewing them merely as a source of data, future research could explore the role of the media as an actor in business network processes.

The media as a type of actor involves controlling resources and performing activities (Håkansson & Snehota, 1995). In light of this, it is not entirely straightforward to pinpoint what the media constitute and what role they play in the business network approach. How do media controlling resources and performing activities fit into networks characterised by connectedness and interdependencies? Intangible resources might include clout, agenda setting, or awareness. Activities may involve producing and disseminating messages (e.g. writing, publishing, and spreading newspaper articles). How are activities connected and resources combined to create value, for whom, to what purpose, and in what way? What is the function for the company, dyad, and network? Do the media constitute a type of intermediary actor, for actors to influence other actors or networks? Ultimately, how do the media work as an

actor? There are several possible ways to view and incorporate the media into IMP research, yet their role remains quite poorly understood.

As alluded to, the media can be conceived as a group of actors in their own right, for instance, newspaper agencies, but also as individual actors, such as *Sydsvenskan*. However, some actors own several media outlets. How can this be understood from an IMP perspective? The media includes much more than just newspaper agencies and articles, such as YouTube content, TV news channels, and other type of media. Quite recently, there has also been a surge of influencers. Drawing on previous research regarding distinctions between political actors and their resources and activities (e.g. Welch & Wilkinson, 2004), it would be relevant to explore ways to categorise and fine-grain media inside an IMP framework. Considering that the media clearly plays some sort of role in industrial markets, the matter warrants additional research. A particular reason why this is relevant is because the media affects the discourse. This is relevant in creating large-scale endeavours and likely in other contexts, such as attempts to instigate some sort of change in networks. Essentially, the media can affect the discourse surrounding entities and phenomena.

A future study exploring the role of the media in the business network would require certain methodological and interdisciplinary considerations. It would seem sound to draw on an interdisciplinary research approach by including literature from management studies (e.g. Engwall, 2014; Vaara, 2014) and discourse (e.g. Janks, 1997; Gee, 1999; Fairclough, 2003; Fairclough, 2005)²¹². For instance, focusing on discursive legitimation strategies used in media texts, Vaara (2014) has already identified position-based authorisation, knowledge-based authorisation, rationalisation, moral evaluation, mythopoiesis, and cosmology as possible analytical tools. Looking at interdiscursivity (e.g. Fairclough, 2005) involving the media in a process of legitimising might be interesting in IMP research. Methodologically, the most suitable research design would be a process study. This could draw on Foucault's vast work, specifically regarding continuity and discontinuity (see e.g. Howarth, 2000, p. 56) including repetition and change. This would require digging deeper into the aforementioned literature, but could involve the interplay between the continuity of discourses and the discontinuity of discourse, as the discourse is continuously being reiterated yet continuously also slightly changing as new actors emerge. As such, acknowledging that (media) actors adopt a discourse yet simultaneously change it, sometimes incrementally or sometimes through critical events imposing major change. From a method standpoint, it would be relevant

²¹² Gee (1999, p. 17) distinguish between 'Discourse' and 'discourse' to denote the difference between language-in-use and Discourse. Simply put, 'Discourse' with a capital 'D' comprises much more than just language.

to complement newspaper articles (or other media) by collecting data from authors and agencies through interviews, making it possible to understand their day-to-day business, interaction with other actors (e.g. companies), or shedding light on ‘why and how’-questions underpinning newspaper articles.

8.4.3 Developing the concept of legitimising in a network setting

The current study indicates that technological, sociopolitical, and economic legitimising are relevant in a network setting, particularly in the process of creating an actor from idea towards reality in an interorganisational context. In line with IMP, the study acknowledges specific actors viewing the focal actor as sufficiently legitimate by satisfying their interests involving a mix of technological, sociopolitical, and economic legitimising, desirable and appropriate for relevant counterparts in a network (cf. Suchman, 1995; Kumar & Das, 2007). It would be worthwhile to continue developing the concept of legitimising by elaborating on the analytical parts of the concept including three forms as technological, sociopolitical, and economic legitimising. Elaborating on legitimising could, for instance, shed additional light on network processes involving mobilisation (see e.g. Ritvala & Salmi, 2011).

All three forms of legitimising are required in a process of realising a large-scale endeavour that includes science, political, and business actors. The three forms are crucial together and individually. In other types of endeavours that involve different types of actors, the three forms of legitimising may, or may not, be relevant to the same extent. In realising the ESS, for example, technological legitimising is evidently a cornerstone. In a context including other types of endeavours, and counterparts, certain forms of legitimising might be foregrounded, due to a need to focus on particular aspects to mobilise a specific actor. Extending this line of reasoning, what does this look like if it is required to mobilise two distinct actors that each value different forms of legitimising, thus requiring a balancing act on which to focus on?

Another way to dig deeper into the three forms of legitimising is by acknowledging that different types of actors use specific forms of legitimising towards other types of actors. In my case, for example, a science actor engaged in economic legitimising towards a political actor. This indicates that legitimising is multifaceted, in which scientific excellence seems partly insufficient unless it is accompanied by other forms of legitimising to satisfy a counterpart’s interests. My study gives reason to believe that economic legitimising is important, yet shines with its absence in current theory.

It would be relevant, in an IMP setting, to acknowledge how a process of legitimising connects to matters involving economic reasoning. In this setting,

it makes sense that an actor and interaction are perceived as legitimate by satisfying interests regarding economic benefits, such as increased profits as well as reduced costs. In some instances, economic legitimising arises due to the characteristics of the endeavour, for example illustrated in my case by attempts involving economic reasoning that highlight tax revenues from electricity usage to mobilise political actors. This raises the question of how possibilities for economic legitimising emerges. In a dynamic process, opportunities for economic legitimising may also arise serendipitously, such as external effects, that in turn enable economic legitimising. Furthermore, reaping proposed economic benefits from economic legitimising becomes dependent on the dynamic performance of the counterpart, dyad, and network over time. A future study could explicate these types of network dynamics in a process involving economic legitimising.

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Appendices

Appendix 1: List of interviews

A few notes about the appendix. Regarding organisation, some of the interviewees have been involved in more than one relevant organisation. For example, Carlile was working as Director at ESS Scandinavia, Director General for the ESS, and employee at Science Village Scandinavia. Moreover, the positions change and have different names. Employees at the ESS change positions relatively frequently within the organisation and thereby the name of the position also changes. For most interviewees, their position is usually from the organisation's website, and in some instances from LinkedIn as the website might not include contact info of all their employees or might not have updated the position.

Table 3 List of interviews

Name	Organisation & Position	Date	Duration	Type of interview (and by whom)
Fahlander, Claes	Lund University, Professor Emeritus. Head of the CATE project	19 September, 2019	1h 10min	In real life, by Susanne & Anna
Olsson, Mike	Lund University, Manager of CATE-Pro. (Currently Business Developer & Project Manager at Big Science Sweden)	28 November, 2019	53min	In real life, by Susanne & Anna
Vieweg, Mikael	Scanditronix, CEO	29 November, 2019	1h 30min	In real life, by Susanne
Fahlander, Mirka	Administrator for the CATE project	9 December, 2019	1h 10min	In real life, by Susanne & Anna
Kinhult, Pia	ESS, Head of Host Relations. Region Skåne, Former Chair.	14 January, 2020	1h 50min	In real life (at ESS), by Susanne & Anna

Name	Organisation & Position	Date	Duration	Type of interview (and by whom)
Göhran, Magnus	ESS: Work Package Manager – Remote Handling Systems, Group Lead – Monolith and Handling Group	15 January, 2020	1h	In real life (at ESS), by Susanne & Anna
Orup, Mats Lavin, Mats Malmqvist, Linus	M. Orup, CEO, RFR Solutions M. Lavin, Production and Quality Manager, RFR Solutions L. Malmqvist, Financial and HR Manager, RFR Solutions	15 January, 2020	1h 35min	In real life, by Susanne & Anna
Anderberg Helasz, Krisztina	Region Skåne, Development Manager	16 January, 2020	1h 27min	In real life, by Susanne & Anna
Rennie, Adrian	Uppsala University, Professor	6 October, 2020	1h 45min	In real life, by Susanne & Anna
Taylor, Jonathan	ESS (DMSC), Head of DMSC	11 March, 2021	1h	Zoom, by Oscar
Holm Rod, Thomas	ESS (DMSC), Group Leader of Data Analysis	12 March, 2021	1h 15min	Zoom, by Oscar
Hall, Anna	Big Science Sweden, Director and ILO ESS	22 March, 2021	50min	Zoom, by Oscar
Hall, Anna	Big Science Sweden, Director and ILO ESS	26 March, 2021	1h	Zoom, by Oscar
Lefmann, Kim	University of Copenhagen, Professor. Involved in early stages of ESS & DMSC	16 April, 2021	1h 45min	Zoom, by Oscar
Womersley, John	Formerly, ESS, ex-Director General 2016-2021. ESRFI, ex-Chair	20 April, 2021	1h	Zoom, by Oscar
Engelmark, Fredrik	Big Science Sweden, ILO CERN and business development & project management	14 February, 2022	2h 10min	Zoom, by Oscar & Susanne
Gjøløv Jensen, Leif	Carlsson & Möller, Sales Big Science	18 February, 2022	1h 30min	Zoom, by Oscar
Ström, Mickael	Low2High Vacuum, Teknisk säljare	4 March, 2022	2h	Zoom, by Oscar & Susanne

Name	Organisation & Position	Date	Duration	Type of interview (and by whom)
Melander, Fredrik	Science Village Scandinavia, Head of R&D Relations. Formerly, Danish Ministry of Higher Education and Science, ex-Senior Advisor	4 March, 2022	1h 50min	Zoom, by Oscar & Susanne
Nilsson, Christoffer	Municipal civil service Lund, Municipal Chief Executive	9 March, 2022	55min	Zoom, by Susanne & Anna
Garner, Oliver	BergmanLabora, Sales Manager	11 March, 2022	55min	Zoom, by Oscar
Ekelöf, Tord	Uppsala University, Professor. FREIA Laboratory, Project Manager	6 April, 2022	50min	Zoom, by Oscar & Susanne
Ekelöf, Tord	Uppsala University, Professor. FREIA Laboratory, Project Manager	10 May, 2022	1h 30min	In real life, by Oscar & Susanne
Ekelöf, Tord	Uppsala University, Professor. FREIA Laboratory, Project Manager	13 May, 2022	2h 30min	In real life (visit FREIA)
Larsson, Allan	Retired. Swedish Government, e.g. ex-Minister for Finance. ESS, Chief Negotiator. ESS-S	22 June, 2022	1h 30min	Zoom, by Oscar & Susanne
Björkander, Benny	RFR Solutions, CEO	23 June, 2022	1h	Zoom, by Oscar & Susanne
Vieweg, Mikael	Scanditronix, CEO	27 June, 2022	1h 10min	Zoom, by Oscar
Broomé, Ulf	nVent Nordic, Regional Sales Manager	30 August, 2022	1h 30min	Zoom, by Oscar
Persson, Patrik	AirSon Engineering, VVS-ingenjör	1 September, 2022	1h 10min	Zoom, by Oscar
Carlsson, Patrik	Big Science Sweden, co-Director & ILO. ESS. ESS-S	5 September, 2022	40min & 40min (2 interviews)	Zoom, by Oscar & Susanne
Leijonborg, Lars	Retired. Swedish Government, e.g. ex-Minister for Higher Education and Research. ESS, ex-Chief Negotiator	15 September, 2022	1h	Zoom, by Oscar & Susanne

Name	Organisation & Position	Date	Duration	Type of interview (and by whom)
Carlile, Colin	Retired. Currently Science Village Scandinavia, Special Advisor. ESS, ex-Director General 2010-2013. ESS-S, ex-Director 2007-2010	29 September, 2022	2h 10min	Zoom, by Oscar & Susanne
Åfeldt, Mats	MCT Brattberg, Sales Manager	29 September, 2022	1h 15min	Zoom, by Oscar & Susanne
Weibull, Marcus	Sigma Lundinova, CEO	26 October, 2022	1h 25min	Zoom, by Oscar & Susanne
Stark, Erik	Österby Gjuteri, Managing Director & Sales Manager	3 November, 2022	30min	Zoom, by Oscar & Susanne
Isaksson, Stefan	Gammadata Instrument, Business Unit Manager	10 November, 2022	1h 30min	In real life, by Oscar & Susanne
Eriksson, Roger	ESS, Communication Officer	21 November, 2022	2h	Zoom, by Oscar & Susanne
Carlile, Colin	Retired. Currently Science Village Scandinavia, Special Advisor. ESS, ex-Director General 2010-2013. ESS-S, ex-Director 2007-2010	22 November, 2022	2h 10min	Zoom, by Oscar & Susanne
Oksanen, Esko	ESS, Instrument Scientist (Lead Scientist NMX)	30 November, 2022	1h 10min	Zoom, by Oscar & Susanne
Carling, Henrik	ESS, Head of Division and Project Manager ICS	2 December, 2022	2h	Zoom, by Oscar
Hedin, Kent	ESS, Head of Conventional facilities division	6 December, 2022	1h 50min	Zoom, by Oscar & Susanne
Petersson Årsköld, Sindra	ESS, Senior Advisor on policy, communication and strategy	8 December, 2022	1h 30min	Zoom, by Oscar
Ferreira, Marcelo	ESS, Section Leader Vacuum Group	9 December, 2022	1h 10min	Zoom, by Oscar
Lindroos, Mats	ESS, Head of accelerator division	21 December, 2022	1h 30min	Zoom (at ESS), by Oscar

Name	Organisation & Position	Date	Duration	Type of interview (and by whom)
Gustavsson, Per-Olof	ESS, Accelerator Utilities group leader	19 January, 2023	2h	Zoom, by Oscar
Lundmark, Anton	ESS, Cooling Systems Engineer	24 January, 2023	1h 50min	Zoom, by Oscar
Lagerblad, Olle	ESS, Engineer	27 January, 2023	1h 55min	Zoom, by Oscar
Qvist, Camilia	EC Konsult, CEO	15 February, 2024	1h 18min	Zoom, by Susanne
Olvegård, Maja	Uppsala University, Associate Professor, Division Head of FREIA (Uppsala University)	29 February, 2024	1h 5min	In real life, by Susanne & Anna

Appendix 2: Interview guides

Interview Guide: Examples of questions for business actors

Interviews with business actors have been using an interview guide in Swedish. The themes and questions below are translated (from Swedish) into English. Company X refers to the interviewed company.

The interview guide:

The individual

- Briefly present your background.
- Present your role at Company X.
 - What have you done so far?
 - What are you currently doing?

The company

- Briefly present Company X.
 - History.
 - When did you start working with research facilities?
 - The ESS?
 - Operations.
 - Number of employees?
 - Research facilities.
- What is important to Company X?

Customers etc.

- What does a typical supplier relationship look like?
 - Most important type of supplier? Why?
 - Approximately how many suppliers do you have?
- What does a typical customer relationship look like?
 - What is important in a customer relationship?
- Most important types of customers? In what way?
- What type of customer contributes the most to your (technical) development?
- Other types of customers that resemble research facilities? Which? In what way?
 - Differences/similarities?
- Other important actors?
 - Do you collaborate with universities? What does that collaboration look like?

- How are universities involved in your collaboration with research facilities?
- Political actors (e.g. Vinnova, the Swedish Research Council, the region)

Big Science as a customer

- How did you come into contact with large-scale research facilities?
 - What made you want to work with research facilities?
- How large part of your company concerns research facilities?
- What research facilities do you mainly work with? Why these?
- How has the collaboration with research facilities affected your company?
- Why do you want to continue (or not) working with research facilities?
 - In what way are research facilities a rewarding customer?
- Do research facilities communicate the benefits of having them as a customer to suppliers? What do they emphasise the most? How?
 - Does it differ between research facilities? How?
 - ESS?
 - Is there anybody else that talks about the benefits of having research facilities as a customer?
- How do research facilities differ from your other customers?
- What advice would you give to other suppliers that want to work with research facilities?
- Are you in contact with other companies that deliver to research facilities?
 - Who do they deliver to? ESS?
 - How does this contact look like? What do you talk about?

ESS as a customer

- How did you come into contact with the ESS?
 - Who initiated the contact? Why?
 - What made you want to work with the ESS?
- What have you delivered to the ESS?
 - How many times have you delivered to the ESS?
 - Standardised or customised products?
- Who is your counterpart at the ESS? Who do you work with?
 - How many people are involved on each side in the collaboration?
- What is your experience of the ESS as a customer?
- In what way is the ESS an important customer?

- What are the benefits for Company X from working with the ESS?
 - How do you notice these benefits in your company?
- Is the ESS different from how Company X work with other research facilities? How?
- Does your (geographical) proximity to the ESS affect the collaboration compared to collaboration with non-Swedish research facilities? How?
- What was unexpected in the collaboration with the ESS? In what way was it unexpected?

Final questions

- Any question(s) I haven't asked but should have asked?
- What do you want to emphasise? What should I bring with me from this interview?
- Other ESS-suppliers I can talk to? Current or past. Specific people?
- Anyone at the ESS I should talk to?
- Other people that would be appropriate to interview?
- Can I contact you again if I have any additional questions?

Interview Guide: Examples of questions for political actors

Examples of questions for political actors. As noted in the methodological chapter, some scientists augment their role and become part of the political landscape.

The interview guide:

The individual

- Briefly present your professional background.
- What are you doing at the moment?

ESS

- Role in ESS history?
 - What does a Role X do?
- How would you summarise ESS' journey from idea into reality?
- What made you convinced that it was worthwhile for Sweden to pursue ESS?
 - What role did ESFRI's Roadmap play? In what way?
- Why build ESS in Sweden? (nationally and internationally)
 - Why Lund?
- Does it differ regarding how the ESS was anchored on a national political level and an international political level? How?
 - Regional level?
- Who was most important to convince to build ESS in Lund?
 - Was the ESS a controversial project? How? To who/whom?
- How did you balance different opinions from scientists and politicians?
 - Are there visible effects of this today?
- How were other actors involved?
 - Vinnova, VR, Region Skåne?
 - Lund University?
 - Research community in general?
- Why were arguments needed to build ESS?
 - Most important argument? Why?
 - Regional level?
- Who did you work closest with during your time as Role X?
- What did you contribute as Role X?
- What is your biggest success as Role X?
- What was hardest in your job as Role X?

- Does ESS differ in any way compared to discussions prior to year 2009?
- What is important for Sweden to become a successful Big Science country?
 - Is this affected by Sweden being new to Big Science? How?
- Anything relevant to comment regarding more recent initiatives? (Teknikparksfunktionen, Science Village Scandinavia, Big Science Sweden, different reports)
- What is required for Sweden to draw benefit from ESS? (society, industry, research)
 - Does this differ compared to how other host countries benefit from their large-scale research facilities? How and why?
- How did you balance both European and national interests?
 - Additional interests that were important? How?
 - Has this affected how ESS looks like today? In what way?
- What is important for the continued survival of ESS?

Organisation, connected to ESS story (e.g. ESS Scandinavia)

- Role at Organisation X?
- What did the scientific and technical argumentation for ESS look like?
- How did ESS become anchored on a political level?
- Do scientists augment their role and enter the political landscape? If so, how and why?
 - How does this affect materialising Big Science Projects?
- How did the differences between science and politics affect ESS?
 - Can you see any impact of this at ESS today?
- Is it appropriate to measure Big Science Projects on the same criteria as other big public investments in infrastructure (e.g. airports)? Why/Why not?
 - How did ESS' business case influence the decision for Sweden to host ESS?
- Why was it important to build ESS outside the three main European Big Science countries?
 - In what ways does Sweden differ?
 - In what way did the arguments for Sweden to host ESS mirror the argumentation commonly seen for hosting a Big Science facility?
- Who was most important to persuade in order to build ESS in Lund, Sweden? Why?
- Any comments on the industry aspect from the early days of ESS?

Arguments connected to ESS

- Why were arguments necessary to build ESS?
- What was the foremost argument for building ESS?
 - In research community?
 - In Sweden?
- Do the arguments differ between politicians and researchers (and companies)? How and why?
- Do the arguments differ between different periods in ESS history? How and why?
- Is it possible to elaborate on how the local region benefit from ESS?
 - Local business and suppliers?

Companies and suppliers

- Can you describe arguments that touch on the industry aspect? Suppliers?
- Was the industry aspect involved in the early stages of ESS (circa pre-2009)? In what way?
- Do you have any contact with Big Science Sweden? How?
 - What do (ILO-)organisations such as Big Science Sweden contribute?
- Advantages of ESS for Swedish industry?
 - For individual suppliers?
- Anything relevant to comment regarding companies or suppliers to ESS in relation to your period as Role X?
- Do you have any comments regarding the company aspect of ESS?
 - What advice would you give to companies that want to benefit from ESS?
 - What advice would you give to suppliers who want to work with ESS?
- Suppliers?
 - What are the benefits for suppliers to work with ESS?
 - Drawbacks?
- Big Science Sweden?
 - How can Swedish companies become more involved in ESS?

Various

- Do you agree that ESS is a phenomenon without obvious predecessors in Swedish research policy and public debate? Why/Why not?
- Does ESS strengthen Sweden as a research nation? In what way?
 - How can ESS strengthen Sweden as a research nation?
- What is the societal value of Big Science?

- Is it important to communicate the societal value of Big Science?
If so, why and to whom?
 - Has this changed over the years? How and why?
- How are Swedish companies affected by ESS?
- How is Swedish research affected by ESS?
- What differs between large-scale research infrastructures such as ESS compared to smaller research infrastructures? (e.g. from a science-political perspective)
- Role of the general public concerning decision-making regarding ESS? (newspaper articles etc.)
- How did ESS Scandinavia become a project on a political level?
- What are the benefits of ESS?
 - For Sweden
 - For Swedish research
 - For Swedish industry
 - For Region Skåne

Final questions

- Any question(s) I haven't asked but should have asked?
- What should I bring with me from this interview?
- Any other people you recommend me to talk to?
- Can I contact you again if I have any additional questions?

Interview Guide: Examples of questions for science actors

Examples of questions for science actors.

The interview guide:

The individual

- Briefly present your professional background.
 - Experience from other large research facilities?
- What are you doing at the moment?
- What is your research interest as a scientist?
 - Will ESS contribute to your own research?

ESS

- Present your role at ESS.
- Why did you choose to work at ESS?
- How long have you been working at ESS?
 - What have you been working with?
 - Anything besides your role as Role X?
- Who have you been working with? (companies, scientists, politicians or other various political initiatives?)
- In your words, what is ESS?
 - How does ESS differ from other big research facilities?
- How would you summarise ESS' journey from idea to reality?

Specific area of ESS where the individual is working (e.g. instrument, division, project)

- Present as much as possible about your work with instrument X.
 - What does a Role X do?
 - At what stage did you join the project?
- Why did you want to work with this project? What draws you to building large research infrastructure instruments?
- Present as much as possible about the instrument.
 - Why was the instrument approved as one of the ESS instruments?
 - What were the arguments? (scientific, technical, business, political)
 - How does this instrument differ from other instruments at ESS?
 - How long does it take to finish the instrument from initial idea to become user-ready?
 - What are the differences between different phases?
- How does interaction with other scientists look like?

- At ESS?
- At other laboratories?
- At other large research facilities?
- How does you work together with industry look like? How does interactions with suppliers look like?
 - What is your experience of working with suppliers at ESS?
 - What was unexpected?
- What types of suppliers have you worked with?
 - What type of suppliers do you work with the most? (size, characteristics, industry)
- What types of products do suppliers deliver to you?
 - Standardised or customised products?
- Do you have an example of a company collaboration that you think suits as an illustration to understand the relationship between suppliers and ESS? Why this specific example?
- Do you have an example of a company that has gained any benefits from working with you? (e.g. learning, tech transfer, innovation, references, new contracts etc.)
 - What are some of the other benefits for suppliers to work with ESS?
- What is the biggest difference between science and industry?
- What are some typical problems in working with industry? Why is this?
 - Any examples?
 - What the companies are able to deliver compared to what you ideally want them to deliver?
 - Do you expect them to innovate on your behalf? How does this look like?
- Any Swedish suppliers that have worked with you?
- How has the division changed over the years as construction of ESS has progressed? (tasks, number of people, interactions with other people)
- What will be the role of the division once ESS is finished?
- How does the division fit into ESS?
- How do you interact with other divisions?
- How many people are in your team?
 - Has it changed over the years? More/Less?
 - What will it look like when ESS is “finished”?

Interaction with industry (similar to subheading above but slightly more general questions)

- Why should companies work with ESS?
- What are the potential benefits for the companies?
- What type of company benefits the most from working with ESS? (size, characteristics, industry)
- What advice would you give to companies who wish to work with large research facilities?
 - ESS, in particular?
- Does ESS communicate benefits to work with ESS to suppliers?
 - What are these benefits?
 - Who does this?
 - Are there other organisations that communicate benefits? In what way?
- How can companies reap the acclaimed benefits from working with ESS? (e.g. innovation)
 - In what way can companies use this in their business?
- Anything relevant to comment regarding the fact that ESS is under construction compared to facilities that are already in operation?
 - For suppliers?
- ESS has room for several new instruments in the future, does this affect suppliers today in any way?
- How should companies get into contact with ESS?
- What are the biggest hurdles for companies to get into contact with ESS?
- What are the biggest hurdles for companies to win contracts at ESS?
- What does your interaction with Big Science Sweden look like?
 - How involved have you been?
 - In what way?
 - How many times?
 - Why?
- How does Big Science Sweden help you?
 - Who at Big Science Sweden do you talk to?
 - How does Big Science Sweden help you get into contact with suppliers?
- How can Big Science Sweden solve your challenges at division X? What challenges?
- Why do you participate in workshops at Big Science Sweden? How does it affect your work at division X?

- Biggest hurdle for a supplier to deliver to ESS? (suppliers at Big Science Sweden)
- How many of the suppliers that you've worked with are Swedish? Names?

Various

- What is essential for the future of ESS?
- Relevant interactions with other actors? (e.g. Big Science Sweden, politicians etc.)
- What is required for Sweden to draw benefit from ESS?
 - What are the benefits? To whom? (business, science, politics, region)
- Does ESS interact more with society compared to your experience at other Big Science facilities?
- Is this community a tight-knit group? In what way? Why is this?

Final questions

- Any question(s) I haven't asked but should have asked?
- What should I bring with me from this interview?
- Any other people you recommend me to talk to?
 - At ESS, in similar roles.
- Can I contact you again if I have any additional questions?

Appendix 3: List of various sources

The table below contains a list of various sources that have been accessed for this study, including text and video. However, they represent merely a handful of sources accessed throughout this study. To find a link (URL) to each source, see the end of each title for a footnote and corresponding list below the table. If N/A is observed in a column, this means that the information is not available or not applicable.

Table 4 List of various sources

Title	Type	Length	Year	Published by
Accelerator Seminar - Marcelo Juni Ferreira: ESS SRF vacuum project: Design and Assembling Plans ¹	Science	1h	N/A	Jefferson Lab/U.S. Department of Energy
Projektet ”SWEbeams” – mot en nationell mötesplats och agenda för MAX IV, ESS och deras forsknings- och innovationsarena ²	Business, science, political document	6 pages	N/A	Vinnova
European Spallation Source ³	N/A	N/A	N/A	ESS own YouTube channel
10 års Jubileumsfirande ⁴	Science, political, general public	N/A	N/A	N/A (starring e.g. Allan Larsson, Lars Börjesson, and Sindra Petersson Årsköld)
European Spallation Source: Dead or Alive? ⁵	Science	N/A	2003	Physics Today
Svenskt värdskap för ESS: Departementsserien 2005:20 ⁶	Political	128 pages	2005	Swedish Government
European Roadmap for Research Infrastructures: Roadmap 2008 ⁷	Science, political document	104 pages (not all)	2008	ESFRI
European Roadmap for Research Infrastructures: Implementation Report 2009 ⁸	Science, political document	31 pages	2009	ESFRI
Konsten att få jätteprojektet ESS att fungera ⁹	General public	20 min	2012	Sveriges Radio

Title	Type	Length	Year	Published by
Industrins framtida kopplingar till ESS och MAX IV- Exempel på internationella och regionala initiativ (TA3, TI5, TI6) ¹⁰	Business, science, political document	63 pages	2012	TITA
ESS Technical Design Report ¹¹	Science	690 pages (not all)	2013	European Spallation Source
Colin Carlile på Frukostklubben 141121 ¹²	Science, general public	27 min	2014	MiH Marknadsförningen i Helsingborgsregionen on YouTube (starring Colin Carlile)
'Texts, drugs and dinosaurs-neutrons show the way' Sindra Petersson Årsköld TEDxLundUniversity ¹³	Science, general public	16 min	2016	TEDx Talks on YouTube (starring Sindra Petersson Årsköld)
Allen Weeks: European Spallation Source — Science for Society ¹⁴	N/A	39 min	2016	Altitude Meetings on YouTube (starring Allen Weeks)
FREIA-laboratoriet/FREIA laboratory Uppsala ¹⁵	Science, political, general public	2 min	2017	Uppsala universitet on YouTube (starring Tord Ekelöf)
A New Force Awakens? The Formation of the European Spallation Source as an Organisational Greenfield Project and the Influences of Identity ¹⁶	N/A	88 pages	2018	Lund University
SWEbeams slutrapport till Vetenskapsrådet och Vinova ¹⁷	Science, political document	54 pages	2018	SWEbeams

Title	Type	Length	Year	Published by
I vetenskapens värld ¹⁸	N/A	262 pages (chapter on ESS, mainly)	2019	Gotlands-Boken (biography by Allan Larsson)
Strategy Report on Research Infrastructures: Roadmap 2021 Public Guide ¹⁹	Science, political document	37 pages (ANNEX II, page 24, mainly)	2019	ESFRI
Accounting the Future: An Ethnography of the European Spallation Source ²⁰	N/A	205 pages	2019	Linköping University
Ken Andersen - The European Spallation Source: The Next-Generation Neutron Facility ²¹	Science	58 min	2019	University of Waterloo on YouTube
Almedalen 2019: Från ord till handling kring forskningsanläggningarna ²²	Political	1h	2019	Lund University on YouTube (starring e.g. Olof Hallonsten and Pia Kinhult)
How to bring world-leading Swedish research infrastructures into the future? ²³	Science, political	57 min	2019	Uppsala universitet on YouTube (starring e.g. John Womersley)
Nationell Science Park i anslutning till forskningsanläggningarna ESS och MAX IV: Slutrapport av regeringsuppdrag ²⁴	Science, political document	34 pages	2020	Vinnova
2019 Activity Report ²⁵	N/A	80 pages	2020	European Spallation Source
Science and data analysis at the European Spallation Source ²⁶	Science	49 min	2020	LINXS on YouTube (starring Thomas Holm Rod)
The Swedish Guide: Big Science Suppliers and Partners 2020 ²⁷	Business	356 pages	2020	Big Science Sweden

Title	Type	Length	Year	Published by
Pia Kinhult on connecting policy with big science ²⁸	Science, political	36 min	2021	SAPEA Communications on YouTube
Mats partikelaccelerator är skaffet på fredsyxan ²⁹	General public	20 min	2021	Sveriges Radio
Nu ska protoner provköras i Sveriges dyraste forskningsanläggning ³⁰	General public	20 min	2021	Sveriges Radio
ESS – Så ska neutronstrålar bidra till framtidens läkemedel och energiteknik ³¹	General public	20 min	2021	Sveriges Radio
2020 Activity Report ³²	N/A	72 pages	2021	European Spallation Source
ASP 0112 Jackson ESS-Neutron ³³	Science	1h 37min (mainly 1h:16min onwards)	2021	Christine Darve on YouTube (starring Andrew Jackson)
The Swedish Guide: Big Science Suppliers and Partners 2021 ³⁴	Business	180 pages	2021	Big Science Sweden
11 ESS – nya idéer – nya möjligheter Mats Lindroos ³⁵	Science	31 min	2021	Kungliga Fysiografiska Sällskapet on YouTube (starring Mats Lindroos)
The Quarantines The MuSECa ³⁶	N/A	18 min	2022	The Quarantines on YouTube
2021 Activity Report ³⁷	N/A	68 pages	2022	European Spallation Source
Avtal med konsortiet för europeisk forskningsinfrastruktur European Spallation Source Eric ³⁸	Politics	11 min	2022	Sveriges Riksdag
Samhällsekonomiska effekter av svenska investeringar i ESS 2010–2020 ³⁹	Business, politics	80 pages	2022	The Swedish Research Council
The Swedish Guide: Big Science Suppliers and Partners 2022 ⁴⁰	Business	420 pages	2022	Big Science Sweden

1. <https://www.jlab.org/video/accelerator-seminar-marcelo-juni-ferreira-ess-srf-vacuum-project-design-and-assembly-plans>

2. <https://www.vinnova.se/contentassets/f0aa07cf5fa34fc08f7d7990d8ba0f9a/swebeams-projektbeskrivning.pdf>
3. <https://www.youtube.com/@essneutron>
4. https://api.kultura.nordu.net/index.php/extwidget/preview/partner_id/335/uiconf_id/23451022/entry_id/0_i0b28hek/embed/dynamic?
5. <https://pubs.aip.org/physicstoday/article/56/4/35/924033/European-Spallation-Source-Dead-or-Alive>
6. https://www.riksdagen.se/sv/dokument-lagar/dokument/departementsserien/svenskt-varvardskap-for-ess_GTB420/html
7. https://www.esfri.eu/sites/default/files/esfri_roadmap_update_2008.pdf
8. https://www.europarl.europa.eu/meetdocs/2009_2014/documents/itre/dv/esfri_implementation_report_2009/esfri_implementation_report_2009_en.pdf
9. <https://sverigesradio.se/avsnitt/45342>
10. <https://oxfordresearch.se/wp-content/uploads/2017/10/Rapport-Industriellt-perspektiv-Oxford-Research-TITA.pdf>
11. https://europenspallationsource.se/sites/default/files/downloads/2017/09/TDR_online_ver_all.pdf
12. <https://www.youtube.com/watch?v=liS0nEligmM>
13. <https://www.youtube.com/watch?v=YBiWDJILtVU>
14. <https://www.youtube.com/watch?v=4zLdmYSdEM>
15. <https://www.youtube.com/watch?v=q6vumxZqW0o>
16. <https://lup.lub.lu.se/luur/download?func=downloadFile&recordOid=8947318&fileOid=8947321>
17. <https://www.swebeams.se/wp-content/uploads/2018/09/SWEbeams-slutrapport-f%C3%B6r-spridning.pdf>
18. <https://www.bokus.com/bok/9789185803699/i-vetenskapens-varld/>
19. https://www.esfri.eu/sites/default/files/ESFRI_Roadmap2021_Public_Guide.pdf
20. <http://www.diva-portal.org/smash/get/diva2:1318384/FULLTEXT01.pdf>
21. <https://www.youtube.com/watch?v=IKYa8tmfWNU>
22. <https://www.youtube.com/watch?v=bfR8DDNu3IY>
23. <https://www.youtube.com/watch?v=F8JAF48sodM>
24. <https://www.vinnova.se/contentassets/4a129ae549874a11995c3319e9a68433/nationell-science-park-i-anslutning-till-forskningsanlaggningarna-ess-och-max-ivvr20-04-v02.pdf?cb=20200408165126>
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