UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

The innovation intermediary's guide to the AI Factory

A study of AI Sweden as an intermediary in a system of innovation

Master's Degree Project in Innovation and Industrial Management
Graduate School, Spring 2021

Felix Enocksson

&

Fredrik Melin

Supervisor: Linus Brunnström

AI
SWEDEN

THE INNOVATION INTERMEDIARY’S GUIDE TO THE AI FACTORY: A STUDY OF AI SWEDEN AS AN INTERMEDIARY IN A SYSTEM OF INNOVATION

Graduate School

School of Business, Economics and Law, Gothenburg University

SE-405 30 Gothenburg

Telephone +46 31-786 00 00

Abstract

This paper investigates the role of intermediaries in innovation systems. By studying how AI Sweden accelerates the use and adoption of artificial intelligence on a national level, it focuses on how an intermediary adds value in a technological innovation system. From interviewing 10 organizations of the AI Sweden network, findings are analyzed through the theoretical lens of diffusion and technology transfer theory, technological innovation systems, and intermediary activities. Based on findings, two main contributions are made. First, we propose to introduce the *AI Factory* as a conceptual framework for better understanding the role of intermediaries as accelerators of technological innovation. In extension to this, findings also contribute a deeper theoretical understanding about the role of intermediaries in technological innovation systems by supporting prior indicative methods of how to analyze innovation intermediaries. Second, it presents five future areas of improvement: *international collaborations, the opinion leader role, relative advantages and knowledge enrichment, standardized procedures*, and finally the *test environment*, which opens a discussion for implications and opportunities for current and future innovation intermediaries.

Keywords: *AI, Diffusion, Innovation intermediaries, Technological Innovation Systems, Technology Transfer*

Acknowledgements

We want to thank our supervisor Linus Brunnström at the School of Business, Economics, and Law at the University of Gothenburg, for the valuable guidance, advice, and recommendations given during the research process. His support and insights helped us design the thesis and challenge our ideas in a constructive manner.

This thesis would not have been possible without the support of AI Sweden. We gratefully acknowledge AI Sweden for their hospitality and willingness to help us during the whole research period. Specifically, we would like to express gratitude to Ebba Josefson Lindqvist, who has been our coordinator, and Mats Hanson (Emeriti Professor, KTH Royal Institute of Technology in Stockholm) for his advice and guidance. Lastly, we want to thank all the partners in the AI Sweden ecosystem that participated in the interviews and enriched this research with valuable insights.

Gothenburg, 3rd of June 2021

Felix Enocksson

Fredrik Melin

"Where data is transformed into something valuable"

Abbreviations

AI – Artificial Intelligence

DF – Data Factory

EL – Edge Lab

GDPR – General Data Protection Regulation

GU – Gothenburg University

HPE – Hewlett Packard Enterprise

IS – Innovation systems

ML – Machine Learning

NIS – National Innovation Systems

OI – Open Innovation

RIS – Regional Innovation Systems

SIS – Sectoral Innovation Systems

TIS – Technological Innovation Systems

TT – Technology Transfer

VGR – The Västra Götaland Regional Council in Sweden

1. Introduction

In the following sections, academic and practical context, inconsistencies, and opportunities will be explored, as they set the stage for this research.

1.1. Theoretical background

Innovation system research has over the past 30 years established itself as the most influential paradigm within international innovation research communities (Lindner et al., 2016). To quickly develop, transfer and diffuse new technology, ecosystems of innovative actors are emerging in Innovation Systems (IS) (Carlsson & Stankiewicz, 1991; Freeman, 1987; Lundvall, 1992; Nelson, 1993). As complexity increases and new types of stakeholders are involved, the relevance of frameworks and concepts that describe the relationships and players in such systems has increased. The most recent variant in this research field, Technological Innovation Systems (TIS) focuses on the development, diffusion, and use of certain technologies and innovations (Bergek et al., 2008; Carlsson & Stankiewicz, 1991; Hekkert et al., 2007). TIS comprise of structural components including networks of actors, such as firms, universities, and institutions, and the relationships and interactions among them (Bergek et al., 2008).

Recently, a new type of actor, innovation intermediaries (Howells, 2006; Klerkx & Leeuwis, 2009), have increasingly been identified as an important component in IS. The intermediary enables collaboration and value creation between actors, which accelerates the transition towards a prosperous and sustainable society (Lindner et al., 2016). Based on early academic iterations of intermediaries (Bessant & Rush, 1995; Kuhlmann & Arnold, 2001; Rogers, 2003), later installations focus on their role as diffusers and facilitators of Technology Transfer (TT) (Aspeteg & Bergek, 2020; Bergek, 2020; Spithoven, 2015). As society trends towards a circular and open economy, the role of intermediaries as facilitators of innovation between stakeholders is more important than ever (Dalziel, 2010). Moreover, understanding how technologies and innovations are adopted and spread within the TIS, through diffusion of innovation (Rogers, 2003), and TT (Sung & Gibson, 2000) is as important. By combining these widely cited theories (Sherry & Gibson, 2002), a process covering the steps from research to implementation is compiled. In addition, activities and factors affecting both the decision process, adoption rate, and the outcome of knowledge transfer are covered (Sung & Gibson, 2000; Rogers, 2003). However, while the theories are widely accepted and used, the relationship between them is still ambiguous (Dubickis & Gaile-Sarkane, 2015).

While the characteristics and functions of innovation intermediaries have been studied, the literature is scattered regarding the role of innovation intermediaries in TIS (Howells, 2006; Warnke et al., 2016). Specifically, the literature on innovation intermediaries lacks contribution in terms of their fulfillment of functions in TIS. In addition, the role of intermediaries in the generation and diffusion of emerging technologies in TIS is not well established (Kanda, del Río, Hjelm, & Bienkowska, 2019; Nilsson & Sia-Ljungström, 2013). The increased academic relevance of innovation intermediaries and the inconsistent views of how and what an intermediary contributes to a TIS lay the grounds for an interesting research opportunity. To answer this opportunity, the role of the innovation intermediary will be studied through the emerging organization AI Sweden and its partner network, further described below.

1.2. Practical background

Ever since the fifth technological revolution, The Age of Information and Telecommunications, started back in 1971, the amount of data generated worldwide has increased dramatically (Statista, 2020). One of the most uprising ways to exploit data is through Artificial Intelligence (AI), which is a process that utilizes data to make machines intelligent and to solve problems that formerly demanded human intelligence (Stanford, 2019). The reason for the increased attention around AI could be explained by the potential opportunities and improvements that can follow when embracing technology. Developing AI requires vast amounts of data and collaboration between many actors (Mikhaylov, Esteve, & Campion, 2018). Still, many of the world's brightest organizations struggle to find innovation outside of their near periphery (Chesbrough, 2003). To solve this, intermediary organizations such as AI Sweden aim to unite actors that share the gains of technological advancement.

AI Sweden, the Data Factory and the Edge Lab

AI Sweden is the Swedish National Center for applied AI, supported by the Swedish government, public, and private sector with the mission of *increasing the use of AI for the benefit of our society, our competitiveness, and for everyone living in Sweden* (AI Sweden, 2021a). Partners within the AI Sweden ecosystem (Figure 1) are welcome to collaborate within the newly conceived *Data Factory* (DF) (see Appendix A). The vision of the DF is to be *where world-leading organizations and practitioners collaborate to push boundaries, develop cutting-edge infrastructure and tools, train AI models, and share key know-how on how to accelerate the use of AI* (AI Sweden, 2021b).

Figure 1. AI Sweden partner network (AI Sweden, 2021c).

A component of the DF is the *Edge Lab* (EL), which is comprehensively described in Appendix A. In short, EL makes it possible for AI Sweden's partners (Figure 1) to *position themselves at the forefront of edge computing and federated learning by scoping projects together, and quickly build a working environment for experiments* (AI Sweden, 2021b).

AI Sweden has attracted an international network of actors (Figure 1) and vastly expanded its operations in a short amount of time (Appendix A), but through the DF and EL it also represents an emerging concept, that has not yet been investigated or related to literature. The relevance of this concept from a research point-of-view is unknown, yet the role and impact of this type of actor remain open for investigation. As a result, an interesting avenue for contribution to research is presented, which will be elaborated on below.

1.3. Problem framing

There are two reasons for exploring and adding to the research on innovation intermediaries' role in TIS. First, there exist few but differing views in understanding the intermediary's role and contribution to TIS. Specifically, literature is scattered regarding the activities and performance of intermediaries (Howells, 2006), and how these relate to other actors in the system. A deeper understanding and clarification as to what and how an intermediary contributes in a TIS would illuminate prior discussions on the impact of intermediaries in systems of innovation. This is rarely discussed in the literature (Kanda et al., 2019), perhaps because of the inaccessibility, rarity, or novelty of relevant real-world case studies. The opportunity to capture insights from one such organization, and of partners in their network, would contribute important insights that clarify the role of innovation intermediaries in emerging technological fields (Warnke et al., 2016). This would imply important contributions to the academic topics of TIS and innovation intermediaries.

The second reason for investigating the intermediary's role in TIS is to identify potential practical areas for improvement or opportunities that have implications for the success of current and future intermediaries. The AI Sweden concept is new, yet its potentially considerable impact on current and future business and research environments is unexplored. Detailing the role of AI Sweden could potentially assist future innovation intermediaries in their strategic positioning and decision-making process. As a result, practitioners would potentially avoid pitfalls and be more likely to maximize not only their contribution to partners but also society.

1.4. Purpose and research question

The current and increasing significance of innovation intermediaries in TIS represents the foundation of this thesis. The purpose of this research is to uncover how AI Sweden and the DF can be used as an innovation intermediary to accelerate applied AI in a system of innovation. As such, the thesis objective is to explore how an intermediary contributes to the advancement of TIS. Since this study will examine innovation intermediaries from the perspective of AI Sweden, the objective of this study will be to investigate AI Sweden from a theoretical perspective. Consequently, the aim of this research is to answer the following question:

- *What role does an innovation intermediary have in accelerating the development and use of AI in a technological innovation system?*

Against this background, this study combines the concepts of TIS, TT, and innovation intermediaries to describe the role of AI Sweden in the development and diffusion of AI. Finally, it presents a conceptual model for how an *AI Factory* can accelerate the development of emerging technologies and the advancement of society.

1.5. Delimitations

This study and its subsequent findings are based only on AI Sweden, and partners of its ecosystem. Consequently, findings disregard any potential differences to other similar or dissimilar intermediary organizations. This delimitation was made for practical reasons, as to align with the exploratory but narrow focus on AI Sweden as the main subject of research and the abductive approach.

1.6. Disposition of thesis

Following the introduction, the disposition of this thesis is illustrated in Figure 2. To begin, a review of relevant literature is done in three parts, explaining the theoretical concepts of TIS, TT, diffusion of innovation and, innovation intermediaries. Based on these concepts, a conceptual framework is constructed. Second, the methodology section includes a description of the practical decisions related to carrying out this study, including the research approach to strategy, design and data collection, quality, and analysis.

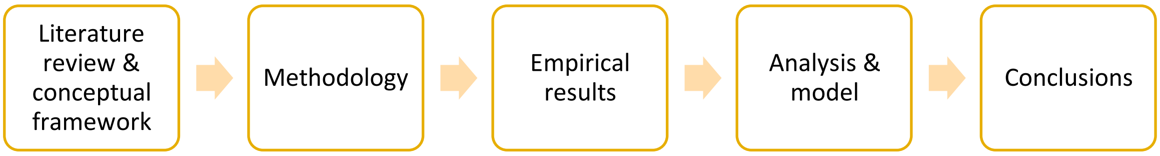

Figure 2. Disposition of thesis.

The second half of this thesis (Figure 2) begins by presenting the empirical results captured in the primary data collection. Second to last, the conceptual framework is matched with empirical findings, resulting in the revised conceptual model: *AI Factory*. In the final section, the research question is addressed before theoretical contributions and practical implications are presented. Lastly, recommendations for future research are outlined, given the limitations of this study.

2. Literature review and framework

To understand IS, it is crucial to grasp the mechanisms of their underlying functions (Nelson, 1993). Additionally, to understand the adoption process of AI within the innovation system, it is of importance to review TT and diffusion theories. Finally, due to the intermediary characteristic possessed by the case organization, theories on intermediary activities and concepts are of importance. For this reason, the following section covers three intersecting topics in respective order: 1) TIS 2) TT and diffusion 3) the activities of innovation intermediaries. Moreover, to understand how these theories could be affected, underlying activities, factors, and functions are further elaborated. Finally, a conceptual framework is presented (section 2.4) that encompasses each of the previous theoretical concepts.

2.1. Technological innovation systems

As seen in Table B1, different systemic designs have been identified in innovation literature: *innovation systems* (Freeman, 1987; Lundvall, 1992; Carlsson & Stankiewicz, 1991; Nelson, 1993), *innovation networks* and *clusters (geographical, sectoral, knowledge)* (Carayannis & Campbell, 2006), and *innovation ecosystems* (Adner, 2006; Jackson, 2011; Stam, 2015). Ensuing is a review of IS in four subsections (see Figure 3): definitions and characteristics, structural components, functions, and adapted theoretical application.

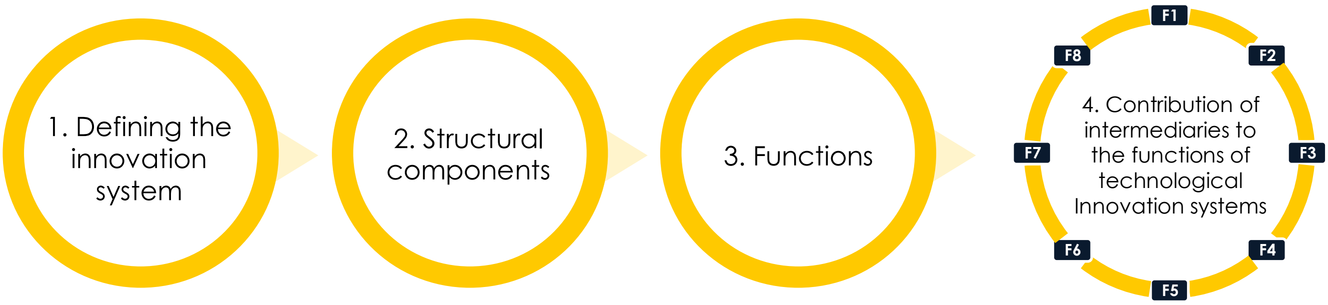

Figure 3. The order of analysis.

First, a review of IS is conducted (see step 1, Figure 3) and the focus of TIS is described and motivated. The focus of TIS goes back to this study's interest in innovation intermediaries, which is predominantly a part of innovation system literature (Howells, 2006). Next, structural components in the TIS are mapped (step 2) using the structure of Kuhlmann and Arnold (2001). Finally, the eight functions (F1-F8) of a TIS (Bergek et al. 2008) are defined (step 3), before they are adapted (step 4) so as to be used in the empirical analysis.

2.1.1. What is an innovation system?

Systems could broadly be defined as *anything that is not chaos* (Boulding, 1985). More commonly, systems are defined as a set of various components that interact, complement and restrict each other. Components may be actors such as firms, governments, institutes and universities but also resources such as knowledge, technology and information (Edquist, 1997). Systems are important because they describe the features and relationships between actors. Also, Innovation rarely happens in isolation. Rather, it is often the output from actors that collectively learn and explore (Lundvall, 2016).

Several different innovation system approaches have been presented in the literature, as seen in Table B1. The main ones are National Innovation Systems (NIS), Regional Innovation Systems (RIS), Sectoral Innovation Systems (SIS), and TIS (Klein & Sauer, 2016). In the first approach, Nelson (1993) describes IS as a set of actors that influence innovative performance on a national level. From the national perspective, networks of actors are framed within the nation-specific policies that determine the level of technology creation, diffusion, and utilization (Lancker, Mondelaers, Wauters, & Huylenbroeck, 2016). The national perspective of IS has been criticized because of increased globalization (Edquist, 1997) and divergence across some sectors (Nelson & Rosenberg, 1993). Also geographically restricted, RIS introduces the concept of a regional or even sub-regional hub for innovation (Asheim & Coenen, 2005; Braczyk et al., 1998; Cooke, 1992; Maskell & Malmberg, 1999) where specific technological policies, regulation or support happens. Here, the system includes a network of actors that depend on the competition and culture in a specific geographical region or sector (Lancker et al., 2016). Lundvall (1992) and Nelson and Rosenberg (1993) instead argue for a sectoral approach. More dynamic in nature, this approach was later developed by Malerba (2004), who defines SIS as a way to explore characteristics of innovator networks, sectoral transformation, and dependencies among actors.

TIS was first introduced in 1991 as the outcome of Bo Carlsson's research on Sweden's Technological System and Future Development Potential. In its basic form, TIS may be restricted to some portion of a global, national, regional, or sectoral system. However, actors on this level are bound by a certain technology field that may or may not be specific for a geographical region or industry (Carlsson & Stankiewicz, 1991). By this view, TT is recognized as the main actor in an innovation system (Carlsson et al, 2002, p. 234). To compare, Edquist (1997, p. 14) broadly defines an innovation system as *all important economic, political, social, organizational, institutional and other factors that influence the development, diffusion and the use of innovations*. Edquist (1997) definition has less sectoral focus than that of Technological Systems, which may be defined as *a network of agents interacting in the economic/industrial area under a particular institutional infrastructure and involved in the generation, diffusion, and utilization of technology* (Carlsson & Stankiewicz, 1991, p. 2). While the focus of Nelson (1993) and Carlsson & Stankiewicz (1991) is mainly upon the introduction and diffusion of technologies, Lundvall (1992) gives a broader definition that also includes non-technical innovations. Metcalfe (1995, pp. 462-463) defines an innovation system as *that set of distinct institutions which jointly and individually contributes to the development and diffusion of new technologies. As such it is a system of interconnected institutions to create, store and transfer the knowledge, skills, and artifacts which define new technologies*. In summary, a system of technological innovations has historically meant different things to different authors. Yet, this may not be problematic since no one definition is right or wrong. All approaches to TIS are interested in technological innovation and the roles of organizations and institutions (Edquist, 1997).

To conclude, IS can be seen from different perspectives. In this study, the definition used is that of TIS as per Bergek et al. (2007). TIS comprises all elements that influence the innovation process for a technology, not only the components solely dedicated to the technology in focus. In this approach, the focus is on the development, diffusion, and use of a particular technology (product, knowledge, or both) in socio-technical systems. A TIS may focus on one product or a knowledge field that is exclusive to the industry, and thus be a sub-system of a sectoral system. In addition, it may span across several sectors if the focus is a more *broad* knowledge field, such as Artificial Intelligence. Finally, TIS are often international in nature but may include a geographical dimension. (Bergek et al., 2007). Similarly, the scope of AI Sweden is focused, yet not restricted to Swedish organizations (AI Sweden, 2021). Per a TIS, firms, universities, research institutes, public arrangements that support innovation, and intermediary organizations that connect the various parties are hence all part of an innovation system (Carlsson, Jacobsson, Holmen, & Rickne, 2002; Van Lente et al., 2003). The approach of this paper is relatable in that the application of IS is conceptual and emphasizes the role of intermediaries, namely AI Sweden, in the diffusion of AI across Swedish sectors. To summarize, TIS uses the concepts of IS on specific technologies (Köhler et al., 2016), which is fitting in the context of AI Sweden. As such, it focuses on the structures that facilitate technological change, and the activities and contributions of actors within, specifically in the perspective of intermediaries.

2.1.2. Mapping of structural components

TIS can be viewed from different structural perspectives (Ibrahim & Marah, 2018). In these, organizations and institutions have traditionally been the main components (Edquist, 2010). The former could be, among others, firms, universities, start-ups or public bodies, while the latter refers to *sets of common habits, norms, routines, established practices, rules, or laws that regulate the relations and interactions between individuals, groups, and organizations* (Edquist, 1997, p. 46).

Perhaps the most common view among scholars is that the core components of IS are actors, institutions, and networks (Carlsson & Stankiewicz, 1991). Actors refer to any and all organizations constituted within such a system, while the network describes the interactions, search, and exchange of information and resources among these actors (Warnke et al., 2016). Carlsson et al. (1992) divide the institutional infrastructure into industrial research and development, academic infrastructure, other institutions, and state policy. Nowadays, IS are more commonly viewed from a university-industry-government perspective (Ranga & Etzkowitz, 2013). For instance, Nilsson and Moodysson (2011) identify three components of an innovation system:

1. The production structure, i.e., companies (both producing and non-producing)
2. The knowledge infrastructure, i.e., universities and research institutes
3. The support structure, i.e., various organizations, often publicly funded, tasked with supporting the economy

The triadic concept is most famously illustrated by The Triple Helix structure (Leydesdorff, 2000). Triple helix emerged in the 1850s (Leydesdorff, 2000) and has increased in popularity among researchers since 2000 (Majava, et al. 2019). Triple Helix provides insights into different innovation actors (components), their relationships, and functions in IS. In addition to the two-sided industry-government perspective, Leydesdorff (2000) recognizes the important role of academia as a component facilitating the production, transfer, and application of knowledge. The concept transcends regional, sectoral, or technological boundaries and focuses on the transfer of knowledge and technology between actors (Ranga & Etzkowitz, 2013). Thus, the main function of a Triple Helix system is to generate, diffuse and distribute knowledge and innovation (Ranga & Etzkowitz, 2013). Perhaps the most frequently applied and analyzed innovation system framework is the one developed by Kuhlmann and Arnold (2001). The model focuses on the two main sub-systems of industry and research and links them through the active role of intermediaries. Specifically, intermediaries such as research institutes or brokers are recognized as crucial in the exchange process of information and technology. These are in turn shaped by the framework conditions, demand, infrastructure, and political system (Figure 4).

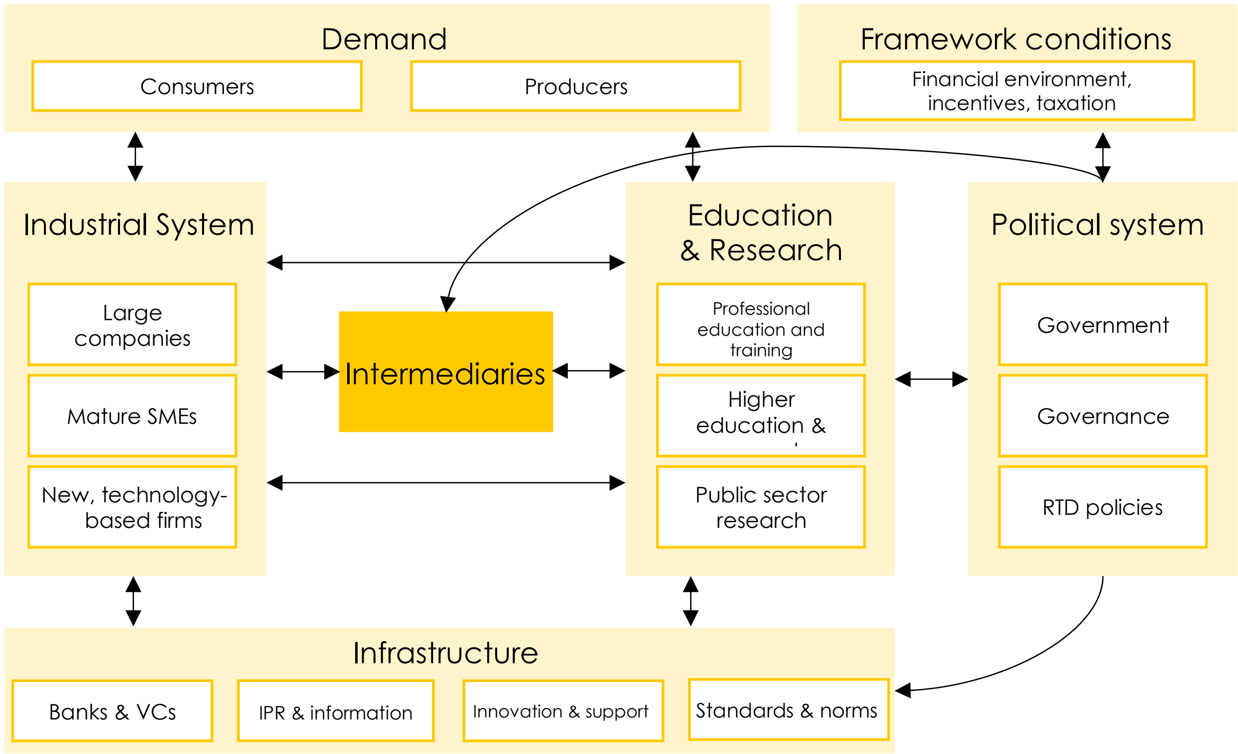

Figure 4. System of innovation components (Kuhlmann & Arnold, 2001).

The actors, components, and functions of IS were introduced by Carlsson et al. (1992) and later exemplified by The Triple Helix structure (Leydesdorff, 2000) and Kuhlmann and Arnold (2001) (Figure 4) have extensively been adopted in academic studies. Recently, it has become apparent that conventional innovation system frameworks lack the tools to capture the modern complexity of components and functions therein. Globalization, digitalization, sustainability, user innovation, technological innovation are all trends that raise questions surrounding the traditional understanding of IS (Warnke et al., 2016). In an effort to capture modern dynamics, recent contributors have developed multi-level frameworks. Perhaps the most important contribution was made by Hekkert et al. (2007) who recognize the importance of activities or *sets and functions* in IS. The Functional Perspective of Hekkert has since been applied by Bergek et al. (2008) in the context of TIS. Additionally, the role of intermediaries as key actors in IS has increasingly been highlighted (Howells, 2006; Meulman, 2017). These modern approaches are valuable to grasp and analyze the progress of technological advancements and are therefore increasingly applied for investigating and modeling the emergence of new technologies and actors in dynamic systems (Köhler et al., 2016).

2.1.3. Re-conceptualizing the functions of technological innovation systems

Functions (Figure 5) can be defined as *the contribution of a component or a set of components to the overall function of the innovation system* (Johnson, 2001). In other words, functions are the activities or processes in an innovation system that are required to generate and spread new technologies (Andreeva & Glaa, 2015; Köhler et al., 2016). Functions have been used to study IS, mainly in terms of performance (Bergek et al., 2016). There is massive room for future research in the field of IS, specifically in regards to functions (Klein & Sauer, 2016). In particular, there is an opportunity for the application and mapping of functions in specific technological IS (Warnke et al., 2016).

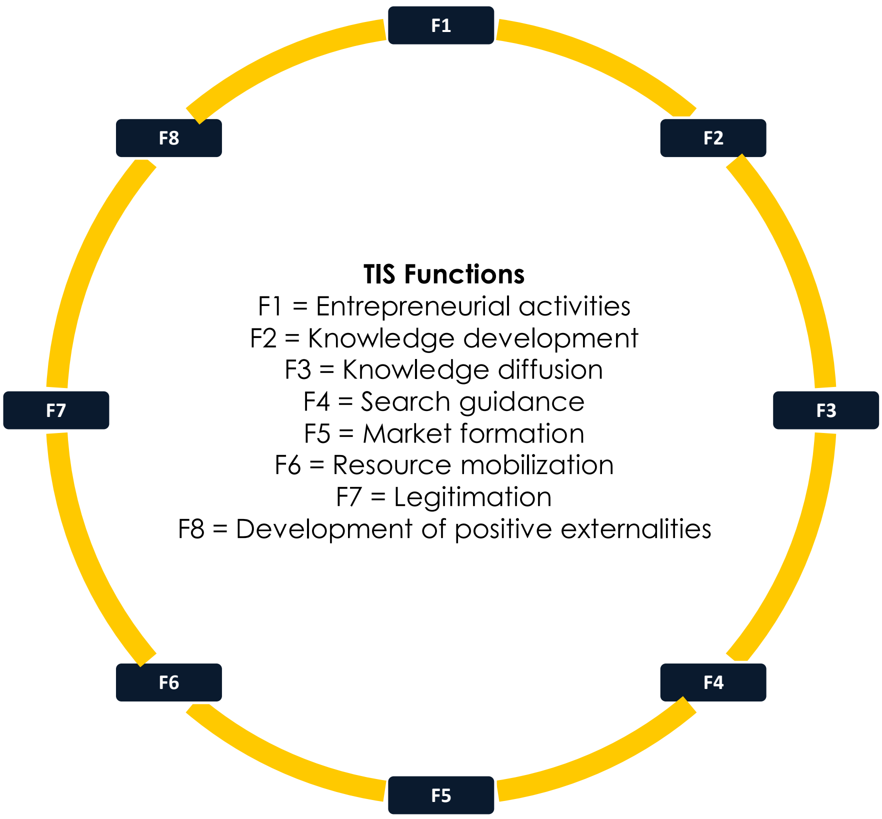

Figure 5. Functions of technological innovation systems.

The listed functions of TIS (Figure 5) are adopted from three articles: Bergek et al. (2008), Hekkert et al. (2007), and, Köhler et al. (2016):

F1. Entrepreneurial activities

There are large amounts of uncertainty in a TIS. These uncertainties are manifested in technologies, businesses, applications, and markets. To reduce uncertainty, experimentation through entrepreneurial activities is required. By probing, failing, and iterating new high-risk opportunities in technology, entrepreneurs establish an environment for social learning. To study this function, one can map the diversity of incumbents, the number of entrepreneurs, and the willingness to experiment with new technologies. In former cases, these activities have been driven by policy instruments, national and international funding directives (Köhler et al., 2016).

F2. Knowledge development

This function concerns the learning and evolution of the TIS knowledge base. The main activities in knowledge development are related to learning by doing and learning by searching. The output of such activities is in the form of applied, technological, scientific, or market knowledge. Typical indicators to map this function are number, size, and orientation of R&D projects, patents, citations, the volume of publications, R&D investments, academic involvement, and learning curves (Bergek et al., 2008; Hekkert et al., 2007).

F3. Knowledge diffusion

An essential function in a system is the exchange of knowledge and information between actors. The main activities in knowledge diffusion are related to learning by interacting and learning by using. This function can be evaluated by mapping the size, intensity, and interconnectedness of the system over time (Hekkert et al., 2007).

F4. Search guidance

Guidance is required as to which direction knowledge development (F2) and learning should take. The direction of learning is key, since it directly influences the direction of technological change in society. The primary activities in this function are any that positively affect the clarity, wants, and direction of technology users. For instance, policy goals can reinforce or stimulate the R&D focus on a particular scientific or technological field. In short, guidance can direct actors to dedicate resources to particular technological challenges or opportunities. Actors' involvement in increasing publications, sentiment, and expectations surrounding new technology may indicate the guidance of search in a system (Hekkert et al., 2007).

F5. Market formation

Normally, new technology is initially less useful or effective compared to existing applications, thwarting their diffusion. Because of this, nascent technologies require protected space where they can be improved upon. For instance, favorable tax regimes or temporary niche markets may be stimulating technological development. Markets are formed in distinct phases: nursing (in which the TIS is formed), bridging (in which the TIS grows), and mature (in which mass markets evolve). Although difficult, attempts should be made to understand the drivers behind the market formation and the sequence in which it is formed. In defining the sequence and drivers of market formation, the size, number, timing, and type of markets could be studied (Bergek et al., 2008). Also, the profiles of users and suppliers, and institutional strategy may be useful signs of analysis.

F6. Resource mobilization

For knowledge development (F2) to be possible, resources are needed. This includes human capital (expertise, applied and basic knowledge), financial capital, and complementary assets (network, services, infrastructure, etc.). For example, government funding programs can be used to spur R&D activities in specific technological fields (Hekkert et al., 2007).

F7. Legitimation

To mobilize resources (F6) and form a solid market (F5), the new technology needs to be considered socially acceptable, desirable, and appropriate. As a result, politics, social factors, and the direction of search (F4) may influence the perceived legitimacy of a technology (Bergek et al., 2008). New technology needs to be incorporated by incumbents, or it will be considered a threat. Because of this, legitimacy is key to counteract resistance to change.

F8. Development of positive externalities

The generation of positive externalities is central in the formation and growth of a TIS. In doing so, the entry of new firms is particularly essential. New firms contribute to a positive feedback loop across all functions of the innovation system. First, they may reduce uncertainty in the system, reinforcing search guidance (F4) and market formation (F5). Second, their presence may increase legitimacy (F7), which consequently could inspire entrepreneurial activities (F1), search guidance (F4, market formation (F5), and resource mobilization (F6). Lastly, a combination of new entrants may result in new collaborative outputs of knowledge development (F2) and diffusion (F3). This function may be analyzed through the co-location of firms, level of interactions among firms, and the overall dynamics of all previous functions (Hekkert et al., 2007).

Contribution of intermediaries to the functions of technological innovation systems

Identifying the general functions of a TIS are key to grasp the underlying mechanisms that facilitate TT and diffusion in a system (Bergek et al., 2008). However, the traditional functions do not specify how intermediaries contribute to TIS, especially in the generation and transfer of emerging technologies (Kanda et al., 2019). Also, additional work is required to understand to which extent innovation system functions are fulfilled by innovation intermediaries, and the type of interactions and indirect effects that intermediary activities can have on the innovation system (Nilsson & Sia-Ljungström, 2013). To gain these insights and provide recommendations to intermediaries and stakeholders of TIS, a conceptualization of the intermediary's contribution to system functions is necessary. Based on previous work done by Lukkarinen et al. (2018), Howells (2006), and Nilsson and Sia-Ljungström (2013), this study proposes that the roles of intermediaries and potential involvement in the TIS functions should be explored. In Table 1, the theoretical connections between TIS functions and the role of intermediaries have been conceptualized.

TIS Function	*Intermediary role*
F1. Entrepreneurial activities	Create conditions for *learning by doing* and *learn by using*. Experiment, validate and train.
F2. Knowledge development	Gather knowledge, process, generate and re-combine; educate and train, provide advice and training, assess and evaluate technology.
F3. Knowledge diffusion	Prototype and pilot; scan, communicate and spread knowledge.
F4. Search guidance	Articulate needs, expectations and requirements; develop strategy, advance key objectives, implement policy, identify challenges and opportunities.
F5. Market formation	Accelerate the application and commercialization of new technologies; invest in new businesses; identify business opportunities.
F6. Resource mobilization	Create and facilitate new networks; manage financial resources; identify and manage human resource needs, organize training programs, project design, marketing, support and planning, sales network and selling, source potential capital funding and organize funding or offerings.
F7. Legitimation	Gatekeeping and brokering; configure and align interests; assess and evaluate technology; arbitration based on neutrality and trust; accreditation and standard setting. Evaluate environmental and social impacts; establish a distinct brand, social acceptance and compliance with relevant institutions.
F8. Development of positive externalities	Support the entry of new actors in the TIS; contribute to the strengthening and benefits of other TIS functions and actors.

Table 1. Conceptualization of the potential contribution of intermediaries in TIS functions, inspired by Kanda et al. (2019) and aggregated from Lukkarinen et al. (2018), Howells (2006) and Nilsson and Sia-Ljungström (2013).

In this conceptualization, it is important to note that intermediaries are actors within TIS. Thus, the connections between the intermediary role and the TIS function are made on different analytical levels. Consequently, this study contributes to the debate on how to conceptualize the role of intermediaries in a systemic perspective.

2.2. Diffusion of innovation and technology transfer

To understand how technologies and innovations are being adopted and spread within a system, diffusion and transfer theories have been applied. In this section, the diffusion of innovation theory, by Rogers (2003), is outlined followed by Sung and Gibson's (2000) TT process. Additionally, factors explaining the velocity of adoption and activities facilitating the processes are described.

2.2.1. Diffusion of innovation

The concept of diffusion of innovation has been widely studied over the last 30 years (Sherry & Gibson, 2002). One of the first researchers to study this concept was Tarde back in 1903. Due to his significant contribution to the diffusion theory, Tarde was later seen as the founding father of diffusing research (Kinnunen, 1996). Subsequently, Ryan and Gross (1943) incorporated the four adoption categories and solidified prior research using a quantitative approach to describe diffusion theory. Their research of hybrid seed corn in Iowa became a revolutionary paradigm within rural sociology and attracted new young researchers to further study and develop the diffusion theory (Kuhn, 1970). Ryan and Gross's research was later applied by Rogers (1962) who popularized the model with the belly curve as we know it today. Ever since his framework has been widely used within multiple disciplines and subjects (Al-Rahmi, 2019; Pelc, 2017; Rao & Kishore, 2010; Wejnert, 2002).

According to Rogers (2003), diffusion can be seen as the process by which an innovation or new idea is communicated and adopted within a social system over time. Therefore, diffusion of innovation can be seen as a social communication theory (Valente & Rogers, 1995). Moreover, according to Rogers (2003), the theory builds on four essential key elements, all of which must be in place in order for diffusion to occur: innovation, communication channels, time, and social systems, all of which will be elaborated below.

Innovation

To understand the diffusion of innovation, innovation needs to be defined. Firstly, innovation should not be confused with the invention, which refers to the process in which innovations are discovered and created (Rogers, 2003). There are multiple definitions of innovation used across different fields and sectors. However, it is important to have a definition that is suitable for the subject undertaken in this study. Schumpeter (1934) defines innovation as the creation of new combinations using existing resources. Schumpeter's definition points out that innovation does not necessarily need to incorporate inventions. Skinner and Hanlon (2015) define innovation as the implementation of significantly improved products or processes. This definition is also in line with Mulgary and Albury (2003) who further widening the definition and include methods and services. The authors additionally stress that the innovation should improve the results in terms of outcomes, efficiency, quality, or effectiveness. Finally, Rogers (2003, p. 12) defines innovation as *an idea, practice, or project that is perceived as new by an individual or other unit of adoption*. This definition indicates that the actual time of origin of the invention is not important. As long as individuals perceive it as new, it could still be seen as an innovation for them.

Communication channels

Communication can be defined as the exchange of information by speaking, writing, or using any other medium in order to reach a common understanding. Therefore, diffusion can be seen as a type of communication where units exchange information concerning a novel idea. As the innovation diffuses, communication channels connect the previous users with the new ones. Moreover, there are various types of channels. For instance, by utilizing mass media channels such as TV, newspaper, and radio, a few individuals have the possibility to reach out to a big audience. However, the power of persuasion in mass media is low compared to interpersonal channels that involve face-to-face communication. Moreover, meanwhile, scientific evidence of new innovations is important to reach out to the first adopters, people mainly rely on subject evaluations from like-minded individuals with prior experience associated with the novel entity. Therefore, diffusion of innovation is a social process. Further, individuals within a group having similarities in attitudes, beliefs, education, and social status are referred to as homophily. When individuals are homophilous the communication and persuasion to change attitudes tends to be more effective. However, one of the most prominent issues with the diffusion of innovation is that most often individuals are distinctive in their social attributes leading to heterophily and hence ineffective communication. (Rogers, 2003)

Time

In behavioral research, time is often ignored. In diffusion of innovation theory, on the other hand, time is a significant element and is seen as one of its greatest strengths. According to Rogers (2003), the time factor is involved in both the innovation-decisions process and the adoption rate, which will be further elaborated on below.

Social system

The last element mentioned by Rogers (2003) is the social system. A social system can be seen as a group of interrelated units with a mutual problem. The problem enables the units to jointly search for solutions and hence accomplish a common goal. The units in these systems can take the form of individuals, organizations, and also subsystems. Moreover, social systems affect the diffusion of innovation in several ways. Firstly, it sets the boundaries within which innovations can spread. Moreover, each system has its norms which are established behavioral patterns. These norms could be seen as a standard of the expected behavior and can appear at both national, religious, and organizational levels. Moreover, each system contains members with different functions. Opinion leaders within a social system can be seen as information providers. Opinion leaders earn trustworthiness and the ability to influence members of the system by demonstrating technology expertise, social skills, and conformity to the norms. Therefore, they have the possibility to both foster and oppose change depending on the systems' structure. Consequently, these members are important targets when introducing new innovations. Change agents are another type of functional member in the system. These agents seek to obtain as well as prevent new ideas to become adopted by influencing the individuals in the system. Moreover, due to the heterophyllous relationship between the change agents and the members, they seek to find less radical but still influential members in the system to bridge the communication gap and thus enable the diffusion of the new idea. These members also referred to as aides, are chosen by the change agents with respect to their expected desire for innovation.

Innovation-decision process

While the elements necessary for diffusion to occur as outlined, it is still unexplained what constitutes the adoption process, and what factors could explain the rate of adoption. In this, and the following section these two aspects will be further elaborated.

Ultimately, the decision process of individuals to either reject or adopt the innovation is a key process in the diffusion of innovation theory. Rogers (2003) explains this decision process through five steps including knowledge, persuasion, decision, implementation, and confirmation, illustrated in Figure 6.

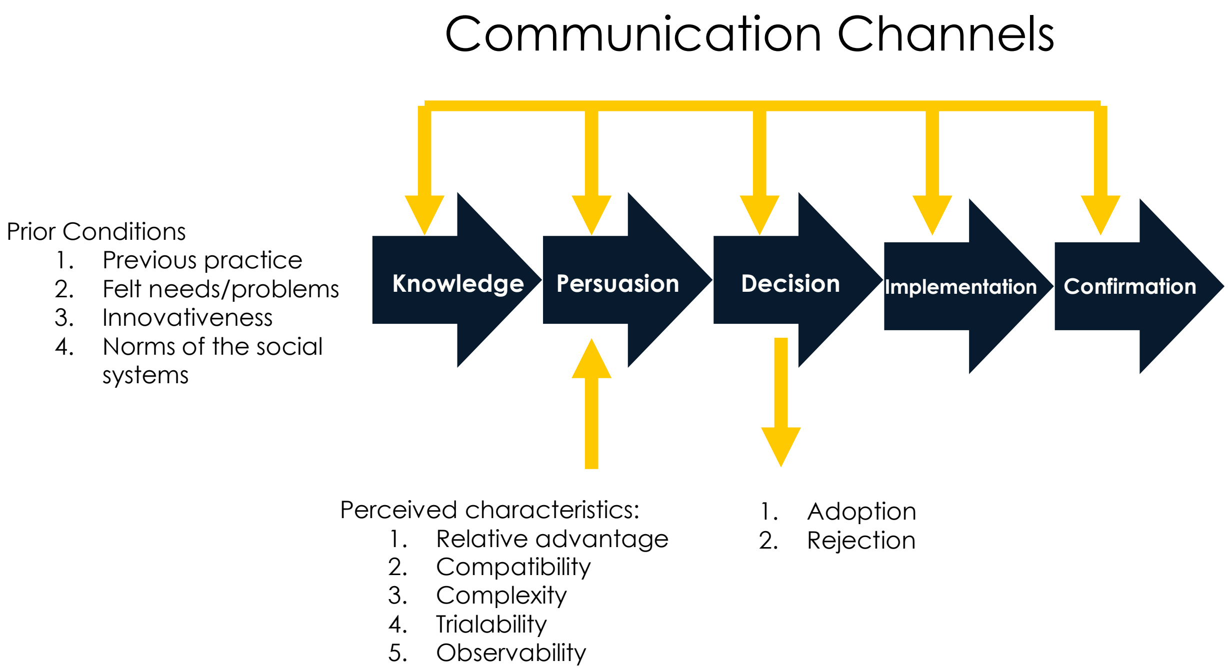

Figure 6. Innovation-Decision Process (Rogers, 1995, p. 163).

The process starts with the knowledge stage where the individuals get in touch with the innovation and its functions for the first time. In this phase, the questions *what is it*, *how does it work*, and *why does it work?* are critical to be answered. *What* is concerned about the awareness of the innovation. The exposure could arise through behaviour that has been initiated or by various communication channels. However, individuals tend to avoid messages that do not align with their own values and attitudes. Moreover, Hassinger (1959) states that the need for innovation is important to consider. This, as individuals in a higher degree, is impervious towards exposure of innovation if it is not perceived as consistent with needs and beliefs. Moreover, once the individual is aware of the innovation, they seek to find out *How* it functions and can be utilized correctly. The more complex technology, the more how-to knowledge is required for individuals to adopt (Rogers, 2003). Finally, *Why* refers to the underlying functionality of the innovation. This knowledge is according to Rogers (2003) not always necessary in order to adopt the innovation, an example of this is the internet. However, if it is not revealed, there is a risk of misusing the innovation thus leading to a discontinuance. Finally, the literature suggests that there is a difference between early versus late knowers of the innovation. The latter tend to have less education and social status. However, knowing about an innovation does not necessarily end up in adoption, but it certainly increases the probability to at least continue to a decision to adopt the innovation (Rogers, 2003).

As illustrated in Figure 6, once there is an awareness of the innovation, the individuals tend to pass on to the persuasion stage. Here, users aim to seek information and proof of concept associated with the innovation. This, to reduce the potential uncertainties and to form a favorable attitude towards the innovation. Rogers (2003) argues that meanwhile the knowledge step is associated with a cognitive view, the persuasion stage is concerned with feelings, that is, how the information is interpreted. Further, persuasion is also forward planning in a way that individuals usually mentally apply the innovation to debone potential effects resulting from an adoption. Therefore, information to successfully do an innovation evaluation is desirable, including advantages and disadvantages regarding the specific individual context. Rogers (2003) states that such information is in many cases collected from near-peers. Finally, a favourable attitude does not necessarily need to be derived from personal needs. Instead, the urge might come from an unwanted future that could be eluded by adopting an innovation. However, these forces do usually result in a slow adoption rate.

After the persuasion stage, the decision process will take place (see Figure 6). To adopt an innovation or not, is a decision to make full use of the innovation or reject it. To make a correct decision, it is, therefore, favourable to have all the necessary information. Rogers (2003) reveals that one way to cope with potential uncertainties associated with an innovation is by providing small-scale trials. This, as many individuals, will not adopt an innovation without first testing it. However, in conformity with the persuasion step, this can be partial substituted by opinions from near-peers. Further, the decision phase does not necessarily need to occur after the persuasion, as each stage in the decision process is a potential rejection point. Moreover, Rogers (2003) mentions three types of innovation decisions: *Optional, Collective*, and *Authority*.

Once the decision to put an innovation into use has been made, the implementation phase starts. Meanwhile, previous phases in the decision process have been towards the mental characteristic, the implementation stage involves putting the innovation into actual practice. Therefore, active information-seeking of where to obtain, how to use, and what problems could appear to take place in this stage. Moreover, the implementation stage becomes more complex if the adopter takes the form of an organization. This, as more people are included, and the decision-makers are rarely the same as the ones utilizing the innovation.

Finally, Rogers (2003) demonstrates that once the innovation has been implemented the individuals usually seek reinforcement of the innovation decision. Moreover, human change in behavior is motivated by internal dissonance which is an uncomfortable state of mind that the individuals seek to eliminate or reduce. This may occur as individuals feel a need for something that an innovation could potentially fulfill. Consequently, this need motivates individuals to seek information in the knowledge phase. Another type of dissonance could occur when the benefits of an innovation have been revealed and understood but not yet adopted. However, once the decision has been made, individuals frequently try to avoid becoming dissonant by instead seeking information that confirms the decision already made. Therefore, supportive messages are important so that the individuals do not reject the innovation after previously adopted it.

Innovation adoption rate

While the requirements of diffusion to occur, and the adoption process now is understood, it is now of interest to how the rate of adoption can be affected. This, as the research question, aims to explore how AI Factory can accelerate the diffusion of AI. Rogers (2003) mentions five variables affecting the rate of adoption seen in Figure 7. Nonetheless, scholars have had different considerations concerning these variables, they are yet the most researched. The first variable mentioned is the *type of innovation decision*, which could potentially affect the velocity of the adoption rate. As an example, authority decisions taken by the government, organizations, or schools could have a positive effect on the adoption rate as a decision taken by few people could affect the whole system. The *communication channels* could additionally affect the adoption rate due to the velocity of awareness-knowledge in the social system. For instance, mass-media or similar one-to-many channels could diffuse the awareness of an innovation at a higher rate compared to interpersonal channels. Moreover, the *nature of the social system* could further affect the adoption rate. This, as a highly interconnected system, is more efficient of spreading awareness and knowledge in relation to a dispersed one. The *extent of change agents' efforts* does also possess some explanatory power. However, change agents will be further elaborated as a part of intermediary activities in a later section. Moreover, *Opinion Leaders*, which also is a member within the social system, has potential to affect the adoption, especially in the persuasion stage (Rogers, 2003). As previously stated, the level of influence is earned by technical expertise, social accessibility, and conformity to the social system. Therefore, to gain leadership the opinion leaders should reflect the structure of the system and not deviate too much from its norms. However, Rogers (2003) further states that opinion leaders could take both an innovative role or a role to oppose change. The innovative opinion leader has the ability to affect the adoption rate due to their position at the center of the interpersonal communication networks. This, as it allows them to act as social models who are imitated by the member in the network.

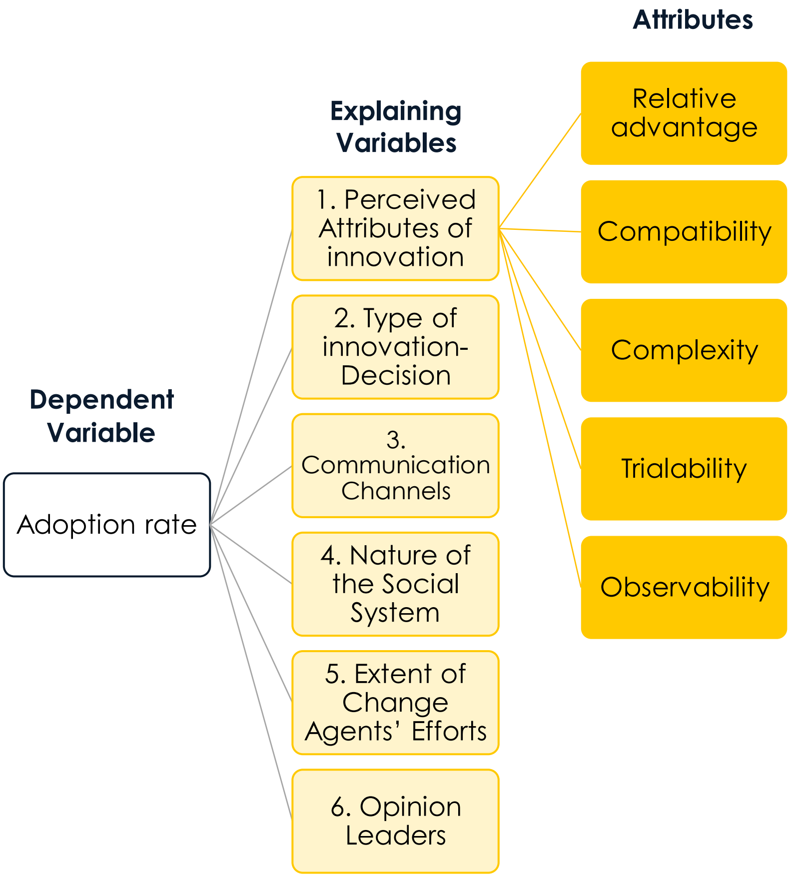

Figure 7. Variables Determining the Rate of Adoption of Innovations (Rogers, 2003).

Finally, the five *perceived attributes of innovation* mentioned by Rogers (2003), *relative advantage*, *compatibility*, *complexity*, *trialability*, and *observability*, has been extensively research

(Holloway, 1977; Moore & Benbasat, 1991; Tornatzky & Klein, 1982). Despite the fact that the attributes are well recognized, Rogers (2003) highlights that each set of individuals is unique, which might as well affect the importance of the characteristics. However, as a general framework, the attributes are still considered to explain between 49 to 87 percent of the adoption rate, making them the most prominent variables (Rogers, 2003). Therefore, those attributes will be further elaborated.

Relative advantage refers to the degree of advantage an innovation has in relation to the existing solutions it ought to replace. These advantages could be economical, prestige factors, low initial costs, and convenience. Therefore, the degree of the relative advantage can be measured as the ratio between the expected benefits and the cost of implementing them. However, regardless of the benefits, the most critical aspect is how the innovation and the benefits are perceived by the individuals in the social system. The perception of relative advantage has a positive relation to the rate of adoption. It is even declared that the perceived relative advantage is one of the strongest predictors for explaining the adoption rate according to diffusion scholars (Rogers, 2003).

Compatibility is seen as *the degree to which an innovation is consistent with existing values, past experience, and needs of potential adopters* (Rogers, 2003, p. 224). Incompatibility with existing norms and values could, therefore, increase uncertainty and thus hamper the adoption rate. This, as the more incompatible the innovation, is the higher degree of behavioural change is required. Moreover, the level of compatibility is further determined by how well it comports with previously adopted innovations. This, as the old technology, can be seen as a reference and a standard linked to the new one. However, this prior knowledge can also result in utilizing the innovation incorrectly. Moreover, there is a trade-off between congruency and rate of adoption. If an idea or entity would be totally congruent with existing values or practices, it would not have been an innovation at all. Further, if there would have been a modest disparity the rate of adoption would, in general, have been higher than if it was significant. This, as the need for behavioural change, is small. On the other hand, the innovation might be considered less impactful if it is highly congruent. However, it might pioneer fewer compatible ideas at a later stage. Furthermore, to fully understand this attribute one must also consider technology clusters. These occur when technologies are interrelated whereby the relative advantage is notable solely when the technologies are utilized jointly (Rogers 2003).

Complexity refers to the degree to which an innovation is perceived as difficult to understand and use. Meanwhile, some innovations are easily understood by the individuals in the social systems, others are more complex. The degree of complexity has a negative correlation to the adoption rate. Therefore, new innovations that can be utilized without the requirement of developing new skills will be adopted more quickly. This is also in line with Katz (1963) who presented a positive relationship between the adoption rate and the degree to which an innovation is easily explained.

Moreover, *trialability* is the degree to which an innovation can be tested end experimented with before being installed and adopted. The possibility to test and try the innovation before adopting it reduces potential uncertainties and thus increases the adoption rate. This is especially the case among early adopters as no precedents exist. Moreover, Dearing (2009) states that this attribute preferrable becomes increasingly important for high-risk and complex innovations.

Finally, *observability* refers to the degree of how visible an innovation is to others. If the result of adopting an innovation is easy to observe, the greater likelihood of adoption it is. However, some innovations are by their nature more difficult to observe, such as software, resulting in slower adoption rates.

Diffusion in organizations

We have so far covered the diffusion process from the view of individuals. However, due to the characteristics following this thesis, the diffusion process from an organizational approach is considered. Moreover, three types of innovation-decisions within organizations are mentioned (Rogers, 2003). Firstly, *Optional innovation-decision*, where the individual takes a decision interdependently from the decisions made by other members of the system. Secondly, *Collective innovation-decision*, refers to the decisions taken by consensus among individuals in the system. Finally, *Authority innovation-decision,* is described as the decisions made by a few people in the social system retaining authority, status, or technical expertise. The innovation decision process in organizations is far more complex than when including solely single individuals. This, not only due to the multiple decision types but also as every individual plays different roles. (Rogers, 2003). Moreover, organizations can be seen as adopters within a social system. These adopters have, in turn, their own characteristics in the forms of norms, cultures, structures, and strategies affecting the adoption and innovation process, thus making it more complex (Askarany, 2009). Moreover, Rogers (2003) highlights that organizations could take the role of opinion leaders. In parallel to the social system incorporate individuals, inter-organizational networks exist in which innovations can diffuse. The literature (Walker, 1971; Rogers, Peterson, & McOwiti, 2002; Rogers, 2003) suggests that these networks contain some pioneers acting as opinion leaders. Once these firms adopted an innovation the adoption rate among other organizations in the network seems to increase (Rogers, 2003).

Criticism of diffusion of innovation theory

Although diffusion of innovation theory widely has contributed to the research, it has also been met by criticism. Firstly, it can be argued that the model is built on outdated research that is less relevant in today's fast-moving society. For instance, Pace (2013) argues that new radical technologies occasionally disrupt the way previous innovations were adopted. Therefore, there might be a lack of scientific understanding of the current adoption process. The complexity and versatility of the adoption process increase whereby the relevance of the original model might be questioned (Peres, Muller & Mahajan, 2010). Moreover, the hierarchical approach of defining the adoption process can be argued. Driessen and Hillebrand (2002) reveal that the arbitrary order is an exception rather than the rule, particularly when the innovation demands little involvement.

Diffusion of innovation theory has additionally been criticized as it assumes that the innovation firstly aims to be adopted by all individuals in the social system, secondly, that the quicker rate of adoption the better, and finally, that rejected or re-invited innovations is not desirable. Therefore, a lot of research has been focused on explaining successful and rapidly diffused innovations rather than more unsuccessful cases. That is, the reason why innovations are rejected or adopted and but later discontinued are less researched resulting in a potential bias in the empirical evidence (Rogers, 1995). Furthermore, due to the broad interested in the area of diffusion of innovation, evidence in research has been derived from multiple application areas and studies with contradicting results. For instance, previous literature reveals that the importance of different factors explaining the diffusion rate of an innovation could vary depending on the specific context (Downs & Mohr, 1976).

However, despite the shortcomings of the model it is still broadly accepted and applied. Moreover, Rogers has continuously improved the model together with other researchers since his first book got released in 1962. Additionally, over 6000 research studies have been testing the theory making it highly reliable (Robinson, 2009).

2.2.2. Technology transfer

Meanwhile, diffusion of innovation explains how technology is diffused among recipients within a social system, TT is concerned about the development and transfer of the technology (Dardak & Adham, 2014). Further, as recipients and developers are interconnected, which will be addressed more in-depth below, and as the AI Sweden ecosystem encloses them both, it is not only of importance to understand the diffusion of innovation, but also the process of TT.

The terms innovation and technology are nearly associated and are often applied interchangeably. Moreover, the definition of technology is manyfold (Rogers, 2003; Choi, 2009; Mitcham, 1994; DeVore, 1987; Bozeman, 2000). Despite the most common view of technology could be seen as a tool, TT cannot be studied solely focusing on the physical object itself. This, as without knowledge and lack of understanding of the application areas, the physical object cannot be utilized. Therefore, knowledge associated with the artifact and the development will not be seen as ancillary but as inherent (Bozeman, 2000). Moreover, Rogers (2003) states that technology possesses a hardware aspect and a software aspect. Hardware is seen as the physical object meanwhile the software is the information aspect of the way it is used. An example of this is a computer whereby the computer itself is the hardware and the code, instructions, and programs, that allow the user to utilize the hardware, is seen as software. This is also in line with Dardak and Adham (2014) arguing that technology is directed towards the use of knowledge.

Transfer can be described as the movement of technology between groups (Weick, 1990). Therefore, TT can be described as the application of information into use (Rogers, Takegami, & Yin, 2001; Segman, 1989). This is also in line with Powers and McDougall (2005) defining TT as the process by which technology is developed by researchers and eventually transformed into marketable commodities. Moreover, despite TT usually originate from basic research and is then diffused to recipients, the TT process is a two-way exchange of information. Meanwhile, technologies flow from developers to the end-users, questions, problems, and feedback flows back to the developers making it an iterative process (Rogers, 2003).

There are multiple models of TT. However, each of the models mentioned by Gibson and Smilor (1991) has limitations when applied in contemporary high-tech organizations. This, as the models are characterized by a one-way flow, also contradicts the definition previously outline. Despite some of the models inaugurating the complexity of TT, it still suffers from linear bias. According to Gibson and Smilor (1991), TT should, instead, be seen as a chaotic, social, and interactive process within networks where actors have different perceptions of the technology at hand. Within these networks, actors exchange ideas, knowledge, and supply feedback streaming backward to the technology developers (Gibson & Smilor, 1991). Moreover, Sung and Gibson (2000) stated that the previous models lacked a profound explanation of the different stages occurring within TT. To overcome these limitations the authors suggested a four-level model consisted of *Creation*, *Sharing*, *Implementation*, and *Commercialization* illustrated in Figure 8.

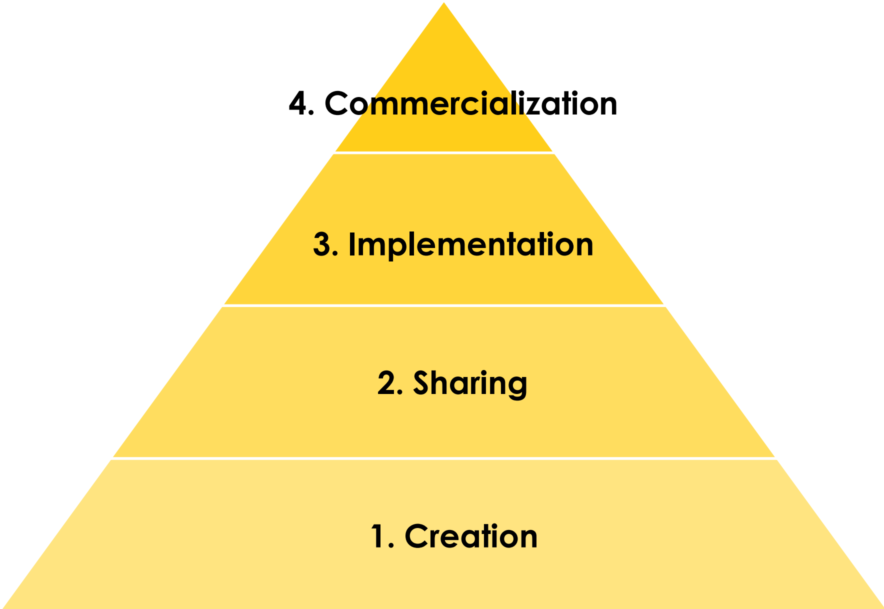

Figure 8. Four Levels of Knowledge and Technology Transfer (Sung & Gibson, 2000).

At level one, *Creation*, people perform state-of-the-art research which is developed into knowledge. The knowledge and results conducted are then diffused in various channels such as publications, news, and conferences. At this level, the collaborative requirements are low between the transceivers and are therefore considered as a passive process (Wahab, Rose, Uli, & Abdullah, 2009). However, collaborations across organizations and national boundaries may exist. At level two, Sung and Gibson (2000) explain the *Sharing* aspect of TT. The authors state that knowledge and technology must transfer across organizational or personal boundaries, as well as become accepted and understood by the users. At the third level, *Implementation*, success is marked by the ability for users to implement as well as the efficiency and timeliness of the TT. The implementation may occur in terms of manufacturing- or process transfer, or as services and best practices. Finally, the fourth level, *Commercialization*, refers to the utilization, distribution, and sales of the technology to consumers. As illustrated in Figure 8, the levels are built cumulatively on each other. The success of commercialization is therefore dependent on the success of implementation, sharing, and creation (Sung & Gibson, 2000). These steps are also in line with the critical events and activities associated with TT explained by Bauer and Flagg (2010).

2.2.3. Key factors and barriers of technology transfer

While the process of TT now is clarified, the factors that facilitate this process are still unexplained. As the DF not exclusively aims to accelerate the use of applied AI, but also encourage innovation, research, and development of new technologies, the key factors affecting the process are of importance. Firstly, the ability to assimilate, modify, adapt, and generate technologies is dependent on education and training. Therefore, the intangible aspects, such as skills and knowledge, might be more critical than the object itself when it comes to explaining the success of TT (Choi, 2009). The significance of these factors can be found in multiple case studies in different industries and constellations (Matsumoto, 1999; Moon, 1998; Parayil, 1992). Moreover, Sung and Gibson (2000) mention four key factors explaining the outcome of TT: *Communication*, *Equivocality*, *Distance*, and *Motivation*. *According* to the authors, communication refers to the *degree to which a medium is able to efficiently and accurately convey task-relevant information and media richness* (Sung & Gibson, 2000, p. 5). Further, the communication factor could be divided into passive and interactive. Interactive communication encourages person-to-person communication, to achieve a better chance of transfer with focused feedback. This interpersonal way of communicating is related to levels three and four in Sung & Gibsons' (2000) model where developers and users meet. Passive communication is usually distributed through media channels with a one-to-many approach, such as scientific journals. Such distribution is cost-saving, although, the sender is unaware of how the knowledge is preserved and utilized. Therefore, this type of communication is related to level one, Creation, in the model seen in Figure 8. The second factor mentioned, distance, is related to cultural aspects and their similarities and dissimilarities. In line with the cultural barriers explained by Johnsson, Gatz, and Hicks (1997), Sung and Gibson (2000) stressed that an understanding of each other's values, attitudes, and ways of doing things, increases the chance of a successful TT. This becomes even more critical as the TT reaches higher levels in the model (from level 1 to 5). Moreover, highly complex technologies are harder to understand, demonstrate, and are usually ambiguous in their use case. Therefore, Equivocality becomes an important factor that must be considered, especially to facilitate the implementation phase. Finally, Motivation refers to the personal incentives, for developers and users, to participate in and bolster TT activities. This factor is associated with cultural aspects as the motivation could increase if such engagement is rewarded. These findings are also in line with Gibson and Smilor (1991) stating that interactive and personal factors are the most important. The authors further mention shareholders' pull for technology, technology champions, cooperation among actors, and success stories as important factors for TT.

There are multiple barriers to overcome in order to successfully transfer a technology. Johnsson, Gatz, and Hicks (1997) mention four challenges that could impede diffusion. Firstly, it is important to understand that the transfer occurs within a social system that sets the boundaries and limits. The technology will not be transferred within the system if there is no beneficial value for the actors within it. Secondly, political decisions and incitements might interfere with the transfer process. Barriers might arise due to unaligned goals and areas of focus in relation to the technology developer. As a third challenge, the authors present economic barriers. New technologies related to heavy investments is riskier and might interfere with the current allocation of resources. Moreover, incumbent firms have a tendency to focus on smaller incremental innovations to optimize their current technologies rather than invest in completely new ones (Christensen and Bower, 1996) which might hamper the transfer process. According to Johnsson, Gatz, and Hicks (1997), personal barriers must also be addressed as personal concerns about a given technology seem to affect the degree of acceptance. Finally, cultural barriers also seem to play a crucial role in TT. Frequently, new technologies are designed within a culture differentiated from that where it is utilized. From an acceptance standpoint, it is therefore important for the designers to familiarize themselves with, and understand the receivers' values, cultures, and social norms (Pacey, 1986).

Moreover, Schneider, Holzer, and Hoffmann (2008) also stress the importance of political and institutional alignment as well the need for relative advantage. However, they further stress that lack of information and access to capital are two additional barriers that could interfere with the transfer process.

2.2.4. Combining technology transfer and diffusion of innovation

Meanwhile, TT could be seen as the development and movement of knowledge and associated hardware between various settings (Markert, 1993), diffusion of innovation emphasizes and explains the behavioural aspects of the adoption process of technologies within a society, group, or organization as a whole (Bauer & Flagg, 2010; Cottril, Rogers, & Mills, 1989; Rogers, 1995). TT is to a higher degree directed towards the technology developers and the transfer of research findings and knowledge related to emerging technologies. Rogers' (2003) diffusion theory is, on the other hand, more concerned about the adoption process from a recipient's point of view (Johnsson, Gatz & Hicks, 1997). However, the relationships and distinctions between TT and diffusion of innovation are ambiguous in the literature. Nonetheless, Dubickis and Gaile-Sarkane (2015) revealed in their review that an overlapping perspective between the theories seems to be dominant. Yet, the level of overlap between TT and diffusion of innovation is still to be researched. However, as illustrated in Figure 9, in this research, both concepts are interrelated and jointly considered, in line with Dubickis and Gaile-Sarkane's (2015) findings. This further allows for a comprehensive understanding of the transfer and adoption process from creation throughout diffusion from both a developer, but also recipient aspect.

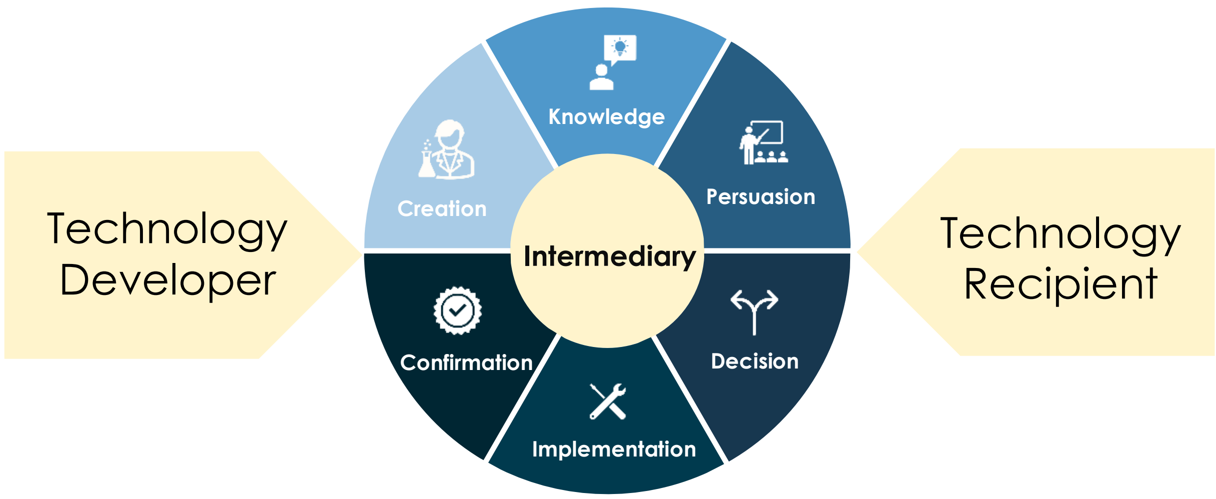

Figure 9. Adoption and Transfer Process. Based on Sung and Gibson's (2000) TT framework and Roger's (2003) innovation decision process.

In Figure 9, TT and the adoption process is linked together. The C*reation* step is mainly related to level one in Sung and Gibson's TT process. Step two, *Knowledge*, refers to the knowledge step in Rogers' (2003) adoption process and its underlying activities. Further, *Persuasion* is concerned about the activities found in level two in the TT process (Sung & Gibson, 2000) as well as the persuasion step in Rogers' (2003) framework. Step four in the adoption and transfer process is reflected by the same step in Rogers' (2003) model. Further, step five, *Implementation*, is related to level three and four in the TT process (Sung & Gibson, 2000) as well as Rogers' (2003) implementation step. Finally, the *Confirmation* step is mirrored by the same step in Rogers' (2003) model. Moreover, intermediaries, seen in Figure 9, have the possibility to facilitate and affect the steps in the process. However, this will be further elaborated upon in the next section.

2.3. The role of intermediaries in innovation systems

In the subsequent sections the following steps will be achieved: review of intermediary definitions and the selected approach for this thesis, a visitation of innovation and technology intermediaries and summarization of intermediary activities.

2.3.1. Defining the intermediary

Ever since the 18th century, middlemen have played a crucial role in the transmission of knowledge and technology. More recently, the increased academic interest of innovation intermediaries has, according to Howells (2006), emerged from:

- Literature on TT and diffusion
- More general innovation research on the role and management of such activities and the firms supplying them
- Systems of innovation literature
- Research into service organizations and more specifically Knowledge Intensive Business Services (KIBS) firms.

Additionally, ever since Chesbrough (2003) popularized the concept of open innovation (OI) the interest from both academia and participants has increased (Hossain, 2012). As an indication of its importance, Chesbrough's research has more than 24,000 citations in 18 years (Google Scholar, May 2021). Moreover, OI refers to an innovation strategy where organizations can and should look outside their doors for innovations and to find ways to exploit and leverage their own. That is, the innovation process does not only occur within the boundaries of the organization but is also distributed across multiple external actors. Furthermore, Vanhaverbeke and Chesbrough (2014) mention three modes of open innovation, all of which have been successfully adopted by a variety of different industries (Diener & Piller, 2010; Gianiodis, Ellis, & Secchi, 2010). Firstly, Outside-in, where organizations utilize and adopt external innovations to improve their products and processes. Secondly, Inside-out, in which the firms can spin-off or license out innovations not suitable for in-house exploitation. Finally, Coupled OI where organizations in a collaborative manner developing new intellectual properties and opportunities. Moreover, there is a broad agreement in literature stating that the coordination of the innovation processes within these open networks is handled by a visible hand, often referred to as intermediaries (Katzy, Turgut, Holzmann, & Sailer, 2013). In alignment with the increasing number of participants exercising OI, the number of intermediaries has followed having an important role which will further be elaborated upon below (Hossain, 2012).

Scholars have discussed many sorts of intermediaries, each defined slightly differently, see Table B2. The main differences between these are their objective focus and location among the actors that they interact with (see Table B2). Based on these studies, prior work also highlights the different strategies and performances of intermediaries (Colombo et al., 2015). Simultaneously, intermediaries have been studied in a variety of isolated environments or industries, such as the finance sector (Cumming, Fleming & Schwienbacher, 2008) food sector (Klerkx & Leeuwis, 2009), or small and medium-sized enterprises (SMEs) (Gredel, Kramer & Bend, 2012).

Most authors have focused on distinguishing between the different types of intermediaries (Colombo et al., 2015; Howells, 2006; Meulman, 2017). In the most systemic view, Van Lente et al. (2003) defines a systemic intermediary as a key organizer in between mostly public and private sector. Similar in its societal focus, the transition intermediary promotes long-term sustainability both in national and international networks (Bush & Bale, 2017; Martiskainen & Kivimaa, 2018; Matschoss & Heiskanen, 2017). Most commonly identified in the literature is the *innovation intermediary* (Howells, 2006; Meaulman, 2017; Dalziel, 2010) which have augmented the early work of Kuhlmann & Arnold (2001). More recently, the technology intermediary (Bauer & Flagg, 2010; Sapsed et al., 2007; Spithoven, 2015; Xiaoyuan, & Yanning, 2011) and *Diffusion intermediary* (Aspeteg & Bergek, 2020; Bergek, 2020) are both mentioned frequently in relation to IS. Spithoven (2015) defines *technology intermediaries* as the actors that facilitate TT in an innovation system. Examples of technology intermediaries could include science parks, incubators, or university interfaces that have as their main purpose to bridge, translate and facilitate flows of knowledge between universities, industry, and public research institutes (Spithoven, 2015; Van Lente, Hekkert, Smits, & Van Waveren, 2003).

Some authors that examine innovation intermediaries with a narrower focus have used more specific definitions. For example, in studying Swedish Science Parks, Löfsten and Lindelöf (2002) define the intermediary as a facilitator for value-added activities between technology-based firms. More broadly, Kuhlmann and, Arnold (2001) defines innovation intermediaries as the brokers between industry and academia. Dalziel (2010, p. 3) state that intermediaries are *organizations or groups within organizations that work to enable innovation, either directly by enabling the innovativeness of one or more firms, or indirectly by enhancing the innovative capacity of regions, nations, or sectors*. With *innovativeness*, Dalziel (2010) refers broadly to either success, growth, competitiveness, adaption or survival. Howells (2006, p. 720) defines an innovation intermediary as *an organisation or body that acts as agent or broker in any aspect of the innovation process between two or more parties.*

To summarize, a wide range of types of intermediaries has been defined, ranging from organizations such as agencies, Science Parks, institutes, incubators, or associations (Colombo, Dell'Era, & Frattini, 2015). The purpose, objectives, ways of collaboration, resources, and partner types of these also vary considerably (Meulman, 2017). From the perspective of IS, intermediaries can be defined either by their characteristics or the activities they perform. Holistically, literature separates innovation intermediaries into *organizations* or *processes* (Howells, 2006). The first type includes firms, agencies or brokers (Klerkx & Leeuwis, 2009) that facilitate intermediation of TT (Shohert & Prevezer, 1996; Watkins & Horley, 1986), adoption (Mantel & Rosegger, 1987), or diffusion (Rogers, 1995) of either technology or knowledge. Processes refer to activities, often performed by consultancy firms, that promote innovation through the exchange of knowledge or innovation between actors otherwise unlinked (Howells, 2006). In activities, scholars usually refer to either *brokering* (Howells, 2006; Kuhlmann & Arnold, 2001) or *bridging* (Bessant & Rush, 1995; Burt, 2004).

This study aligns with a more general view of the role of intermediaries in innovation, technology, and diffusion. As the gist of this research is to study how AI Sweden, as an intermediary, can accelerate applied AI in Sweden, the scope will be limited to innovation, diffusion, and technology intermediaries. Hence, organizations such as agencies, Science Parks, institutes, incubators, or associations could all be considered intermediaries, independent of differences in scope and purpose. In referring to intermediaries more holistically, the definition used in this study thus fits the industry-agnostic mission statement of AI Sweden (AI Sweden, 2021b): *to accelerate the use of AI for the benefit of our society, our competitiveness, and for everyone living in Sweden*.

2.3.2. Intermediation in innovation and networks

As identified by Ranga and Etzkowitz (2013), TT and diffusion are key functions within the IS and the benefits of including a third party in the process are well documented (Howells, 2006). Diffusion intermediaries usually act as brokers aiming to facilitate and accelerate the rate of adoption (Stewart & Hyysalo, 2008). This, by enabling trialability, demonstrating the value of the new technology to end-users, and supplying knowledge and technical know-how (Dicecca, Pascucci & Contò, 2016). Moreover, the importance of intermediaries in TT is a consequence of the gaps between technology producers and users (Sari, Alamsyah, Asmara, Kusnandar, & Mulatsih, 2017). Gaps in information, incentives, norms, management styles, or culture could all be factors that hinder TT and diffusion between actors. Intermediaries are essential to fill these gaps (Bauer & Flagg, 2010; Klerkx & Leeuwis, 2009). This is also in line with Edler and Yeow (2016) emphasizing the benefits of diffusion intermediaries bridging culture, motivation, and knowledge between developers and end-users.

One of the first researchers to point this out was Hägestrand (1952) and Rogers (1962) who revealed that intermediaries, in the form of change agents, had the possibility to influence the decision-making process and support the implementation of new technologies (Stankiewicz, 1995). The change agent's role in the social system is to influence clients in their decision process. This is done towards a direction favourable for the change agency and the client, including securing the adoption of new technologies but also preventing certain undesirable ones. Change agents can take multiple forms such as consultants, teachers, salespeople, development workers, etc., all of which acts as a communication link between a resource system and a client system. Moreover, the needs of the client must be communicated so that the change agent can facilitate the innovation flow associated with that specific need. Feedback is then generated from the client system to the agency via the change agent so that adjustments can be made to meet constantly changing needs (Rogers, 2003).

One of the main reasons for the existence of change agents in the technical and social chasms between the clients and the change agency. This, as the agency systems in general, includes individuals maintaining a higher degree of expertise associated with the innovations. However, as previously mentioned, there are some degrees of heterophyllous between the change agency and the clients. Besides the radical characteristic of the individuals in the agency system, the knowledge gap further increases the difficultly to directly communicate with the clients. Therefore, the change agent could be seen as the bridge between the two systems with one foot in each world. Rogers (2003) mention seven roles that change agents can take when introducing new technologies:

1. To develop a need for change
2. To establish an information-exchange relationship
3. To diagnose problems
4. To create an intent in the client to change
5. To translate an intent to action
6. To stabilize adoption and prevent discontinuance
7. To achieve a terminal relationship

In 1995, Bessant and Rush describe external consultancy services as being the central activities of an intermediary. Through bridging actors within the knowledge system, consultants establish linkages and connect users with technological opportunities. In 2006, Howells contributed perhaps the most holistic yet generally accepted contribution to literature on intermediaries in systems of innovation. He identifies the main activities of an intermediary as *provide information to actors about potential collaborators*, *broker transactions between two or more parties*, *mediate between already collaborating institutions or organizations* and *assist actors to find advice, funding and support for the outcomes of collaboration.* Based on these activities, Howells (2006) formulated a list of ten specific functions that are commonly adapted in literature:

1. Foresight and diagnostics
2. Scanning and information processing
3. Knowledge processing
4. Gatekeeping and brokering
5. Testing and validation
6. Accreditation
7. Regulation and validation
8. Protecting results
9. Commercialization
10. Evaluation of outcomes

Based on the activities presented by Howells (2006), several authors have further explored the role of intermediaries. Most define intermediary activities as either contributing to networking or technology development and brokering (Agogué, Yström, & Masson, 2013; Dalziel, 2010). In agreement with Howells (2006), Agogué et al. (2013) see brokering, mediation, networking, and evaluation as key intermediary activities. Traditionally, brokering activities describe how the intermediary helps a firm in the search for innovation, technology, or knowledge. Hence, the intermediary's primary role as a broker is to match the demand of actors and transfer technology or knowledge between them (Dalziel, 2010). Adding to the traditional view, Agogué et al. (2013) introduce the activity of *collective exploration,* which describes how the intermediary may initiate a connection between several organizations that seek to collaborate on cutting-edge technology but lack the partners to do so. In doing so, the focus is to explore new ideas with new actors of the network (Agogué, Berthet, Fredberg, Le Masson, Segrestin, Stoetzel & Yström, 2017).

More recently, intermediaries have been discussed in terms of how they create and transfer value through the coordination of projects or networks (Aspeteg & Bergek, 2020; Bergek, 2020). Based on the early work of Shohet and Prevezer (1996), Klerkx and Leeuwis' (2009) view of intermediaries is that they establish and manage innovation networks. In this, there are similarities to literature findings on the contributions of intermediaries in IS (Nilsson & Ljungström, 2013). Similarly, another important function of the intermediary is to bridge actors across sectors. However, there is a lack of literature in studying this phenomenon (Agogué et al., 2013). In summary, most literature does not see the intermediary as an active initiator of exploratory processes. Rather, intermediaries are usually the matchmakers between innovative firms or the facilitator of innovative activities. In this, their purpose is to combine already existing knowledge, or participants in a network to result in new combinations or solutions. Conclusively, the role of the intermediary is not binary, but usually a collective mash of networking and brokering activities.

2.3.3. Summarizing the Activities of Intermediaries

The defining factor for an intermediary's impact on its objective and influence in a system of innovation is its activities (Howells, 2006). Several authors have, with some variety, made attempts to define the typical intermediary activities. Based on the contribution of these authors, activities can be summarized conceptually into three main themes of activities: *bridging*, *brokering*, and *testing*, as seen in Appendix C and Figure 10.

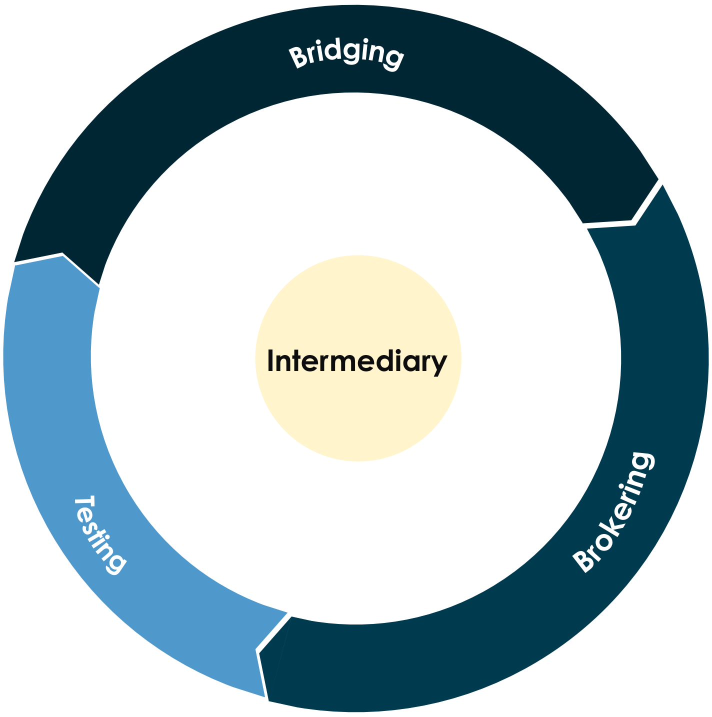

Figure 10. Main intermediary activities, as summarized by literature review in Appendix C.

Next, the intermediary activities illustrated in Figure 10 and Appendix C, is detailed in full:

Bridging

The intermediary role of *bridging* can be summarized in three main features: *establish linkages between actors, support and create networks* and *identify and develop needs for change*. Each of these groups the key bridging activities of an intermediary that is mentioned in literature. *Establish linkages between actors* can be traced back to Chesbrough (2003), Bessant and Rush (1995), Meulman (2017), Shohet and Prevezer (1996) and Spithoven and Knockaert (2011). Holistically, bridging activities include actions that close the gaps between the principal actors within the innovation system. Specifically, these activities contribute to building technological communities or alliances of public institutions, universities, and industry actors.

Support and create networks refer to system-level activities that is more recently featured by scholars such as Dalziel (2010), Aspeteg and Bergek (2020) and, Nilsson and Ljungström (2013). These activities contribute to market identification, legitimation and, formation, but also system infrastructure creation. For instance, the intermediary can guide companies through institutional challenges such as permits or support systems or advance sustainable transition by opening up emerging niches to new users. In this, the intermediary plays an important role in the facilitation of bilateral or multilateral exchanges.

Lastly, *identify and develop needs for change* represents the activities pioneered by Rogers (1995) and later developed by Bessant and Rush (1995). As previously mentioned, change agents fulfill seven roles that facilitate the adoption of new technology. From the perspective of the intermediary, these are necessary both at a network and individual level. In the former case, identification, articulation, and selection of options are needed to spur the joined forces of actors. In the latter case, intermediaries not only aid the client in articulating the need for change but also in translating these intents to actions.

Brokering

Brokering can be broken into the features *gatekeeping and brokering*, *transfer knowledge* and *resource coordination*. Based on the work by Hargadon & Sutton (1997), Howells (2006) describe how intermediaries do *gatekeeping and brokering* by not only facilitating linkages across actors, but also diffusing knowledge or technology from outside the system. In this role, the intermediary acts as an agent or broker between companies and external experts. This is aligned with a more hands-on approach, which may include project management, managing external resources, and organizational development. Moreover, activities include contractual or technical advice related to transactions of two or more parties. In sum, the intermediary can, as a broker, act as a knowledge repository where users can extract and combine ideas into new solutions.

In *transfer knowledge*, intermediary activities focus on the knowledge dimension. As per Spithoven and Knockaert (2011) and Meulman (2017) intermediaries can be expected to absorb, develop and diffuse knowledge through various activities. First, scanning and information processing is accomplished to gather market research. Then, this knowledge is transferred externally and internally through either training and development or education. To outside actors, the intermediary may establish an information exchange relationship or facilitate the creation of synergies. For instance, in the transfer of basic and applied university knowledge to the marketplace.

Finally, Bauer and Flagg (2010) and Shohet and Prevezer (1996) highlight how *resource coordination* is a key function of intermediaries. In this function, activities include providing other actors access to resources or assisting in the search for resources, both human and financial. Thus, the intermediary role is supportive to other actors in terms of offering assistance associated with technology research, product development, and product commercialization.

Testing

In the activity theme of *testing*, the intermediary fulfils the features of *ideation*, *commercialization* and *protection*. In *ideation*, activities such as testing and validation of new technology have been covered by Howells (2006), Bauer and Flagg (2010) and, Dalziel (2010). Importantly, the intermediary uses foresight and diagnostics to test and forecast the trajectory of technological opportunities. By providing roadmaps and articulating business cases, it promotes investments in new technologies.

Commercialization and *protection* typically associate with the output of collaboration and innovation (Benassi & Di Minin, 2009; Bessant & Rush, 1995; Howells, 2006). In commercialization activities, the intermediary is active through sales channels and in the evaluation of outcomes. For example, intermediaries support firms by activating its sales network, and by financial support in the early stages of development. For unestablished firms, communication and brand management is carried out to create early traction. In *protection*, intermediaries perform activities related to intellectual property rights and regulation. Specifically, formulation and control of patents and trademarks may be important for remaining in control of emerging technologies post the ideation stage. At last, intermediaries rarely perform formal regulation. Yet, they can be an informal arbiter between actors that transact in the system.

2.4. Conceptual framework

From summarizing literature findings, a theoretical framework has been conceptualized (Figure 11). The framework is composed of three main theoretical components: functions of TIS (see 2.1.3), innovation process (see 2.2.4), and intermediary activities (see 2.3.3).

The innovation intermediary and its activities (Howells, 2006) can be considered components of a TIS (Bergek, 2020). The functions F1-F8 (Figure 11) of a TIS are the activities that facilitate the performance of a system and are commonly used to study IS (Bergek et al., 2008, 2016; Hekkert et al., 2007; Köhler et al., 2016). Very few authors have discussed to which degree the functions of a TIS are fulfilled by the activities of innovation intermediaries and diffusion theories. However, this connection is made in the conceptual framework (Figure 11), which can be used to investigate the role of the innovation intermediary in contributing to TIS functions and diffusion activities (Howells, 2006; Lukkarinen et al., 2018; Nilsson & Sia-Ljungström, 2013).

The list of defined intermediary activities is long but can be summarized into *brokering*, *bridging*, and *testing* (Appendix C). In the conceptual framework (Figure 11), these activities capture how the intermediary facilitates, supports, and interacts with other actors in the TIS. Finally, within the boundaries of the TIS, diffusion, and transfer of technologies and innovations occur. In the conceptual framework, the theories are jointly affecting the adoption of innovations and technologies.

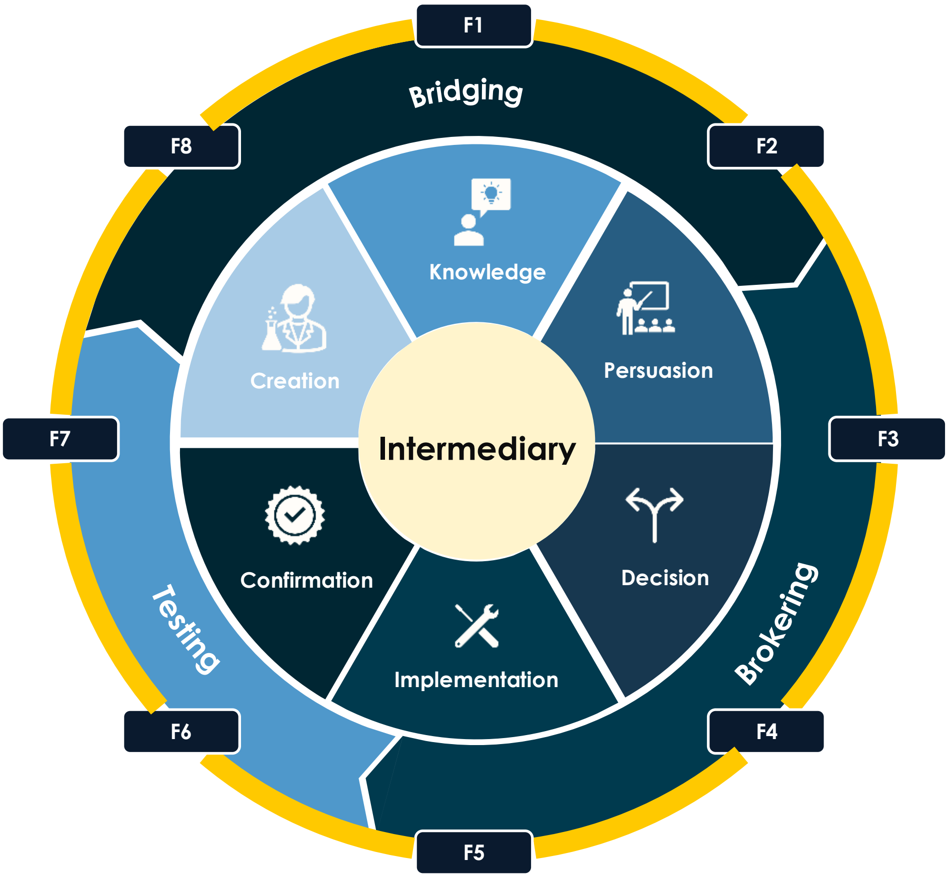

Figure 11. Conceptual Framework.

To summarize, the conceptual framework (Figure 11) captures how innovation activities, TIS functions and, the innovation process previously outlined are all interconnected and related to the innovation intermediary. According to literature, the intermediary has a central part in the formation of networks and the transformation and diffusion of technology and knowledge. All in all, the theoretical backdrop gives a comprehensive toolbox as to how the contribution of an intermediary can be analyzed. Conclusively, the framework can be deployed to investigate the role of innovation intermediaries in TIS.

3. Methodology

The aim of the third chapter is to enclose all the choices and aspects concerning the methodology of the research conducted. Themes discussed in this chapter concern the research strategy followed by research design and data collection. The chapter ends with an examination of the research quality. After this chapter the readers will understand how the authors reached the conclusions.

3.1. Strategy

This research is grounded on abductive reasoning due to the rather unexplored field of research and its exploratory kind. Moreover, existing theories and hypotheses will not be tested nor developed. Instead, the focus will be on explaining the role of AI Sweden, which could be seen as a poorly defined concept. Meanwhile, deductive reasoning aims to reveal the truth based on a known claim or a belief, that is, going from general to specific, inductive reasoning aims to reveal general assertions and theories based on specific evidence (Kolko, 2010). However, the deductive approach is criticized due to the complexity and lack of information on how to select theories to test with hypotheses. Inductive reasoning, on the other hand, is criticized due to the adequate amount of existing literature required in order to enable theory-building (Bell et al., 2019). As a way to overcome these limitations, abductive reasoning allows for a back-and-forth engagement with the literature, theories, and the social world, as illustrated in Figure 12. This, to best explain causes and effects with the evidence available (Mantere & Ketokivi, 2013).

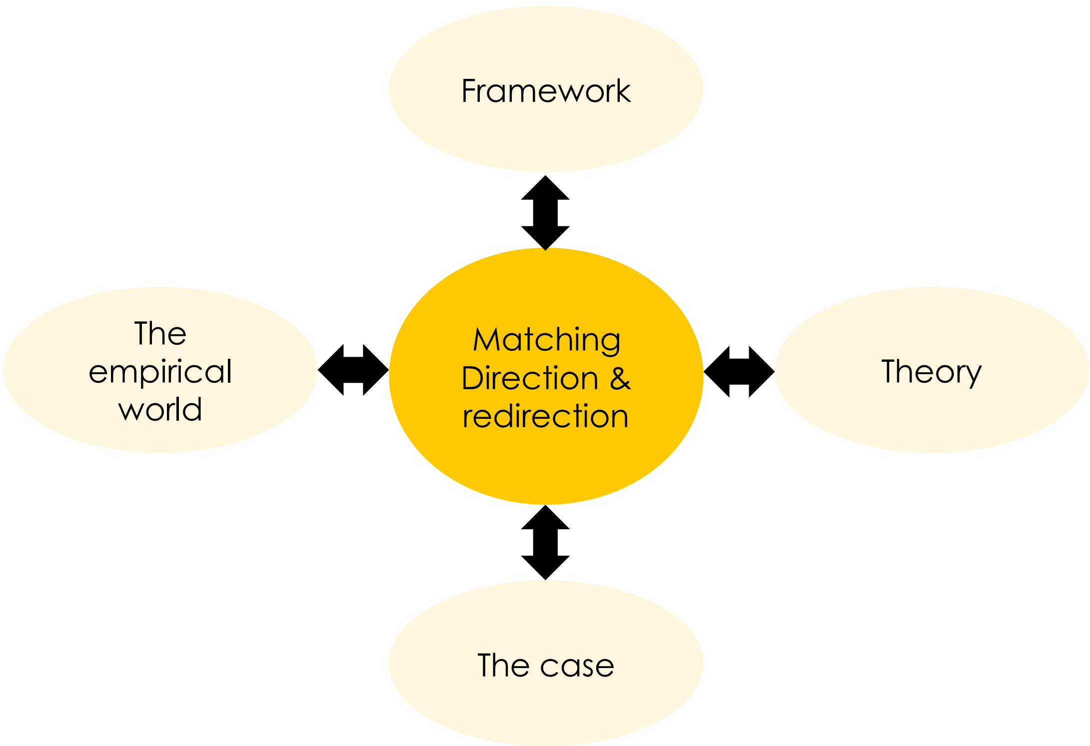

Figure 12. Abductive reasoning (Dubois & Gadde, 2002, p. 555)

Therefore, abductive reasoning is in line with the approach applied in this thesis, where the focus has been shifted between empirical data and theory to investigate how a phenomenon occurs resulting in a plausible conclusion. This, by analyzing collected opinions and insights. Moreover, as the empirical data was analyzed, new factors appeared affecting the theoretical framework necessary to consider. Therefore, to improve the relationship between secondary and empirical findings, an iterative process was used, where the framework was revisited and modified continuously. This, in line with Dubois and Gadde (2002) stating that a theory cannot be comprehended without empirical data.

In selecting a suitable research strategy in relation to the research objective of this study, a qualitative approach will be more appropriate than a quantitative one, for several reasons. First, a qualitative approach is suitable given the dynamic and social environment of this study. For instance, intermediaries and actors in TIS operate on different contextual levels, and hence intermediary functions in TIS cannot be analyzed based on quantitative measures (Kanda et al., 2019). Furthermore, instead of focusing on statistics and hard data, the focus in this dissertation will be on capturing the value of words and observations. Moreover, data can be collected and analyzed in parallel, which potentially allows for redirecting the focus of the study depending on findings. Therefore, based on the new collection of data, the focus of the research can be altered along the way to capture unexpected findings. The novelty and lack of pre-set direction of the research also entail that words, qualitative information, and reasoning are preferred over quantified data and analysis. As the purpose of this research is to uncover how AI Sweden and the DF can be used as an innovation intermediary to accelerate applied AI in an innovation system, the attention of the study is on subjective views and opinions from experts rather than observations of an already existing phenomenon. Therein, the goal of this research is to investigate experts' perceptions, attitudes, and reflections. That is, to get a close look to understand the situation through the subject's point of view in the TIS. At the same time, quantitative research is limited by strict guidelines and guides on how to proceed with the research. On the other hand, qualitative research is more open and descriptive (Bell et al., 2019). With the objective of capturing in-depth thoughts and opinions of respondents, semi-structured interviews are preferably based on the flexibility and alignment with the exploratory nature of this research.

3.2. Design

In general, the research design contributes as a framework to guide the data collection and the following analysis (Gray, 2019). In order to best capture and describe a certain phenomenon, as well as earn in-depth knowledge, this thesis will take on a typical case-study design (Yin, 2018). Conducting a case study is preferable when studying a contemporary real-world case taking an explanatory manner. The design is especially suitable for research directed by a research question asking *what*, *how*, or, *why* a phenomenon exists or works, which is in line with this study (Yin & Davis, 2007).

There are multiple types of archetypical research designs. Firstly, comparative design, which is usually conducted when the focus lies on investigating the distinguished characteristics and contrasting findings by applying an identical method to more than two cases. However, this is not in line with the research question nor the goal for this research. Secondly, the cross-sectional design is often used to prevail characteristics in a population at a single point in time. This, by investigating cases across different sectors. The choice of a case study over a cross-sectional approach is motivated by the fact that this research is based on a single case and will not be done at one point in time. On contrary, the cross-sectional design aims to produce general findings using a sample of cases within a population, applying a more structured data collection method. Moreover, as this thesis aims to study a single case, a longitudinal approach is not an option. Finally, experimental design is not suited for this study as the intention is not to manipulate a controlling variable and analyze the effects (Bell et al., 2019).

Although case study research is widely accepted, it comes not without any concerns. Researchers have questioned the rigidness as many researchers have been sloppy by not following a structured or systematic process. Additionally, the case-study approach has also gained popularity outside the research realm which has resulted in ambiguous usage of the design and thus confusion in regard to the quality. Therefore, in line with this research, it is important to highlight the methodic procedures to overcome this confusion.

3.3. Research Process

The overall research has followed the steps seen in Figure 13. As previously stated, the research followed an abductive reasoning approach. This is revealed by the back-and-forth flow of information illustrated in Figure 13. In this section, the introduction process, including a selection of the research area and formulating the scope and research question, will be elaborated. In the following section, the remaining processes will be outlined.

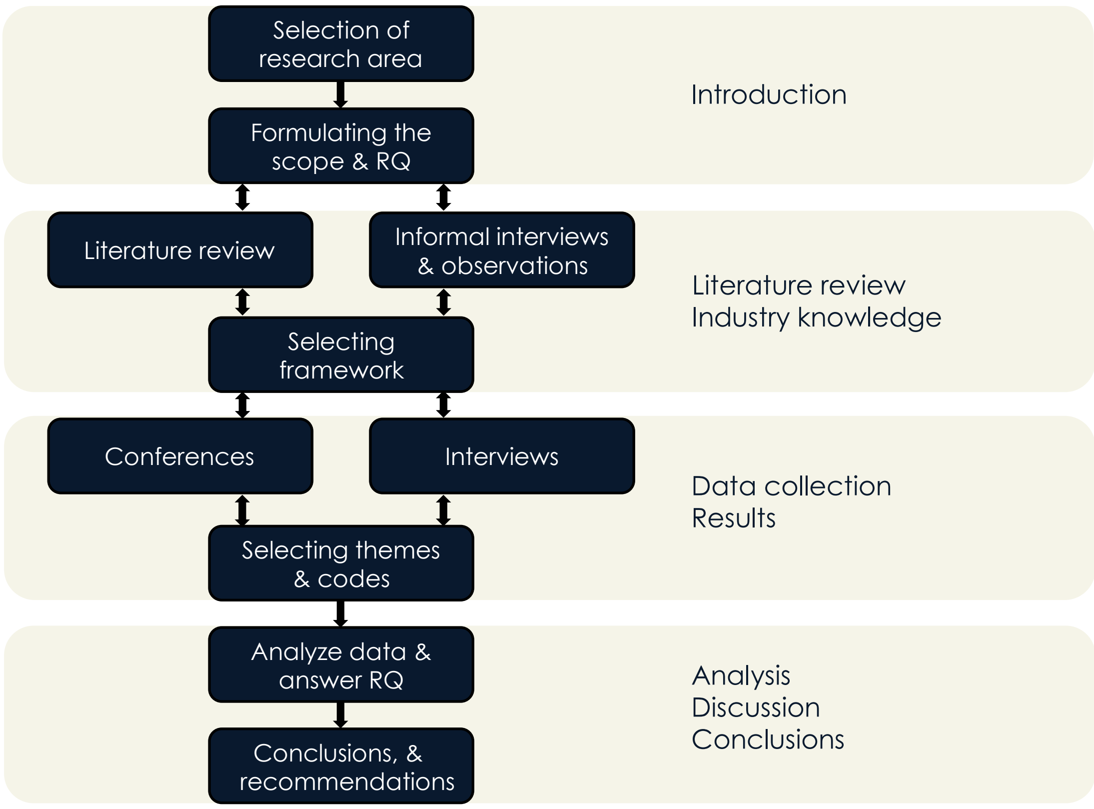

Figure 13. Research process.

The selection of the research area was picked based on both personal interests in AI and innovation concepts, and a request from AI Sweden. As a novel and unexplored field, AI Sweden wished for a better theoretical understanding of their role in the ecosystem. Moreover, previous literature was investigated to get an understanding of what had already been written. However, due to AI Sweden's novel characteristics, a gap in existing literature was found. In addition, a research proposal, including research area and proposed research question, was established and discussed with supervisors at GU and AI Sweden. Therefore, both creative and rational thinking was applied in the process, which tend to result in value adding research (Saunders et al., 2009)

Moreover, due to the abductive approach applied to this research, the formulation of the research question took an iterative process and was not affirmed until the end of the research. The theories applied and the focus on the research shifted under the research process based on the data collected. Therefore, the initial research question was more general, but became successively narrowed down (Saunders et al., 2009). In line with this research, this procedure of formulating the research question is suitable when the nature of research area is ambiguous (Blomkvist & Hallin, 2015).

3.4. Data Collection

The method for conducting the literature and the procedures used to collect primary data are presented below. As the aim of this research is to investigate how AI Sweden as an intermediary can increase the usage of AI, the primary data were collected from both AI Sweden and their partners. Furthermore, to enrich the understanding of the research area and the specific context, as well as to complement the interviews, observations were applied.

3.4.1. Secondary Data Collection

A literature review was conducted primarily for two reasons. First, secondary data is essential for any dissertation to provide the basis for the justification of the research question (Bell et al., 2019). This, as the data gathered in the literature review, aims to create awareness of previously conducted research and reveal potential gaps. Additionally, the literature will support the empirical findings and enable a discussion to draw conclusions from. Secondly, due to the abductive reasoning applied, theoretical concepts from the literature were used to guide the development of the theoretical framework and interview guide using an iterative procedure (Malhotra, 2017).

Bell et al. (2019) mention two types of approaches used to conduct a literature review, systematic and narrative. This research will mainly follow a narrative approach, which is in line with the process following the abductive reasoning. This, as a narrative approach, is likewise an iterative and non-structured approach (Juntunen & Lehenkari, 2021). Moreover, the choice of a narrative review is further motivated by the relatively uninvestigated research context. Therefore, the choice of literature continuously changed as the researchers successively familiarized themselves with the environment through observations. Consequently, the definitions associated with the theories and concepts could not be set prior to the study, which the systematic approach requires (Xiao & Watson, 2019). Moreover, the narrative review is less strict in regard to exclusion and inclusion criteria in contrast to the systematic approach (Holstein, & Gubrium, 2016). In addition, a more flexible approach was desirable. This, as it aligns with both the exploratory foundation of this research and the aim to explain the research objective through theoretical concepts.

Furthermore, the gap between narrative and systematic approaches has decreased as researchers have started to mix the procedures (Bell et al., 2019). This, to seize some of the benefits associated with the systematic review, including increased replicability, transparency, and decreased research biases (Xiao & Watson, 2019). Similarly, after the initial research phase whereby understanding associated with the research environment was gained, some systematic process methods were incorporated in terms of targeting keywords, mentioned below.

Keywords: Technology transfer, Diffusion of innovation, Innovation systems, Innovation intermediaries

As a source of secondary data, academic online databases were used. The sources were limited to the search engine provided by Gothenburg University Library and Google Scholar. Moreover, as a means to increase the quality of the literature used a critical review selection was applied (Bell et al., 2019). The first criterion concerned the prerequisites that the literature had to be peer-reviewed and written in either English or Swedish. Secondly, the interest and impact of the literature included in this research were observed by the number of citations. Consequently, the literature was sorted by the number of citations and was selected outwards from there. However, despite a high grade of citations, to keep the research focused, the literature was selected based on how relevant it was to the research question. The exclusion and inclusion criteria used are summarized in Table 2.

Inclusion Criteria	*Exclusion Criteria*
Academic publications	Not peer-reviewed academic reports
Peer-reviewed	Other languages than English or Swedish
Consultancy reports	Financial intermediary
English or Swedish language	Sources related to specific cases in Technology Transfer
	Other articles than academic- or consultancy reports

Table 2. Inclusion & exclusion criteria for secondary data collection.

3.4.2. Primary data collection

Primary data has been collected through interviews with partners and other organizations related to AI Sweden. The goal of the interviews was to get interviewees to talk about their experiences, perspectives, and to capture their language associated with a predetermined subject (Rubin & Rubin, 1995). Moreover, interviews in this research are defined as a *professional conversation* (Kvale, 2007) and are preferable in qualitative research due to their flexibility and the social prevalence associated with interviews (Braun & Clarke, 2013).

In this research, a combination of theoretical sampling and snowball sampling has been utilized. Firstly, in collaboration with AI Sweden, the respondents were selected using a snowball sampling approach (Braun & Clarke, 2013). This, as key informants at AI Sweden, were asked to select appropriate partners to interview. One of the greatest advantages of snowballing is that it reveals the connectedness of participants in a network (Bell et al., 2019). However, some criteria were desired. The researchers requested to interview partners within all sectors including universities, the public sector, and the private sector. Moreover, the respondents had to be actively related to the business environment associated with the purposed research questions. Due to the various sectors and roles possessed by the respondents, multifaceted knowledge could be captured. Moreover, the findings using a snowball sampling approach are very unlikely to be representative of a whole population. Therefore, the findings from the empirical data cannot be generalized (Bell et al., 2019) However, this was not the underlined goal of this research. Secondly, in line with the abductive reasoning and grounded theory, elements from the theoretical sampling strategy were applied. This, due to the iterative procedure between sampling, data collection, and analysis. As a consequence, as the interviews proceeded, the key informants were asked to select respondents not only with respect to their relevancy to the research area but also to their ability to contribute to an understanding of the theoretical concepts.

In general, qualitative research tend to include a smaller sample size compared to quantitative studies. Moreover, there are no strict rules of how large the sample size should be (Patton, 2002). However, in line with the recommendation given by Braun and Clarke (2013), ten interviews were performed. This, including a total of eleven interviewees examined in Table 3. Moreover, as a consequence of the combined sampling method used, saturation could be met. This, as the researchers, could request additional interviews until the data collected failed to generate new information (Morse, 1995). However, because of the non-randomized selection process, biases have likely occurred. Nevertheless, due to the variety within sectors, organizations, and roles (see Table 3) the result is not expected to be negatively affected.

#	*Date*	*Company*	*Type*	*Role*	*Duration*
1	2021-02-17	AI Sweden	Intermediary	Senior Project Manager, Eco-system and Node Manager East	50 min
2	2021-02-19	AI Sweden, Zenseact	Intermediary	Acting Head of Data Factory	60 min
3	2021-04-13	Datafabrikken	Intermediary	Head of Secretariat DIGITAL21	42 min
4	2021-03-30	Hewlett Packard Enterprises	Private	Chief Technologist	73 min
5	2021-04-06	CGiT	Private	Head of Sales	52 min
6	2021-04-16	Sony	Private	Research Director	50 min
7	2021-05-04	Google	Private	Technology advisor and Cloud architect	44 min
8	2021-04-22	VGR	Public	Regional Development Officer	53 min
9	2021-04-15	GU/Bitlab (Business IT Lab)	Academia	Senior Lecturer, PhD, Director	47 min
10	2021-04-27	Imperial College London	Academia	Professor of Digital Strategy and Innovation	54 min

Table 3. Interview details.

The interviews took the form of a semi-structured approach. This, as the researchers started the investigation with a relatively clear picture of the research field, gained from observations, which are further elaborated in the next section. By applying a semi-structured approach, the focus could be aligned towards relevant uncertainties, but at the same time allow for new aspects to emerge (Bell et al., 2019). To keep the interview both structured and flexible a detailed interview guide was elaborated with questions covered in the interviews (see Appendix D). However, the respondents were free to move from the subject to discuss supplementary topics that were deemed to be relevant and vital for the researchers. The interview guide was based on the initial research questions and consisted of open-ended questions so that the interviewees could answer on their own terms. Open-ended questions were preferable to encourage in-depth and detailed responses and to open a discussion about what is important for them (Braun & Clarke, 2013). At the end of the interviews, the interviewees were asked if there was something additional the researchers should have taken into consideration or had overlooked. This, to get a nuanced result and to decrease the risk of questions being missed out in the interview guide. Moreover, due to the synchronous approach and the time constraints at hand, the interviewees had the chance to read and familiarize themselves with the interview questions and themes prior to the interviews to make the answers more thoughtful. However, this might come with a drawback as the degree of veraciousness and spontaneousness might be affected (Bell et al., 2019). Moreover, the interview guide followed an iterative process in line with the abductive reasoning process. With the insight gained from the interview, the interview guide was revised with respect to the theories and concepts and the data collected. This approach could make the conclusions less replicable. However, due to the benefits following the abductive reasoning and the relatively unexplored field, this approach was considered most suitable.

Moreover, prior to the interviews, the researchers were familiarized with the research field to increase the level of perceptiveness and jargon under the interviews. Because of the circumstances followed by the pandemic, face-to-face interviews were not an option. However, as a substitute for face-to-face interviews, virtual interviews using software applications were used. These online tools allow for a synchronous interview and simultaneously provide flexibility due to the convenient accommodation (Bell et al., 2019). Further, due to the non-comparable characteristics of the interviews, the respondents had the possibility to decide some of the details in the interview procedure, such as location, time, and software. This, to make the interviews as natural and relaxed as possible. The interviews were performed utilizing the internet mediums Google Meets, Zoom, and Teams. In addition, one phone call interview occurred according to the respondent's desire. Despite respondents had the possibility to familiarize themselves with the interview guide prior to the interviews, the interviews started with an introduction of the researchers and the background behind the study. Furthermore, to capture the language used and answers in their own terms, all interviews were recorded. However, to avoid misunderstanding, the researchers asked for permission to record the interviews in advance. Further, to increase the quality of the recordings and to unpeg the possibility of being overheard, the interviews were encouraged to be held in quiet and private places. Moreover, in order to encourage the respondents to be open-minded and less restricted, anonymity was provided as no names are revealed (Bell et al., 2019). After each interview, information about the quality of the interview, the first impression of interesting insights gained, and the time spent was noted down. Moreover, the recordings were subsequently transcribed into Microsoft Word on the same day so that the data could be further analyzed and processed. Before sending out the transcript for validation by the respondent, the other researcher had to approve.

3.4.3. Observations

As a complement to the interviews and to build an initial understanding around AI Sweden and the role of the DF, observations were used. The observations have additionally contributed to contemporary knowledge around the research field and given the researchers a contextual understanding of the current uncertainties, challenges, and culture associated with the business environment. Observations were made through participation in meetings and selected knowledge-disseminating initiatives hosted by the organization. The meetings and initiatives were selected on a subjective basis by AI Sweden using a purposive sampling approach (Bell et al., 2019). The first type of meeting observed was the monthly strategy meetings hosted by and focused on the DF department. The second observation was made through participation in the weekly Monday meetings, which are dedicated towards the whole organization and aim to update and align the teams. Additionally, two initiatives in the form of webinar conferences hosted by AI Sweden were observed: DF Day and AI Transformation Day.

In the first meeting, the researchers presented themselves and the research proposal to inform all the participants of the reason for the presence. However, in the following meetings and during the conferences the researchers took a complete observer role and did not interact with the people. Consequently, the researchers face the risk to incorrectly interpret the situation. Additionally, participants in the meetings might also be hesitant to reveal certain information and become influenced as a reaction to the presence of the observers (Gray, 2019; McCarney et al., 2007).

3.5. Data analysis

In contrast to quantitative research, qualitative research, in general, involves large and complex data sets due to its unstructured characteristics. Navigating through qualitative data is not a simple task, especially as the procedure, in comparison to quantitative research, is less analytical with ambiguous rules (Bell et al., 2019). However, guidelines and strategies are provided in the literature and applied in this research to overcome these challenges. By combining thematic analysis (TA) and grounded theory (GT) in line with the abductive reasoning, the data analysis was executed in parallel with the development of the theoretical framework.

TA, which is one of the most common strategies within qualitative research to analyze data, aims to match concepts or patterns into themes (Bell et al., 2019). This can be done by identifying key features in the data guided by the research question in either a bottom-up or top-down procedure (Braun & Clarke, 2014). Furthermore, Braun and Clarke (2013) mention six steps in the thematic approach, which are illustrated in Figure 14. Firstly, the researchers should read and get familiarized with the collected data. This was done by listening to and transcribing the data. Notes were written down along with timestamps to easily find quotes in a later stage. Secondly, interesting features found in the data were coded and categorized manually by the researchers. In a third step, the codes were compared and compiled into potential themes. Therefore, the codes could be seen as building blocks for the themes. In line with the abductive reasoning and GT, this process took an iterative form as the codes were revisited as the interviews proceeded and the theoretical framework developed in order to determine the best possible fit. Once the empirical data were saturated and the interview process was finished, the fourth and the fifth step were brought in. In those steps, the themes were reviewed and renamed to better fit the relevant theory. Those themes were subsequently applied in the following sections of the research and enabled for identification of key features (Braun & Clarke, 2013). Finally, in the last step, the theory and the empirical data were analyzed jointly. The themes were used to present the data in a structured manner.

Figure 14. Outline of analysis process, adapted from Braun and Clarke (2013).

Applying TA comes both with advantages and risks. While the method is widely recognized for its flexibility in terms of the research question, methods of data collection, and theoretical framework. It is also limited in terms of providing information of continuity and contradictions within individual reflections. However, the focus and the design of this study do not require such in-depth information. Moreover, because of its relatively easy-going approach, TA is preferable for less experienced researchers in comparison to the more labor-intensive methods (Braun & Clarke, 2013). Another disadvantage, mention by Bell et al. (2019), is the risk of losing parts of the story being told by the respondents. This, as the social setting, might get lost when picking chunks of text out of the context. Additionally, as the coding procedure is a subjective interpretation of the transcripts, it can be argued to be biased due to individual judgment. To mitigate these drawbacks, key features extracted from the coding process were divided into multiple steps. Moreover, the coding process was done by both researchers. Subsequently, the codes were reviewed and approved by the other author before being applied. The coding process was further facilitated by the clear categorization of subjects in the interview guide.

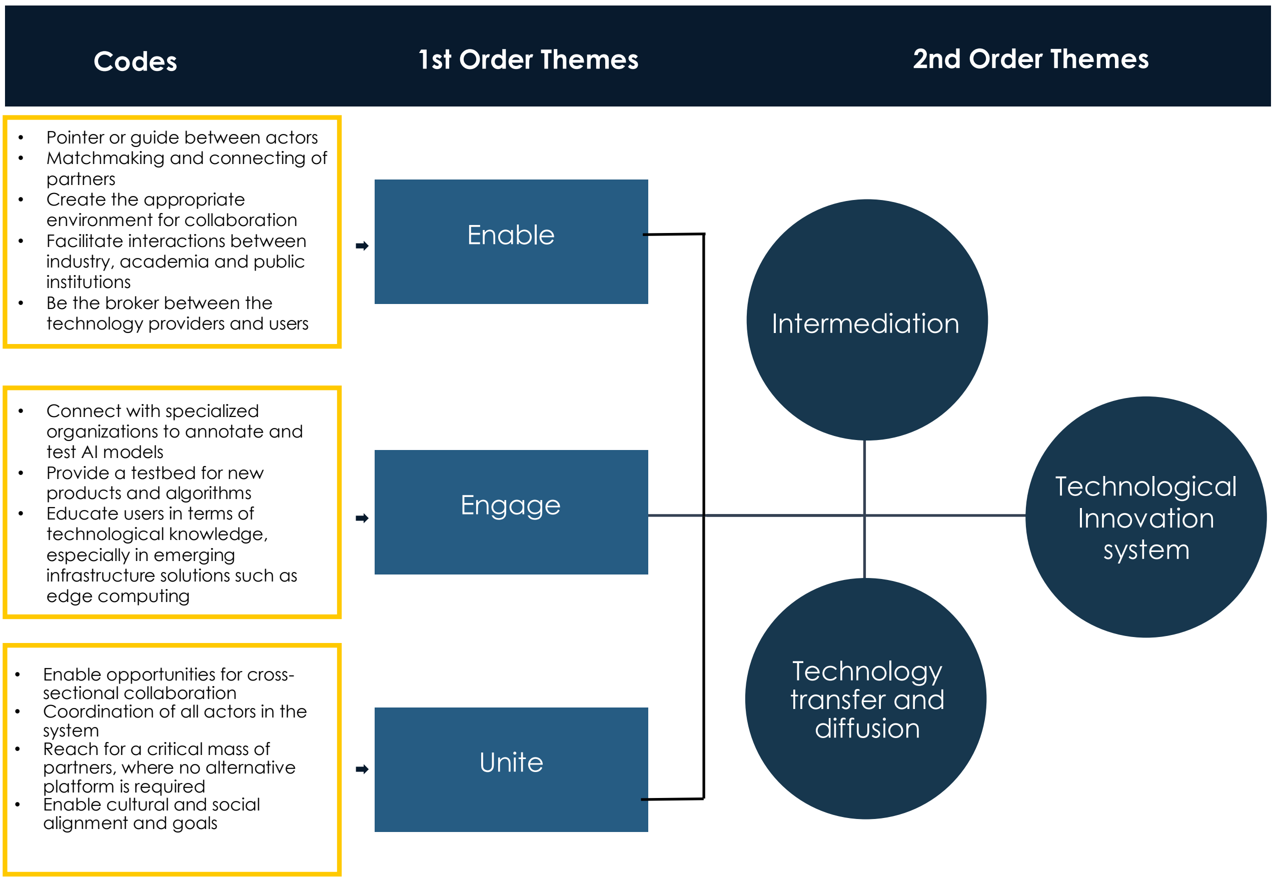

Figure 15. Data analysis framework.

As seen in Figure 15, the codes derived from the coding process were then merged into the 1st order themes: *Unite*, *Engage*, and *Enable*. These themes evolved from the iterative process previously mentioned, and reflects the main activities performed by the DF. The definitions of these themes are further elaborated in the following chapter. Finally, in the analysis, the 1st order themes and its underlying activities were consequently linked to functions, activities and factors related to the theories under the 2nd order themes.

3.6. Research quality

When assessing quantitative academic research, the perhaps most commonly used concepts are *validity* and *reliability* (Bell et al., 2019). While these have been applied also in qualitative research, Lincoln and Guba (1985) argue the appropriateness of four alternative criteria: *credibility, transferability, dependability* and *confirmability.* Although there is no consensus in regards to which criteria is the most appropriate for evaluating qualitative research, the criteria of Lincoln and Guba (1985) are quite adaptable yet established. Because of this, they will be applied to evaluate the quality of the findings in this study.

Credibility is related to internal validity, in that, it questions the believability of findings (Bell et al., 2019). Specifically, credibility refers to the findings' degree of trustworthiness and that the research has been carried out in accordance with good practice. But also, it refers to the compatibility of applied theory and empirical findings. To improve the credibility of this study, all interviews will be recorded and fully transcribed. Also, to guarantee the congruence of empirical data, the authors offered to send out the transcripts and quotations used to the respondents for validation. However, none of the respondents wished for controlling the transcripts before publication whereby all were validated.

Transferability is related to *external validity*, in that it questions to what degree the findings can be applied to other contexts (Bell et al., 2019). Here, *transferability* refers to how well the findings of this study can be generalized to other environments or samples. Because of the rather narrow scope and unique context in this research, the generalization of this study's findings related to all populations will arguably be limited. Moreover, concerns over the generalizability associated with case studies have been questioned. However, as this research will apply a single-case design, the aim is not to form a generalized conclusion. In contrast, valuable insights and theoretical recommendations based on the specific context will be provided (Yin, 2018).

Dependability is related to *reliability* in that it questions if findings can be applied at other times. For qualitative research, reliability refers to the rigidity of the research process, meaning the extent to which it can be repeated by others (Bell et al., 2019). In this study, the design and execution will be methodically documented in all steps. By applying this so-called *auditing* approach, which includes documenting the problem formulation, records, transcripts, and decisions made, the appropriateness associated with the research procedures could be audited by peers.

Moreover, several steps will be taken to differentiate the context of the interviews with respect to time and place. Otherwise, because of the ongoing pandemic, findings would potentially be affected by an unusual variance in either positive or negative attitudes (Bell et al., 2019). To counter this, interviews will be held at different times throughout the day, over a span of at least two months in 2021.

Confirmability is related to *objectivity* in that it questions the objectiveness of (Bell et al., 2019). While complete objectivity is not possible for a study such as this, some steps will be taken to improve it. First, the authors will work together in controlling and questioning the validity of all findings. To further minimize subjectivity, interview transcripts and coding will be conducted together by the authors, but also with the outside help of an objective supervisor.

Finally, throughout the research, ethical considerations have been taken into account. The measures taken in connection with ethical considerations aim to mitigate the harms and risks associated with participants. With clear communication between the researchers and respondents, potential implications were carefully considered. Therefore, information and purpose of the interviews were provided in advance, including the interview guide used in the interviews (Miles & Huberman, 1994). Furthermore, the respondents were offered full anonymity. However, a mutual agreement of revealing the company name as well as their positions were achieved. This was desirable as it was expected to increase the overall credibility. The interviews were recorded only after the respondents agreed and the researchers highlighted that no questions were compulsory. Additionally, as previously mentioned the respondents had the opportunity to validate the transcripts and quotation used in the research, this, for both ethical and credibility reasons (Bell et al., 2019).

4. Empirical results

This section captures the primary data collected from interviews, that have been coded into the 1st order themes *unite*, *enable* and, *engage*. The empirical results are summarized in Table 4.

In *unite*, activities are related to how AI Sweden attracts and nurtures its partner network. *Enable* includes activities that drive interactions between actors in the field of applied AI. Finally, *engage* demonstrates the hands-on activities that AI Sweden, through the DF and EL, does to collaborate and co-develop emerging technologies.

Summary of AI Sweden and Data Factory's main activities

UNITE

- Enable opportunities for cross-pollination across industries
- Give access to case studies, partners and collaborations in a wide range of industries
- Coordination of all actors in the system
- Find and gather companies of different backgrounds
- Enable the development of new businesses and enterprises to transition into a data economy
- Reach for a critical mass of partners, where no alternative platform is required
- Be used for firms to find each other and regional experts in a vibrant AI community
- Communicate a sense of urgency by emphasizing ethics and sustainability goals

ENABLE

- Pointer or guide between actors
- Matchmaking and connecting of partners
- Create the appropriate environment for collaboration
- Bridging of relationships
- Facilitate interactions between industry, academia and public institutions
- Be the broker between the latest technology providers and AI users
- Enable interactive communication channels
- Enable best practices, standards, and technology development

ENGAGE

- Connect with specialized organizations to develop, annotate and test AI models
- Provide a testbed for new software products and algorithms
- Educate users in terms of technological knowledge, especially in emerging infrastructure solutions such as edge computing
- Diffusion of awareness and advantages
- Emphasize knowledge more than developing proof-of-concepts (POCs) in technical applications
- Collaborate strongly with academia and research institutes to develop long and short-term educational programs, collaborative projects and research programs
- Make it easier and faster for companies to deploy and experiment on datasets.
- Evaluate and manage feedback

Table 4. Main empirical results, as summarized in 1st order themes.

As previously described, the activities of AI Sweden can be summarized into three main themes (Table 4). Next, these themes are elaborated by interviewees and accompanied by direct quotes, to fully capture the results of the primary data collection. In the final section (4.4), other observations are summarized that could not fit within any of the 1st order themes.

4.1. Unite

The first of the 1st order themes captures how AI Sweden *unites* a network of actors. Collectively in the view of respondents, AI Sweden is described as an evolving ecosystem where partners can build, collaborate, illustrate and experiment with AI. The attraction of such an ecosystem is facilitated by numerous activities and procedures in terms of positioning. First, partners recognize the value of a network where collaboration and access to the latest information in the AI space is available. The possibility to share knowledge through national focus groups is a driver for companies to join the ecosystem. Holistically, partners recognize the role of AI Sweden as important for the adoption of AI and to an extent for tackling ethics and sustainability goals. In general, a sense of urgency is notable across respondents, who acknowledge that organizations will need to adopt AI, or they are not likely to survive. In answering what attracted them to the AI Sweden ecosystem and DF, partners said that:

"The collaborative focus at AI Sweden has from our perspective not been possible in this way before in the AI space, and it is definitely appealing" – Google

"You can discover business values earlier in an innovation process by collaborating in the AI Sweden ecosystem." – HPE

"There is a golden opportunity in the Data Factory to take a role in the collaboration between private businesses and governmental bodies in the data sharing economy. [...] There is a good opportunity to facilitate and enable the development of new businesses and enterprises to transition into the data economy" – Digital21

"Data Factory can reach a critical mass of partners, where no alternative platform is required. This can then be used for firms to find each other and regional experts from a vibrant AI community." – Sony

"How useful is it to have a 1-kilometer railroad? In the field of AI, many of us are laying 1 kilometer railroad tracks but we all use different width between the tracks. Data Factory could help with the coordination of a railway system." – VGR

As mentioned above, partners value access to a wide range of partners. Access to case studies, partners, and collaborations in a wide range of industries is a main contributor as to why partners join AI Sweden. Having a place where companies can trade best practices is quite valuable. Partners note that it's important that AI Sweden has broad sector coverage:

"One great thing about AI Sweden is that it has been superb in finding and gathering companies of different backgrounds" – VGR

" We see great value in the partner network of AI Sweden. The sharing of knowledge and experience among partners that do different projects in different industries is absolutely the most valuable factor." – Google

AI Sweden enables opportunities for cross-pollination across industries. For instance, partners active in automotive can find synergies from healthcare providers." – HPE

Interviewees add that DF softens the challenge of regulation and privacy legislation with a regionally located platform for collaboration. This makes it easier and faster for companies to deploy and experiment on datasets. Respondents sum up how AI Sweden attracts small and regional companies:

"AI Sweden is a great way for small companies to get exposure, show hands-on what they are made of and get access to new business opportunities." – Google

"Right now, SMEs in the AI space are behind in general. Most of them don't know what to do or how to approach the problems at hand. They can't afford to hire people full time to work on AI research or to work on data science projects. This is a case where innovation intermediaries will be quite valuable and probably for a long time, which is to help companies bond together, provide a service to share competencies and data housing. Pooling data in the Data Factory may be interesting for SMEs in particular, since they may not have the same flow or availability of data to work with by themselves" – Imperial College London

In line with the above, the presence and activity of both SMEs and incumbents are notable components of the AI Sweden network. This is highlighted by several respondents as a key feature that attracts them to the network.

Challenges

Respondents note some challenges in orchestrating actors within the AI ecosystem. Notably, establishing a high degree of credibility is challenging but quite important for an innovation intermediary to attract partners. In addition, one respondent recognizes that there is still room for a more collaborative environment at AI Sweden, in that it is currently more suitable for regional and smaller companies than others. Another respondent notes that most innovation intermediaries are quite fragile. Some intermediaries will grow and build a self-fulfilling prophecy, while others may encounter the trickiness of the business model:

"It's difficult to say whether the concept of an innovation intermediary will grow or not in the future. It depends on what they do. Sometimes members are hard to attract, they don't want to pay, how do you make it self-sustaining without clear revenue streams that are not government subsidies or membership fees?" – Imperial College London

There is also a concern that companies who are eager to take part in the partner network struggle to see their role. To mitigate this, respondents encourage the innovation intermediary to set up a structured system with clearly defined roles and expectations.

Opportunities

In addition to the existing activities of AI Sweden in uniting players in the AI field, several respondents are optimistic about the future opportunities within the partner network. In general, partners want to be a part of the acceleration of applied AI and thus increase the competitiveness and quality of life on a national level. Interviewees mention how the sharing of knowledge and expertise will likely reinforce the growth of the AI ecosystem:

"Spreading knowledge through events, sharing of project experiences, gathering partners, all these activities help to increase the knowledge base of AI in Sweden" – Google

"AI Sweden is and could be a platform for a vibrant AI community. There is no other community, either nationally or regionally that is vibrant and collaborative. This could generate more start-ups, knowledge and flows of information." – Sony

Interviewees see the role of AI Sweden as multifaceted in the future. For instance, they note that the partner network could be used for organizations to find specialized firms in different AI niches, where there is a notable lack of visibility today. There is still a need to create and spread awareness for how and why companies should participate in an AI ecosystem. In addition, respondents recognize that there is a great opportunity for creating an international hub for AI development and diffusion. In this role, AI Sweden could, according to partners, attract international talent and investments while documenting best practices AI initiatives both internationally and around the country.

4.2. Enable

The 2nd theme describes how AI Sweden *enables* the facilitation of activities among partners. In this role, findings include the activities enabled between actors in the network, and of AI Sweden for making these interactions happen.

Partners appreciate the role of AI Sweden as pairing partners and experts so that they can collaborate in a test environment and develop new technologies. In particular, AI Sweden creates an environment for competitors in the private sector to collaborate that would not be possible otherwise. The innovation intermediary facilitates digitalization in smaller and medium-sized companies by sharing knowledge, facilitating educational programs, pilot projects with industry, and more. Partners describe the facilitation role of an innovation intermediary such as AI Sweden as:

"An innovation intermediary provides a solution, platform, mechanisms, not necessarily the data itself. It can be a pointer or guide for the user to get access to the right public data." – Digital21

"Generally, expertise is available internally. However, value lies in the networks that can be created regionally. Matchmaking of partners is perhaps the most attractive value proposition that is offered at AI Sweden." – Sony

"Intermediaries traditionally have a bridging and facilitation role between industry and academia. But a big role for intermediaries in not only solving a particular problem by staffing it, which is also a typical innovation intermediary activity, but rather matchmake firms with emphasis on their respective internal activities. Firms want to connect based specifically on what they are doing, not on a theoretical basis." – Imperial College London

Respondents highlight that AI Sweden enables several inventive collaboration opportunities. Access to data and the ability to work with data is all facilitated within DF. DF makes available a wide range of data sets that would not be available elsewhere. DF enables cross-collaboration across these data sets, opening the possibility to unlock new value for organizations. However, DF enables the optionality for collaboration but does not force the user to a certain solution. Also, DF is not so much for annotating data (increasing data quality), but its focus is on combining a wide range of data sets. For infrastructure solutions, many companies sell solutions but do not use the technology themselves. DF helps companies to understand customers' needs by connecting them within the organization. The value of giving partners access to a common data-sharing platform is further highlighted by partners:

"Something very valuable is to enable organizations to share data with each other from different use cases" – Google

"Data Factory can facilitate the bridging of data sets across sectors and businesses. It can activate traditional companies that have loads of unused data, and connect these with the right competencies in smaller and more modern firms" – Sony

According to respondents, DF creates collaborative workspaces and means to develop AI solutions that can be taken into business development within different sectors. Still, business development is not done in-house, but the facilitation of networks and partners is the main objective. This gives partners the ability to test top hardware and technologies before adopting them by themselves. Partners describe how the DF has initially worked as an infrastructure testbed where the private sector has the ability to try out different algorithms and tools. From this, partners provide feedback and can choose which companies to build commercial relationships with. In building relationships, AI Sweden has facilitated feedback meetings with the users of DF, with the purpose of improving new business solutions. A smaller-sized company notes that DF is very valuable in that it provides marketing exposure from being a core partner, lead generation to potential customers (such as Volvo and Ericsson), and trust and confidence to generate sales.

On a separate note, partners identify the value of DF as a testbed for different solutions:

"Google cloud services are available through AI Sweden. We support AI Sweden and this initiative by setting up an environment where companies can request time and resources within the Data Factory. […] The main idea of collaborating with Data Factory is to get users to test different solutions, including Google Cloud, and manage projects in a protected environment." – Google

"Via Data Factory, companies can discuss and get a better understanding whether they should be use cloud solutions or invest in their own storage and compute" – CGit

From trying out different solutions, partners detail how they can make more informed investment decisions. For instance, partners can benchmark new tech before making investment decisions. This helps users determine whether cloud, on-premises, or a hybrid solution is the most suitable solution for their business.

Challenges

AI Sweden also faces several challenges in its role as *enabler*. Some companies will initially be hesitant to potentially share competitive advantages in terms of knowledge and experience. From the data provider (supplier) point of view, there are challenges in terms of incentives for sharing data. Additionally, some sets of data from academia cannot be shared with intermediaries, while some can. It's a challenge to distribute data, and much data lies idly with partners. To combat these challenges, partners note how DF helps users from a data compliance point of view:

"In Data Factory, partners can find common ground to tackle and solve legal issues specific to data." – Sony

"Much work is done within Data Factory to tackle the legal challenges. […] Legal questions are a big challenge. Today, everything is about data. The legal challenges are many, such as Cloud act, Schrems II, GDPR among others." – Google

Opportunities

According to interviewees, AI Sweden has the potential to help partners in even more ways. Informally, it can contribute as a broker between partners and leading experts to mitigate the lack of technical knowledge and infrastructure that is needed to apply AI. AI Sweden has the potential to work as a lead generator for organizations searching for commercial partners. It is noted that most big tech companies are generally organized and quite far in their AI journeys. A key target group for the DF concept is SMEs or start-ups that haven't started their digital journey. DF can be used to reduce the barriers for SMEs to take part in the digital economy. Complex AI such as edge computing will be part of this journey as well, but not for all. While not currently, an innovation intermediary may work as advisors that connect companies with good technology consultants like Capgemini or Accenture.

4.3. Engage

The 3rd theme describes the role of AI Sweden in *engaging* with its partners. Interviewees mostly relate these key activities as happening through the DF or the EL. In the DF, AI Sweden provides users with data storage, tools to curate, preparation and annotation of data, and the infrastructure capable to perform these tasks. Interviewees express the value of these activities as:

"There are bricks of data that are sitting idly with each one of us. In the Data Factory we get the opportunity to put these bricks together figuratively into a wall, to

build something useful. DF is where data is transformed into something valuable" – VGR

"Hours, days or even years of time can be saved when AI solutions can be built on top of each other rather than from scratch each time" – HPE

"To have an adapted infrastructure for AI solutions and publicly available for partners is immensely valuable." – Google

Partners emphasize that DF is not an extension of a company's R&D per se, but it allows testing and validation of network topology, algorithms, and DL models. For instance, data infrastructure (DGX 1 and DGX A) in the DF is provided by CGit, who in turn get valuable knowledge and hard data. Partners describe this type of exchange in the following way:

DF has been a great asset in terms of providing a testbed for new software products such as Schedule IQ. […] *AI Sweden provide a safe environment for testing and feedback, rather than direct implementation at a customer." – CGit*

"The knowledge available at AI Sweden can help partners, but Data Factory also gives users the ability to test different solutions in different environments such as cloud, on-premise or within the Edge Lab. […] We are using and building frameworks for FL that are also used within AI Sweden. This can help us to build better solutions. To have someone doing this in practice is fantastic as it gives use more insights about how to do it ourselves. " – Google

Partners highlight that the main difference from the interactions with DF and industry counterparts is that, in the former, learning is more emphasized. In a commercial relationship, a data scientist usually wants a specific tool and finds it with a solution provider. However, with DF, users can get a deeper understanding of how the technology and infrastructure works. In total, AI Sweden provides knowledge transfer, resources (in terms of access to data processing power), and technical advice. Specifically, AI Sweden shares not only data and/or expertise in exchange for access to data, but also legal expertise and knowledge about data sharing. The role of the educator is exemplified in the EL, where partners see AI Sweden as a leader in the emerging field of edge computing. Many partners are excited about the prospects of the EL, and note that:

"AI Sweden has the opportunity to educate their users in terms of technical knowledge, especially in emerging infrastructure solutions such as edge computing" – HPE

"The greatest opportunity for innovation within the AI space is with edge devices. Big data is not radical innovation, but edge computing is. Edge computing is the future of AI. Edge Lab is not one day too early." – Sony

"80% of all data is created at the edge, in our cars, mobile phones, devices. In the future, it will be impossible to centralize this data because of cost and compute reasons" – HPE

By providing free testing in a sandbox environment, DF can help research and projects to run much faster than previously. Partners also underline that the innovation intermediary is not entirely commercially driven, which makes it different from private initiatives. It emphasizes knowledge more than developing proofs-of-concept (POCs) in technical applications. For instance, both AI Sweden and its Norwegian counterpart Digital Norway (DN) collaborate strongly with academia and research institutes in developing long and short-term educational programs, collaborative projects, and research programs. DN also collaborates with large public data providers in sharing geographical and road data.

Challenges

Long-time partners note that the intermediary role of AI Sweden has matured and improved, from being quite chaotic initially. Still, there is uncertainty about how to develop the value proposition. For instance, DF must position itself as to not directly competing with the business models of users/partners. Google notes that a potential future challenge of AI Sweden is that:

"There is a risk in that AI Sweden becomes to research heavy. That the problems they want to solve are too big. Federated learning as an example, is a good problem to tackle, but it may be too advanced to be relevant for the masses today. […] AI Sweden shouldn't become a research institute, but instead use its reach to help the maximum amount of companies to accelerate the use of applied AI and ML" – Google

In addition, respondents recognize that the DF concept is nascent and there is no precedent for how to do it. As such, a challenge is the lack of knowledge about the best practices of how to rig and deploy a DF.

Opportunities

Still, partners see great potential in the DF concept in the industry, public sector, and academia. For instance, VGR notes that DF has the potential to become a testbed for public procurement. DF could improve on the current system by being a transparent platform where the public sector quickly can deploy and test the usefulness of data. For this purpose, AI Sweden could be the broker between the latest technology providers and the public sector. VGR notes that:

In public healthcare we would like to see Data Factory as a platform to connect with specialized organizations to develop, annotate and test AI models. […] Long term, Data Factory could have the potential to become a brokering platform for public procurement." – VGR

To summarize, DF is identified by interviewees as having the potential to become a shared data infrastructure for all actors active in the AI space in Sweden. The demand for deploying data with an intermediary also exists in academia. Gothenburg University (GU) says that:

"If we can use AI Sweden and Data Factory to store and activate some of our proprietary data, that's an opportunity that we would not think twice about" – GU

4.4. Observations from industry, academia and public sector

This section summarizes interview observations that could not fit either of the 1st order themes. The findings are grouped according to the traditional pillars of the Triple Helix structure, which is also how the interviewees were categorized (Table 3): industry, academia and public sector.

Industry

In every crisis, including the COVID pandemic, respondents have realized the need to diversify and scale down to more flexible organizational units. Historically, most companies have been reliant on cloud services to store data. The issue is that the cloud is too expensive when the company starts scaling its data operations. Yet, most firms don't have the resources or knowledge to invest in their own data infrastructure. Instead, companies increasingly look to use decentralized IT solutions (multi-cloud), including edge computing solutions. In industry, such solutions have emerged in the form of platforms that are hosted by large companies, such as HPE. In these, customers can freely choose from a range of AI solutions. To become more flexible, companies are working in more agile ways where business development and operations go in parallel. For a small company, processes are not in place to slow down R&D and investment decisions can be made in less than a day. Still, in the advanced use of AI algorithms, a few companies are leading the way and these have an important role in showing the way for others. In general, the big players are already on track with their AI development, while SMEs must accelerate to catch up. For example, a company such as Sony, which has over 30 global R&D centers with a focus on core research, system development, and applied solutions in AI technology, is quite far in terms of AI understanding. The opinion regarding market leadership is divided, however, and in the specific field of AI infrastructure, several giants are lagging the small companies in terms of applied knowledge. In terms of how to keep market leadership, it is stated that:

"To remain competitive in the AI space, incumbents must either acquire cutting edge companies, or join agile collaborative network." – HPE

Interviewees also note that AI is increasingly used for the good of society. For instance, it can be used for global sensing and monitoring, disaster prediction, and mitigation, with the purpose to increase the effectiveness in sectors such as agritech, pharma, and farming. Thus, advancing AI on a national level is partially an awareness issue. Mostly, it's an issue of execution caused by frictions in organizations and issues in convincing internal stakeholders (resistance of technology adoption at the individual level), as explained:

"The enthusiasm to adopt a particular technology could be more of an explanation of regional differences in terms of resistance from internal stakeholders more so than any national policies or directives." – Imperial College London.

The interplay between different actors is described by interviewees from several points of views. For instance, leading AI companies are yet to generate new business or product ideas from either academia, DF or the network of AI Sweden. Instead, experts within the company are the ones searching and generating new ideas, mostly from doing individual research. For large companies

AI research projects could span 5-10 years into the future with the purpose of creating solutions that can be implemented in business units. In such projects, the company sometimes contributes funds to research institutes focused on AI, in exchange for research or knowledge. On contrary, public and private companies often have barriers that make collaboration difficult. Usually, they are too different in terms of technological maturity and objective. Also, legal hurdles may afflict the opportunity of collaboration. Industry-academia is generally considered a more natural match.

Challenges

Today, private companies face several hurdles in the adoption of new technology, such as AI and edge computing. One partner summarizes the challenges for private firms:

"There are three main AI challenges for companies today: 1) organization (competences and agile workflow) 2) collection of data and 3) operationalization of data." – HPE

Barriers to developing and deploying AI models are generally lack of resources and competencies. For example, SMEs (users) have less than 100 employees but need the competencies to handle regulatory issues, jurisdictional law, technical solutions, and IP rights to work with AI. Together in a system, knowledge and resources can be shared to overcome these barriers. Another organizational barrier is that IT often is separated from management, which results in conflict. To successfully adopt new technologies, IT can no longer be centralized and the communication gap between management and IT must be overcome.

Academia

Respondents see the role of academia as wholesome in the AI landscape. Primarily, they note that the focus in academia is on strategic research, where clusters of researchers within the university collaborate to accelerate the field of applied AI. In addition, it facilitates resources, storage and compute infrastructure, data analysis tools, and methods for analysis. There is also a role for academia to help organize, coalesce innovative ecosystems to produce knowledge and graduates that go into industry.

Interviewees express that like the vision of AI Sweden, the vision of academia is to improve society and spread knowledge. Also, both actors are supposed to be neutral in the eyes of other participants in the system. However, respondents see universities as generally more constrained than an intermediary. For instance, data for strategic research cannot be shared with third-party intermediaries. But some similar tensions exist in raising money and facilitating members and firms. The intermediary can be seen as more practical, which can be attractive for private firms. On the other hand, universities have high degrees of credibility, which is attractive. Either way, academia, and intermediaries can find a positive exchange in knowledge and marketing purposes.

University-industry collaboration may include facilitating applied research projects, sharing experts (professors, Ph.D. students), creating forums for talking to each other, doing cross-collaboration and executive education, sharing access to company data, and coordinate activities in the digital space (inside the business school). The focus of academia is not the latest technology in AI (it's rather peer-reviewed research), so the aims of big tech and universities are not the same. The primary objective for academia is ensuring the relevancy of research and students in society.

Interviewees highlight that areas of high economic growth usually see high levels of activity between academia and industry. In these, universities are a key knowledge contributor to R&D operations. On the topic of AI and industry-academia dynamics, it is said that:

> *"Most companies are cutting back on basic science research. That's a fact. On average, companies are moving away from the space of academia, not toward it. With the one exception of AI research. This is likely because of the access of data that you have in companies that makes it more attractive. They could import professors, offer them a job where they get access to data that they wouldn't have at the university. This has turned out to be an attractive proposition for some people and has led to a boom in scientific publications in this one space where companies are actually increasing their R&D." – Imperial College London*

However, some interviewees express concerns that resources are sometimes spent in academia to make minimal improvements on existing solutions. For instance, huge investments are made to increase the efficiency of image classification by .01% only to get published in an academic journal. This is quite uninteresting for an incumbent that needs to develop products to a fast pasted consumer market. Yet, to make an applied solution is very important. Respondents view the incremental improvements of efficiency as essential when developing new products, in terms of costs and energy efficiency, so the industry-university relationship is still very important.

Challenges

In academia, partners note that diffusion of new knowledge is a problem - researchers are working within silos which is problematic when trying to get new research out to industry. New ideas come from research requirements in university – not companies as much. While there has been some resistance to working with industry, generally this type of collaboration is considered an opportunity. Universities' business models are changing in terms of TT. It's not only about licensing agreements but there could be other models that would be beneficial to a local ecosystem. The focus of most technology hubs within universities is the organizational implications of digital technologies. The scope is usually all digital technologies and how they can be used within organizations such as companies, government institutions, NGOs, and universities.

Industry actors have also been concerned that business schools usually lack the right competencies to be recruited. On this topic, it is noted that:

> *"Many PhD students that are studying AI are being snapped up by industry quite rapidly. Some of them who would have pursued a career in academia isn't now so the pipeline is getting thinner. This is a challenge for academia." – Imperial College London*

Challenges for academia in advancing AI are lack of resources, setting up appropriate data infrastructure, and obtaining experts with hands-on experience to drive research projects and education. Partners note that universities have in many cases spent too many resources on AI infrastructure without getting enough in return. On the other hand, hardware is generally considered the easiest part, while finding the right competence is the hard part.

Public sector

In the past, governments have usually been the regulator (setting the rules within a sector) with the broad objective of increasing economic growth in a region. Now, the government is funding some activities of innovation intermediaries and for SMEs or organizations that develop AI infrastructure or do applied research in AI. The Interactivity among innovation system actors is increasing, and governments that cannot keep up with regulation are getting caught because of further digitalization and IT migration into different sectors:

"We are now seeing different use cases of AI in different sectors, which is forcing governments to increase interactivity and responsiveness to stakeholders in industry and academia." – Imperial College London

As mentioned by respondents, academia collaborates with public institutions whose data is very sensitive. On the question of whether AI Sweden could facilitate such a relationship, interviewees say that a permissioned data space, where certain datasets would be restricted between certain actors, would support continuity in the relationship between academia and the public sector, and thus make a transition to a more collaborative network easier. The public sector has huge disclosure limitations on, for instance, patient data in healthcare. This makes the implementation of AI very slow and ineffective since they must invest in their own infrastructure solutions. On the topic of sensitive data, VGR states that:

"Computers are probably better at keeping a secret than a human. The problem lies in defining what a secret is. This makes separating private and public health data a great challenge" – VGR

Respondents recognize that you need all components (industry, academia, government) to create a strong ecosystem. If you only have one you are likely to fail or become vulnerable in terms of economic growth. For public bodies, there are challenges in terms of decision making and regulatory agreements for each decision made at a regional level:

"Industry and government must work to increase turn-around time to be able to react more to help with economic growth and to build the ecosystem." – Imperial College London

To conclude, the trend according to partners is that there needs to be more pro-activity on the government side, the willingness of academia to engage with industry, and to have industry working together with these three different stakeholders.

5. Analysis

Section five applies the theoretical framework to analyze the empirical findings. The analysis is separated into the 2nd order themes *TT and diffusion*, *the intermediary role of DF* and *DF in TIS*, as seen in Figure 16. The aim of the selected separation is to enable a practical synthesis of codes and dimensions as well as dismantle the theories. This, so that conclusions can be drawn based on the first-order themes. Therefore, activities, factors, and functions associated with the theories under the 2nd order themes are linked with 1st order themes, presented in the tables under each section.

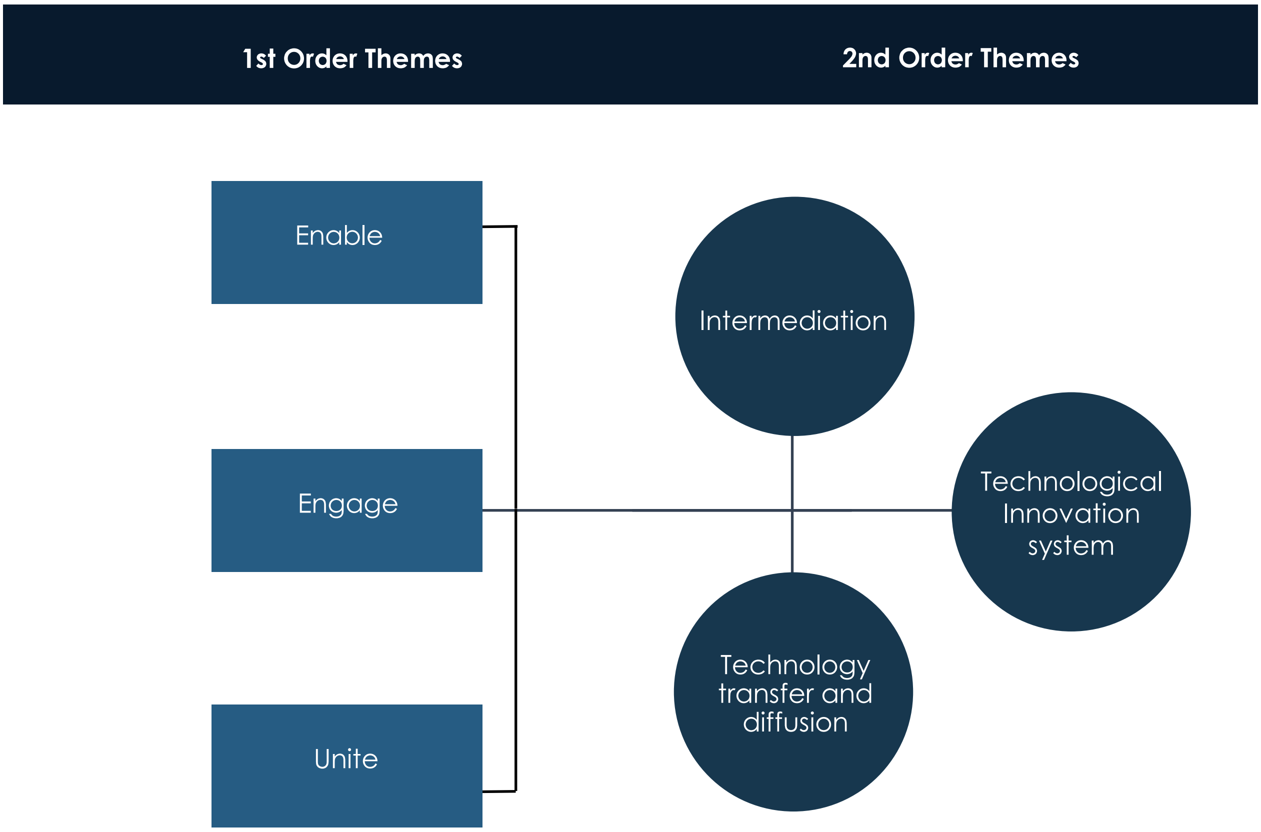

Figure 16. Thematic analysis.

5.1. AI Sweden in technology transfer and diffusion

The role of AI Sweden as an intermediary aiming to accelerate the exercise of AI is highly related to the theories of TT and diffusion. To further explore this, connections between the 1st order themes and the activities and factors compiled from the literature have been drawn, as illustrated in Table 5.

	Activities	**Unite**	**Enable**	**Engage**
Process activities	Technology reserch development	x	x	x
	Spread of knowledge, awareness, & acceptence		x	x
	Proof of concept	x	x	x
	Success storys	x		x
	Implementation support & best parcitces		x	x
	Reinforcment of decisions		x	
	Feedback evaluation			x
Facilitation Factors	Target influencial people	x		
	Align values, motivations, golas, & needs	x	x	
	Understand attitudes, culture & social norms	x		x
	Accomodate Education & Demonstrations		x	x
	Open up interactive communication channels		x	
	Reveal and clarify relative advantages & benefits		x	x
	Encourage testing, experimenting, and observing			x
	Take an opinion leader role	x		

Table 5. Activities and factors associated with the Technology Transfer and Decision of innovation process.

Moreover, the activities in Table 5 were divided based on the belongingness to the adoption and transfer process (see Figure 9), or to the factors affecting the adoption or transfer rate (see section 2.2.1 and 2.2.3)

5.1.1. Process Activities and Factors

I n theory, Sung and Gibson (2000) mention four levels of TT whereby creation is the first. The gist of Creation is to perform state-of-the-art research and consequently knowledgify and diffuse the findings to enable the development and diffusion of the generated knowledge. Further, Sung and Gibson (2000) emphasize the importance of developers to understand the values, attitudes, and ways of doing things in order to overcome cultural barriers (Johnsson, Gatz, & Hicks, 1997). Moreover, TT is seen as a chaotic interactive and social process within networks. In line with the empirical data, DF *unites* multiple partners within different sectors to jointly collaborate and develop AI. Moreover, DF *enable* and encourage research and development in a united manner in which actors can learn from each other in an experimental AI environment. In line with Rogers (2003), empirical data further indicates that this open environment allows for experimental projects to run much faster than previously due to aligned goals and motivations. However, the respondents point out that DF should not be seen as an extension of the R&D labs, but rather as a place for testing and learning.

Moreover, five steps explaining the adoption process are stressed. The process includes knowledge, persuasion, decision, implementation, and confirmation. The knowledge step aims to answer the questions *what it is, how it works,* and *why does it work* (Rogers, 2003). According to empirical data, parallels can be drawn from activities found within AI Sweden. Firstly, through an open and experimental environment, AI Sweden aims to demonstrate and share knowledge concerning AI technology across partners in the ecosystem. Further, AI Sweden offering technical know-how and expertise so that partners can gain in-depth knowledge of how the technology and the infrastructure works. Furthermore, in line with Rogers (2003) respondents states that awareness and information about how AI works becomes increasingly urgent as more complex the technology becomes. Additionally, respondents stress that AI Sweden has the opportunity to diffuse awareness and educate potential users of emerging technologies, such as edge computing.

However, empirical data emphasizes that the awareness and knowledge stage, mentioned by Rogers (2003), is especially important for small and medium-sized businesses due to a lack of in-house expertise and resources. Furthermore, there is an aligned opinion between the respondents in that lack of knowledge and competencies is one of the greatest barriers to the diffusion of innovation. Therefore, to facilitate the adoption process, this step could be seen as critical for AI Sweden to manage. This step is also in line with Sung and Gibson (2000) who mention that, in order for technology to transfer, it is important to share knowledge across boundaries.

In the persuasion stage in the conceptual model Rogers (2003) stresses the importance of proof of concepts to reduce potential uncertainty. Moreover, the advantages and disadvantages to implement the technology should be revealed so that recipients are fully aware of the consequences of adopting it. The respondents agreed upon that AI Sweden had the opportunity to become an experimental environment where solutions could be tested and best practices developed. This function could also be connected with the decision stage, which could be facilitated by small-scale trials as individuals seldom adopt a technology that has not been tested beforehand. Moreover, Rogers (2003) emphasizes that examples of successfully implemented cases, to mirror the potential advantages and disadvantages, have the potential to increase the adoption rate. Such information is usually collected from near-peers, which could potentially be found in the large ecosystem possessed by AI Sweden. However, this was not requested by the respondents. However, creating a favorable attitude towards the technology is crucial at this step. Sung and Gibson (2000) additionally stress the importance of that the technology becomes understood and accepted in order to facilitate the TT.

Once the technology is accepted there is a need for implementation (Roger, 2003). Therefore, information on how to use and install the technology is requested. As mentioned, lack of knowledge and competence is seen as a barrier to adopting AI technology. Moreover, as mentioned by the respondents, the creation and training of AI algorithms is just the half journey, the other half is to deploy it. However, AI Sweden has an opportunity to supply expertise and link recipients with developers in their ecosystem. Additionally, best practices and demonstrations can be exhibited through the physical infrastructure possessed by the DF, which also could facilitate the TT (Sung & Gibson, 2000). Yet, respondents also indicate that DF is a new concept and might therefore lack knowledge of best practices. Rogers (2003) further states that once a technology is implemented, individuals usually seek reinforcement of the decision made. However, empirical findings did not indicate that such requirements were coveted from AI Sweden. Nevertheless, this could be implemented to enhance the choice made by the recipients. Moreover, from the literature, it can be concluded that the diffusion and TT process is not a one-way flow of information, but rather an interlinked processes (Sung & Gibson, 2000; Rogers, 2003). Within the process, partners provide feedback, questions, and potential problems that flow back to the developers. This feedback is further valued by the respondents as it could facilitate the development of new products and business solutions.

In order to accelerate the adoption of technology, some key factors need to be considered (Rogers, 2003). Firstly, the literature suggests that authority decisions could increase the adoption rate. Therefore, people with the power to influence and affect a whole system, such as an organization, should be targeted. However, empirical data indicate that there is a gap in understanding of the advantages offered by AI technology between the management and the engineers. Therefore, AI Sweden has an opportunity to target influential people to accelerate the diffusion of AI. Moreover, the type of communication channels is also expected to affect the adoption rate (Rogers, 2003). To increase the adoption rate the literature emphasizes that mass-media channels outperform interpersonal channels when diffusing awareness. However, it is also stated that more complex technologies might demand interpersonal channels in order to understand the technology. AI Sweden, as an international hub for AI, shares knowledge through initiatives hosted by national focus groups for their partners. These initiatives usually take a one-to-many approach. The absence of partner-specific initiatives could be explained by the risk of starting to compete with partners, which is undesirable. However, rather than passive communication, Sung and Gibson (2000) emphasize that interactive meetings between developers and recipients have the greatest potential to facilitate the TT. Moreover, Choi (2009) states that intangible assets are in many cases more important than the hardware itself when explaining TT. This is also in line with Rogers (2003) emphasizing that technology is composed of both hardware and software whereby both must be mastered to be able to benefit from the technology. The respondents state that when it comes to applying AI, install hardware is the easy part and well known. Yet, knowledge of how to utilize the hardware, that is, the soft skills are in many cases more demanding and are further away from existing experiences.

Moreover, Rogers (2003) reveals five characteristics of an innovation that has been extensively researched (Holloway, 1977; Moore & Benbasat, 1991; Tornatzky & Klein, 1982) and best explains the adoption rate. First off, relative advantage explains the benefits of adopting the new technology in comparison to existing solutions (Rogers, 2003). Empirical data emphasize that there are no doubts about how important AI will become for future development. However, concerns arise as the knowledge stage fails to fully inform key users, such as managers, about the advantages. Moreover, the literature stresses that it is essential to understand how the relative advantage is perceived by the potential users, rather than what it actually is in order to increase the adoption rate. This points towards more tailored demonstrations and examples of successfully implemented based on the specific recipient. However, as previously stated, empirical data shows that there is a risk for a disinterested intermediary to focus on face-to-face relationships due to competitional concerns. However, respondents further urged that there is also a lack of general understanding of the value proposition deriving from applied AI, stressing the importance of communication about the relative advantage even further. Additionally, Rogers (2003) mentions that initial investments have the possibility to decrease the adoption rate. This is also confirmed by the respondents describing a need for large initial investments required for AI development and infrastructure. Therefore, the potential benefits become even more important to understand in order to support the potential investment. On the other hand, some of the respondents mention that the benefits resulting from applied AI might be too good. Thus, creating frictions within organizations where employees prevent the implementation due to fear of being replaced or becoming redundant. This is also emphasized by Sung and Gibson (2000) who disclosed that motivation in from personal incentives is an important factor to consider to facilitate the TT and diffusion.

Furthermore, compatibility is explained in the literature as the degree to which a technology is consistent with existing values, needs, and past experiences. This, as technologies not aligned with these elements, would require a big behavioral change, which is not desirable. This is also mentioned by Johnsson, Gatz, and Hicks, (1997) and Sung and Gibson (2000), who stress that it is important for technology developers and recipients to understand each other's values and attitudes. This is not mentioned by the respondents as an activity carried out by DF. Moreover, the empirical data distinguish between the type of actor and their compatibility with AI. For instance, meanwhile, the healthcare industry is concerned about General Data Protection Regulation (GDPR) and data sharing regulations, the respondents state that some of the SMEs are more concerned about lack of resources and previous experiences to implement AI. Yet, it should also be noticed that some of the respondents stated that many of the giant firms lagged behind due to inertia and lack of competence compared to the SMEs. Nevertheless, this further indicates that different actors are in need of different information. Finally, Rogers (2003) mentions that certain technologies are parts of technology clusters in which multiple technologies are interrelated. AI could be seen as such technology as it requires multiple Hardware and software to function.

Complexity is according to the literature the degree to which an innovation or technology is difficult to understand and use. The easier it is to apply, the higher the expected adoption rate. The respondents are unanimous in that there is a lack of competence when it comes to applied AI. Consequently, the shortage of skilled workforce could therefore make the technology more difficult to understand and to use. Moreover, due to the increased demand for human capital, such as computer scientists, some of the respondents indicate that there might be a chance that companies could become reluctant to share knowledge. However, this is in contradiction to what Chesbrough (2003) advocates, as openness comes with great benefits. Nevertheless, one of the main goals of DF is to share knowledge and expertise so that the rate of complexity could decrease.

The lion's share of the respondents described DF as an environment for experimentation and testing. Moreover, the empirical data reveals that partners emphasize the benefits of having an environment where hardware, software, and knowledge are gathered in a one-stop-shop manner. Additionally, it allows partners to try the technology before potentially adopting it. According to the literature, this could increase the adoption rate as it diminishes potential uncertainties and expose the relative advantage (Rogers, 2003). Trialability becomes even more important as the level of complexity increases (Dearing, 2009). Moreover, due to lack of resources and high initial investments, respondents find it convenient to test it and learn about it before fully adopting it.

Observability, which is the last essential factor to consider according to Rogers (2003), illustrates how visible technology is. If the benefits of adopting AI become widely known and clear, the probability of adopting it increases. In line with reflections made by respondents from AI Sweden DF hope to increase the observability by showing successful results from implementing AI. However, the benefits of such technology could be difficult to observe as the perceptions of the relative advantage might be different depending on the recipient.

5.2. The intermediary role of AI Sweden

As the main objective of this research is to study the role of AI Sweden, its activities as an intermediary are a key field of analysis. The 1st order themes *unite*, *enable* and *engage* can be analyzed through the lens of be theoretical theme *bridging, brokering* and *testing*. In comparing them, there is an apparent match in certain intermediary activities, as seen in Table 6.

Theoretical theme	Features	Unite	Enable	Engage
Bridging	Establish linkages between actors	x	x	
	Support and create networks	x		
	Identify and develop needs for change	x		
Brokering	Gatekeeping and brokering		x	
	Transfer knowledge			x
	Resource coordination			x
Testing	Ideation			x
	Commercialization			x
	Protection			x

Table 6. Intermediary activities matched with 1st order themes.

In comparing theoretical themes and empirical results, there is an apparent match in certain intermediary activities, as seen in Table 6. First, AI Sweden achieves neutral facilitation and acceleration of a wide network of actors. In addition, it connects and spreads specialized knowledge. For instance, it is positioned as the hub of data in complex multilateral exchanges. Finally, it enables users to perform early-stage innovation through the testbed (EL), from ideation up until the commercialization stage. Findings in Table 6 show that AI Sweden takes an active role as a neutral initiator in the exploratory innovation process, and breaks the view of the traditional literature of either being an innovation facilitator or broker. Next, the empirical results are analyzed through the lens of activities covered in literature, to expand the findings illustrated in Table 6.

5.2.1. Bridging

In literature, there is an emphasis on the intermediary's role in *establishing linkages between actors* (Shohet & Prevezer, 1996; Spithoven & Knockaert, 2011), *supporting and creating networks* (Aspeteg & Bergek, 2020; Dalziel, 2010; Nilsson & Ljungström, 2013) and *identifying and developing needs for change* (Bessant & Rush, 1995; Rogers, 1995). In all of the aforementioned, there are clear similarities to AI Sweden's role of *uniting*. First, a key attraction of AI Sweden, according to interviewees, is its ability to gather a wide range of actors across several sectors and regions. Similarly, Spithoven and Knockaert (2011) see the intermediary as decreasing the gap between principal actors within the system. In the spirit of open innovation (Chesbrough, 2003), actors connect and collaborate in the DF, which bridges activities and knowledge, resulting in new alliances or collaborations being formed in the AI ecosystem. For example, SMEs have the ability in the EL to present dataset solutions to big tech companies, and regional actors get access to an international network of AI researchers through the AI Sweden partner network. This happens between different forms of institutions and networks and can be related to the activity of *building linkages with external knowledge systems*, according to Shohet and Prevezer (1996).

AI Sweden also facilitates multilateral exchanges and coordination of research, as per Dalziel (2010). As an example, public institutions, private companies, and universities all participate and share experiences under the AI Sweden umbrella, allowing actors to be quicker and more informed about their decisions. Although not a typical consultant as defined by Bessant and Rush (1995), AI Sweden identifies and facilitates technological change, as per Rogers (1995). Companies that have yet to adopt AI are encouraged to do so through informative sessions, and by the articulation of opportunities. On the other hand, AI Sweden is particular in its neutral position. By neutrally sourcing services and partners, it connects buyers and sellers and translates their intent to action. This would align with how intermediaries create value through coordination, rather than brokering, as to not compete with technology suppliers (Aspeteg & Bergek, 2020).

5.2.2. Brokering

AI Sweden *enables* both gatekeeping (Howells, 2006) and resource coordination (Bauer & Flagg (2010). As an agent, it manages external resources and relationships through matchmaking and project management. For instance, both research projects and technical development run simultaneously in the DF, through collaborations with both public and private stakeholders. Access to resources is not given directly to partners, however, they are invited to use on and off-premises data infrastructure in consolidation with AI Sweden. Thus, the relationship puts emphasis on TT and knowledge sharing, rather than commercialization. This may be explained by the complex nature of the technology in the testbed (EL), where users are matched in the development phase more so than in the diffusion stage (Aspeteg & Bergek, 2020). This would support the claim that simple technology involves different processes related to the diffusion of innovation (Howells, 2006), while technology such as edge computing is more advantageously developed through coordination.

Interviewees emphasize how the flow of information in the AI field moves too fast for any party to keep up with. In relation to literature, the intermediary is key in locating key sources of knowledge, absorbing it, and transferring it to the marketplace (Bessant & Rush, 1995; Spithoven & Knockaert, 2011). In this regard, AI Sweden is a source of specialized knowledge, legal, compliance, or technical know-how. For instance, there are significant compliance risks associated with data sharing, especially for public institutions and international cooperation. By compiling knowledge and experiences from different actors and testing these in a protected environment, actors can find synergies and fruitful exchanges previously infeasible. The exploratory activities that are encouraged in the EL reminds of *collective exploration* (Agogué et al., 2013), in that competitors share a common space to collaborate on projects or ground-breaking technologies.

However, previous literature only recognizes this intermediary type as existing in-between state-funded organizations and private firms, or in the middle of university-industry relationships. The role of a neutral, non-institutional matchmaker in multilateral and multisector data sharing processes is something not previously discovered in literature and should therefore be underlined.

5.2.3. Testing

In the DF, different data storage solutions are gathered, form Google Cloud, on-premises and edge computing. Through *engaging* with partners, AI Sweden articulates the pros and cons of these different solutions and allows organizations to ideate and realize potential business cases. Similarly, testing and validating new technology is an important but expensive endeavor for new firms (Howells, 2006). Through the EL, partners are encouraged to use the existing infrastructure to develop and iterate new solutions. After the creation of a proof-of-concept, users are encouraged to materialize their vision outside of the DF. Importantly, DF does not commercialize its users, as to not clash with suppliers. However, it is present in stages of sourcing, ideation, and the evaluation of outcomes (Howells, 2006). In addition, while DF is bounded to internal activities, some users may utilize the network for external activities. For instance, several partners are attracted by the generation of potential leads in the partner network. Informally, DF is viewed by some as a potential procurement space, which marks it as somewhere in between a broker (Bessant and Rush, 1995) or agent (Howells, 2006). Another difference between findings and literature is that protection related to IPR, or formal regulation is not within the scope of AI Sweden's activities, in the sense that it is only done through informal legal advice. In line with the findings of Nilsson and Ljungström (2013), the focus of DF is to enable partners to innovate, rather than to generate, implement or protect these innovations themselves.

5.3. AI Sweden in technological innovation systems

As previously highlighted, there is a gap in the understanding of intermediary contributions to the functions of TIS. In this section, empirical findings will be related to the conceptualization of the potential contribution of AI Sweden and DF to TIS functions, inspired by Kanda et al. (2019) and aggregated from Lukkarinen et al. (2018), Howells (2006) and Nilsson and Sia-Ljungström (2013).

A comparison between empirical findings and intermediary activities in TIS functions is presented in Table 7.

TIS Function	Intermediary role in theory	Unite	Enable	Engage
F1. Entrepreneurial activities	Create conditions for *learning by doing* and *learn by using*. Experiment, validate and train.	x		x
F2. Knowledge development	Gather knowledge, process, generate and re-combine; educate and train, provide advice and training, assess and evaluate technology.			x
F3. Knowledge diffusion	Prototype and pilot; scan, communicate and spread knowledge.			x
F4. Search guidance	Articulate needs, expectations and requirements; develop strategy, advance key objectives, implement policy, identify challenges and opportunities.	x	x	
F5. Market formation	Accelerate the application and commercialization of new technologies; invest in new businesses; identify business opportunities.		x	x
F6. Resource mobilization	Create and facilitate new networks; manage financial resources; identify and manage human resource needs, organize training programs, project design, marketing, support and planning, sales network and selling, source potential capital funding and organize funding or offerings.	x		
F7. Legitimation	Gatekeeping and brokering; configure and align interests; assess and evaluate technology; arbitration based on neutrality and trust; accreditation and standard setting. Evaluate environmental and social impacts; establish a distinct brand, social acceptance and compliance with relevant institutions.	x	x	
F8. Development of positive externalities	Support the entry of new actors in the TIS; contribute to the strengthening and benefits of other TIS functions and actors.	x		

Table 7. 1st order themes matched with theoretical role of intermediaries in TIS functions.

To summarize, AI Sweden and DF participates in all functions of the TIS. As illustrated by Table 7, there is an observable match between AI Sweden activities and the theoretical contribution of intermediaries to TIS functions. Through *unite*, DF fulfils entrepreneurial activities (F1), search guidance (F4), resource mobilization (F6) and legitimation (F7). By *enable*, it also contributes to search guidance (F4), market formation (F5) and legitimation (F7). Finally, *engage* is matched with entrepreneurial activities (F1) and knowledge development and diffusion (F2, F3). In conclusion, all activities (1st order themes) of DF actively contribute to more than one function of the TIS. This affirms DF as an active stakeholder and key influencer of the TIS. In the following section, the contribution of DF to each TIS function is elaborated.

F1. Entrepreneurial activities

In theory, uncertainty in a system is reduced through entrepreneurial activities. Activities such as experimentation and testing of new business ideas and solutions are facilitated by conditions that allow for *learn by doing* and *learn by using.* As uncovered in empirical findings, AI Sweden and

DF contributes to these conditions in several ways. By *uniting* actors, DF gives access to case studies, partners and collaborations in a wide range of industries. DF gives direction and works in close collaboration with companies of all sizes. DF also encourages the development of new solutions through testing and iteration by *engaging* with partners. In EL in particular, companies are provided a testbed for new software products and algorithms. This is highlighted by partners as particularly interesting for SMEs that lack the resources to test emerging technology in-house.

F2. Knowledge development

Knowledge development describes how learning is gathered, processed, generated and re-combined in the system. Theoretically, intermediaries could educate and train, provide advice, training and assess technology. In this function, a clear parallel could be drawn to DF's role of *engage*. Partners underline how DF facilitate the transfer of knowledge even more so than the development of proof-of-concepts (POCs) in technical applications. DF educates users in terms of technological knowledge, especially in emerging infrastructure solutions such as edge computing. Although the focus on education and forms of advice is apparent, DF positions itself as a platform and aggregator where leading technological companies can participate. Thus, the evaluation and assessment of emerging technology is done by participating partners more so than AI Sweden.

F3. Knowledge diffusion

The diffusion of knowledge is a key function in a TIS. The conceptual role of intermediaries has traditionally been to help prototype and pilot new ideas, but also to scan, communicate and spread knowledge. Like with F2, DF fulfils this function by *engaging*. Specifically, DF connects with specialized organizations to develop, annotate and prototype new AI algorithms and models. Moreover, DF helps spread the accumulated knowledge through various activities. For instance, DF collaborates strongly with academia and research institutes to develop long and short-term educational programs, collaborative projects and research programs.

F4. Search guidance

Guidance of search is a function which describes how opportunities, challenges and needs for growth are identified and addressed in the system. Theoretically, intermediaries play the role of articulating these, but also setting expectations or strategies in place to capture any identified opportunity. Overall, DF accomplishes this through *uniting* and *enabling* (Table 7). First, DF unites actors in the system by creating a sense of urgency. This is communicated by articulating both the opportunity in the field of AI, and what could happen if organizations don't act on this opportunity. Through *enabling*, DF also facilitates the interactions between industry, academia and public institutions. However, while DF is a matchmaker of actors, it does not set the policy that guides the actors in the system. Rather, it connects and finds synergies across actors that are working towards the common objective of adopting AI. Hence, DF not only helps in defining the challenge at hand, but acts as a broker and guide for firms that want to participate in collaborative projects.

F5. Market formation

The formation of a protected or regulated market is crucial for improving and diffusing emerging technologies. Intermediaries in theory fulfil the role of accelerating new technologies or identifying or investing in new business opportunities. Correspondingly, the acceleration of AI on a national level is the main objective of AI Sweden. To succeed in this, it does not invest directly in businesses, but rather acts as a broker and test environment for to-be commercial solutions. AI Sweden supports companies by providing a data infrastructure that would otherwise be inaccessible for most companies given economic reasons. In the EL, edge computing solutions can be iterated upon and shared among partners before these are absorbed internalized and commercialized externally. By creating an environment for collaboration through *engage* and *enable,* DF has attracted partners also internationally, and hence crosses the traditional definition of regional market formation.

F6. Resource mobilization

Resources could be defined as human capital, financing, or complementary assets in the form of networks, services or infrastructure. In a TIS, these need to be mobilized for knowledge to develop and diffuse. According to literature, intermediaries can be key in identifying, organizing or sourcing such resources in a TIS. In the field of applied AI, AI Sweden is actively coordinating actors in the system. By *uniting*, AI Sweden creates a supportive network which enables opportunities for cross-pollination across industries. Although AI Sweden is not a financier, it organizes projects and services through its data infrastructure that is financed through a mix of public, private and in-kind contributions. A key resource that DF provides to partners, emphasized in empirical findings, is knowledge. Here, legal and technical know-how is shared through the role of *engaging***.** However, DF is not an explicit channel for companies to generate leads or resources, although some partners recognize that the network could be used this way.

F7. Legitimation

AI Sweden and DF directly contributes to the legitimation of the TIS by *unite* and *enable* (Table 7). In theory, a technology such as AI must be seen as appropriate and desirable from a social view, to be considered attractive rather than threatening for incumbents. The objective of AI Sweden is to accelerate the use of applied AI in Sweden, and increasing legitimacy of the tech is certainly part of this. First, AI Sweden finds, gathers and coordinates all actors in a TIS, ranging from SMEs, institutions and incumbents. By brokering and bridging, AI Sweden aligns the interests of these actors while remaining trustful. This is achieved by neutral positioning, strong brand management and compliance with the appropriate institutions. From the beginning, AI Sweden has also emphasized its relationship with incumbents, such as establish big tech companies. In these interactions, not only hard KPIs, but ethics and sustainability goals are highlighted. In doing so, DF has managed to attract companies that would otherwise be considered typical to resist change.

F8. Development of positive externalities

The entry of new firms is particularly important to the growth of a TIS. The function of developing positive externalities describes how new firms can reinforce and create a positive feedback loop to the other functions of the system. DF helps create the appropriate environment for collaboration and hence contributes to this function by *uniting*. DF is an open platform where actors of different interests or competencies are encouraged to build and collaborate. Partners, including start-ups, are encouraged to test new solutions that would otherwise be accessible only to resourceful partners. SMEs are also given a platform to connect with larger companies, creating a more diverse and equal playground for developing creative solutions. All in all, DF attracts new actors to enter the partner network, which reinforces and adds to the network effect of the system.

5.4. Summary of analysis and proposed conceptual model

Based on previous analytical findings, *AI Factory* (Figure 17) is derived as a revised conceptualized framework. The framework captures the role of an innovation intermediary in TIS, and can be viewed in terms of its innovation process, or it's structural components.

In the innovation process, *AI Factory* (Figure 17) depicts the process from which the innovation intermediary facilitates the transformation of collaboration, open innovation (Chesbrough, 2003), and entrepreneurial activities (Köhler et al., 2016) into the accelerated development and diffusion of applied AI. In the TIS, actors of academia, public and private sector are increasingly externalizing knowledge and activities to the innovation intermediary, to maximize their innovative output.

Secondly, it portrays the intermediary activities that enable this transformation. In internalizing the input of innovative firms and institutions, the role of the AI Factory is to perform activities that *unite*, *engage* and *enable*. In these activities, there is an observable match with how it fulfills the theoretical functions of a TIS (Bergek et al., 2008) and achieves knowledge and technology diffusion (Rogers, 2003).

Through *unite*, AI Factory realizes the mobilization of resources and legitimation of the network through bridging activities. By identifying, supporting, and activating actors of the TIS, it creates a platform for technology development that spans across industries. To cross-regional and sectoral boundaries, it fosters the need for change and aligns the attitudes, norms, objectives, goals and, values of different stakeholders. In addition, it communicates success stories and projects with a focus on technological development, all to unite organizations to share and contribute to the growth of the network.

In *enable*, activities focus on the activation of relationships and interactions inside the *AI Factory*. Through *enable*, AI Factory contributes to market formation and guidance of search for actors in the TIS. In connecting and linking the activities of stakeholders, it unlocks synergizing effects and the creation of new relationships. To achieve this, the innovation intermediary reveals benefits, educate and give new actors of the network a platform to communicate.

In *engage*, AI Factory takes a hands-on approach in the creation and diffusion of knowledge and technology. Through ideation, testing and iteration it is active in the early development stage of emerging technology and research. At this stage, it connects to specialized firms and uses internal resources to implement new solutions. In conversations with partners, the innovation intermediary uses external feedback and evaluation to conceptualize best practices. As to remain neutral, these are then externalized and commercialized by other actors of the TIS.

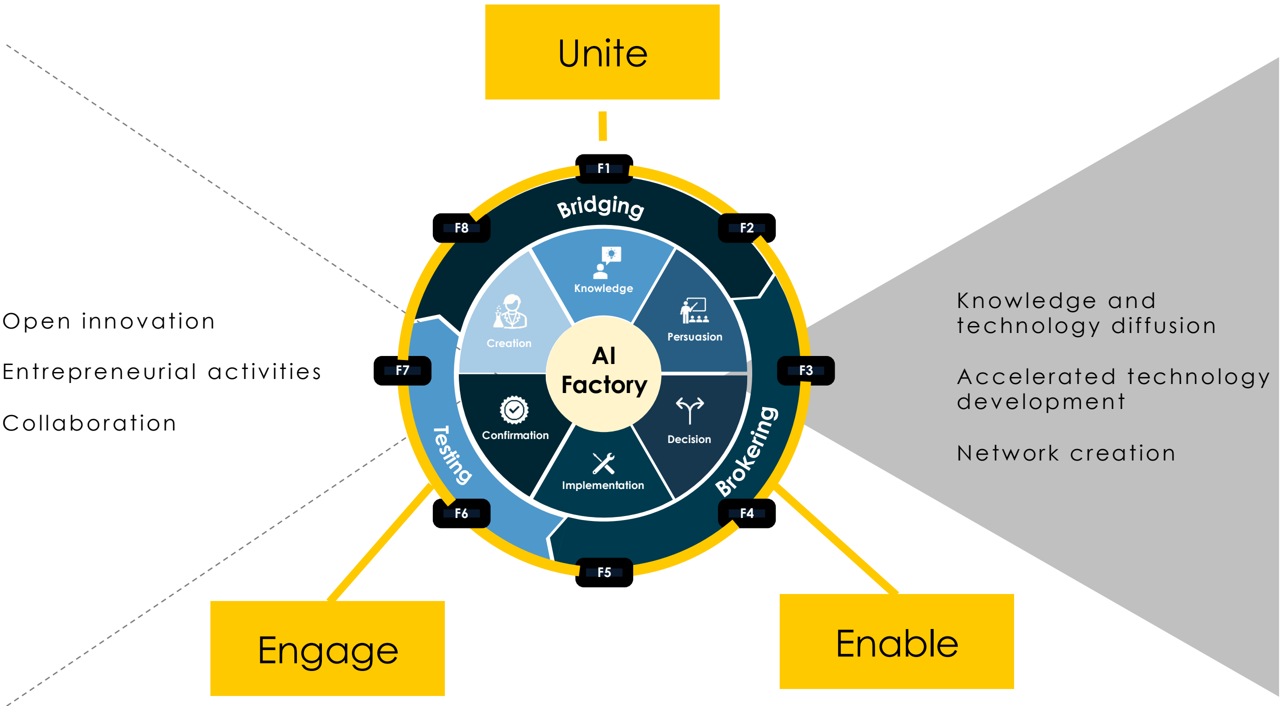

Figure 17. Revised conceptual framework AI Factory.

In summary, *AI Factory* (Figure 17) gives a comprehensive overview of the intermediary role as an active component of a TIS. As input, actors search for innovation outside of their organizational boundaries and use the AI Factory to leverage their innovation efforts. The AI Factory unites these efforts under a common objective, not bound by regional or sectoral restrictions. It then enables the collaboration of these actors by finding mutual benefits across the marketplace. Finally, it directly engages with individual stakeholders, to transform their ideas into viable commercial enterprises. This speeds up the innovation process of stakeholders across the TIS, and accelerates the search of the network for a more technologically sustainable environment.

6. Conclusion

This final chapter answers the research question and presents theoretical contributions and managerial implications. To conclude, limitations and research recommendations are provided.

6.1. Addressing the research question

This section aims to answer the revisited research question:

- *What role does an innovation intermediary have in accelerating the development and use of AI in a technological innovation system?*

Matching the theoretical framework with empirical findings, *AI Factory* is conceptually conceived as a framework to capture how AI Sweden achieves the accelerated development and use of AI. The AI Factory achieves the accelerated development and use of AI by *unite, enable,* and *engage*.

AI Factory's role of *unite* can be ascribed to activities of coordination, network creation and cross-pollination across sectors. In TIS, *unite* fulfils the functions related to entrepreneurial activity, guidance of search, resource mobilization and legitimation. Similarly, *unite* is matched with *bridging* activities, which captures how AI Factory may establish linkages between actors, support and create networks and identify and develop needs for change. Moreover, AI Factory can be seen as a social system in which AI can be transferred and diffused. As a controlling unit in this system, AI Factory can participate in multiple process activities and affect the transfer and diffusion of applied AI through various factors, such as education, demonstrations, and aligning attitudes. By *uniting* actors in this system, values, motivation, and goals can better be interpreted, and communicated. Furthermore, by increasing the interconnectedness, opening up communication channels, and encouraging interactions among influential people in the system, AI Factory has the opportunity to affect the adoption rate. However, as a neutral intermediary, there is always a tug-of-war between meeting specific demands and the risk of being too general in their approach to partners. In sum, AI Factory unites a variety of stakeholders, ranging from start-ups to public institutions, to unlock new ways of collaboration and synergies that aid the transition of society towards a sustainable AI-driven economy.

Enable describes how AI Factory connects, facilitates, and bridges interactions between actors of industry, academia, and public institutions. Similar to traditional brokering and gatekeeping activities, *enable* features elements of matchmaking. As a matchmaker, it connects users and producers and helps partners in the navigation of knowledge and technology. By *enable*, it fulfils the TIS functions of search guidance, market formation and legitimation. Moreover, by *enabling* collaboration among actors in the social system, the degree of compatibility can increase by uniting values and norms leading to a joint perception of AI's relative advantage. Further, as a result of collaboration within the AI Factory, best practices can be derived and demonstrated among participants, decreasing the complexity of the technology. Finally, by assisting the collaboration across sectors, valuable knowledge and reinforcement of decisions can be shared among partners to facilitate the adoption process.

As a final point, AI Factory *engages* in key activities to accelerate the diffusion and the development of applied AI. By providing trialability through hands-on testing and by offering technical expertise, the adoption rate has the potential to increase. The level of complexity is also anticipated to diminish as partners are expected to better understand how and why the technology works. Furthermore, by offering an environment where actors can *engage* and experiment, feedback and reflections will arise that could be utilized to better understand the needs of actors in the system. In line with this, e*ngage* fulfils the TIS functions entrepreneurial activities and knowledge development and diffusion. *Engage* is also matched with the intermediary activities related to ideation, knowledge transfer, and commercialization. These activities are embodied in the EL, where a testbed is provided for participants to test and co-create emerging business solutions. As part of this, AI Factory connects with specialized organizations to develop, annotate and test AI models. Ultimately, the outcome of *engage* is to establish an international centre for the latest and greatest in AI, to speed up the transfer of applied technology and knowledge to marketplace participants.

Lastly, in comparing the role of AI Sweden and the functions of TIS, there is a clear overlap that should be highlighted. Empirically, AI Sweden is a key contributor to all functions of the TIS, which confirms that intermediaries play an active role in the direction and development of TIS. Specifically, the list of TIS functions is fulfilled as follows:

1. Entrepreneurial activity: AI Sweden facilitate cross-sector collaborations, technology testing and iteration for companies of all sizes. In the EL, companies that lack resources are provided a testbed for development and iteration.
2. Knowledge development: AI Sweden opens an arena for knowledge transfer, and positions itself as a platform and aggregator where leading technological companies can collaborate.
3. Diffusion of knowledge: AI Sweden spreads accumulated knowledge through diagnostics, scanning and idea development. However, commercialization is externalized through partners.
4. Guidance of search: AI Sweden creates and communicates a sense of urgency while guiding the interactions between industry, academia and public institutions.
5. Market formation: AI Sweden does not invest directly in businesses, but acts as a test environment for to-be commercial solutions. It provides access to data infrastructure that would otherwise be inaccessible for most companies.
6. Resource mobilization: AI Sweden is not a financier, but it organizes infrastructure, human capital and legal and technical know-how through its projects that are financed through a mix of public, private and in-kind contributions.
7. Legitimation: AI Sweden define and align the interests of SMEs, institutions and incumbents through neutral positioning, strong brand management and compliance with the appropriate institutions. A challenge is to balance neutrality and trust in a large network.
8. Developing positive externalities: AI Sweden attracts new actors to enter the partner network, which reinforces the network effect of the system. In this, catering to the needs of many but also the few is an identified challenge.

In conclusion, the role of the innovation intermediary in accelerating the development and use of AI in an innovation system can be summarized by the AI Factory framework. In short, the role of the AI Factory is captured by the following interviewee quote:

"Where data is transformed into something valuable"

6.2. Theoretical contributions

Combining empirical and literature findings on intermediary activities result in two main theoretical contributions. First, this thesis introduces *AI Factory* as a conceptual model for capturing the role of innovation intermediaries in TIS. As a neutral initiator in the exploratory innovation process, it breaks the view of the traditional literature of being either an innovation facilitator or broker (Agogué et al., 2013; Bessant & Rush, 1995; Hargadon & Sutton, 1997; Howells, 2006). Instead, it takes a leadership role in the co-creation of emerging technology up until the commercialization stage, which lets it internalize the visions of partners across sectors and regions while remaining neutral. By including partners in the collaborative innovation process, it leads the exploration into *the unknown* (Agogué et al., 2017) of potentially emerging technological regimes. The existence of a neutrally perceived, non-institutional, and non-regionally bound organization that actively drives the pinnacle of technological progress across sectors is something not previously discovered in literature and should therefore be underlined.

Second, this work contributes a deeper theoretical understanding of how to evaluate the role of intermediaries in TIS. First, by considering an overlap between intermediary activities and functions of TIS, it supports previous literature (Howells, 2006, Lukkarinen et al., 2018, that indicates this as a possible method for assessing intermediaries' impact in TIS. Specifically, this has been illustrated through a non-private, non-public actor active in the field of AI in Sweden. Moreover, the ambiguous relationship between TT and diffusion of innovation theory (Dubickis & Gaile-Sarkane, 2015) has been further understood through the lens of an intermediary. This, as in the AI Factory, the role of the intermediary imply involvement in both TT and diffusion of innovation theory as they occur simultaneously rather than two partially overlapping processes.

6.3. Practical implications

This thesis does not only provide important implications for intermediaries such as AI Sweden, but it also provides useful practical takeaways for future stakeholders. In the near future, the interactive landscape of competitive organizations is expected to change, as firms move to more collaborative and open systems of innovation. In such an environment, the importance of innovation intermediaries will be of key significance. As such, highlighting potential areas for improvement, challenges, or opportunities in regard to the role of innovation intermediaries, is of utmost importance for future practitioners.

Within the themes, *Unite*, *Enable*, and *Engage,* six key opportunities and challenges have been identified. These should be further utilized by innovation intermediaries to maximize their contribution to TIS:

- Besides building a national ecosystem, AI Factory should participate in international collaborations for two main reasons. Firstly, international talents and experts could be attracted to fill and maintain the skilled workforce. Secondly, inspiration and knowledge in similar initiatives should be shared on an international basis, especially within the European Union in which potential synergies could be found. This would also enable the development of best practices and standards to facilitate the adoption of applied AI.

- To provide information and influence the ecosystem, AI Factory should take an opinion leader role. In order to earn a leadership role, credibility, technology expertise, social competencies, and conformity with the norms in the ecosystem should be demonstrated. Therefore, AI Factory should continuously strive to understand the partners' needs and be at the forefront of technology development and know-how. This should be done through continuous interactions and engagements with partners. Moreover, as an opinion leader, AI Sweden has the possibility to increase the adoption rate of applied AI by utilizing its influential position and communication networks. This, as information associated with AI, could easily be diffused and in a receptive manner. Additionally, to achieve a snowballing effect, influential people possessing permission to make authority decisions, or pioneer organizations, should be targeted. Finally, it should be noted that if AI Sweden deviates too much from the norms of the ecosystem it tries to influence, it can lose its credibility and thus its leadership role. Therefore, the lion's share of resources should be directed towards the general needs in the ecosystem rather than on highly complex and specific technologies. However, to keep the technology expertise, it is of importance to be involved and understand the latest technologies.

- An understanding and a clear picture of the relative advantage and knowledge associated with both the development and utilization of AI is of significant importance. Therefore, AI Sweden should focus on initiatives that reveal the benefits of applying AI. Moreover, it is of importance to understand that advantages vary between partners in the ecosystem, as they may be perceived differently. Therefore, one could argue that individual initiatives and communications should be established. However, to keep the neutral position, AI Sweden should provide general information and knowledge of the advantages concerning AI, rather than focus on niche solutions. Additionally, it is of usefulness to recognize that the perceived advantages could also hinder the adoption of AI. This, because of individual concerns of being replaced by the technology and become redundant. Moreover, technology champions and key persons within organizations should be targeted, as they may have the potential to influence organizations and evoke a sense of urgency to change. Another important consideration in the system is the change agents. Change agents are important actors since they bridge the knowledge gap between developers and recipients. Nevertheless, by providing a general understanding of the benefits, norms, values and, attitudes towards AI, AI Sweden should align actors in the ecosystem and thus increase the adoption rate of new technology. At the same time, AI Sweden could link and matchmake partners within the ecosystem to fill the gap of specific needs and requirements. Finally, by increasing the knowledge and understanding of AI in the ecosystem, the behavioral change necessary to apply AI should decrease and thus accelerate the adoption. However, despite the permeated need for knowledge regarding AI, the type of knowledge is also highly specific between actors. As an effort to discourage the lack of general knowledge, AI Factory, should focus on educational initiatives. These initiatives could also be co-hosted by the academic sector, change agents, and other members of the ecosystem through interactive channels.

- AI Factory should focus on setting standards to facilitate and accelerate the adoption process and reduce the potential complexity. Therefore, standardized solutions for sharing data across actors, deployment and implementation processes, and legal barriers should be compiled. Moreover, setting standards would further decrease the barriers for SMEs to apply AI due to their limited resources. Additionally, settings standards could also encourage organizations across sectors to support one another. This is also applicable for large industrial organizations, that have the possibility to guide their suppliers in applying AI to increase their overall value chain productivity.

- As a procurement platform, AI Sweden could be viewed as an environment in which developers and recipients get along and collaborate. The platform should further provide a testbed for recipients and developers where solutions and emerging technologies are tested and evaluated. In a quickly evolving environment, AI Sweden should further use the testbed to encourage quicker technology development processes. Lastly, the testbed should also facilitate the decision process by revealing demonstrations and hands-on experiences.

As a neutral intermediary, limitations arise of what could be accomplished without interfering with the partner's business models. However, by utilizing and guiding partners within the ecosystem, AI Factory does not necessarily need to manage specific needs or demands.

6.4. Limitations and recommended future research

The limitations of this study open potential opportunities for future research. First, this study does not measure the relative performance of its research subject or its resulting framework, *AI Factory*. Specifically, the extent and relative contribution of the 1st order themes contribution to the output of intermediaries is still unexplored. Through quantitative analysis such as a longitudinal study, future research could extend the degree to which we understand the relative impact of intermediary activities and factors, and which ones should be emphasized to maximize the performance and output of intermediation. This contribution would improve the understanding and performance of future innovation intermediaries. Second, AI Factory is a new concept, derived from findings in the sectoral field of AI. However, the performance of this framework is untested in alternative TIS. The framework should be practically and theoretically applied in other emerging sectoral systems to increase the understanding of the intermediary role in TIS.

Finally, further understanding is needed in terms of what external or internal factors pressure partners to join one intermediary network or another. For instance, it was mentioned during interviews that the legal and compliance issues of collaborating across data are a huge barrier for collaboration, which is mitigated by working through an intermediary. Future research should study to which degree data obstacles drive the relevance of innovation intermediaries, as this could have an impact on future performance, and applicability in other types of IS. In addition, future research should consider the importance of external factors, such as data compliance laws or sustainability directives, versus other factors, as the critical motivational drivers that attract partners to the intermediary's network. This query becomes especially interesting when the intermediary reaches internationally and across different sectors, as the explanatory variables predictably have less to do with regionally bound factors. As a result, this thesis predicts that the study of intermediaries in TIS will not only remain relevant but increase in relevance as regional boundaries diminish and actors search for innovation in the most effective systems.

References

Adner, R. (2006). Match your innovation strategy to your innovation ecosystem. *Harvard business review*, *84*(4), 98.

Agogué, M., Berthet, E., Fredberg, T., Le Masson, P., Segrestin, B., Stoetzel, M., ... & Yström, A. (2017). Explicating the role of innovation intermediaries in the "unknown": A contingency approach. *Journal of Strategy and Management*.

Agogué, M., Yström, A., & Le Masson, P. (2013). Rethinking the role of intermediaries as an architect of collective exploration and creation of knowledge in open innovation. *International Journal of Innovation Management*, *17*(02), 1350007.

AI Sweden. (2021a). About AI Sweden. Retrieved 2021-04-11 at https://www.ai.se/en/about-0

AI Sweden. (2021b). The Data Factory. Retrieved 2021-05-22 at https://www.ai.se/en/data-factory

AI Sweden. [AI Sweden]. (2021c, 8 February). Data Factory Day and grand opening of Edge Lab – 2021 [Videofile]. Retrieved 2021-02-10 from https://www.youtube.com/watch?v=tZi3H3u-3VY&ab_channel=AISweden

Allen, T. J. & O'Shea, R. P. (2014). Building Technology Transfer within Research Universities: An Entrepreneurial Approach. *(pp. 1–10). Cambridge: Cambridge University Press.*

Andreeva, R., & Glaa, B. (2015). Public Intermediaries as Key Facilitators of Diffusion: The Case of Renewable Energy in Sweden.

Asheim, B. T., & Coenen, L. (2005). Knowledge bases and regional innovation systems: Comparing Nordic clusters. *Research policy*, *34*(8), 1173-1190.

Askarany, D. (2009). Diffusion of Innovations in Organizations. *SSRN Electronic Journal.*

Aspeteg, J., & Bergek, A. (2020). The value creation of diffusion intermediaries: Brokering mechanisms and trade-offs in solar and wind power in Sweden. *Journal of Cleaner Production*, *251*, 119640.

Bauer, S. M., & Flagg, J. L. (2010). Technology Transfer and Technology Transfer Intermediaries. *Assistive Technology Outcomes and Benefits*, *6*(1), 129-150.

Bell, E., Bryman, A., & Harley, B. (2018). *Business research methods*. Oxford university press.

Benassi, M., & Di Minin, A. (2009). Playing in between: patent brokers in markets for technology. *R&d Management*, *39*(1), 68-86.

Bergek, A. (2020). Diffusion intermediaries: A taxonomy based on renewable electricity technology in Sweden. *Environmental Innovation and Societal Transitions*, *36*, 378-392.

Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., & Rickne, A. (2008). Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. *Research policy*, *37*(3), 407-429.

Bessant, J., & Rush, H. (1995). Building bridges for innovation: the role of consultants. *Research Policy*, 97-114.

Blomkvist, P., & Hallin, A. (2015). Method for engineering students: Degree projects using the 4-phase Model. Studentlitteratur AB.

Boulding, K. E. (1985). The world as a total system.

Bozeman, B. (2000). Technology transfer and public policy: a review of research and theory. *Research Policy, 29(4), p.627-655.*

Braczyk, H. J., Cooke, P. N., Heidenreich, M., & Krauss, G. (Eds.). (1998). *Regional innovation systems: the role of governances in a globalized world*. Psychology Press.

Braun, V., & Clarke, V. (2013). Successful qualitative research: A practical guide for beginners. Sage.

Breschi, S., & Malerba, F. (1997). Sectoral innovation systems: technological regimes, Schumpeterian dynamics, and spatial boundaries. Systems of innovation: Technologies, institutions and organizations, 1, 130-156.

Burt, R. S. (2004). Structural Holes and Good Ideas. *American Journal of Sociology*.

Bush, R. E., & Bale, C. S. E. (2017). The role of intermediaries in the transition to district heating. *Energy Procedia*, *116*, 490-499.

Carayannis, E. G., & Campbell, D. F. (Eds.). (2006). *Knowledge creation, diffusion, and use in innovation networks and knowledge clusters: A comparative systems approach across the United States, Europe, and Asia.* Greenwood Publishing Group.

Carlsson, B., & Stankiewicz, R. (1991). On the nature, function and composition of technological systems. *Journal of evolutionary economics*, *1*(2), 93-118.

Carlsson, B., Jacobsson, S., Holmén, M., & Rickne, A. (2002). Innovation systems: analytical and methodological issues. *Research policy*, *31*(2), 233-245.

Chesbrough, H. W. (2003). Open innovation: *The new imperative for creating and profiting from technology*. Harvard Business Press.

Choi, H. J. (2009). Technology Transfer Issues and a New Technology Transfer Model. *The Journal of Technology Studies.*

Christensen, C. M., & Bower, J. L. (1996). Customer power, strategic investment, and the failure of leading firms. *Strategic management journal*, *17*(3), 197-218.

Clarke, V., & Braun, V. (2014). Thematic analysis. In *Encyclopedia of critical psychology* (pp. 1947-1952). Springer, New York, NY.

Colombo, G., Dell'Era, C., & Frattini, F. (2015). Exploring the contribution of innovation intermediaries to the new product development (NPD) process: a typology and an empirical study. *R&D Management*, *45*(2), 126-146.

Cooke, P. (1992). Regional innovation systems: competitive regulation in the new Europe. *Geoforum*, *23*(3), 365-382.

Cooke, P. (2002). *Knowledge economies: Clusters, learning and cooperative advantage*. Routledge.

Cottrill, C. A., Rogers, E. M., & Mills, T. (1989). Co-citation analysis of the scientific literature of innovation research traditions: Diffusion of innovations and technology transfer. *Knowledge*, *11*(2), 181-208.

Cumming, D., Fleming, G., & Schwienbacher, A. (2008). Financial intermediaries, ownership structure and the provision of venture capital to SMEs: Evidence from Japan. *Small Business Economics*, *31*(1), 59-92.

Dalziel, M. (2010, June). Why do innovation intermediaries exist. In *DRUID Summer Conference* (Vol. 2010, p. 24).

Damanpour, F., & Wischnevsky, J. D. (2006). Research on innovation in organizations: Distinguishing innovation-generating from innovation-adopting organizations. *Journal of engineering and technology management*, *23*(4), 269-291.

Dardak, R. A., & Adham, K. A. (2014). Transferring agricultural technology from government research institution to private firms in Malaysia. *Procedia-Social and Behavioral Sciences*, *115*, 346-360.

Dearing, J. W. (2009). Applying diffusion of innovation theory to intervention development. *Research on social work practice, 19*(5), 503-518.

Dearing, J.W. & Cox, J.G. (2018). Diffusion Of Innovations Theory,

DeVore, P. W. (1987). Technology and science. Wright (Eds.), Conducting technical research (pp. 27-45). Mission Hills, CA: Glencoe.

Dhalander, L. & Gann D.M. (2010). How open is innovation? *Res. Policy, 39 (2010), pp. 699-709.*

Dicecca, R., Pascucci, S., & Contò, F. (2016). Understanding reconfiguration pathways of agri-food value chains for smallholder farmers. *British Food Journal*.

Diener, K., & Piller, F. T. (2010). The Market for Open Innovation: Increasing the efficiency and effectiveness of the innovation process. *RWTH Aachen University, Technology & Innovation Management Group.*

Dosi, G., Freeman, C., Nelson, R., Silverberg, G., & Soete, L. (1988). *Technical change and economic theory*. Laboratory of Economics and Management (LEM), Sant'Anna School of Advanced Studies, Pisa, Italy.

Downs, G. W. & Mohr, L. (1976). Conceptual Issues in the Study of Innovations. *Administrative Science Quarterly, 21, pp. 700-714.*

Driessen, P. H., & Hillebrand, B. (2002). Adoption and diffusion of green innovations. *Marketing for sustainability: towards transactional policy-making*, 343-355.

Dubickis, M. & Gaile-Sarkane, E. (2015). Perspectives on innovation and technology transfer. *Procedia-Social and Behavioral Sciences.*

Dubois, A. & Gadde, L-E. (2002). Systematic combining: an abductive approach to case research. *Journal of Business Research, Vol. 55, pp.553-560.*

Edler, J., & Yeow, J. (2016). Connecting demand and supply: The role of intermediation in public procurement of innovation. *Research Policy*, *45*(2), 414-426.

Edquist, C. (2010). Systems of innovation perspectives and challenges. *African Journal of Science, Technology, Innovation and Development*, *2*(3), 14-45.

Edquist, C. (Ed.). (1997). Systems of innovation: technologies, institutions, and organizations. Psychology Press.

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of management review*, *14*(4), 532-550.

Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of management journal*, *50*(1), 25-32.

Everett, R. M. (1962). Diffusion of innovations (1st ed.). *New York: Free Press of Glencoe.*

Feller, J., Finnegan, P., Hayes, J., & O'Reilly, P. (2012). Orchestrating' sustainable crowdsourcing: A characterisation of solver brokerages. *The Journal of Strategic Information Systems. Volume 21, Issue 3, September 2012, Pages 216-232*

Freeman, C. (1987). *Technology, policy, and economic performance: lessons from Japan*. Pinter: London.

Freeman, C. (1995). The 'National System of Innovation'in historical perspective. *Cambridge Journal of economics*, *19*(1), 5-24.

Frey, R.E. (1991). Another Look at Technology and Science

Galbraith, J. K. (1967). The new industrial state. *Boston, MA: Houghton Mifflin.*

Gianiodis, P. T., Ellis, S. C., & Secchi, E. (2010). Advancing a typology of open innovation. International Journal of Innovation Management, 14(04), 531-572.

Gibson, D.V. & Rogers, E.M. (1994). R&D collaboration on trial: the Microelectronics and Computer Technology Corporation. *Harvard Business Press.*

Gibson, D.V. & Smilor, R.W (1991). Key variables in technology transfer: A field-study based empirical analysis. *Journal of Engineering and Technology Management, 8.*

Google scholar. (2021). Retrieved 2021-05-12 from https://scholar.google.se/scholar?hl=sv&as_sdt=0%2C5&as_vis=1&q=open+innovation+chesbrough+2003&oq=ches

Gray, D. E. (2019). Doing Research in the Business World. London: SAGE publication Ltd.

Gredel, D., Kramer, M., & Bend, B. (2012). Patent-based investment funds as innovation intermediaries for SMEs: In-depth analysis of reciprocal interactions, motives and fallacies. *Technovation*, *32*(9-10), 536-549.

Guo, J., & Guo, B. (2013). How do innovation intermediaries facilitate knowledge spillovers within industrial clusters? A knowledge-processing perspective. *Asian Journal of Technology Innovation*, *21*(sup2), 31-49.

Hargadon, A., & Sutton, R. I. (1997). Technology brokering and innovation in a product development firm. *Administrative science quarterly*, 716-749.

Hassinger, E. (1959). Stages in the adoption process. *Rural sociology*, *24*(1), 52.

Hekkert, M. P., Suurs, R. A., Negro, S. O., Kuhlmann, S., & Smits, R. E. (2007). Functions of innovation systems: A new approach for analysing technological change. *Technological forecasting and social change*, *74*(4), 413-432.

Holloway, R. E. (1977). Perceptions of an innovation: Syracuse university project advance (Doctoral Dissertation, Syracuse University). *Retrieved from ERIC. (Publication No. AAT 7811656).*

Holstein, J. A., & Gubrium, J. F. (2016). Narrative practice and the active interview (Vol. 67, pp. 67-82). London: Sage.

Holzmann, T., Sailer, K. & Katzy, B. R. (2014). Matchmaking as a multi-sided market for open innovation. *Technol. Anal. Strateg. Manag., 26 (2014), pp. 601-615*

Hossain, M. (2012). Performance and potential of open innovation intermediaries. Procedia-Social and Behavioral Sciences, 58, 754-764.

Howells, J. (2006). Intermediation and the role of intermediaries in innovation. *Research policy*, *35*(5), 715-728.

Hägerstrand, T. (1952). The propagation of innovation waves. *Lund Studies in Human Geography, Series B 4, 3–19.*

Ibrahim, A., & Marah, A. (2018). A comparative analysis of national innovation systems' structures and their developmental impacts (Evidences from BRICS countries). *Научный журнал НИУ ИТМО. Серия «Экономика и экологический менеджмент»*, (1).

Jackson, D. J. (2011). What is an innovation ecosystem. *National Science Foundation*, *1*(2), 1-13.

Jacobsson, S., & Johnson, A. (2000). The diffusion of renewable energy technology: an analytical framework and key issues for research. *Energy policy*, *28*(9), 625-640.

Johnson, A. (2001, June). Functions in innovation system approaches. In *Nelson and Winter Conference, Aalborg, Denmark* (pp. 12-15).

Johnsson, S.D., Gatz, E.F., & Hicks, D. (1997). Expanding the content base of technology education: Technology transfer as a topic of study. *Journal of Technology Education, 8(2), p.35-49.*

Juntunen, M., & Lehenkari, M. (2021). A narrative literature review process for an academic business research thesis. *Studies in higher education*, *46*(2), 330-342.

Kanda, W., del Río, P., Hjelm, O., & Bienkowska, D. (2019). A technological innovation systems approach to analyse the roles of intermediaries in eco-innovation. *Journal of Cleaner Production*, *227*, 1136-1148.

Kanter, R.M. (1988). When a thousand flowers bloom: structural, collective and social conditions for organizational innovation. *Research in Organizational Behavior, vol. 10. JAI Press, Greenwich, CT, pp. 169–211*.

Katz, M. M., & Lyerly, S. B. (1963). Methods for measuring adjustment and social behavior in the community: I. Rationale, description, discriminative validity and scale development. Psychological Reports, 13(2), 503-535.

Katzy, B., Turgut, E., Holzmann, T., & Sailer, K. (2013). Innovation intermediaries: a process view on open innovation coordination. Technology Analysis & Strategic Management, 25(3), 295-309.

Kinnunen, J. (1996). Gabriel Tarde as a Founding Father of Innovation Diffusion Research. *Acta Sociologica. 39 (4): 431–442*

Kivimaa, P., & Martiskainen, M. (2018). Innovation, low energy buildings and intermediaries in Europe: systematic case study review. *Energy Efficiency*, *11*(1), 31-51.

Kivimaa, P., Hyysalo, S., Boon, W., Klerkx, L., Martiskainen, M., & Schot, J. (2019). Passing the baton: How intermediaries advance sustainability transitions in different phases. *Environmental Innovation and Societal Transitions*, *31*, 110-125.

Klein, M., & Sauer, A. (2016). *Celebrating 30 years of innovation system research: What you need to know about innovation systems* (No. 17-2016). Hohenheim Discussion Papers in Business, Economics and Social Sciences.

Klerkx, L., & Leeuwis, C. (2009). Establishment and embedding of innovation brokers at different innovation system levels: Insights from the Dutch agricultural sector. *Technological forecasting and social change*, *76*(6), 849-860.

Knockaert, M., & Spithoven, A. (2014). Under which conditions do technology intermediaries enhance firms' innovation speed? The case of Belgium's collective research centres. *Regional Studies*, *48*(8), 1391-1403.

Kuhlmann, S., & Arnold, E. (2001). RCN in the Norwegian research and innovation system. Fraunhofer.

Kuhn, T. S. (1970). The structure of scientific revolution. *Chicago: University of Chicago Press.*

Kvale, S. (2007). *Doing interviews.* London: Sage.

Köhler, J., Braungardt, S., Hettesheimer, T., Lerch, C., Nabitz, L., Sartorius, C., & Walz, R. (2016). *The dynamic simulation of TIS functions in transitions pathways* (No. 48). Fraunhofer ISI Discussion Papers-Innovation Systems and Policy Analysis.

Landry, R., Amara, N., Cloutier, J.S., & Halilem, N. (2013). Technology transfer organisations: Services and business models. Technovation, 33(12):431-49.

Leydesdorff, L. (2000). The triple helix: an evolutionary model of innovations. *Research Policy 29 2000 243–255*.

Lincoln, Y.S., & Guba, E.G. (1985). Naturalistic inquiry. Newbury Park, CA: Sage.

Lindner, R., Daimer, S., Beckert, B., Heyen, N., Koehler, J., Teufel, B., ... & Wydra, S. (2016). *Addressing directionality: Orientation failure and the systems of innovation heuristic. Towards reflexive governance* (No. 52). Fraunhofer ISI Discussion Papers-Innovation Systems and Policy Analysis.

Lukkarinen, J., Berg, A., Salo, M., Tainio, P., Alhola, K., & Antikainen, R. (2018). An intermediary approach to technological innovation systems (TIS)—The case of the cleantech sector in Finland. *Environmental innovation and societal transitions*, *26*, 136-146.

Lundvall, B. Å. (2016). Innovation as an interactive process: from user–producer interaction to the national systems of innovation. *The Learning Economy and the Economics of Hope*, *61*.

Löfsten, H., & Lindelöf, P. (2002). Science Parks and the growth of new technology-based firms—academic-industry links, innovation and markets. *Research policy*, *31*(6), 859-876.

Majava, J., Isoherranen, V. & Kess, P. (2019). Business Collaboration Concepts and Implications for Companies.

Malerba, F. (Ed.). (2004). Sectoral systems of innovation: concepts, issues and analyses of six major sectors in Europe. Cambridge University Press.

Malhotra, G. (2017). Strategies in research. International Journal for Advance Research and Development, 2(5), 172-180.

Mantel, S. J., & Rosegger, G. (1987). The role of third-parties in the diffusion of innovations: a survey. *Innovation: Adaptation and growth*, 123-134.

Mantere, S., & Ketokivi, M. (2013). Reasoning in organization science. *Academy of management review*, *38*(1), 70-89.

Markert, L. R. (1993). Contemporary technology: Innovations, issues, and perspectives. *South Holland, Illinois: Goodheart-Willcox*

Maskell, P., & Malmberg, A. (1999). Localised learning and industrial competitiveness. *Cambridge journal of economics*, *23*(2), 167-185.

Matschoss, K., & Heiskanen, E. (2017). Making it experimental in several ways: The work of intermediaries in raising the ambition level in local climate initiatives. *Journal of Cleaner Production*, *169*, 85-93.

Matsumoto, M. (1999). Reconsidering Japanese industrialization: Marine turbine transfer at Mitsubishi. *Technology and Culture*, *40*(1), 74-97.

McCarney, R.,Warner, J., Iliffe, S., Haselen, R. V., Griffin, M., & Fisher, P. (2007). The Hawthorne Effect: A Randomised, Controlled Trial. *BMC Medical Research Methodology 7*

Metcalfe, S. (1995). The economic foundations of technology policy: equilibrium and evolutionary perspectives. *Handbook of the economics of innovation and technological change*.

Meulman, W. F. (2017). Challenges for innovation intermediaries in technology transfer: forming controls and alliances.

Mikhaylov, S. J., Esteve, M., & Campion, A. (2018). Artificial intelligence for the public sector: opportunities and challenges of cross-sector collaboration. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *376*(2128), 20170357.

Miles, M. B., & Huberman, A. M. (1994). Qualitative data analysis: An expanded sourcebook. Sage.

Mitcham, C. (1994). Thinking Through Technology. *The University of Chicago Press*

Moon, S. M. (1998). Takeoff or self-sufficiency? Ideologies of development in Indonesia, 1957-1961. *Technology and Culture, 39(2), 187-212.*

Moon, S. M. (1998). Takeoff or self-sufficiency? Ideologies of development in Indonesia, 1957-1961. *Technology and Culture, 39(2), 187-212.*

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information systems research*, *2*(3), 192-222.

Moussavi, A., & Kermanshah, A. (2018). Innovation systems approach: A philosophical appraisal. *Philosophy of Management*, *17*(1), 59-77.

Mulgary, G. and Albury, D. (2003). Innovation in the Public Sector. *Strategy Unit,*

Nelson, R. R. (Ed.). (1993). *National innovation systems: a comparative analysis*. Oxford University Press on Demand.

Nelson, R. R., & Rosenberg, N. (1993). Technical innovation and national systems. *National innovation systems: A comparative analysis*, *1*, 3-21.

Nilsson, M., & Moodysson, J. (2011). Policy coordination in systems of innovation: A structural-functional analysis of regional industry support in Sweden. *Lund: Lund University, CIRCLE*.

Nilsson, M., & Sia-Ljungström, C. (2013). *The Role of Innovation Intermediaries in Innovation Systems* (No. 1021-2016-81779, pp. 161-180).

OECD. (2007). Innovation and Growth: Rationale for an Innovative Strategy. OECD Publishing. Retrieved 2021-03-21 from http://www.oecd.org/science/inno/39374789.pdf

OECD. (2007). Innovation and Growth: Rationale for an Innovative Strategy. OECD Publishing. Retrieved 2021-03-21 from http://www.oecd.org/science/inno/39374789.pdf

of Rural Population Change, Community Development and Voluntarism. *Routledge, New York, London.*

Pace, S. (2013). Looking at innovation through CCT glasses: Consumer. *Journal of Innovation Management, 1(1), pp. 38-54.*

Pacey, A. (1986). The culture of technology. *Cambridge, MA: MIT Press.*

Parayil, G. (1992). The green revolution in India: A case study of technological change. *Technology and Culture, 33(4), 737-756.*

Parayil, G. (1992). The green revolution in India: A case study of technological change. *Technology and Culture, 33(4), 737-756.*

Patton, M.Q. (2002). *Qualitative evaluation and research methods*. (2nd ed.) Thousans Oaks, CA: Sage.

Pelc, K.I. (2017). Diffusion of Innovation in Social Networking. In: Zacher L. (eds) Technology, Society and Sustainability. Springer, Cham.

Peres, R., Muller, E. & Mahajan, V. (2010). Innovation diffusion and new product growth models: A critical review and research directions. *International Journal of Research in Marketing, 27(2), pp. 91-106*.

Powers, J. B., & McDougall, P. P. (2005). University start-up formation and technology licensing with firms that go public: a resource-based view of academic entrepreneurship. Journal of business venturing, 20(3), 291-311.

Rambaldi, G., Chambers, R., McCall, M., & Fox, J. (2006). Practical ethics for PGIS practitioners, facilitators, technology intermediaries and researchers. *Participatory learning and action*, *54*(1), 106-113.

Ranga, M., & Etzkowitz, H. (2013). Triple Helix systems: an analytical framework for innovation policy and practice in the Knowledge Society. *Industry and higher education*, *27*(4), 237-262.

Rao, K. U. & Kishore, V. (2010). A review of technology diffusion models with special reference to renewable energy technologies. *Renewable and Sustainable Energy Reviews, 14(3), pp. 1070-1078.*

Reinsel, D., Gantz, J., & Rydning, J. (2017). Data age 2025: The evolution of data to life-critical. *Don't Focus on Big Data*, *2*.

Rickne, A. (2000). New technology-based firms and industrial dynamics: Evidence from the technological system of biomaterials in Sweden, Ohio and Massachusetts. *Doktorsavhandlingar vid Chalmers Tekniska Hogskola*, (1659), 1-340.

Roberts, E.B. (1988). Managing invention and innovation. *Research Management 31, 11–29*.

Robinson, L. (2009). A summary of diffusion of innovations. Available at: http://www.enablingchange.com.au/Summary_Diffusion_Theory.pdf

Robinson, L. (2009). A summary of diffusion of innovations. Retrieved 2021-04-28 from: http://www.enablingchange.com.au/Summary_Diffusion_Theory.pdf

Roessner, J. D. (2000). Technology transfer. Science and technology policy in the US. A time of change. *London: Longman.*

Rogers, E. M. (1962). Diffusion of innovations. *(1st ed.). New York: Free Press.*

Rogers, E. M. (1995). Diffusion of innovations. *(4th ed.). New York: Free Press.*

Rogers, E. M. (2003). Diffusion of innovations. *(5th ed.). New York: Free Press.*

Rogers, E. M., Takegami, S., & Yin, J. (2001). Lessons learned about technology transfer. *Technovation*, *21*(4), 253-261.

Rogers, E. M., Jeffery, C. P., & McOwiti, T. (2002). Diffusion of a Policy Innovation: Non-Smoking Ordinances in New Mexico.

Rubin, J. J. & Rubin, I.S. (1995). *Qualitative interviewing: The art of hearing data*. Thousand Oaks, CA: Sage.

Ryan, B. & Gross, C. N. (1943). The Diffusion of Hybrid Seed Corn in Two Iowa Communities. *Rural Sociology 8.*

Santos, T. S., Chais, C., Ganzer, P. P., & Olea, P. M. (2018). Technology transfer between universities and companies: Two cases of Brazilian universities. *RAI*, *15*(1), 2.

Sapsed, J., Grantham, A., & DeFillippi, R. (2007). A bridge over troubled waters: Bridging organisations and entrepreneurial opportunities in emerging sectors. *Research Policy*, *36*(9), 1314-1334.

Sari, K., Alamsyah, P., Asmara, A. Y., Kusnandar, K., & Mulatsih, S. (2017). Critical Role of Intermediaries on Technology Transfer: Case Study of BIOTROP and Center for Mariculture Development of Lampung. Journal of Technology Management, 16(1), 33-45.

Saunders, M., Lewis, P., & Thornhill, A. (2009). Research methods for business students. Pearson education.

Schneider,M., Holzer, A., & Hoffmann, V. H. (2008). Understanding the CDM's contribution to technology transfer. *Energy Policy 36 (2008) 2930–2938.*

Schumpeter, J.A. (1934). The Theory of Economic Development: An Enquiry into

Science. Academy of Management Review, 38(1): 70–89.

Segman, R. (1989). Roundtable on Technology Transfer. Technology Transfer Research Groups. *The University of Texas at Austin, Lago Vista, Texas*.

Sherry, L & Gibson, D.C. (2002). The Path to Teacher Leadership in Educational Technology.

Shohet, S., & Prevezer, M. (1996). UK biotechnology: institutional linkages, technology transfer and the role of intermediaries. *R&D Management*, *26*(3), 283-298.

Skinner, M., & Hanlon, N. (Eds.). (2015). Ageing resource communities: New frontiers of rural population change, community development and voluntarism. Routledge.

Skolimowski, H. (1966). The structure of thinking in technology. *Technology and Culture, 7(3), 371-383.*

Spithoven, A. (2015). Technology transfer as a driver for location of R&D active firms on science parks. *International Journal of Innovation and Regional Development*, *6*(1), 80-101.

Stam, E. (2015). Entrepreneurial ecosystems and regional policy: a sympathetic critique. *European Planning Studies*, *23*(9), 1759-1769.

Stankiewicz, R. (1995). The Role of the Science and Technology Infrastructure in the Development and Diffusion of Industrial Automation in Sweden. *Technological Systems and Economic Performance: The Case of Factory Automation pp 165-210.*

Stanford. (2019). Artificial Intelligence Index 2019 Annual Report. Retrieved 2021-01-13 from https://hai.stanford.edu/research/ai-index-2019

Statista. (2020). Volume of data/information created, captured, copied, and consumed worldwide from 2010 to 2024. Retrieved 2021-01-13 from https://www.statista.com/statistics/871513/worldwide-data-created/

Stewart, J. & Hyysalo, S. (2008). Intermediaries, Users and Social Learning in Technological Innovation. *International Journal of Innovation Management 2008 12:03, 295-325.*

Sung, T. K., & Gibson, D. V. (2000). Knowledge and technology transfer: levels and key factors. International Conference on Technology Policy and Innovation (ICTPI).

Tarde, G. (1903). The laws of imitation. *Parsons, E. C. New York, NY: Henry Holt.*

Tornatzky, L. G., & Klein, K. J. (1982). Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings. *IEEE Transactions on engineering management*, (1), 28-45.

Valente, T.W. & Rogers, E.M.(1995). The Origins and Development of the Diffusion of Innovations Paradigm as an Example of Scientific Growth. *Science Communication. 1995;16(3):242-273.*

Van Lancker, J., Mondelaers, K., Wauters, E., & Van Huylenbroeck, G. (2016). The Organizational Innovation System: A systemic framework for radical innovation at the organizational level. *Technovation*, *52*, 40-50.

Van Lente, H., Hekkert, M., Smits, R., & Van Waveren, B. A. S. (2003). Roles of systemic intermediaries in transition processes. *International journal of Innovation management*, *7*(03), 247-279.

Vanhaverbeke, W., & Chesbrough, H. (2014). A classification of open innovation and open business models. *New frontiers in open innovation*, *6*, 50-68.

Wahab, S.A., Rose, R.C., Uli, J., & Abdullah, H. (2009). A Review on the Technology Transfer Models, Knowledge-Based and Organizational Learning Models on Technology Transfer. *European Journal of Social Sciences – Volume 10, Number 4.*

Walker, J. L. (1971). Innovation in State Policies. *Politics in the American States: A Comparative Analysis. Boston: Little Brown. PS(E).*

Warnke, P., Koschatzky, K., Dönitz, E., Zenker, A., Stahlecker, T., Som, O., ... & Güth, S. (2016). *Opening up the innovation system framework towards new actors and institutions* (No. 49). Fraunhofer ISI Discussion Papers-Innovation Systems and Policy Analysis.

Watkins, D., & Horley, G. (1986). Transferring technology from large to small firms: the role of intermediaries. *Small business research*, *35*(5), 715-728.

Weick, K. (1990). Technology as equivoque: Sense-making in new technologies. In: P.S. Goodman and L.S. Sproull (Eds.), Technology and Organizations. Jossey-Bass. San Francisco, CA. pp. l-44.

Wejnert, B. (2002). Integrating Models of Diffusion of Innovations: A conceptual Framework. *Annual review of Sociology 28, pp. 297-326.*

Xiao, Y., & Watson, M. (2019). Guidance on Conducting a Systematic Literature Review. Planning Education and Research, 93-112.

Xiao, Y., & Watson, M. (2019). Guidance on conducting a systematic literature review. Journal of Planning Education and Research, 39(1), 93-112.

Xiaoyuan, Z., & Yanning, Z. (2011). Development of Chinese science and technology intermediaries and their integration into the open innovation paradigm. *Technology Analysis & Strategic Management*, *23*(1), 25-48.

Yin, R. K. (2018). Case study research: Design and methods, applied social research. Methods series, 6.

Yin, R. K., & Davis, D. (2007). Adding new dimensions to case study evaluations: The case of evaluating comprehensive reforms. New directions for evaluation, 2007(113), 75-93.

Appendix A: AI Sweden's Data Factory and Edge Lab

In this section, context is given to the non-theoretical foundation that this research builds upon. To capture this, the researchers met with representatives from AI Sweden during the initial stage of the thesis process. In a collaborative process, potential research areas and proposals were carried out and noted down which eventually led to the initial research proposal. Moreover, a mapping of the state-of-the-art was conducted to gain knowledge and understanding of the latest technologies used in the research area.

AI Sweden and the Data Factory

The *Data Factory* concept was first introduced by AI Sweden in 2017 as a research environment where industry and academia could collaborate to train and develop AI algorithms (AI Sweden, 2021a). By bringing together developers of the required data infrastructure and the people who develop the AI algorithms, the idea was to enable faster development and research of AI. While the hardware components in the *Data Factory* are not necessarily innovative by themselves, the method of putting these components together differentiated the hardware from a storage and compute (AI Sweden, 2021c).

The vision of Data Factory is to be *a world leading center of excellence for building data factory solutions harboring cutting-edge infrastructure and strategic know-how that concretely accelerates the use of AI and pushes the boundaries for AI innovation and research* (AI Sweden, 2021c).

In short, the *Data Factory* comprises the technological infrastructure, data, legal frameworks and know-how of managing and accessing large and complex datasets. It enables users to donate or license data, access data and to use storage and compute power for cutting-edge AI projects. Specifically, a *Data Factory* is comprised of 1) testbed 2) suite of algorithms and ready-to-use solutions 3) storage and compute infrastructure. Currently, it's financed by a mix of public, private and in-kind contributions (AI Sweden, 2021c).

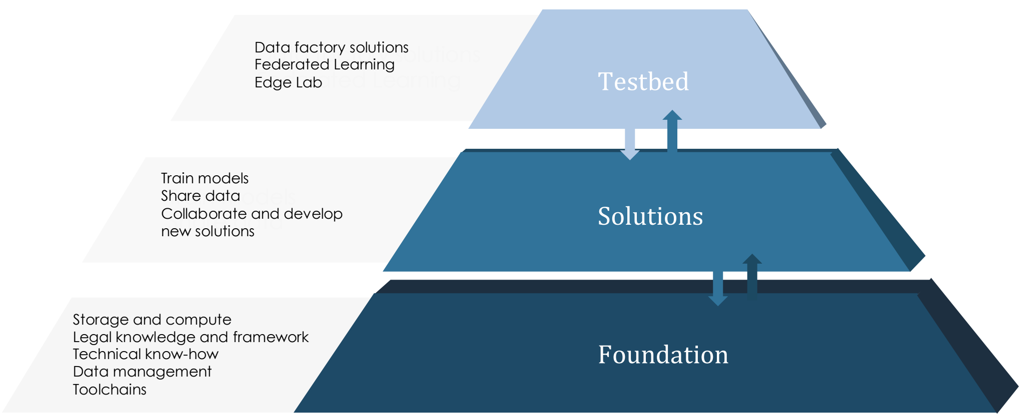

Figure A1. The Data Factory overview (AI Sweden, 2021).

Primarily, Data Factories could reduce risk for users and accelerate AI development. Further, it's main value proposition is to provide 1) resources to train algorithmic models 2) an environment to explore data factory solutions 3) datasets and models 4) knowledge accumulation 5) collaborative toolchain development. (AI Sweden, 2021a)

The Edge Lab

Competitive firms want to accumulate, activate and transfer large amounts of data (AI Sweden, Data Factory Day). To manage data in a scalable, non-costly and compliant manner is a great challenge that involve a variety of stakeholders in most industries (AI Sweden, 2021c). In tackling this issue, companies have realized that bigger storage is not a feasible solution. The most promising solutions are currently developing in the nascent field of *edge computing*. Introduced by Google in 2016, edge computing is where training of AI algorithms happens at the device node, such as smart phone rather than at a centralized data base. By 2025, edge devices will create more than 90 trillion gigabytes of data, or 51% of the data generated around the globe (Reinsel, Gantz, & Rydning, 2017). High demands on energy needed, costs in data storage and transfer, latency and compliance make current solutions unsustainable. Edge computing is one of the latest technological advancements in the field of AI, that tries to solve this challenge (AI Sweden, 2021c).

Edge computing is in high demand in sectors such as automotive, healthcare, finance, insurance, consumer products, telecom, among others. The demand is rapidly expanding and applications are now being tested in areas such as IoT, manufacturing, film making, infrastructure, logistics, retail and linguistics. As a part of the Data Factory, the Edge Lab is the world's most advanced edge computing facility. It allows for cross-sector collaboration between private, public and academic stakeholders. By being able to test state of the art edge computing technology in an open environment, actors can configure, share and apply models in real world scenarios from a wide range of data sets. (AI Sweden, 2021c)

Appendix B: Innovation systems and intermediary types in theory

	National Innovation System (NIS)	*Regional Innovation System (RIS)*	*Sectoral Innovation System (SIS)*	*Technological Innovation System (TIS)*
Founding authors	Freeman (1987), Dosi et al. (1988), Lundvall (1992), Nelson (1993), Edquist (1997)	Cooke (1992), Braczyk et al. (1998), Maskell and Malmberg (1999), Asheim and Coenen (2005)	(Breschi & Malerba, 1997; Breschi et al., 2000; Malerba, 2002-2005)	Carlsson & Stankiewicz (1991), Jacobsson & Johnson (2000), Rickne (2000), Johnson (2001), Hekkert et al. (2007), Bergek et al. (2008)
Basic concept	Networks of actors are framed within the nation-specific policies that determine the level of technology creation, diffusion and utilization.	A local innovation system, where regulatory intervention and technology transfer happens in the region or sub-region.	Sectors have different characteristics and innovation and technology evolve over time, shaped by knowledge, actors and institutions.	Innovation and technology transfer happens between various actors, restricted only to a common technology rather than their geographic locations.
Components	1. Private and public firms 2. Universities 3. Government agencies	1. Firms 2. Institutions 3. Knowledge infrastructure 4. Policy-oriented regional	1. Institutions 2. Actors and Networks 3. Knowledge and Technology	1. Actors (and their competencies) 2. Networks 3. Institutions

Table B1. Innovation system frameworks in theory, overview inspired by Klein and Sauer (2016).

Intermediary types	***Authors***	***Focus***	***Located***
Systemic intermediary	Van Lente et al. (2003)	Articulation, organization, alignment and mobilization of long term systemic strategy and functions.	Between industry, policy makers, research institutes and others, although primarily public focus.
Innovation intermediary	(Howells, 2006; Meulman, 2017; Dalziel, 2010; Kuhlmann & Arnold, 2001; Nilsson & Ljungström, 2013)	Holistically generate, combine and facilitate knowledge and technology in the innovation system it is active in.	Between two or more actors in the innovation system.
Technology intermediary	(Spithoven & Knockaert, 2011; Bauer & Flagg, 2010; Xiaoyuan, & Yanning, 2011; Sapsed et al., 2007; Shohet & Prevezer, 1996)	Facilitating the technology transfer between key actors in the system.	Targeted to structural shortcomings in the innovation systems.
Diffusion intermediary; change agents	(Rogers, 1995; Bergek, 2020; Aspeteg & Bergek, 2020; Bessant & Rush, 1995)	Adoption of a new technology specific component rather than development of technology.	Between technology suppliers and technology adopters along the supply chain.
Transition intermediary	(Bush & Bale, 2017; Martiskainen and Kivimaa, 2018; Matschoss & Heiskanen, 2017)	Create awareness in society of sustainable solutions, build networks, support experimentation in local niches, scale up novel solutions, and aggregate and share learning outcomes.	Between local projects and global and local fields.

Table B2. Intermediary types, covered in literature.

Appendix C: Conceptual summary of intermediary activities

Theme	*Features*	*Activities*	*Contributing literature*
Bridging	Establish linkages between actors	• Build bridges between key actors and build technological communities • Close gaps between the principal actors within the innovation system • Build alliances and bridge activities across public research institutions, universities, and industry • Build linkages with external knowledge systems	Chesbrough (2003) Bessant & Rush (1995) Meulman (2017) Shohet & Prevezer (1996) Spithoven & Knockaert (2011)
	Support and create networks	• System-level activities • Market identification and formation, and system infrastructure creation • Legitimation and facilitation of bilateral or multilateral exchanges	Dalziel (2010) Aspeteg & Bergek (2020) Nilsson & Ljungström (2013) (Agogué et al., 2013, 2017)
	Identify and develop needs for change	• Develop a need for change; create an intent in the client to change • Articulation of specific needs and selection of options • Diagnose problems and translate an intent to action	Rogers (1995) Bessant & Rush (1995)
Brokering	Gatekeeping and brokering	• Agent and broker tailored resources, link researchers and companies • Project management, managing external resources • Consulting (technical advice) and organizational development	Hargadon & Sutton (1997) Howells (2006) Chesbrough (2003) Meulman (2017)
	Transfer knowledge	• Education, training and localization of key sources of knowledge • Absorb and diffuse knowledge by scanning and information processing • Establish an information exchange relationship or creation of synergies • Transfer basic and applied university knowledge to the marketplace	Meulman (2017) Spithoven & Knockaert (2011) Klerkx & Leeuwis, (2009)
	Resource coordination	• Providing access to resources, technology support and grant development • Offer assistance associated with technology research, product development, and product commercialization	Bauer & Flagg (2010) Shohet & Prevezer (1996)
Testing	Ideation	• Testing, validation, foresight and diagnostics • Make a business case • Provide roadmaps to promote investments in new technologies	Howells (2006) Bauer & Flagg (2010) Dalziel (2010)
	Commercialization	• Sales and marketing activities • Evaluation of outcomes, communication and implementation	Howells (2006) Bessant & Rush (1995)
	Protection	• Intellectual property formulation; IP control and brand protection • Regulation; self-regulation; informal regulation	Howells (2006) Benassi & Di Minin (2009)

Appendix D: Semi-structured interview guide

BACKGROUND INFORMATION

1. Name, age?
2. What is your education?
3. What is your current role within your company or institution?

AI IN GENERAL

5. Have you or are you currently working with or researching AI? If so, how?
6. What would you say is the main challenge of implementing AI?
   a. What is the potential value of AI in the future?

DATA FACTORY AND TECHNOLOGY TRANSFER RELATED

5. Within your organization, how are you working with, researching, testing or developing new technology?
   a. What are some challenges?
6. Within your organization, how is Data Factory used?
   a. If not currently a user, how do you wish it could be used?
   b. What problems is Data Factory solving?
7. Is there anything else that you consider relevant for this research topic or want us to investigate? What result do you want to see from us?

COLLABORATION

8. Are you currently working with other sectors? Such as academia, government or private sector?
   a. If no, why not?
   b. If yes, how? Are you sharing knowledge, experiences or data with other actors?
   c. If yes, what are some challenges encountered?
9. AI Sweden has a created a great network/ecosystem of partners, how do you think this could be exploited in order to accelerate applied AI in Sweden?