Industrial Symbiosis involving SMEs in France

A qualitative study for a challenging approach

Gabrielle Dattée, Léa Pons
Abstract

Industrial Symbiosis (IS) refers to the collaboration of traditionally separate industries that benefit each other through the physical exchange of materials, water, energy and/or by-products. Firms engaging in IS approach aim to mutualize resources or equipment (i.e. mutualization synergies), or to substitute resources with the output of another company (i.e. substitution synergies). Despite the obvious economic, environmental and social benefits provided by IS, this procedure remains fledgling, especially in France.

In order to gain a deeper understanding of the challenges induced by such a procedure, we conducted a qualitative study involving the interviews of seven actors who brought a global perspective towards IS implementation in French SMEs and who provide information and organizational framework so that to create successful IS networks.

Studying IS involving SMEs in France highlights several challenges that embrace the specificities of the scope of our study: firms suffer from a lack of structure, a lack of resources (i.e. human, time, material), and a short-term vision, and are evolving within an extremely bureaucratic and highly procedural country.

Implementing a successful IS in France with SMEs requires at first to overcome the entry barriers when approaching SMEs, which is often the role of facilitators working in associations. The other main stakeholders involved in the synergies, firms but also public and private actors, must establish a common network in order to carry properly the synergies and to make them sustainable. As France is characterized by place-oriented IS systems, networks that lead to synergies are built at a local scale which is relevant for mutualization synergies, but which can appear as an obstacle to detect substitution synergies as it may not involve enough firms.

Keywords

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1. Introduction

This chapter outlines the topic and the theoretical background of the present research. The significance of exploring new economic paradigm is discussed and the gaps identified in the existing literature concerning Industrial Symbiosis in Small and Medium-sized Enterprises in France lead us to formulate the question and the objectives of this study.

1.1. Theoretical Background

On May 2018, 30th France has started to live on credit on its resources, Global Footprint Network claims. This NGO analyses at a national and a global scale the ratio between natural resources use and their renewal capacity during one year. This imbalance between natural resources and their use is increasing each year: in 2016, the Earth Overshoot Day occurred in August 3rd while in the 1980’s it was in November (Global Footprint Network, 2018).

Firms have already tried to address such environmental issues with the spreading of tools helping to evaluate among others resource consumption. The implementation of new regulations has also forced companies to make an effort into sustainability. For example in France, the Grenelle II law promulgated in 2010 imposes firms from every sector with more than 500 employees on presenting an extra-financial report that contains waste management and other indicators of economic, environmental, and social performance.

Significant improvements have thus been achieved thanks to these kind of measures (Ambec et al., 2009) but they have been mainly focusing on an internal perspective, without taking the firms’ immediate environment (Boiral, 2005). As a result, environmental strategies within firms are not efficient enough and way too costly on the long term (Erkman, 2001).

Defining Industrial Ecology and Industrial Symbiosis

Firstly defined in 1989 by Robert Frosch and Nicholas Gallopoulos as “all the practices leading to reducing industrial pollution”, Industrial Ecology (further written IE) introduces an operational and innovative approach to enhance sustainability in firms by considering the industrial system as a whole and not only focusing on the intra-firm level (Erkman, 1997, 2001). It is worth noticing that in the IE context, the term ‘industrial’ refers to all human activities occurring within the modern technological society. Thus, tourism, housing, medical services, transportation, agriculture and so on are part of the industrial system (Erkman, 2001).

The concept of IE is quite surprising and oxymoronic, as it mixes two terms which appear to be contradictory at the first glance (Erkman, 2001). Whereas people have always considered industrial system as isolated from biosphere (Erkman, 2001), IE is based on the opposite assumption: the industrial system can be seen as a certain type of ecosystem (Frosch, 1995). Indeed, from a practical point of view, one of the most obvious analogies regarding industrial and natural ecosystem is the existence of an “industrial food chain” (Erkman, 2001). As in natural ecosystems where some species or their waste feed other
species, the industrial ecosystem can be approached in the same way: a similar process of waste recovery can be imagined between various economic entities, where waste of a company can be used as raw material for another (Erkman, 2001). As stressed by Motoyuky Suzuki, the Zero Emission Forum’s director in Japan, after labor and capital productivity, comes now raw material productivity.

In practice, IE operates at three different levels: the intra-firm level (within one company), the inter-firm level (between two or more companies) and the national/global level (regional and wider global networks of manufacturing activity centers) (Roberts and Greenhalgh, 2000). One of the application of IE at the inter-firm level is called Industrial Symbiosis - further called IS (Chertow, 2000).

As IE, IS is based on a biological analogy. The term ‘symbiosis’ refers to the biological situations where at least two otherwise unrelated species exchange materials, energy, or information in a mutually beneficial manner, thus taking advantage of synergies (Ehrenfeld and Gertler, 1997; Chertow, 2004). Following the same path, IS aims to connect firms for mutual economic and environmental benefits by looking after two potential types of synergies between entities: mutualization and substitution. Mutualization synergy deals with the integration of infrastructures, services and/or activities of two or more companies, reducing the demand for resources (Adoue, 2010; Bayona et al., 2013). Substitution synergy designates the consumption of a resource of a company which is replaced by a residual output from another company, such as waste, by-products or unrecovered energy (Adoue, 2010; Bayona et al., 2013). For instance, in one hand, firms decide to share some equipment that they both use; and in the other hand, firms use waste from other firms as a secondary raw material. Both synergies attempt to enhance the performance of all entities as well as being more economical and environmental efficient (Adoue, 2010), but substitution is the most integrated form of IS. In addition, the geographic aspect of IS is a key issue as IS often focuses on creating synergies on co-located companies (Ehrenfeld and Gertler, 1997; Chertow, 2000).

The role of facilitators in symbiotic synergies

The significance of the role played by facilitators, also called coordinators, while implementing IS networks has been widely acknowledged in previous literature (Mirata, 2005; Chertow & Ehrenfeld, 2012). In most cases, these facilitators are an industry association or a state agency (Hatefipour, 2012), which are able to plan current and future developments of IS networks, thus creating long-term sustainability (Mirata, 2005). Domenech and Davis (2009) have identified three main activities of the coordinators: (1) the promotion of IS principles through the organization of workshops and meetings between co-located companies; (2) the identification of possible synergies and the help for their implementation; (3) the creation of an institutional framework that encourages cooperation between entities. If they want to implement successful IS networks, the facilitators must enjoy strong legitimacy among all members of the networks and they have to be recognized as crucial actors; otherwise their decisions will be disregarded and the IS network will be likely to fail (Domenech & Davis, 2009).
The context of SMEs in France

Small and Medium-sized Enterprises (further written SMEs) are independent firms which employ less than a given number of employees. This number varies across countries: 250 in the European Union, 550 in the United States and 200 in some other countries (OECD, 2005). Financial assets are also used to define SMEs. In the EU, annual turnover should not exceed 50 million euros and alternatively, balance sheets should be less than 43 million euros (OECD, 2005). As the present study is taking place in France, the definition of SMEs given by the EU will be used. Among the 4.2 million enterprises located in France, SMEs represent 99% of them and in this way constitute a major economic actor on the French territory (CEDEF, 2018).

According to Calogirou et al. (2010) SMEs are responsible for 60 to 70% of the environmental impact and contribute therefore more to greenhouse gas emissions than large enterprises. However, environmental regulatory measures often underperform in the context of SMEs (Hillary, 2004; Lynch-Wood and Williamson, 2013). In parallel, studies prove that SMEs located in Europe and in North-America tend to show a growing engagement and a greater willingness to implement sustainable procedures (Lapointe and Gendron, 2004; Biowé et al., 2008).

SMEs are often very locally anchored and lean on strong bounds with actors of local community (Murillo and Lozano, 2006). In order to remain competitive, SMEs are very likely to gather into SMEs clusters as it enhances their size, performance, innovation and employment (Karaev et al., 2005; Braune et al., 2016). SMEs within a cluster gain cost advantages and have access to resources that are not available to competitors that do not belong to the cluster (Pouder and St John, 1996). These clusters were defined by Porter in 2003 as a “geographically proximate group of interconnected companies, suppliers, service providers and associated institutions in a particular field, linked by externalities of various types”. Thus we can consider that IS networks is one form of a cluster.

1.2. Research Gaps

Despite extended research on Industrial Symbiosis, some areas remain unexplored. Many studies highlight the benefits of IS systems whereas they should be analyzed more deeply, especially the relationships among all stakeholders of the network (Zhang et al., 2014). Most of the contributions focus on the engineering and technical feasibility of the exchanges, trying to find concrete material exchanges between different companies already located within a specific network (Simboli et al., 2013). There are still few studies that aims at understanding the social structure of IS networks and the conditions under which they can operate (Domenech and Davis, 2011). There is also much debate about how to make IS suitable and effective in each specific context (Simboli et al., 2013).

Although the importance of small and medium-sized enterprises (SMEs) contribution to society and economy has been widely acknowledged (Fuller, 2003; Vives, 2006; Johnson, 2015), there is a deficiency in IS research in the context of SMEs. The concepts of IE and cases of successful IS have been mainly studied in large companies' context (Ruiz Puente et al., 2015) even though measures undertaken by those firms could lead to induced
actions in SMEs (Salmi, 2007; Van Berkel, 2007; Beers and Biswas, 2008; Yang and Feng, 2008; Shi et al., 2010).

Almost all previous studies about IS focus on cases studies in China, Scandinavia, the Netherlands and the USA (Ehrenfeld and Chertow, 2002; Heeres et al., 2004; Mirata and Emtnairah, 2005; Wolf and Petersson, 2007; Zhu et al., 2008; Geng et al., 2009; Spekkink, 2013). To the best of our knowledge, there is no research taking France as an example. This is even more surprising when one considers that IS is part of the measures on which French government wants to rest on for energy transition (Ministry of Energy Transition and Solidarity, 2016).

Therefore, the present thesis aims at filling these gaps by analyzing the specifics of IS regarding French SMEs. Since the role of facilitators is crucial for implementing IS networks, we consider that it would be interesting to gather their different points of view. That’s why we choose to interview people working in public and private organizations that promote IS in France. We consider that they are the best for answering our research question.

1.3. Research Question

Based on the research gaps identified above in the existing literature, our study aims at answering the following research question:

What are the challenges induced by Industrial Symbiosis involving SMEs in France and how to overcome them?

1.4. Research Objectives

In relation to our research question, our research is designed to achieve the following purposes:

1) To identify the challenges faced by French SMEs for implementing IS synergies.
2) To provide recommendations for overcoming these challenges.
3) More broadly, to gain deeper understanding of IS networks in France.

1.5. Structure of the Study

Chapter 2: Theoretical Framework – The relevant concepts of the study are presented by critically introducing the different theories related to these concepts.

Chapter 3: Research Methodology – The scientific and practical method are outlined, in order to justify our research approach and design.

Chapter 4: Empirical Findings – The empirical results obtained during the interviews are presented through a conceptual framework.
Chapter 5: Data analysis and Discussion – The empirical findings presented in the previous chapter are confronted to the theoretical framework built earlier and further discussed.

Chapter 6: Conclusions and Recommendations – The conclusions of our qualitative analysis are drawn and the answer to our research question is presented.
2. Theoretical Framework

This chapter draws a theoretical framework related to the relevant concepts for our study. This framework introduces the concept of IE, and is then focused on a deep understanding of IS, through the analysis of its driving forces, the presentation of a model of analysis (SNA), the application of IS concept to SMEs, and the application of IS concept in France.

2.1. Understanding Industrial Ecology

Even though IE term has emerged since the late 1940’s, the industrial system until the end of the 20th century has remained isolated from biosphere, and the processes addressed to solve pollution issues remain focused on an end-of-pipe approach (i.e. solving the consequences of pollution and not the other phases of life product cycle) which is inefficient on the long-term and way too costly (Erkman, 2001).

In 1989, arguing that the industrial production drawing indefinitely in raw material in order to generate products to be sold and waste to be eliminated is not a sustainable process, Frosch and Gallopoulos, both working at General Motors Research laboratories, introduce the concept of industrial ecosystem. In their article Strategies for Manufacturing, they draw the analogy between a natural ecosystem and an industrial one: “plants synthesize nutrients that feed herbivores, which in turn feed a chain of carnivores whose wastes and bodies eventually feed further generations of plants” (Frosch and Gallopoulos, 1989, p.148). As also stressed by Lowe and Evans (1995), the system must move towards a closed-loop model: “waste from one industrial process can serve as the raw materials for another, thereby reducing the impact of industry on the environment” (Frosch and Gallopoulos, 1989, p.149).

However, this analogy should not be taken at face value, as underlined by Frosch and Gallopoulos (1989). Ayres (1995) highlights differences between biological organisms and elementary units of the industrial system (i.e firms), especially the inability for firms to reproduce themselves. As noticed by Levine (2008, p.33), “products, that is, goods and services exchanged for something of value, are characteristic of industrial systems, but relatively rare in the ecological system”. Furthermore, natural processes will inherently reach the most efficient whereas this has to constitute a deliberate act for firms. These statements lead to the definition of Erkman (1998, p.9) of the industrial system as a “particular configuration of flows and stocks of material, energy, and information, as in biological systems”. As another distinction from the natural ecosystem, industrial ecosystem works faster and faces many external characteristics that can interfere with its well-being (Erkman, 2001), such as price of raw material, strategic or political events.

In order to overcome the imperfection of industrial ecosystems (Frosch, 1995) compared to natural ecosystems, IE rests on the management of the relations between the organizations involved (Boons & Baas, 1997). A central aspect of IE are connections, especially organizational and human connections (Cohen-Rosenthal, 2000). This analysis follows the path of Ehrenfeld (1997) who conceptualizes IE as a social process, leading to reconsider mankind’s role and behavior towards nature (Beaurin and Brullot, 2011). This is in opposition to the work of the scientist Allenby (1992), who focuses on energy
and material flows and who believes that technology can enhance industrial ecosystem to make it become a mature ecosystem. By approaching IE in this way, Allenby (1992) does not take into account social issues and transformations that may be induced by IE principles (Beaurin and Brullot, 2011). As researchers, we are interested in human interactions within organizations, thus Ehrenfeld’s vision suits our research design the most since it is focused on social aspects of the analogy between industrial and natural ecosystems. Hence, as it suggested by several authors, IE cannot be implemented by the natural market coordination and requires an intentional coordination of the actors involved (Boons and Baas, 1997; Mirata, 2005; Beaurin and Brullot, 2011).

As explained previously in the introduction, IE has three different types of applications: at the intra-firm level (within one company only), at the inter-firm level (between two or more companies) and at the regional/global level (regional and wider global networks of manufacturing activity centres) (see Figure 1).

![Figure 1: IE operates at three different levels (retrieved from Lifset and Graedel, 2002, p.10)](image)

As seen in Figure 1, Industrial Symbiosis is one possible application of IE at the inter-firm level. The present thesis focuses on Industrial Symbiosis only, which will be more detailed in the next section. Since we are interested in studying human interactions at the heart of this phenomenon, we choose to follow the approach of Ehrenfeld (1997) which gives us a map for analyzing Industrial Symbiosis.

### 2.2. Understanding Industrial Symbiosis

#### 2.2.1. Definition of IS

Within the framework of IE, Industrial Symbiosis has emerged as an innovative concept to respond to environmental challenges, and has soon become its own field of research.
A lot has been written to characterize IS but Chertow’s definition (2000) has been accepted by many authors and still prevails nowadays (Yang and Feng, 2008; Costa and Ferrao, 2010). That’s why the present thesis relies on this definition. Chertow (2000, p. 313) states that “Industrial symbiosis engages traditionally separate industries in a collective approach to competitive advantage involving physical exchange of materials, energy, water, and/or by-products”. By making one firm’s output another firm’s inputs, IS fosters resource efficiency and leads to environmental and economic benefits. Chertow (2000) adds that the keys to IS are collaboration and cooperation between firms so that to take advantage of the synergistic possibilities offered by geographic proximity.

This statement highlights the need for a territorial anchorage for companies, mainly because the relationships between entities involve exchanges of tangible resources such as materials, energy and by-products; and these exchanges occur more efficiently and less costly over short distances (Zhang et al., 2014). Utilization of shared infrastructures are also encompassed within IS context (Mirata and Emtairah, 2005), and this is only possible if firms are located in a determined geographic area. Intangible resources might also be exchanged, for instance knowledge or human resources (Mirata and Emtairah, 2005; Jacobsen, 2006).

By combining a large range of studies, Mirata and Emtairah (2005) have created a comprehensive framework for IS (see Figure 2).

![Framework of IS](image)

*Figure 2: Framework of IS, retrieved from Zhang et al. (2014)*

The economic, environmental and social benefits of IS will be highlighted in the next section. Formation conditions will be discussed later both in the section 2.3. in which driving forces of IS are disclosed, and in the section 2.4. in which social interactions between members of IS networks are covered.
2.2.2. Benefits of IS

Many studies have shown the two main dimensions where IS provides benefits: the economic and the environmental one (Boons & Baas, 1997; Jacobsen, 2006; Sokka et al., 2011). However, as creator of a local community gathered around the IS procedure, IS provides also social and societal benefits as it will be explained further. In this way, IS addresses the three challenges of the triple bottom line, a concept developed by John Elkington in 1997 referring to the three branches of responsibility: economic, environmental and social.

Economic benefits

The ‘cost-based’ approach is seen as a main driver for the emergence of IS networks (Lowe and Evans, 1995). The economic benefits of IS implementation are of several types. First, by implementing substitution synergies, recovery of material which used to represent no financial value provides new revenue through these additional sales (Cosgriff Dunn and Steinemann, 1998; Korhonen et al., 2004). Furthermore, the material exchange avoids firms to pay for collect, treatment and removal of these material that are now reused. Thanks to the implementation of an efficient closed-loop system, firms can save resources and create less waste, which in turn leads to significant costs savings in waste management.

Secondly, mutualization enables decreasing use of raw material (for example transport mutualization induces gas saving) and naturally induces an increase of performance and of competitiveness (Erkman, 2004). In addition, mutualization especially of transport represents an important economy of scale that can improve collective infrastructures whom the whole society could benefit from (CECP, 2007).

But the competitive advantage provided by IS does not rely only on improved resource efficiency. It also includes reducing costs through innovative product or process changes, increasing revenue, diversifying business, and managing risk (Laybourn and Morrisey, 2009). Indeed, 70% of all synergies created in Europe involve technologies or production process innovations and 20% incorporate new R&D (EREP, 2014).

Finally, implementing IS can be used as a marketing argument (Lombardi and Laybourn, 2012) since companies can emphasize on their green procedures, which in turn enables to reach new markets, and therefore to increase their competitive advantage.

However, Ren et al. (2016), who aim to build a design for sustainability in IS, find that pursuing sustainability performance in an industrial symbiosis may decrease the financial profit, if the manner of industrial symbiosis (the way resource and energy flow among the symbiosis network) is not adapted to each entity.

Environmental benefits

Chertow and Lombardi (2005) suggest that “the environmental benefits of industrial symbiosis are quantified by measuring the changes in consumption of natural resources, and in emissions to air and water, through increased recycling of materials and energy.”
It is reported that with the implementation of IS, flows can be optimized in the network and significant environmental benefits can be achieved in process synergies (Zhang et al., 2013).

However, quantifying environmental assessments of IS has been demonstrated as being very complicated because of the multiplicity of tools possible to use, the potential role of the contextual factors (such as green policies), the properties of the surroundings, and the lack of knowledge regarding how certain emissions affect the environment (Wolf and Karlsson, 2008). While determining the environmental benefits of IS, many authors have used life-cycle assessment, a standardized methodology for assessing multiple environmental impact categories along the whole production chain (Henriksson et al., 2018). For instance, Eckelman and Chertow (2013) show that local exchanges of materials and energy can lead to environmental saving, thanks to waste saving, CO2 reduction within the processes, water and raw material saving. Environmental benefit is also highlighted by reduction of environmental damages for inhabitants living around thanks to reduction of gas and water emission (Streimikiene, 2015).

**Social and societal benefits**

By creating new activities linking the firms, IS implementation enables employment market consolidation (Martin et al., 1996). Job creation is also fostered by local IS networks which make the territory more attractive and business retainer (Lombardi and Laybourn, 2012), and thus which prevent firms from relocation (Erkman, 2004; Brullot, 2009). In addition, these jobs generated with the implementation of IS are constituted of more stable and more diversified missions, such as environmental management, transport or recycling (Oree, 2008), generating skills improvement as well as higher satisfaction and well-being for employees.

Moreover, IS approach can enable to secure access to critical resources such as water, energy and raw material (Chertow and Lombardi, 2005) to local communities which would have been threatened otherwise. It also encourages networking of actors who historically are not used to work together (Buclet, 2009), thus it creates a business environment based on trust (Hewes and Lyons, 2008). In such environment, firms are more likely to share experiences and best practices, which ultimately encourage eco-innovation and green growth.

**2.3. Driving forces of IS**

Large differences between countries exist in the ways IS networks are built. Their forms vary considerably across diverse social contexts (Lombardi and Laybourn, 2012). Policymakers’ approaches to stimulate such synergies are also multiple (Wang et al., 2015). Therefore it is crucial to understand the driving forces behind each type of IS systems. We can classify them according to three main aspects: the geographic boundaries, the actors involved and the policy approaches. (Boons et al., 2015).
2.3.1. The geographic boundaries of IS networks

As stressed by Chertow (2000) and many scholars after her, the territorial anchorage is a key factor for successful IS networks. Lombardi and Laybourn (2012) reject this statement and consider instead that geographic proximity is neither a necessary nor a sufficient factor for the emergence and then the success of IS networks. Therefore, the most comprehensive division of IS networks is made between those which focus strongly on a specific place (industrial park, city, region) and those which occur over spatially dispersed firms (Boons et al., 2015). Most of IS networks are found at a small scale, formed around a specific company or industry. For instance, IS networks in Sweden have been built around the forest industry. Larger scale has also emerged mainly based on port industries (Hewes and Lyons, 2008).

Eco-Industrial Parks (further written EIPs) is “a community of manufacturing and service businesses located together on a common property” (Lowe, 2001), seeking enhanced environmental, economic and social performance through collaboration. The collective benefit is expected to be greater than the sum of individual benefits of each company involved. Indeed, EIPs are an approach that has been proved to balance effectively environmental-friendly practices and regional industrial development (Côté and Cohen-Rosenthal, 1998; Roberts, 2004; Gibbs and Deutz, 2005; Chertow, 2008). Co-location in industrial parks facilitates synergies between businesses. Indeed, companies are often close to each other and they are usually mixed, that is to say they combine different types of activities and services which may facilitate opportunities for synergetic exchanges (Kincaid and Overcash, 2001; Sterr and Ott, 2004). Furthermore, co-location enables to take advantage of economies of scale more easily (Ruiz Puente et al., 2015). In the literature, Kalundborg (Denmark) has been designated by many authors as the most successful case of eco-industrial parks; Frosh (1995, p. 49) presents it as an “exemplary industrial ecosystem”. This project, started in the 1990’s around a refinery, a power plant, a biotechnology industry, gypsum plant and the local municipality, permits to save among others 3 million m3/year of water, 20,000 tons/year of oil and $15 million/year (Anderberg, 2005). For more details, see Figure 3.

IS networks occurring over larger geographical boundaries are called virtual eco-industrial parks. It means that a group of businesses are geographically separate but are still working together to minimize their environmental and enhance their economic performance. The best example of virtual industrial-park is found in the UK with the National Industrial Symbiosis Program (NISP) launched in 2005 which aims at implementing IS at a national scale (Lombardi and Laybourn, 2012). Managed by both a national coordination body and local structures, NISP enabled, among others, to divert over 47 million tons of industrial waste from landfill, to cut use of virgin materials by 60 million tons and industrial water by 73 million tons, to generate £1 billion in additional sales as well as to create and safeguard over 10,000 jobs in less than 10 years (International Synergies, 2013).
2.3.2. Actors involved in IS networks

Commonly, IS networks engage a wide range of actors who work together in order to increase the density of the networks, that is to look for additional synergetic relationships (Boons et al., 2015). Major agents are of course participating companies which may be gather either in homogeneous or heterogeneous industrial parks (Simboli et al., 2014). In the literature, there is no consensus about this issue: Reniers et al. (2010) claim that in homogeneous parks it is easier to develop synergies whereas Sterr and Ott (2004) argue that greater heterogeneity increases the opportunities for findings relevant partners for the exchange flows. Already involved firms play also a more informal role. This is due to the effect of mimetic isomorphism, described at the tendency of an organization to imitate another because managers believe that it would be beneficial for their own structure (Martinez-Ferrero and Garcia-Sanchez, 2017). Thus, in the case of IS networking, a company may decide to join a network because neighboring companies have already done so (Sinding, 2002).

Apart from participating companies, IS networks involve a combination of public and private sectors, including governmental agencies, industry associations, Chambers of Commerce, NGOs, knowledge institutes, consultancy firms and local communities (Simboli et al., 2014; Boons et al., 2015). All of them are designated as being facilitators of IS implementation since they play an important role in each step of its development: financing projects, providing information, facilitating the relationships between the involved firms (Ayres, 1995; Heeres et al., 2004). Public institutions such as national governments or public agencies can provide strong incentives to encourage IS.
development. The regulatory system, especially environmental legislation and norms consistent with IS principles, is considered as being a critical factor to engage companies (Simboli et al., 2014). In the Netherlands, a number of EIPs has emerged as a result of former policies which promote sustainable business practices (Boons et al., 2015).

Among all the role played by these stakeholders, the one of “Champion” should be carefully considered as it designates one or more key individuals or organizations that promote and support IS vigorously (Hewes and Lyons, 2008; Sakr et al., 2011). Local institutions often assume this central position as they are more aware of local conditions. They can influence the social and economic context of the IS network as well as provide a bridge between involved companies and national governments (Korhonen et al., 2004; Mirata, 2005; Costa and Ferrao, 2010). They are also strongly engaged in organizing events (informal meetings, workshops, conferences) so as to establish a dialogue and create a cooperative culture between companies, as well as provide information on further synergetic opportunities Costa and Ferrao, 2010).

The success of IS networks relies heavily on all these actors who act in combination. Therefore, they can be seen as tied together within a social network. We are going to further develop this in the following section 2.4. Social Network Analysis.

2.3.3. Policy approaches

Apart from geographical boundaries and the involvement of numerous actors, policies undertaken by local authorities are part of the driving forces of IS. A wide range of policies can be implemented in order to encourage IS development and to coordinate actors involved in IS networks.

Spontaneous vs planned symbiosis

IS can be driven in two distinct ways: through a planned development launched by the government and public structures, or through a self-organization made by private actors (Chertow, 2007).

In general, spontaneously launched IS networks are recognized as being more successful (Heeres et al., 2004; Chertow, 2007; Deutz and Gibbs, 2008), even though these networks need external entities to support the process and enable the transition (Ashton, 2011). The driving forces of these symbiosis is made by private actors for an economic purpose (cost reduction or revenue enhancement for example). Each initiative is previously studied in order to see whether it is feasible under a market approach (Chertow, 2007).

A planned industrial symbiosis is initiated by a group of diverse actors, including governmental agencies that are supposed to facilitate land planning and organizational process (Chertow, 2007). The goal of such kind of symbiosis is to create an EIP, which is the “most accomplished form of IS” (Frosch, 1995). However, attempts to plan IS have led to many failures. Indeed, they usually induced a lack of active participation from businesses because their motivations and interests were poorly considered by the project leaders (Gibbs, 2003). Self-organizing networks appear to be more resilient than those planned (Heeres et al., 2004).
In order to overcome the barriers induced by planned IS networks, Costa and Ferrao (2010) introduce a third approach seen as a combination of planned and spontaneous perspectives: the middle-out approach.

**The middle-out approach**

“The middle-out approach induces the development of a strategy to create positive feedback loops among agents (e.g. government, industries) that may guide their actions into setting the conditions to support IS emergence” (Costa and Ferrao, 2010, p. 984). It is a process that combines both top-down governmental directives and bottom-up spontaneous business initiatives. Firms interact with their local government, suggesting their own solutions to the specific issues they faced, and then they obtain the necessary legal authorization to implement these solutions (Costa and Ferrao, 2010). The middle-out approach also requires that constant feedback occurs between all actors in order to adjust both interventions and regulations so that to support IS more effectively. Therefore, it can be defined as a 5-step process: (1) assessment of the national and local contexts; (2) identification of the actors involved in the IS networks; (3) identification of current and expected interventions from actors; (4) monitoring of actions; (5) feedback to improve upcoming interventions (Costa and Ferrao, 2010).

The success of Kalundborg might be explained by the implementation of such approach. At the beginning, the exchanges between businesses were driven by social networking, but later they were fostered by national environmental regulations (Jacobsen and Anderberg, 2004). This example shows that spontaneous IS initiatives can be enhanced by a dynamic process of government and industry interventions (Costa and Ferrao, 2010).

**2.3.4. Orientations of IS systems**

In light of what has been said previously, three types of IS systems emerge: process-oriented, residue-oriented and place-oriented (Boons et al., 2015). Process-oriented system suggests that this is a certain type of industrial activity that leads to the development of IS – for instance bio-based activities in Sweden enabled the occurrence of forestry IS networks. Yet, social and regulatory contexts are still of great importance as the emergence of these IS networks lies on the presence of relevant firms in a pre-existing local area (Van Beers et al., 2007). The principal actors are the companies involved but other actors might attempt to extend the network to the neighboring places (Boons et al., 2015). Process-oriented systems are seeking first environmental and economic benefits (Van Beers et al., 2007).

Residue-oriented IS system is formed by a network of bilateral residue flows. Its scale may vary from local to national as members join and leave the network. A distinction within these networks can be made on one hand between those where policy-makers and associations promoting IS provide frameworks that encourage synergies (e.g. the NISP in the UK); and on the other hand those where IS is only encouraged through open databases (Boons et al., 2015). An example of database is found at the European level as the EU
has recently implemented eSymbiosis, a database that provides information about companies, their location and their material streams (Cecelja et al., 2015).

Finally, IS networks can be place-oriented, meaning that instead of being based on specific material exchanges, they occur at a specific location whose boundaries are rigid. Here, benefits for the local community are the primary reason for the development of the network (Boons et al., 2015); thus local authorities, agencies and research institutes have a strong connection and involvement with the network (Costa and Ferrao, 2010; Ruiz et al., 2015). In this configuration, IS is likely to be just one among several environmental and/or economic initiatives to be run (Boons et al., 2015).

2.4. Social Network Analysis

Although IS may appear to be a highly technological project, many studies found social factors to be playing the most important role in its development. Indeed, IS is not a natural phenomenon, it cannot arise without human willingness. IS rests on social interactions between members of the networks: business entities of course but also all their stakeholders including public and private institutions and agencies, research institutes, universities, governments, banks, suppliers, customers and so on. IS networks are embedded in social systems and thus are shaped by social relations (Uzzi, 1997). In other words, beyond technical feasibilities of the mutualization and substitution synergies, social aspects play a significant role in the development of IS networks (Domenech and Davis, 2009). By the term ‘social aspects/elements/components’, one needs to consider such features as regulation systems, trust, beliefs, knowledge (Domenech and Davis, 2009). They all influence the way IS is shaped.

Therefore, IS networks cannot be fully understood in isolation of the social context in which they occur (Domenech and Davis, 2011). Understanding this context is crucial for having successful policies promoting IS and ultimately for further developing IS in the most efficient way (Domenech and Davis, 2011).

Social Network Analysis (further written SNA) has been used by previous studies (Domenech and Davis, 2009, 2011; Schiller et al., 2014) as a methodological and theoretical framework in order to offer insights to the social components of IS networks, the role played by the different actors and the structure in which the interactions between them take place. In particular, it has been successfully applied when localized phenomena of industrial symbiosis have been a key focus (Schiller et al., 2014). The present thesis will bring insights of IS networks localized in specific places in France, such as Dunkerque, the Aube region or the Massif Central. Consequently, SNA can be applied in this study.

2.4.1. Structure and organization of SNA

SNA examines social environments and processes in a different perspective by putting the emphasis on the relationships among social actors. The unit of analysis is a cluster of individuals or organizations and the relationships between them (Easley and Kleinberg,
IS among French SMEs are the unit of analysis taken into account in the present study. SNA represents networked structures in terms of nodes, which characterize the members of the network, and the links that connect them (Wasserman and Faust, 1994). These ties are of different nature, including material flows, social interaction, information or other transactions (Schiller et al., 2014). Wasserman and Faust (1994) add that the structure of the network shapes the actions of its members by providing both opportunities and constraints. They also state that the social and economic environment resulting from the network is set-up by “lasting patterns of relations among actors”.

Next, the concepts inherent to SNA are disclosed and defined:

- **Network**

According to Domenech and Davis (2009, p. 74), networks can be described thanks to seven key characteristics: (1) interactions between actors are based on cooperation and (2) rely on trust; (3) prevalence of informal agreements rather than formal contracts; (4) relationships happen over the long-term and are recurrent; (5) communication between members is frequent and reciprocal; (6) shared and sometimes tacit rules govern the way the network operates; (7) intended goal is mutual benefits.

Even if all IS networks are not organized in the same manner, these characteristics apply to most of them.

- **Nodes and ties**

Actors are represented by nodes and are linked together with ties (Domenech and Davis, 2009). These ties can be direct or indirect, symmetric or asymmetric, implying that either the relationship is reciprocal or single-way between members of the network (Ashton, 2008). In the case of IS networks, the nodes represent the organizations and the ties the exchanges between them. The presence of ties enables the sharing of knowledge and facilitate the creation and diffusion of innovation (Keeble and Wilkinson, 1999; Giuliani and Pietrobelli, 2011). The distance between two nodes is called “path distance” (Yang and Knoke, 2001).

- **Characterization of network structure**

Three factors influence the structure of the network. The latter can be either open or closed, meaning that it promotes the integration of new members or it establishes barriers to entry. The second factor deals with the quality of the bonds, weak or strong, depending on the frequency and the quality of the interactions between actors. Finally, the geographic distance influences networks as they may be local or extended (Domenech and Davis, 2009).

All these aspects are useful to analyze the structure of IS networks.
- **Reciprocity**

Reciprocity refers to the pursuit of mutual gains in a global and long-term perspective (Shan *et al*., 1994). It implies especially direct gains resulting from interactions but also gains that are indirect, spread over time or compensated by other members of the network. It fully applies to IS networks because, as said previously, their primary feature is the fact that companies are engaged in mutually beneficial exchanges (Domenech and Davis, 2009).

- **Trust**

Trust is considered as an accelerator and even as the major enabler of network creation (Hewes and Lyons, 2008): without trust between members, a network cannot function. Trust represents a crucial component for cooperative business, thus for IS networks (Yap & Devlin, 2016). For trust to emerge, all actors must be driven by common values, translated then in common goals, and must share solidarity towards actions of others (Lewis and Weigert, 1985). Trust must be also reinforced by past actions and empirical evidence (Domenech and Davis, 2009). The homogeneity of the network and its level of connectedness affect positively the level of trust whereas the size of the network affects trust negatively (Lewis and Weigert, 1985). Furthermore, pre-existing relationships between firms also play a crucial role in establishing trust in the really beginning of the network’s creation and over the long term (Baker, 1987). On the contrary, the absence of communication inevitably leads to a lack of trust between members of the network. Hence, facilitators are needed in order to foster communication and then trust (Ehrenfeld & Gertler, 1997; Chertow & Ehrenfeld, 2012).

- **Embeddedness**

Embedded networks are characterized by trust, information transfer and joint-problem solving (Uzzi, 1997). These features allow a greater performance for the members. Companies which are part of embedded networks are more likely to be flexible and adaptable, and therefore to gain competitive advantages (Uzzi, 1997). Hewes and Lyons (2008) suggest that deeply integrated networks cannot work without the presence of champions. This implies the great role played by facilitators in implementing successful IS networks.

### 2.4.2. Applicability of SNA to IS networks

By applying SNA to the cases of Kalundborg in Denmark and NISP in United-Kingdom, two well-known and studied IS networks in the literature, Domenech and Davis (2009) prove that institutional, social and cultural factors shape the decision of firms to participate in IS networks. They also highlight trust, commitment among members, perception of risks and cooperative culture as having a great impact on further development of these networks. These features were mainly the results of the small size of the network. In another study of Kalundborg (2011), they point out that the
embeddedness of the network favors the rapid diffusion of ideas and information, allowing the identification of new IS opportunities.

Schiller et al. (2014) emphasize on the embeddedness. Companies that are linked with more ties with other entities, meaning that they are involved in a higher number of synergetic exchanges, tend to show greater economic benefits from IS.

Chopra and Khanna (2013) have also studied the Kalundborg case. They show that pre-existing relationships between companies, in particular with the central node (a power plant) ensure the success of this IS network. Furthermore, they highlight the role of facilitators as nodes (the Symbiosis Institute and the Environmental Club) in fostering the synergetic exchanges within the network. This point is also highlighted by Domenech and Davis (2011) but they suggest that informal knowledge and information transfer play a more significant role.

When analyzing the case of Barceloneta in Puerto Rico, Ashton (2008) claims that trust in other members and interpersonal relationships are the foundations for IS network. Puerto Rico Manufacturers’ Association, acting as facilitator, is also a key factor of success.

2.5. IS in SMEs

Due to the unique economic, social and cultural aspects of any country, the definition of SMEs varies around the world (OECD, 2005). Given that the scope of our research is based on French SMEs, we will focus on the definition given by the European Union, which is in accordance with the one from OECD. The European Commission (2018) states that SMEs are companies with fewer than 250 employees and that have either an annual turnover of less than 50 million euros or an annual balance sheet not exceeding 43 million euros. In the EU-27, SMEs accounted for 99.8% of the total number of enterprises, and they generated 58.6% of the total added value.

The specifics of SMEs towards environmental management

In the current context, competitiveness in SMEs is determined by their ability for innovation in products, processes and organization, and more broadly for implementing systemic eco-innovation (Ruiz Puente et al., 2015). Nonetheless, environmental management in SMEs is still negligible. This is due to two kinds of obstacles: external and internal. Among them, one can argue that SMEs over consider the costs of implementing environmental measures but are not aware of their advantages (Ruiz Puente et al., 2015). Environmental regulation is also mainly done for large companies, preventing SMEs from increasing their awareness towards such issues. In this way, they do not have the necessary influence on their stakeholders – for instance it is hard to convince suppliers to reduce the packaging used (Ryan et al., 2005). Moreover, SMEs suffer from a lack of resources, mainly time, money but also full-time employees dedicated to environmental issues. Their corporate culture is also criticized as they have mainly a short-term vision, they suffer from a lack of cooperative culture and their owner
does not have personal implication in environmental management (Berger-Douce, 2005; Ryan et al., 2005; Ruiz Puente et al., 2015).

To overcome these barriers, Berger-Douce (2005) suggests that a collective approach towards environment could be implemented among SMEs uniquely. Indeed, she points out that it enables managers to share experiences with non-competitors, leading to a “safety effect”: managers realize what can be done and how it can be achieved in terms of environment in structures similar to theirs. She also identifies the financial incentive as being of great importance for SMEs. However, environmental collective approach that gathers only clusters of SMEs is hard to achieve in the business reality (Berger-Douce, 2005; Ryan et al., 2005). One collective approach that could work for SMEs is IS (Ruiz Puente et al., 2015).

**The specifics of IS in SMEs**

IS, traditionally led by large companies, can become one of the main policies for SME clusters (Ruiz Puente et al., 2015). However, for IS strategy to be implemented effectively, SMEs need to be gather into clusters within industrial parks (Ruiz Puente et al., 2015; Chen et al., 2017) or EIP. The advantages induced by EIP are even more important for SMEs whose scope is often limited to the local scale, as most of them are micro or family-owned businesses, increasing their willingness in improving their competitiveness (Ruiz Puente et al., 2015; Chen et al., 2017). IS networks might also be considered as an evident strategy for SMEs wishing to be more open towards their local communities who are their primary customers. Furthermore, a small firm can increase its visibility through synergistic partnerships with larger, better-established companies (Sinding, 2000). SMEs encounter financial and technical difficulties when they wish to create synergies with other entities. Indeed, the one-to-one model is usually used to detect potential synergies between corporations. But this model is questionable when it deals with waste flows associated with SMEs because the exchange of these flows must compensate the cost and impact of transportation (Ruiz Puente et al., 2015). Distance between companies is decisive when it comes to substitute raw materials with waste products (Chertow, 2000; Tudor et al., 2007). Eco-industrial parks enable to overcome these difficulties of financial and technical feasibility. However EIPs should not be viewed as the panacea because it may be a challenge to relocate SMEs into industrial parks when they have been previously implemented in another place (Chen et al., 2017).

**2.6. IS in France**

The national context plays a significant role in defining the governmental policies towards IS. The social, political, financial and cultural systems affect the way IS manifests itself (Boons et al., 2015). In order to clarify the context of the present paper, an overview of IS in France is given.

First, it is worth noticing that French terminology for IS is different from its European neighbors. Indeed, there is confusion between IE and IS: policy-makers use the term IE or Territorial Industrial Ecology to refer what academics call IS. However, the term
circular economy is often preferred in the laws as it seen as being more comprehensive and intuitive (Boons et al., 2015).

France has known a late start in implementing IS networks but the past few years the number of experimentations has increased (Schalchli, 2012). Two of them are considered as being the most advanced: the one in Dunkerque, supported by the association ECOPAL and the one in the Aube region, carried by CEIA. These experimentations are still struggling in creating synergies over the long term and most of exchanges involve only mutualization synergies, in particular in waste management (Brullot et al., 2014). We choose to interview people working in these two historical associations and in more recent ones in order to highlight possible differences of views regarding our research question.

French IS networks mainly occur at a local scale, with a strong connection to a specific place. Only a few of them succeed in creating interactions at a broader regional scale. One reason for that lies on the fact that cooperation across administrative boundaries is heavily bureaucratically complex due to excessive bureaucracy (Boons et al., 2015). The territorial approach is a key feature, therefore IS networks are embedded in territorial context (economic, political, environmental, organizational) which might differ according to the place in which IS networks are located (Brullot et al., 2014; Boons et al., 2015). In addition, their size is small as they involve a few organizations.

Even though it is widely acknowledged that the private sector needs to be involved, the public sector often drives IS initiatives. Indeed, IS networks are primarily promoted through the Circular Economy Institute, created in 2013, ADEME, the French Environment and Energy Management Agency and the Chamber of Commerce and Industry (Schalchli, 2012; Brullot et al., 2014). In this context, it is interesting to look at how SMEs face the challenges in implementing IS.
3. Research Methodology

In this chapter, we outline the methodology that guides our study. We describe and justify our ontological, epistemological and axiological stances as well as our research approach and design, making sure that they are all linked together. We also state how we conduct the literature search. Then, we present our data collection and analysis methods. We end by expressing our ethical considerations.

3.1. Scientific Method

3.1.1. Research paradigm

A research paradigm is a “philosophical framework that guides how scientific research should be conducted” (Collis and Hussley, 2004, p. 43). Waite and Hawker (2009, p. 685) define a philosophy as “a set or system of beliefs [stemming from] the study of the fundamental nature of knowledge, reality and existence”. The researcher’s assumptions about the world and the nature of knowledge determine the paradigm of the study. Within the field of Business Research, two kinds of paradigms coexist.

The first one, positivism, finds its origin in natural sciences but it is now also well spread over social sciences. Positivist researchers consider that social reality is singular, external, objective and independent of social actors (Collis and Hussey, 2014). It implies that social reality is not affected by the act of investigating it. Furthermore, any assertion can be proven with logical or mathematical proof, assuming that social reality can be measured. Conclusions of the research as well as explanations and predictions of social phenomena are exclusively based on theories (Collis and Hussey, 2014). But positivism does not go without critics. The main ones state that it is impossible to distinguish between people and the social contexts in which they operate; it is misleading to capture complex social phenomena in a single measure; and researchers cannot be entirely objective as they bring their own values and interests to their study (Collis and Hussey, 2014).

Interpretivism has been developed as a second paradigm in response to these critics. It rests on the assumption that social reality is multiple, highly subjective, shaped by our perceptions and socially constructed (Collis and Hussey, 2014). The researchers interact with the phenomenon under study, they are part of it and cannot be separated from it. Therefore, social reality is affected by the act of investigating it (Collis and Hussey, 2014). Unlike positivism which focuses on measuring social reality, interpretivism aims at exploring its complexity within a particular context with a view to gaining interpretive understanding.

As researchers, we believe that social reality is multiple, highly dependent of its context. IS networks are a social construct, due to human interactions. They are also dependent on the context in which they occur, as highlighted in our literature review. Therefore, we want to interview people having a specific role in IS implementation in France but in different contexts in order to bring the most complete insights to our research question. Above all, we consider that we cannot be completely objective because our values and
beliefs play an important part in analyzing our data and thus in drawing conclusions. For these reasons, we choose to embrace interpretivism in this thesis.

We describe further the philosophical assumptions about ontology, epistemology and axiology that have been made; the research approach that has been used; and the data collection and data analysis methods which have been employed. It is worth noticing that all of them are interrelated: if the researchers accept one of the assumptions within a particular paradigm, the others for that paradigm are complementary (Collis and Hussey, 2014). Therefore all of them directly stem from interpretivist paradigm.

3.1.2. Ontology

Collis and Hussey (2014) define ontology as a philosophical consideration that deals with the nature of reality. The questions one must wonder include the following ones: what kind of entities exist in the social world? Are they independent of our perceptions of them? Are they external to social actors or constructed by them?

In social science, there are two main ontological stances: objectivism and constructionism. Objectivism implies that social phenomena are independent from social actors whereas constructionism suggests that they result from social interactions and are constantly revised (Collis and Hussey, 2014).

We decided to adopt constructionism as our ontological perspective. The reality we are studying - IS among French SMEs - is socially constructed because the formation of industrial synergies is not a natural phenomenon. Instead, it is developed by several individual and organizational actors (including SMEs, IS promoters, government) in a particular place, at a particular moment.

3.1.3. Epistemology

Epistemology refers to the validity of knowledge, that is what is or should be considered as acceptable knowledge (Collis and Hussey, 2014, p. 47). In particular, it determines whether or not the social world can be studied scientifically and if it is appropriate to apply the methods coming from natural sciences to social sciences.

From a positivist perspective, only observable and measurable phenomena can be validly considered as knowledge because they are the ones providing facts and credible data. It focuses on causality and law-like generalizations (Saunders et al., 2012). In this context, researchers generate hypotheses and test them in order to confirm or reject theories previously stated (Collis and Hussey, 2014).

On the contrary, interpretivist researchers argue that “beliefs determine what should count as facts” because facts are too reductive (Collis and Hussey, 2014). The social world is too complex to be explained and theorized with scientific methods. Instead, the research must focus on subjective meanings and details of situation (Saunders et al., 2012).
The latter approach is the one we choose to follow because we are more interested in collecting people’s opinions, beliefs and feelings on the challenges faced by French SMEs when implementing IS.

3.1.4. Axiology

Axiological assumption is concerned with the role of the researcher’s values when collecting and analyzing the data and making conclusions (Collis and Hussey, 2014, p. 47). Under positivism, phenomena are regarded as objects which were already present before the investigation and will still be there after the research has been done (Collis and Hussey, 2014). Positivists argue that their research is value-free as they are objective and independent of the data being collected and analyzed (Saunders et al., 2012).

We find the last assumption less convincing in social sciences since we directly interact with our interviewees. That’s why we adopt the other mindset which considers the research as being value-bound and subjective. As researchers we are part of what is under investigation; our values help to recognize facts correlated with our research question and to draw interpretations from them (Collis and Hussey, 2014). Also, as we will explain in section 3.1.7., we may have some preconceptions that interfere with the outcomes of the present study and thus they cannot be regarded as being completely objective.

3.1.5. Research approach

According to Collis and Hussey (2014), there are two distinct research approaches: deduction and induction. Saunders et al. (2012) add abduction as a third approach. A deductive approach consists of a conceptual and theoretical structure being developed and then tested by empirical observation. The research moves from the general to the specific, with particular examples being deduced from general inferences (Collis and Hussey, 2014). Deductivism is composed of the following sequential steps: starting with the theory, setting the hypothesis, collecting data, analyzing data, confirming or rejecting the hypothesis, revising the theory (Blaikie, 2009).

An inductive approach is the exact opposite. The theory is developed from the observation of empirical reality. It goes from the specific to the general, with general inferences being induced from particular instances (Collis and Hussey, 2014). Generalizations come from patterns and characteristics newly discovered (Blaikie, 2009, p. 83).

Regarding abductive research approach, it is qualified as the process of “collecting data to explore a phenomenon, identify themes and explain patterns, to generate a new or modify an existing theory which you will subsequently test through additional data collection” (Saunders et al., 2012, p. 145). It consists of observing a fact and then discovering why this fact occurs. In that sense, it can be seen as a synthesis between deductivism and inductivism.

We embrace an inductive research approach. We start by collecting data about the challenges of IS implementation involving SMEs in France. To do so, we design an interview guide (see Appendix 1) that we address to social actors, mostly facilitators.
working in associations promoting IS. Our goal is first to discover new findings about the challenges and the way to overcome them in the specific context of French SMEs, and then to generalize them to other similar contexts (e.g. other countries).

### 3.1.6. Research design

Research design is “the science and the art of planning procedures for conducting studies so as to get the most valid findings” (Collis and Hussey, 2014). More specifically, it is concerned with the choices made in terms of the methodology and methods used in order to address the research question. The way chosen to investigate the research question is driven by the research paradigm. Therefore, all features of the research need to conform with that paradigm (Collis and Hussey, 2014). In particular, a good research design is characterized by the use of appropriate research methods. The methods are the techniques used to collect and analyze data. Two main kinds of methods exist: quantitative and qualitative (Collis and Hussey, 2014).

A quantitative research aims at testing theories through the test of hypotheses about relationships between different variables which are quantifiable and measurable. Then, it serves the purpose of positivist researchers. On the other hand, a qualitative research emphasizes on the depth of the data which tends to be rich in details and nuances (Collis and Hussey, 2014).

In accordance with our interpretivist paradigm, we choose to conduct a qualitative study through interviews. Indeed, our goal is to get a deeper understanding of industrial symbiosis among the SMEs in France, not to quantify that phenomenon.

### 3.1.7. Preconceptions

Preconceptions are the personal opinion and experiences as well as previous knowledge of the researchers about their subject prior to the study (Saunders et al., 2012). They play an essential role when identifying a problem, setting the direction of the study and conducting the research. Preconceptions affect the outcomes of the research and may lead to biases; that’s why it is crucial to be aware of them (Saunders et al., 2012).

Before conducting this research, we had absolutely no idea what the concepts of industrial ecology and industrial symbiosis meant. We wanted to tackle sustainable issues and therefore we did some researches about it. We found the topic of industrial symbiosis while reading articles and newspapers. Regarding our specific subject, we can say that we did not have any preconception and all information about it was completely new to us.

However, as business students, we attended courses about Corporate Social Responsibility and Socially Responsible Investing which gave us guidelines on how to investigate our research topic. Above all, one of us used to do an internship as junior consultant. She had to settle a project of waste oil management between different companies, following the principles of circular economy. In that context, she became particularly aware of the need for a change in the economic paradigm and she understood
the importance of CSR as a performance tool for companies. Therefore, we can state that we had some preconceptions but they were limited; they did not affect directly our research outcomes.

3.2. Practical Method

3.2.1. Literature search

The literature review consists of a “critical evaluation of the existing body of knowledge on a topic, which guides the research and demonstrates that the relevant literature has been located and analyzed” (Collis and Hussey, 2014). It helps to identify gaps that the researchers will fill by investigating a specific issue that has received little or no attention yet. Collis and Hussey (2014) argue that a literature search needs to be systematic and methodical in order to be as exhaustive as possible. To do so we have followed the procedure they provide (Collis and Hussey, 2014).

First, we have defined the scope of our research. Second, we have determined our keywords used for searching such as industrial ecology, industrial symbiosis, waste management, industrial synergies, resource efficiency, small and medium sized enterprises, SMEs sustainable strategy and so on. We have then selected relevant publications from high-quality journals, namely Journal of Cleaner Production, Journal of Industrial Ecology, Journal of Environmental Planning Management. We have started to read the most recent articles and we have worked back in time, meaning that we have used the references at the end to find previous researches. We have tried to use only peer-reviewed articles to maintain the highest possible quality for our literature review chapter. At some point, we have recognized the references cited in other studies and thus we have realized that our literature search was systematic and thus was about to come to an end. To keep up to date, we have continued to search the literature while writing our thesis.

3.2.2. Data collection method

When it comes to collect data, two strategies can be undertaken according to the types of data the researchers want to gather. The first one involves the collection of primary data which is generated from an original source, such as surveys, interviews or even focus groups (Collis and Hussey, 2014). In addition, one can also gather secondary data which comes from existing sources, for instance publications, databases or internal records (Collis and Hussey, 2014). It has therefore been collected for another purpose than the one of the actual study. Secondary data tends to be less time-consuming; however, it might not be aligned with the investigation of the specific research question (Saunders et al., 2012). Furthermore, the researchers cannot control the quality of this data (Saunders et al., 2012).

Considering the strong disadvantages inherent to secondary data, we have decided to collect exclusively primary data. We think that primary data is the only one that can provide clear answers to our specific research question since, to the best of our
knowledge, our study has not been done previously. Our data is new and collected for the specific purpose of our master thesis. Nonetheless, we also consider collecting secondary data to support our findings if needed. Additional information will eventually come from organizational and institutional websites, and newspapers.

Primary data was collected through seven phone interviews. Under interpretivist paradigm, interviews can be unstructured or semi-structured. With unstructured interviews, questions are not prepared prior to the interview (Collis and Hussey, 2014). For our study, we use semi-structured interviews where some questions are prepared in advance about the main topics of interest and further questions are developed during the interview (Collis and Hussey, 2014). Questions were asked in a flexible order, allowing the interviewees to structure their statements the way they want. It enables us to gather additional information that would probably not be tackled otherwise.

3.2.3. Qualitative sampling

In a positivist study, the sample must be representative of the population; thereby care is taken to select a random sample. A random sample is an unbiased subset of the population where everyone has equal chance of being selected, ensuring that it represents the phenomenon under investigation (Collis and Hussey, 2014).

In an interpretivist research, there is no need to select such sample. Three main methods exist for choosing a non-random sample (Collis and Hussey, 2014). One might consider snowball or networking sampling which includes participants relevant to the studied phenomenon. These people are then asked to introduce the researchers to others with similar experience (Collis and Hussey, 2014). The second sample is called judgmental or purposive and it is similar to snowball sampling but the researchers decide to not pursue other contacts that may arise during interviews. Natural or convenience sample is the last sampling method; it involves only available people and the researchers have no influence on its composition (Collis and Hussey, 2014).

We started by using a purposive sample. Indeed, we have begun to contact people, via emails and LinkedIn, who have an experience with industrial symbiosis: either people working in associations or organizations promoting IS or researchers specialized on that topic. We wanted to constitute a heterogeneous sample to gather as different beliefs as possible. Our sample is then constituted by seven people who act as facilitators of IS implementation in different areas of France. They work in associations or organizations, either public or private, which are also different from each other regarding their date of creation, their activities, their location. All our respondents have then an external point of view towards the phenomenon of IS in SMEs. We have chosen this stance because as seen in our theoretical framework, IS is not well developed in France and facilitators are often the ones giving the impulsion of the IS dynamics. Consequently, it appears interesting to hear the facilitators in France about their opinion of the challenges faced by SMEs. We assumed that, although all our interviewees have a similar role, they would have distinct approaches while applying industrial symbiosis in SMEs.

Next, we used the snowball sampling method: we asked our interviewees to introduce us to other people that might be relevant to the purpose of our research. When we have
started to recognize similar findings in different interviews, we assume that new information was not likely to occur and that we have dealt with the whole issue. Therefore, we have chosen to stop searching for new interviewees and we start to analyze our data.

3.2.4. Conducting the interviews

Before conducting our interviews, we have followed an interview protocol which consists of preparing the questions in advance, knowing the respondents and asking questions ethically. First, we have prepared an interview guide (see Appendix 1), which was sent prior to the interviews if asked by our respondents. The interview guide can be made of either the main topics to be covered or a more structured list of questions to be asked during the interview (Bryman and Bell, 2003). Our guideline is composed of such a list of questions, which covers the topics we identified in our literature review: benefits and brakes for SMEs to implement IS; role of SMEs’ stakeholders and more specifically of the members of existing IS networks; ways to implement sustainable IS over the long term. Through the process of the interviews, we also add new questions that arose with prior respondents in order to confront different opinions on a new topic. For example, one of our interviewees claimed that IS synergies might stop if people in charge within a SME leaves. It led us to ask to the following respondents what the solutions can be to overcome this challenge that we were not aware of previously.

Secondly, we have recorded available information about our respondents and their organizations beforehand so as to ask the most relevant questions possible when interviewing them.

All our interviews took place between April 2018, 24th and May 2018, 22nd. As seen in table 1, their length varies from 35 to 51 minutes. After having requested permission for recording, we began each interview by explaining our research question and the purpose of our study, and then we continued by asking questions, from the most general to the most specific ones. At all times, we were careful to give sufficient time to reply and we also listened attentively to what was said, in order to not miss any information and to pick up on new ideas.

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Organization</th>
<th>Role</th>
<th>Length of the interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clémence REJNERI</td>
<td>Club d’Ecologie Industrielle de l’Aube (CEIA)</td>
<td>Project manager</td>
<td>45 minutes</td>
</tr>
<tr>
<td>Alice SARRAN</td>
<td>Inddigo</td>
<td>Consultant</td>
<td>50 minutes</td>
</tr>
<tr>
<td>Name</td>
<td>Organization</td>
<td>Position</td>
<td>Duration</td>
</tr>
<tr>
<td>------------------</td>
<td>---------------------------------------------------</td>
<td>-----------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Peggy RICART</td>
<td>ECOPAL</td>
<td>Director</td>
<td>42 minutes</td>
</tr>
<tr>
<td>Cindy DERAIL</td>
<td>Maceo</td>
<td>Project manager</td>
<td>51 minutes</td>
</tr>
<tr>
<td>Clémence ROLDAN</td>
<td>Association Industrielle de la Région de Meyrieux (AIRM) / Desautel</td>
<td>Former project manager of SIEL Now QSE Responsible</td>
<td>35 minutes</td>
</tr>
<tr>
<td>Emilie ALBISSE</td>
<td>Agence de l’Environnement et de la Maîtrise de l’Energie (ADEME)</td>
<td>Project manager</td>
<td>48 minutes</td>
</tr>
<tr>
<td>Benjamin ARNAUD</td>
<td>Centr’Alp</td>
<td>Project manager</td>
<td>39 minutes</td>
</tr>
</tbody>
</table>

*Table 1: Presentation of our interviewees and length of the interviews*

A report of each interview which highlights the key findings can be retrieved in Appendixes 2 to 8.

### 3.2.5. Data analysis method

Miles and Huberman (1994) consider that three main features composed qualitative data analysis: data reduction, data displays and finally conclusions and verifications. They provide a general analytical procedure on which we base our analysis. We begin by converting our data into a written record, ensuring that it is well referenced. The next phase consists of coding the data. Then we try to group these codes into categories according to patterns or theme that arise (Miles and Huberman, 1994). We pay attention to maintain a certain consistency, removing some themes which appeared to be irrelevant regarding our research question. At these various stages, we write summaries of our actual findings that we use after to construct generalizations. Generalizability is the extent to which the findings can be applied to other cases or settings (Collis and Hussey, 2014). We keep on doing this whole process until we find our generalizations sufficiently robust.

In the next chapter, we will go more into details about the themes we have highlighted through our interviews, so that we can gain a deeper understanding and provide an answer to our research question.
3.2.6. Ethical considerations

Research ethics is concerned with the manner in which the research is conducted and how the findings are reported (Collis and Hussey, 2014, p. 30). We have considered such ethical aspects as independency and objectivity, affiliation, dignity and informed consent of respondents, confidentiality and anonymity, honesty and transparency, misrepresentation, plagiarism (Bryman and Bell, 2011; Collis and Hussey, 2014).

Our topic is chosen based on our own interest and we have no personal benefits in obtaining specific results. We have absolutely no affiliation that may influence our research, such as conflict of interest or sponsorship. Despite our previous axiological statement, where we claimed that our research is value-bound, we try to be as objective as possible regarding the literature and the data analyses.

We also carefully examine ethical considerations concerning our interviewees. We respect their dignity by ensuring that no harm and discomfort occur during our research. We ensure that we have their informed consent, meaning that they gave us their agreement of their participation based on emails containing accurate information about the purpose of our study. The respondents were asked about whether they would agree that we use their names in the study and they all gave us their agreement. Actually, they were more than happy to do so because, as one of them explained us, IS is still quite unknown in France and they appreciate any kind of work that can help to make firms’ managers more aware of it. Finally, we will send to all our respondents our final thesis.

Furthermore, we guarantee that we do not act deceptively as we are honest and transparent in communicating information to all stakeholders about our research. We are also very careful in avoiding misrepresentation and misunderstanding by reporting our research findings accurately.

3.3. Limitations of the Research Design

Industrial Symbiosis has received attention in the existing literature and previous theses but it was often studied under the scope of engineering, highlighting technical processes or technical feasibility. Moreover, the previous business researches which tackle that topic have used case studies as their data collection method. We wanted to test a new approach and that’s why we chose to conduct interviews. As a result, we do not have any research model on which we can build on.

The second limitation of our research design deals with the fact that we interview French-speaking people. We try to be as accurate as possible while translating in English what they have said but we are aware that a bias may emerge from this situation.

3.4. Overall Quality of the Research

To assess the quality of our research, we follow the model of Tracy (2010, p. 840) who suggests eight “big-tent” criteria for excellent qualitative research. As shown in table 2,
his framework proposes a number of different goals to be fulfilled in order to insure the quality of the study.

<table>
<thead>
<tr>
<th>Criteria for quality (end goal)</th>
<th>Various means, practices and methods through which to achieve</th>
<th>How it was achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Worthy topic</td>
<td><em>The topic of the research is:</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- relevant</td>
<td>The topic is relevant socially and is gaining more and more importance over the years, at local, national and European scale.</td>
</tr>
<tr>
<td></td>
<td>- timely</td>
<td>It is likely to be a great solution for businesses in order to answer upcoming environmental challenges.</td>
</tr>
<tr>
<td></td>
<td>- significant</td>
<td>We identify research gaps.</td>
</tr>
<tr>
<td></td>
<td>- interesting</td>
<td></td>
</tr>
<tr>
<td>2- Rich rigour</td>
<td><em>The study uses sufficient, abundant, appropriate and complex:</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- theoretical constructs</td>
<td>Relevant literature is used and systematically analyzed.</td>
</tr>
<tr>
<td></td>
<td>- data and time in the field</td>
<td>Qualitative method allows to get richer data and deeper understanding.</td>
</tr>
<tr>
<td></td>
<td>- sample(s)</td>
<td>Accurate description of all the methods used is given.</td>
</tr>
<tr>
<td></td>
<td>- context(s)</td>
<td>All chosen methodological stances are connected.</td>
</tr>
<tr>
<td></td>
<td>- data collection and analysis processes</td>
<td></td>
</tr>
<tr>
<td>3- Sincerity</td>
<td><em>The study is characterized by:</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- self-reflexivity about subjective values, biases and inclinations of the researchers</td>
<td>We are honest and transparent in assessing our biases and goals.</td>
</tr>
<tr>
<td></td>
<td>- transparency about the methods and challenges</td>
<td>Authenticity is marked throughout the research process.</td>
</tr>
</tbody>
</table>
### 4- Credibility

*The research is marked by:*
- thick description, concrete detail, explication of tacit (non textual knowledge) and showing rather than telling
- triangulation or crystallization
- multivocality
- member reflections

Primary data is used and comes from interviewees which have different background and experience.

Respondents are quoted with care of avoiding translation biases.

We try to provide as many details as possible to improve understanding.

We do our best to ensure internal and external validity as well as reliability.

### 5- Resonance

*The research influences, affects or moves particular readers or a variety of audience through:*
- aesthetic, evocative representation
- naturalistic generalizations
- transferable findings

The research follows the guideline given by Umea University in terms of fonts and layouts.

We include schemas to enhance visualization of the processes.

### 6- Significant contribution

*The research provides a significant contribution:*
- conceptually/theoretically
- practically
- morally
- methodologically
- heuristically

The research aims at filling a gap identified in the existing literature.

Managerial implications are discussed.

Further researchers are highlighted.

### 7- Ethical

*The research considers:*
- procedural ethics (such as human subjects)
- situational and culturally specific ethics
- relational ethics
- exiting ethics (leaving the scene and sharing the research)

Permissions to record and quote the respondents are systematically asked.

We follow ethical considerations suggested by Umea University during all the research process.
<table>
<thead>
<tr>
<th><strong>8- Meaningful coherence</strong></th>
<th><strong>The study:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- achieves what it purports to be about</td>
</tr>
<tr>
<td></td>
<td>- uses methods and procedures that fits its stated goal</td>
</tr>
<tr>
<td></td>
<td>- meaningfully interconnects literature, research question/foci, findings and interpretations with each other</td>
</tr>
</tbody>
</table>

We pay much attention to connect our research questions and objectives with the literature review, the methodology, the findings and the interpretation and the conclusion.
We answer to our research questions at the end of the thesis.

*Table 2: The Eight “Big-Tent” criteria (Tracy, 2010, p. 840); table retrieved from Nicol (2013)*
4. Empirical Findings

In this chapter, the empirical results obtained during our seven interviews conducted are presented. The findings are analyzed through a framework composed by five themes which are: the SME’s approach of IS; their interaction with the main stakeholders; the political perspective; the territorial perspective; and finally the technological perspective. The findings consist in a situational analysis and suggestions given by the interviewees for improvement related to every concept of the framework.

We have interviewed seven people who are all playing different roles in IS implementation in France.

Emilie Albisser works at ADEME, the French Environment and Energy Management Agency that provides technical, operational and financial support for IS implementation.

Peggy Ricart, Clémence Rejneri, Cindy Derail and Benjamin Arnaud work in associations promoting IS at a local scale. Peggy Ricart is the Director of ECOPAL, one of the first French IS associations created in 2001 and based in Dunkerque, that aims to promote IS projects in the North Region. Clémence Rejneri is Project Manager and facilitator within the Club de l’Ecologie Industrielle de l’Aube (further written CEIA), a French association based in the Aube region, created in 2003, that aims to promote IS and to create meetings between regional firms. Cindy Derail is Project Manager within Maceo, a French association based in the Massif Central, which targets the firms located in this area. Benjamin Arnaud is Project Manager within Centr’Alp Association, acting as facilitator in Rhône-Alpes region.

Alice Sarran works as consultant in Inddigo, a cabinet which provides consulting mission related to IS and that has SMEs as clients.

Clémence Roldan used to work as the Project Manager of SIEL that supports IS implementation in the Rhône-Alpes Region. She is now QSE (Quality, Security, Environment) Responsible in the Desautel factory, a factory that has implemented IS.

4.1. Approach of SMEs towards IS

Current state

Despite an acknowledged and growing interest in IS, IE and more generally in environmental themes within the SMEs in France, as stressed by Sarran, IE and a fortiori IS still suffers from a lack of upstream communication, which explains the few amount of identified initiatives within France, especially the ones including SMEs.

First, the jargon related to IS or IE is sparsely democratized, often reserved for a certain class of professionals, as Ricart outlined. Furthermore, as six out of the seven interviewees (Roldan, Ricart, Albisser, Derail, Arnaud and Rejneri) agree on, SMEs, regarding their small structure, often lack of time, and availability, which can be an obstacle to IS implementation. Roldan claims that the “managers in SMEs wear often
several hats and in this way they are often hard to reach”. Thus, delegation power is very low in SMEs, even if, as argued by Albisser, “SMEs directors remain more approachable than CEOs of larger firms”, which is infirmed by Arnaud according to whom “big firms are easier to reach considering their bigger amount of human resources”.

Ultimately, one of the brakes identified by Roldan and Arnaud is that synergies require a long-term investment, that is often conflicting with the projection capability of SMEs: Roldan described during the interview how a project of creation of a mutualized solar farm that would provide electricity to several firms failed because they had to commit for 15 or 20 years, which appeared as barely achievable regarding the fragile structure of SMEs.

Recommendations of the interviewees

Aiming to convince an increasing number of SMEs to look after potential synergies, many interviewees, including Albisser, Derail, Roldan, converge on the necessity to adapt the terminology used when talking to SMEs. In this way, Derail suggests to “talk directly of synergies to the interlocutors from SMEs, which will provide them a concrete vision of what IS is about”. Other interviewees sensitize SMEs by introducing the concepts of “common sense policy”, as discussed by Ricart, or of “exchange of good practices”, as Roldan said. Derail and Rejneri also mention that they rely on previous successful experiences to convince potential interested: for example, Rejneri aims to create some “files synthesizing successful implementations, in order to offer visits of industries or meetings with CEO of industries already involved in IS”. According to her, the ability to forge some links with its neighbors provided by implementing IS can be a convincing argument. However, Arnaud has troubles providing previous successful examples. Indeed, those projects “require a large amount of time” and the launch of IS synergies through his association is recent (two years and a half only). For example, Arnaud launched a project of a mutualized collect of pallets within the area of action of his association Centr’Alp a year and a half ago, and the project comes up very slowly.

In addition, considering the lack of time and availability of SMEs employees, Sarran emphasizes the importance of “upstream studying internal mechanisms of SMEs” in order to contact the relevant interlocutors, as mentioned by Arnaud. Furthermore, Roldan adds that the best way to foster SMEs to take part to such synergetic projects is to “start from their own needs” rather than presenting them a ready-made strategy. “If a CEO has trouble handling a type of waste, he will manage to take time to find a solution.” Thus, Albisser claims that the procedure must be quickly set up, and “the facilitators must be responsive and also flexible towards their interlocutors within the SMEs in order to adjust themselves to the SMEs’ agenda,” which is often very busy.

Finally, the financial argument should be taken into account, as IS is a “cost-saving approach that attracts investors” from Ricart’s point of view. Rejneri suggests to present IS to SMEs as a “potential economic gain”. In the first instance, Roldan advocates to begin with small nature actions that can be realized with few means and in a short time: she evokes in this way a service implemented in her factories (Desautel) of small ads between industrial firms called Tam-Tam for one-off cases of recovery. “For example, if
a firm faces storage issues for pallets, its neighbors can host them”. Based on the same approach, Arnaud has launched an email-ad platform between firms within his area: the firms can send by emails some resource they wish to get rid of and the email is transmitted to a mailing list of the firms around.

Moreover, some tools are suggested by Roldan in order to face the issue of long-term investment: SMEs could for example “subscribe an insurance that would take over the long-term investment” if the firm collapsed or moved away. ADEME could also provide subsidiaries in order to reduce the length of return on investment, but such procedures have not been implemented yet: for now, ADEME provides financial grants for implementing IS in case of large synergies, but does not provide any long-term support.

4.2. Interactions with the stakeholders

Current state:

As IS is characterized by a collective approach, “it is based on human contact and interactions”, Albisser claims. However, several interviewees, including Albisser, notice the lack of communication between co-located firms. In addition, Arnaud underlines the difficulties of communication at the intra-firm level, and in this way even more between the firms. This lack of internal communication can have an impact on the IS implementation: the decisions of launching IS are taken with top management, and the employees in charge of the operational implementation of the synergies are often not aware of it before the last moment.

Additionally, even though IS is based on a “voluntary approach”, Ricart says, IS projects often “rely on the motivation of a few people whose departure may lead to its failure”. This scenario is confirmed by Rejneri through the example she gave us of a synergy between a sugar factory and a construction industry: the sand presented on the sugar beets had been detected as a useful resource for the construction industry for building embankments on the road. This synergy detection led to 15,000 tons of sand given each year by the sand factory to the construction industry for ten years. However, when the people within each firm who were in charge of managing this synergy left, the synergy was abandoned and is no longer happening anymore. This assumption is approved by three interviewees, Sarra Arnaud and Roldan, and Albisser adds that the “associative facilitators also face a high turnover rate” that also participates to the projects’ weakening.

Regarding the shareholders within the SMEs, according to Albisser, “they are either intimately convinced of the interest of IS, or they are interested by the cost-saving aspect”. This means that shareholders mostly do not represent a barrier to IS implementation, and will at the opposite push the process if they see a financial interest.

Therefore, Derail underlines the importance of community support, which will be analyzed further; Roldan and Albisser assign to big firms the role of example, as they could build link with their suppliers and implement a common IS procedure for instance. Arnaud adds that the “big firms already play an incentive role towards SMEs regarding
CSR but IS is still emerging”. Finally, Albisser underlines the role of consular chambers, which are public entities in charge of representing the private sector, in enhancing IS as they guide territories and assert firm’s vision within these territories.

**Recommendations of the interviewees:**

In a holistic view, one of the main recommendations is claimed by Sarran: the responsibilities of each stakeholder must be clearly stated, in order to monitor properly and efficiently the project.

Thereafter, six out of the seven interviewees (Sarran, Derail, Roldan, Rejneri Arnaud and Albisser) meet up on the importance of a strong figure, maintaining close relationships with SMEs, that will be able to create the links between all the entities involved in the IS, to overcome the lack of communication noticed, and to oversee the whole project by being dedicated to it. According to Sarran, Derail, Albisser, Arnaud and Rejneri, this role can be played by the facilitators working in associations, like the CEIA in which Rejneri works, ECOPAL which is led by Ricart, or Cent’Alp in which Arnaud works. Arnaud insists on the necessity to sustain the role of facilitator: for example, his job is funded by ADEME during three years, but the association needs to pay for it after these three years, thanks to the members’ fees or money brought from services provided to the employees working in the area. Sarran thinks that this role can also be assigned to “a president of firms’ association, or a retired CEO of SME”. Derail uses the phrase “core of actors” to designate this role of leader towards IS implementation; Roldan thinks that this can also be the responsibility of the CCI (Chamber of Commerce and Industry).

According to Derail, sustainable cooperation could also come from the creation of an “association gathering all the stakeholders of the territory” (firms, associations, consular chambers, region, municipalities…), in order to create a common involvement from everyone related to IS implementation, enabling actions’ monitoring, and compensating the departure of actors.

**4.3. Political perspective**

**Current state:**

As claimed by Roldan, “SMEs in France culturally lack of trust” regarding the government, their competitors, or the firms located in the neighborhood, which highlights the role of the facilitator. This generates a poor communication with SMEs that are often confused with regulation. The regulatory brake is expressed by four out of the seven interviewees (Ricart, Roldan, Derail and Arnaud). For example, Roldan explains that a project of solar panels on roofs implementation had been suggested, but a legal problem had been issued: it is forbidden to put some electric wires above roofs without having RTE norm. This led to the failure of the project.

Even though Derail claims that government still does not provide sufficient financial support, according to Albisser government seems to open gradually: for example, in the
Grand Est region, it aims to lead inspectors of classed installation being responsible of other themes such as energetic efficiency, and maybe IE. Moreover, Albisser stresses that some partnerships were made with Water Agency, the Region, and DREAL (Regional Environment, Planning and Housing Agency) in order to enhance the support to firms interested in implementing IS. DREAL provides a non-financial but technical support for IS implementation. The role of DREAL is underpinned by Ricart that adds that it can sometimes push border-line projects regarding regulation. Arnaud stresses the role of ADEME as a major financial support to IS implementation. For example, as mentioned earlier, ADEME finances through calls for expression of interest during a certain amount of time the salaries of facilitators in associations, like Arnaud.

**Recommendations of the interviewees:**

Several interviewees agree on the fact that overregulation may be harmful for IS implementation: both Albisser and Ricart express the wish of streamlining procedures, and “let the cluster form without being overwhelmed by regulation” (Ricart). Albisser also highlights the role of jurists, who create a link between regulation and SMEs, especially about the waste-status in France. Arnaud adds that Government could play a role regarding the regulation about waste, in order to “make it easier for firms that wish to reintroduce waste in the value chain”. However, Sarran runs counter Albisser and Ricart’s opinions: according to her, “government should implement regulations in order to force SMEs” to launch these types of procedures.

More generally, Derail claims that involving community within the process could enable it to follow up the whole procedure and in this way, to provide support if needed.

**4.4. Territorial perspective**

**Current state**

The territorial anchorage is seen by several interviewees as one of the major assets to conduct successful IS. Sarran underlines the importance of proximity and diversity of SMEs in order to optimize synergies potential. Additionally, Sarran, Derail and Albisser argue that SMEs are willing to work with their neighbors, more than with distant firms (at a similar cost).

Anyhow, depending on the type of flow, targeting a wider scale may be needed as discussed by Rejneri and Ricart. Albisser argues that “creating connections between the different associations dedicated to IS could enable to discover new potential synergies”, considering the type of flow that is concerned (whether or not a material flow).

Both Sarran and Derail stress the importance of adapting each IS strategy to the territory that it is anchored to, for example whether it takes place in the countryside or in the mountains. This is why they seem skeptical regarding ADEME’s goal to expand IS at a national scale. Derail considers it hard to implement, except through a “joint approach
with small local actors”. According to her, there is a need of alliance of local and territorial projects.

**Recommendations of the interviewees:**

The first advice that stands out the interviewees is the necessity to adapt each strategy to the territory on which it aims to be implemented. This highlights the importance of associations, clubs or consulting cabinets that, as external actors, provide specific advices and strategies to each scenario. Hence, Centr’Alp has launched meetings for firms’ CEOs, through breakfast or firms’ visits. In the same way, Rejneri’s association, CEIA, organizes workshops twice a year for detecting synergies. These workshops are composed of about twenty firms located in the same area. Following the NISP approach (National Industrial Symbiosis Program), every firm fills a form with its resources (used, in stock, or needed) and connection is naturally made through a roundtable. In this way, two SMEs, a delicatessen and a cheese dairy, realized during a workshop that they were delivering to the same customers (hypermarkets and supermarkets) and that they both suffered from half-full delivering trucks. Hence, they decided to create a common storage space, and to mutualize trucks journey, enabling to optimize transport and delivery costs. Rejneri underlines that they even now rent out this space for other SMEs. The firms took an advantage of their similar location and delivery journeys and managed to save costs and also to generate a new common revenue.

IS can also be used as a “boost for the territory” according to Derail. She mentions the example of a firm selling saugues wool that had to face the plummeting of the wool market. It was approached by a firm that uses since the wool to pad mattresses. This alliance enabled to launch new activities on the territory, as well as a touristic activity about the discovering of agricultural world and of sheep shearing.

In order to create a territorial emulation, Albisser insists on the necessity from the municipality and the territorial institutions to involve firms in the territorial procedures. For example, at the autonomous harbor of Strasbourg, firms located in this area were invited to the steering committee which provided them a global vision of their zone and a better look of how to take advantage of it.

**4.5. Technological perspective**

**Current state**

From a technical perspective, i.e. the technical issues of implementing IS in SMEs, Rejneri and Derail suggest that the first hurdle deals with the lack of awareness of the firms regarding their flows. Consultancy services can be undertaken to raise awareness of these flows but Rejneri also points “the lack of time-commitment of SMEs” concerning such studies, which “prevents sometimes from detecting potential synergies”.

Apart from that, Roldan and Derail agree on the fact that substitution synergies are almost non-existent or very unusual, because, as stressed by Roldan, they rely on a high level of trust which can represent an obstacle towards the synergy strategy. Furthermore, as explained by Arnaud, the heterogeneity of the firms located in one area can make
substitution synergies hard to find. Mutualization synergies are more common and also easier to implement, for example “waste management with a mutualized provider, mutualized hiring of a secretary”. Especially, Albisser highlights the problematic of industrial secret that makes firms reluctant to provide their data about resources consumption and needs. However, the meetings organized by Rejneri led to some substitution synergies, such as the use of black carbon present in the production process of a tire manufacturer in order to recovery it into coloring for a manufacturing company.

Recommendations of the interviewees:

Besides the meetings organized by associations as mentioned before, Sarran and Albisser converge on the need of expanding data collecting software at a national scale. In order to be relevant and efficient, the collect mode needs to be homogenized: i.e. every type of resource must be characterized in the same way on all the tools provided to the SMEs, in order to be able to compile these data. Ricart evocates the idea of creating a “mobile application that would make this data collection easier, faster and more efficient”. In addition, in order to face the privacy issue, firms should be able to fill up their details anonymously. Albisser underlines the possible role of the facilitator for the data collection, as they are trusted by firms and has a global vision of the organization of the territory.
5. Discussion

The empirical findings presented in the previous chapter are compared to the theoretical framework built earlier in chapter 2 and further discussed.

5.1. Approach of SMEs towards IS

The confrontation of the theoretical framework and the empirical findings enables to confirm some issues towards SME’s approach of IS in France.

First, the difficulty of apprehending the concept of IS due to its terminology in France is confirmed by both literature and the interviewees: it is argued that the term circular economy is preferred in laws as being more comprehensive and intuitive (Boons et al., 2015), which meets up with the remarks of the interviewees, who claim that the jargon used when talking about IS is often scary for SMEs and hardly understandable.

Secondly, the majority of the interviewees agree on the fact that SMEs suffer from a lack of structure, time, and money which can represent a brake for IS implementation, which is in accordance with Berger-Douce’s, Ryan’s and Ruiz Puente’s opinion (Berger-Douce, 2005; Ryan et al., 2005; Ruiz Puente et al., 2015). These authors also argue the lack of cooperative culture and a short-term vision, which are elements that are pointed out by Roldan, are an obstacle of taking part of a project that induces a long-term investment.

The recommendations proposed by the interviewees also converge with the suggestions of the authors: Berger-Douce suggests to create a healthy communication between managers that would be able to exchange their mutual experience while overcoming with the competitive aspect (Berger-Douce, 2005). This idea catches up with the strategies implemented by the associations like CEIA, or Centr’Alp that organize breakfasts where CEOs gather, or firms’ visits. Thus, authors and interviewees rely on the fact that previous engaged actors can influence positively potential new actors to take part to synergies, under the effect of mimetic isomorphism (Martinez-Ferrero and Garcia-Sanchez, 2017).

Despite the fact that SMEs over consider the costs of implementing environmental measures but are not aware of their advantages (Ruiz Puente et al., 2015), the interviewees rely on the fact that financial incentive is a major leitmotiv to convince SMEs to take part to IS, as mentioned by Berger-Douce (2005), Lowe and Evans in 1995 (the cost-based approach is a main driver for the emergence of IS networks) and by Erkman (2004) when he claims that IS naturally induces an increase of performance and of competitiveness.

5.2. Interactions with the stakeholders

Both the interviewees and the authors agree on the fact that IS rests on a collective approach and social interactions within the network. This is in accordance with the role of SNA as a tool to represent the nature of interactions and embeddedness of the actors within the zone where IS is implemented. As IS is based on a voluntary approach as mentioned by Ricart, the development and the design of synergies rely on trust among
the different actors of the network. The literature confirms this social and inter-organizational aspect by claiming that embedded networks are characterized by trust, information transfer and joint-problem solving (Uzzi, 1997). However, it is often noticed by the interviewees that SMEs suffer from a lack of trust among government or firms located in the neighborhood which can become an obstacle to a proper IS implementation, or slow down the process due to cultural characteristics of SMEs, which are often family-owned businesses.

The fundamental role of social aspect within IS implementation (Domenech and Davis, 2009) converges with the major thought that has come up from the interviews regarding stakeholders’ influence within IS implementation. The project leans often on a few people motivated that are trusted by the firms involved and that support the whole project. Both interviewees and authors agree on the fact that a strong leader is needed to conduct the project (Hewes and Lyons, 2008; Sakr et al., 2011). The authors call it “Champion” while the interviewees refer to facilitators within association. Their role will be efficient only if their responsibilities and power of action have clearly been identified upstream. The importance of these motors is confirmed by Chopra and Khanna (2013) who highlight the role of facilitators as nodes regarding SNA.

There was few mention by the authors of the role of the large companies in prompting the SMEs to take part of IS. As stressed by Arnaud and confirmed by the literature, big firms have an emerging role in motivating SMEs to become more aware towards sustainability issues (Ryan et al., 2005), but IS is not developed enough yet to be promoted by big firms.

5.3. Political perspective

As mentioned before, trust, or lack of trust can affect deeply relationships between political actors and SMEs. Instead of seeing the Government as a helping actor towards IS implementation, SMEs perceive it as a regulator that will interfere with their projects by overwhelming them with regulation, without taking into account the economic interests of the firms, as explained in their interviews.

The role of Government towards IS planning remains a subject of debate in the literature and between the interviewees and this divergence of positions highlights the key problematic of political action, especially in a centralized country like France, country in which all the procedures are heavy and time consuming due to excessive bureaucracy (Boons et al., 2015). However IS initiatives are often driven by public sector in France, through the Circular Economy Institute, ADEME, the French Environment and Energy Management Agency and the Chamber of Commerce and Industry (Schalchli, 2012; Brullot et al., 2014). Some of the interviewees confirm the important influence of public actors, like ADEME, but others complain about the lack of financial support. ADEME still has a major role towards IS implementation, as it is shown by the fact that it is financing the job of Arnaud during three years within Centr’Alp, in order to facilitate the expansion of the association and the projects conducted inside. As explained in the literature, the middle-out approach appears as providing the healthier organization for conducting IS, as it takes into account both public and private interests and perspectives.
This is confirmed by the interviewees: indeed, this model relies on trust among the stakeholders (including towards Government) and mutual help. The Government here will play the role of the supporter of the initiatives and feedback provider and not only the regulator. Therefore, the 5-step process explained in the literature appears relevant for our study: the assessment of national and local contexts are made up by private and public actors; then, through an identification of the actors mainly conducted by the associations such as CEIA, Centr’alp or ECOPAL, the current and expected interventions are defined and shared between the different actors. The government and the local communities have moreover the role to monitor the actions with the help of the firms and the associations involved. By the end, feedback is provided by stakeholders in order to improve next interventions (Costa and Ferrao, 2010).

Despite the emergence of this middle-out approach, interviewees also claim that SMEs are often confused and unaware with the regulation and how to apply it, and will not be likely to implement IS regarding the legal constraints. This legal issue is a specificity of France where regulation can be stricter than in other countries, for example regarding the waste status. Indeed, it is suggested by the interviewees that a softened regulation concerning the reintroduction of waste in the value chain could lead to expansion of synergistic possibilities within the country, such as financial incentives from the government.

5.4. Territorial perspective

As highlighted by literature and well represented through SNA, IS rests on ties of firms that are geographically close to each other, especially when they are gathering into clusters (Ruiz Puente et al., 2015; Chen et al., 2017). The territorial anchorage is confirmed by the interviewees as one of the major asset for a successful IS, as distance is seen as decisive when it comes to substitute raw materials with waste products.

France is a very centralized country, and so are the IS networks. They occur within a specific location which is already hosting a lot of firms strongly supported by the local community and the local authorities (Costa and Ferrao, 2010, Ruiz et al., 2015). This theoretical statement is confirmed by the interviewees who claim that regional public actors play a substantial role when launching IS.

However, it has also been observed by the authors that spatially dispersed firms can also have the willingness to gather into virtual eco-industrial parks, even if it is very scarce. (Boons et al., 2015), which can appear as contradictory with the local scale of most of the IS networks. This target of a wider scale by SMEs is mentioned by the interviewees as a mean for developing new types of synergies, especially substitution synergies. Yet, the strategy implemented should be appropriate for the territory supporting the implementation, as advised by Derail and Sarran, in order to be mutually advantageous for the firms and for the region itself. Indeed IS can expand the attractiveness of a territory by enhancing a local activity, as Derail claims.
This territorial anchorage remains a major component for IS, and in this way the ambition of ADEME to conduct IS at a national scale looks still hard to implement, as are converging the authors and the interviewees.

### 5.5. Technological perspective

From a technological point of view, it appears as much in the literature as in the thoughts of the interviewees that substitution synergies occur less likely than mutualization synergies.

However, both literature and interviewees diverge on the conditions that facilitate the apparition of synergies: while Arnaud argues that the heterogeneity of the network represents an issue to develop substitution synergies, the literature states that the mix of companies and of activities and services may facilitate the opportunities for synergetic exchanges (Kincaid and Overcash, 2001; Sterr and Ott, 2004).

Whether or not diversity and proximity are considered as an asset for synergies, as Sarran claims, it appears from the empirical and theoretical research conducted, that the key factor that will guarantee efficient synergy is communication between the firms and between the stakeholders potentially involved in IS. From a technological perspective, the interviewees highlight the problem of the heterogeneity of the tools used at a national scale to enable firms to provide data about their resource needs and uses. It is also noticeable that firms often have troubles disclosing their data as they feel it could be used against them. This issue highlights the importance of trust at a technological level between the firms. To counter these issues, it is suggested by the interviewees to provide a homogenized tool on which firms could at first write down their data anonymously. It is in accordance with Cecelja (2015) who consider the European database eSymbiosis as a major tool for creating synergies between firms.

### 5.6. Synthesis

IS is a collective approach, socially constructed, that rests on actors that interact within a network in which they operate and which they contribute to build. They act as nodes and are linked together with synergies schematically represented by ties. The motivations of SMEs to be part of an IS network are diverse and may differ according to the territorial anchorage in which they are. However, in all cases, other members of the network influence the ways they implement synergies with other entities.

In France, key actors are the associations promoting IS at the local scale. They act as a facilitator of the implementation of synergies by transferring information and knowledge; and by providing a bridge between all stakeholders involved in the network (companies, government, consular chambers, and other public and private organization). Therefore, they have a central position in the social network.
Even if the territorial dimension is crucial in France, as the systems are place-oriented, the IS networks are first and foremost a social network built on reciprocity of exchanges, honest communication, and mutual trust. Social implication of SMEs is the key issue to favour IS synergies over the long-term. Ultimately, it is translated by shared values with all other actors involved.

However for enhancing IS success towards SMEs, associations promoting IS need to integrate them better into the network. SMEs consider themselves as overly dependent on others, and above all they still feel ostracized in the network in which they are part of.
6. Conclusions and Recommendations

In this chapter, we will draw the general conclusions of the study and we will demonstrate how our findings answer our research question. It is also the opportunity to state theoretical and practical contributions. We will end by highlighting the limitations of our study and by suggesting potential further researches.

6.1. General Conclusions

The objectives of the present study were first to identify the challenges faced by French SMEs when implementing IS synergies, and subsequently to provide recommendations for overcoming these challenges. This was in order to address the research gaps we identified in the existing literature. More specifically, our research question was: What are the challenges induced by Industrial Symbiosis involving SMEs in France and how to overcome them?

To answer that question, we designed a qualitative study and we interviewed seven people recognized in France for having a specific role in the field of Industrial Symbiosis in France. Most of our respondents are part of organizations promoting IS, either public or private. Some of these organizations are well-established and longstanding actors (e.g. Ecopal, CEIA, ADEME) whereas others are newcomers (e.g. Centr’Alp). We assumed that this heterogeneous sampling would allow to gain deeper understanding and different insights on our specific topic. It enables us to gather the most possible accurate findings.

Through these interviews, we managed to answer our research question. In particular, we found that these challenges were from several natures: SMEs can be hard to approach when such procedures are suggested. Furthermore, some inter-organizational barriers may also appear between the SMEs and the main stakeholders involved in IS. Furthermore, some political, territorial and technological issues need to be addressed.

To overcome these barriers, our respondents provided us useful thoughts and advices that we confronted with literature in order to validate them. Considering the place-oriented aspect of IS networks in France, SMEs should rest on the experience of previously engaged firms located in their area in order to conduct IS. This communication between neighbors could also permit the SMEs to overcome the terminological barrier which has been identified as a potential brake to SMEs.

The major role of the facilitators coming from an external node (association, consultancy cabinet...) is also highlighted as he or she will be trusted by all the stakeholders. The facilitator plays a central role for the prospection of the potential interested entities; the organization of meetings with firms desiring to take part of IS in order to see if there is any possible matching between their resource needs and uses; the follow-up and the support for firms during the whole process. One’s holistic knowledge of the process and the region will be helpful for firms.

The organizational major issue that follows is the establishment of a common governance and of the responsibilities of the actors involved. This could be established by the creation
of a territorial association that would enable a proper monitoring of actions and compensate the eventual departure of actors.

From a political point of view, the role of government towards planning or not symbiosis remains a point of debate for interviewees and authors. Based on their knowledge and experience, the third alternative model, namely called “Middle-out Approach” appears as the most relevant approach as it mixes public and private actors’ interests, and it is monitored by both Government and local actors. The Government has also a role to play regarding the regulation, which remains very strict regarding the waste status. This can represent a severe brake for implementation of IS.

Moreover, in order to be successful, strategies need to adapt to each territory, as each territory has its specificities towards resource availability, major sectors of firms implemented, and climate constraints. This explains the necessity of a local involvement, from the municipality as much as from the regional Chamber of Commerce that are aware of their territory’s specificities and challenges, and that will manage to implement the most appropriated IS strategy regarding to them.

Finally, from a technological point of view, as mentioned before, IS networks in France are generally place-oriented, and in this way substitution synergies appear as hard to find within the location. In addition, firms in France are generally reluctant to disclose their data about resource consumption. All these factors explain the fact that SMEs tend to conduct in a bigger proportionality mutualization synergies rather than substitution. However, all these procedures are still very long to implement, especially in France. It highlights the key role of the facilitator to monitor the collect of data as he or she is being trusted by all the actors. One of the relevant recommendations provided by the interviewees is also to homogenize all the tools available for firms to provide their data about resource needs and consumption in order to converge to a more national procedure. However, as mentioned, France has the specificity of having a multiplicity of territories that have their own specificities, and is a centralized country, which induces that synergies will be created on local networks with actors having close relationships. In this way, for now, targeting a national scale is seen as extremely difficult.

6.2. Theoretical Contributions

We argue that the main theoretical contribution of the present paper is the expansion of the literature concerning IS networks in France, with insight on better integrating SMEs into them. These topics have been previously acknowledged as forming a research gap.

As students enrolled in Business studies, our goal was not to provide a technical approach of IS in France, but rather to analyze it from a managerial and inter-organizational perspective. Hence, our study expresses a global and transversal point of view. To the best of our knowledge, it is the first study which addresses the topic of IS from the perspective of the external facilitators. We have emphasized their role in the creation and the development of IS synergies between SMEs. Consequently, we are able to add a feature in the framework of Miratah and EmTarirah (2005): aside from the cooperation among companies, the facilitators are also part the formation conditions (see figure 2).
Another theoretical contribution relies on the use of the Social Network Analysis to discuss our findings. It turned out to be a useful tool to understand how SMEs are embedded in IS networks and more generally how all the actors of French network, both public and private, are linked together.

From the methodological perspective, this study contributes to the field of IS through the use of qualitative approach. Indeed, most of previous studies were based on case studies. By interviewing key actors of French IS networks, we provide deeper understanding on what drives the occurrence of SMEs among IS network, what the challenges are and how to overcome them.

### 6.3. Practical Implications

We consider that the present study makes a contribution for the management of Industrial Symbiosis in France towards SMEs. Indeed, we are able to provide recommendations for enhancing and further developing IS in France which is still at its early stage despite recognized benefits, simultaneously economic, environmental and social.

In particular, the role of facilitator in the success of IS was highlighted more precisely than it stands in the literature. One’s concrete power of action was detailed, such as the implementation of workshops gathering potentially interested firms in order to make them know each other better, and to highlight their needs and uses regarding resources.

Secondly, solutions towards the financial issue towards implementing IS regarding the necessity of a long-term investment were emitted. In this way, it was suggested for instance to create some insurance systems for these procedures, where public actors could take in charge the rest of the investment in case of a firm goes bankrupt or leaves the territory. It is already the case for IS project led by ADEME targeting SMEs. Indeed, ADEME provides the investment for implementing the project, and firms have to pay it back just from the moment they have earned the double of the investment provided by ADEME. This allows firms to conduct IS procedures (here at an intra-firm scale) without fearing of losing all their investment in case of failure.

Moreover, even if the national scale appears still hard to target yet, it is suggested to tend to it by making the associations communicate between each other. This could potentially highlight new synergies opportunities, and overcome the territorial challenge. This expansion comes also with homogenized and user-friendly tools for companies to disclose their data. This tool could be a mobile application that would for example instantaneously detect when two firms match their need and their use of resource. Even though this is only hypothetic now, they represent further areas that can be taken in account by the actors to overcome the financial and organizational issues of potential interested SMEs.
6.4. Quality criteria of the study

As interpretivist researchers, our study produces findings with low reliability but high validity (Collis and Hussey, 2014). Indeed, reliability refers to “the accuracy and precision of the measurement and the absence of differences if the research were repeated” (Collis & Hussey, 2014, p. 52), which is difficult to assess under interpretivist paradigm since the researchers can have an influence on what is under study. Validity considers “the extent to which a test measures what the researcher wants it to measure and the results reflect the phenomena under study” (Collis & Hussey, 2014, p. 53). Validity can be assessed from both external and internal perspective. External validity is the degree to which findings can be generalized and extended to another similar settings (Bryman & Bell, 2011). Internal validity refers to the extent to which previous theory and collected data fit together (Bryman & Bell, 2011).

We assess the overall validity of our research by stating that through our interviews we were able to evaluate the challenges induced by IS within French SMEs and our results reflect this phenomenon under study. External validity is hard to assess in a qualitative study since findings are not easily generalizable. It is especially true in the present thesis since we have captured the characteristics and the interactions of IS networks in France. Each country has its own specificities, particularly regarding the social context, the types of policies undertaken or the actors involved in the IS networks. As a consequence, we are aware that our findings can be hardly generalized and extended to another context, for instance another country. However, we argue that our internal validity is valuable because, as seen in the discussion, most of our findings confirm what has been previously stated by scholars. We are also able to provide new contributions to the theory thanks to the data we have collected.

6.5. Limitations and Further Researches

Our first limitation is concerned with language as we conducted our interviews in French. We tried to be as accurate as possible with the meanings while translating in English but we are aware that a bias could emerge from this situation. From our interpretivist perspective, it could mean that we lost part of the meanings when we quote them in our empirical findings chapter. This highlights a potential future study to be written in French.

A second limitation relates to the selection of our sample. It enables us to get deeper understanding of our phenomenon under study but almost uniquely from an external point of view. Indeed, we only interviewed one person in charge of IS issues within a SME. We are aware that it constitutes a limit because it would have been interesting to obtain more results from an internal perspective. Further research could therefore imply a sample made of managers or owners of French SMEs.

Finally, we have highlighted two results in our analysis that appear to be worth of future research. On one hand, we realized that the lack of cooperation between companies was a great barrier to the development of IS in France. This is due to a non-cooperative culture in our country, especially regarding business. Therefore it would be interesting to extend
this study to another setting, for instance the Scandinavian one which is known to be cooperative, and to compare the results between both contexts. One the other hand, we found that when managers in charge of IS issues were leaving the SMEs, it happens sometimes that the project failed because their successors were not aware of and involved in such policies. This represents a major hurdle for larger IS implementation. Thus we recommend that a future study tackles this issue by investigating how to implement long-term IS strategy in SMEs.
List of References


Ryan, Y., Byrne, P., O’Regan, B., & Moles, R. (2005). *Establishing an Eco-Industrial Network for SMEs within the Mid-West Region of Ireland*. Centre for Environmental Research, University of Limerick, Ireland.


Appendix 1: Interview guide

As part of our studies, we are writing a thesis which purpose is to discover what challenges French SMEs are facing while implementing Industrial Symbiosis. We are interested in discovering what the drivers and hurdles are, how to deal with these challenges, what kind of relationships link SMEs to other entities in IS networks. We are also keen to know how your organization have contributed to the development of IS networks involving SMEs clusters.

We thank you for having accepted to answer our questions. Below you will find our general questions but the interview being semi-structured, other issues might arise during the interview process.

1. According to you, what are the factors that encourage SMEs to participate in projects of industrial symbiosis?

2. What are the potential obstacles?

3. How did you succeed in convincing SMEs to take part of your IS project? What kind of difficulties did you face?

4. How do you assess the role of SMEs’ stakeholders in their willingness to implement industrial synergies?
   → Local association promoting IS, government, local community, clubs of entrepreneurs, customers (especially B2B customers), competitors

5. How do you assess the experience of IS in SMEs?
   → Practical application, actual benefits and new issues, potential improvements to set up

6. What needs to be changed in order to improve the efficiency and the influence of IS in France?
Appendix 2: Interview report - Clémence REJNERI

May 5th, 2018

<table>
<thead>
<tr>
<th>Name</th>
<th>REJNERI Clémence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
<td>Project manager of Industrial Ecology in Club d'Ecologie Industrielle de l'Aube (CEIA)</td>
</tr>
<tr>
<td></td>
<td>IS network facilitator</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organization (name, place, date of creation, partners…)</th>
<th>Club d'Ecologie Industrielle de l’Aube (association promoting IE in Aube)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2003</td>
</tr>
<tr>
<td></td>
<td>26 members</td>
</tr>
<tr>
<td></td>
<td>Academics and research centers (University of Troyes), unions, collectivities, institutions, companies (all sizes and sectors)</td>
</tr>
<tr>
<td></td>
<td>60 to 70% of public financing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Financing</th>
<th>Goal of the association:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- create a network of interactions and information transfer</td>
</tr>
<tr>
<td></td>
<td>- promote the development of innovative projects of IS based on synergies between companies of any sector</td>
</tr>
</tbody>
</table>

**Agenda 2016-2018:**
- Organize seminars each year to coordinate all the organizations involved in IS in the region
- Management of a community and of a platform
- Workshops twice a year to discover and implement synergies between 20 companies, following the NISP approach
- → each firm fills a document with all its resources (used, available, needed); then a correlation is made naturally when they all meet
- → CEIA can help for the implementation phase of synergies if needed
- Identification and documentation of previous experiences in the territory, divided in several themes (energy, waste…) with the objective of offering both company tours and training based on these experiences (meetings with CEO already engaged in IS)

<table>
<thead>
<tr>
<th>Factors encouraging SMEs to implement IS procedures</th>
<th>Obstacles/issues towards the implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>- economic benefits (focus on this during the workshops with companies)</td>
<td>- Lack of time and availability of SMEs decision-makers, who are very requested on other topics</td>
</tr>
<tr>
<td>- environmental benefits</td>
<td>- Weak delegation of authority in SMEs</td>
</tr>
<tr>
<td>- Opportunity for creating relationships with local economic actors which are unknown</td>
<td>- As a firm, knowing your potential synergies takes time; thus the study of the opportunities is often done partially, which makes it unsuccessful</td>
</tr>
<tr>
<td>- Possibility of fundings from l’ADEME (but not occurring right now in the CEIA since there is no significant synergies implemented yet)</td>
<td></td>
</tr>
</tbody>
</table>
### Differences between SMEs and large companies

<table>
<thead>
<tr>
<th>Differences between SMEs and large companies</th>
<th>How to promote IS towards SMEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>- more time and availability: someone else than the CEO can go to the workshops, usually one employee is dedicated to environmental issues</td>
<td></td>
</tr>
<tr>
<td>- more resources in larger firms: a lot of money to optimize flow and resources management</td>
<td></td>
</tr>
<tr>
<td>- use of concrete examples and successful experiences for the prospection of new firms to include in CEIA</td>
<td></td>
</tr>
<tr>
<td>- Customize the prospection regarding the specific issues and needs of each company</td>
<td></td>
</tr>
</tbody>
</table>

### Other

**IS**: work on the external environment of the firm, relationships with all stakeholders. Synergies rely on the possibility of flows transporting

**Role of ADEME**: partner, source of proposals and advices: provides grants and other financial supports, organizes training, encourages CEIA to meet with other actors of IS

**Examples of successful synergies:**

- **AT France (delicatessen, family-run business) & Lincet (cheese dairy, SME)**: they realized that they were delivering to the same clients (supermarkets) and their delivery trucks were not full; therefore they have created a common storage space, enabling to optimize deliveries and transportation (occupancy rate of the trucks are now of 98%) → rent this storage space to other SMEs

- **Cristal Union (sugar manufacturer) and Eiffage (Construction industry)**: sand on the beetroots used to manufacture sugar is then reused by Eiffage for embankment (need of 500,000t/year)

- → **15 000t/year of sand has been given to Eiffage** for 10 years; but it stopped when people dedicated to this synergy in each company left

- **Kohler (US manufacturer entreprise américaine of bathtub) & Michelin**: during a workshop of CEIA, detection of Kohler’s need for black carbon which comes from Michelin’s process

- Other possible synergies: employee responsible for fire safety may provide recommendations and analyses to other companies (advantage for companies and new practical case for Michelin, with a new field of experiment)
### Appendix 3: Interview report - Alice SARRAN

**May 14th, 2018**

<table>
<thead>
<tr>
<th>Name</th>
<th>Alice SARRAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
<td>Circular Economy and IE Project Manager</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Company/organization (Location Date of creation Number of employees)</th>
<th>Inddigo</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Type of actions related to IE/IS</th>
<th>EI actions often ordered by municipalities, municipalities collectivities rather than SMEs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>As a consultant: no role of prospection of firms (lack of experience, very time consuming) → role of CCI (Chambre of Commerce and Industry)</td>
</tr>
<tr>
<td></td>
<td>Different way to increase interest for IE: visit firms (audit) or gathering of firms during collective workshops (like Clémence REJNERI) in order to collect data</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors encouraging SMEs to implement IS procedures</th>
<th>Obstacles/issues towards the implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>- A common strong governance: need to establish an action plan for several years, with a clear repartition of responsibilities</td>
<td>- sometimes the project relies on one person or two whom departure leads to the failure of the project</td>
</tr>
<tr>
<td>- Upstream communication</td>
<td>- no pre-established ideal scheme for implementing IS: need to adapt strategy to each case</td>
</tr>
<tr>
<td>- Proximity and diversity : most of the synergies happen on an industrial zone</td>
<td>- despite a real interest of SMEs: lack of communication</td>
</tr>
<tr>
<td>- Presence of a facilitator (ex: club de l’EI de l’Aube, Clémence REJNERI) or someone who has good relationship with SMEs (ex: a president of firms’ association, a retired CEO…)</td>
<td></td>
</tr>
<tr>
<td>- possibility of financing by ADEME at a local scale</td>
<td></td>
</tr>
<tr>
<td>- SMEs are more interested by connecting with their neighbors than save costs</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Role of stakeholders towards implementation</th>
<th>Suggestions to make IS procedures become more sustainable</th>
</tr>
</thead>
<tbody>
<tr>
<td>- The government could implement regulatory measures for SMEs</td>
<td>- Target a national scale</td>
</tr>
<tr>
<td></td>
<td>- Develop studies in order to make firms</td>
</tr>
</tbody>
</table>
more aware about their flows *(Cf operation ‘TPE/PME gagnantes sur tous les coûts → Cf Emilie ALBISSER’s interview)* in order to facilitate synergies

- increase awareness within SMEs

- need to study inside mechanisms of SMEs for environmental procedures in order to find the relevant interlocutors: syndicates?

- Target strategic structures

<table>
<thead>
<tr>
<th>Assessment of IS for SMEs</th>
<th>- Strong support by ADEME but financing only at a local scale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- EIP (eco-industrial parks) not really good defined in France, existence of labeled industrial parks but no real EIP</td>
</tr>
<tr>
<td></td>
<td>- 5 synergies currently launched by ECOPAL</td>
</tr>
</tbody>
</table>
## Appendix 4: Interview report - Peggy RICART

**May 18th, 2018**

<table>
<thead>
<tr>
<th>Name</th>
<th>Peggy RICART</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
<td>Director</td>
</tr>
</tbody>
</table>

**Company/organization**
ECOPAL

**Location**
Dunkerque

**Date of creation**

**Number of employees**

<table>
<thead>
<tr>
<th>Type of actions related to IE/IS</th>
<th>Regional association (targets wider than in Dunkerque only) enabling launching of IE/IS projects. 400€ of fees/year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• The firms point their products they need to recover, and their needs of inputs</td>
</tr>
<tr>
<td></td>
<td>• ECOPAL manages flows and makes them available for firms</td>
</tr>
<tr>
<td></td>
<td>• Need to be efficient during this year in order to make SMEs adhere again the next year: ECOPAL provides them an activity report synthetizing: time, financial, CO2, logistics benefits</td>
</tr>
<tr>
<td>Creation of a virtual tool to collect homogenized data of firms</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors encouraging SMEs to implement IS procedures</th>
<th>Obstacles/issues towards the implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Attracts the investors: looking for resource matching → territorial marketing</td>
<td>• jargon not really accessible, reserved to a certain class of professionals</td>
</tr>
<tr>
<td>• cost saving</td>
<td>• sometimes overwhelmed by regulation (DREAL may sometimes push some borderline projects regarding regulation</td>
</tr>
<tr>
<td>• common sense policy</td>
<td>• lack of time, huge work in long term support of companies</td>
</tr>
<tr>
<td>• skill improvement</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Role of stakeholders towards implementation</th>
<th>Suggestions to make IS procedures become more sustainable</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Government must support and push and gain in flexibility</td>
<td>• Target firms at a wider scale than regional for some flows that cannot be found within the region</td>
</tr>
<tr>
<td>• Government must give the means to communities to enable the clusters to organize themselves → not over regulate</td>
<td>• Role of the community: create collective roadmaps, ADEME wishes to do it at a national scale, but it will take time.</td>
</tr>
</tbody>
</table>
- the procedure must originate from SMEs
- within the SMEs: main interlocutor is the director of the firm, and then the HSE/QSE responsible

| Assessment of IS for SMEs | works only at regional scale but need to not be overwhelmed by regulation |
## Appendix 5: Interview report - Cindy DERAIL

**May 18th, 2018**

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
</tr>
</thead>
</table>
|     | Cindy DERAIL  
Circular Economy and financial engineering Project Officer |

| Company/organization (Location Date of creation Number of employees) | MACEO association  
Massif Central |

| Type of actions related to IE/IS | - Supports actors towards IS and IE procedures implementation within the Massif Central region  
- Has developed a tool enabling firms to communicate easily their resources and needs |

<table>
<thead>
<tr>
<th>Factors encouraging SMEs to implement IS procedures</th>
<th>Obstacles/issues towards the implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Existence of previous relationships between SMEs</td>
<td>- legal procedures can create difficulties for example to implement mutualization (regarding risks and security especially)</td>
</tr>
<tr>
<td>- Existence of a core of actors that are able to encourage other firms to take part to IS (ex: a charismatic or motivated CEO)</td>
<td>- necessity of taking in account territorial context to adapt the strategy (e.g. different type of strategy if rural, urban, mountain territory) (for mountain, the goal will be to attract new inhabitants)</td>
</tr>
<tr>
<td>- Existence of a facilitator (often within an association) that will be able to organize meetings with actors, identify synergies, communicate, know all the actors, remobilize them, and who are trusted by them</td>
<td>- if there is a lack of financial support (from government, ADEME…)</td>
</tr>
<tr>
<td>- in order to motivate the SMEs, use as an example a concrete successful experimentation and organize meetings with actors of these experimentations so they can relate their experience</td>
<td>- the technical jargon (IE, ..) often scares the SMEs → rather talk directly of synergies</td>
</tr>
<tr>
<td></td>
<td>- requires a large amount of time, logistics and organization</td>
</tr>
<tr>
<td></td>
<td>- IE/IS not publicized enough</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Role of stakeholders towards implementation</th>
<th>Suggestions to make IS procedures become more sustainable</th>
</tr>
</thead>
<tbody>
<tr>
<td>- importance of decision-makers within the SMEs</td>
<td>- creation of a territory association mixing actors within firms, associations, consular chambers that will enable actions’ monitoring and compensate the departure of actors</td>
</tr>
<tr>
<td>- importance of the facilitator (cf above)</td>
<td></td>
</tr>
</tbody>
</table>
- importance of including collectivity within this association in order to enable it to follow-up the procedure

- at a national scale: the willingness of ADEME looks hard to implement or through a joint approach with small local actors → there is a need of alliance of local and territorial projects

| Assessment of IS for SMEs | example of successful IS: Saugues wool: the wool market was plummeting, the objective of IS was to create value in this branch → use of wool to pad mattresses → **has launched new activities on the territory, and a touristic activity**: led to the discovering of the agricol world, and of sheep shearing |
## Appendix 6: Interview report - Clémence ROLDAN

**May 18th, 2018**

<table>
<thead>
<tr>
<th>Name</th>
<th>Clémence ROLDAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
<td>Deputy HSE manager</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Company/organization</th>
<th>Desautel Factories: small SMEs in the sector of metallurgy, plastics → manufacturing familial SMEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td></td>
</tr>
<tr>
<td>Date of creation</td>
<td></td>
</tr>
<tr>
<td>Number of employees</td>
<td></td>
</tr>
</tbody>
</table>

### Type of actions related to IE/IS

- Has launched the SIEL project: has generated a lot of different projects but hard to maintain over time
- Has launched a service of small ads between industrial firms called “Tam Tam” for one-off cases of recovery
- Mutualization is more implemented: waste management with a mutualized provider, mutualized hiring
- No substitution synergy launched but this type of synergy in France remains very scarce because it involves a high level of trust
- Test of creation of a mutualized solar farm that would provide electricity to several firms but these firms had to engage themselves for 15 to 20 years → very complicated for SMEs
- Think small at first: for example if a firm faces storage issues, its neighbor can host some pallets

### Factors encouraging SMEs to implement IS procedures

- Start from the issues brought by the industrial sites’ managers more than from the economic leverage (for example: if the CEO has trouble handling a type of waste, he will manage to take time to find a solution)
- Use the wording “good practices exchanges” when discussing with SME’s in order to encourage them

### Obstacles/issues towards the implementation

- Lack of time: all the managers within SME’s wear several hats → hard for them to find time to go outside the firm
- Difficulty towards investing, especially on the long-term: need for SME’s of a very short ROI → ADEME can decrease this ROI, but time is needed to build projects
- Cultural brake: firms don’t trust themselves and SMEs don’t trust government
- Regulatory brake: for example, wish to implement solar panels on roofs, but it...
was forbidden to put some electric wires without having the RTE norm → the project implementation failed

- Projects can rely on specific persons without who they fail

<table>
<thead>
<tr>
<th>Role of stakeholders towards implementation</th>
<th>Suggestions to make IS procedures become more sustainable</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Depends a lot of firms</td>
<td>- Work in relation with insurances who could take in charge the long-term investment and give the possibility to reduce the investment in case of bankruptcy or move of the firms</td>
</tr>
<tr>
<td>- Government and regional authorities must at least facilitate the process</td>
<td>- Create some contracts that will provide safety to the project even though it remains very linked to the people in charge: the goal would be to get to the point where the project is mature enough to not suffer from peoples’ departure</td>
</tr>
<tr>
<td>- Need of a project manager, that will be source of motivation for the other actors (role of CCI (= Chamber of Commerce and Industry), regional authorities... ); anyone who is specially dedicated to that and has a good relationship with firms</td>
<td></td>
</tr>
<tr>
<td>- Big firms can set an example</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assessment of IS for SMEs</th>
<th>- negative: still a lack of interest for sustainable development and environmental management in small familial SMEs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- positive: increase of good feedback after implementation of IS in SMEs</td>
</tr>
</tbody>
</table>
Appendix 7: Interview report - Emilie ALBISSER

May 18th, 2018

<table>
<thead>
<tr>
<th>Name</th>
<th>Emilie ALBISSER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
<td>In charge of Circular Economy</td>
</tr>
<tr>
<td>Company/organization</td>
<td>ADEME</td>
</tr>
<tr>
<td>(Location</td>
<td></td>
</tr>
<tr>
<td>Date of creation</td>
<td></td>
</tr>
<tr>
<td>Number of employees</td>
<td></td>
</tr>
</tbody>
</table>

| Type of actions related to IE/IS | - Has launched the operation “TPE/PME gagnantes à tous les coûts” literally: “micro-enterprises/SMEs winners by all sides” (with a wordplay with “coûts” that means cost, and that has the same pronunciation than “coups” that means here “sides”)  
→ in Auvergne-Rhône-Alpes region: operation with 50 witness-firms that were able to generate cost savings thanks to a multi-flow mutualization: experience that shows to other firms the real economic potential  
→ implementation of an easy and fast support mechanism for SME : the consultants have to find some quick actions to implement with a ROI that is less than 1 year.  
→ Average cost saving estimated to 180€/year/employee  
→ Objective of massification: reach a 500€ saving level, then 2000€ for 2019 or 2020.  
→ Financing process: each firm pays a package (6000€ worth for a firm of 80 employees for example) only if the plan raises at least 12 000€ of cost saving, otherwise the operation is free for the firm.  
→ Light diagnostics, target of fast cost saving (for example behavior changing, prevention…)  
→ Operation focused on an intra-firm level (no synergy oriented)  
→ Firms’ awareness objective  
**IE and not IS**  
- At the moment, ADEME supports approx 15 IS procedures  
- A lot of tools are existing in order to capitalize material/waste/resources of firms with a possibility to keep data anonym if wanted → the data are often collected by the facilitator |

<table>
<thead>
<tr>
<th>Factors encouraging SMEs to implement IS procedures</th>
<th>Obstacles/issues towards the implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Need of an external associative motor: for example at Lyon, or at the autonomous harbor: try to make firms communicate with each other</td>
<td>- Data privacy issue, industrial secret</td>
</tr>
<tr>
<td></td>
<td>- Firms not very open to their external environment, lack of communication with neighbors, fear</td>
</tr>
</tbody>
</table>
- Or need of a **firm** that is questioning itself about EI/IS ex: Golbey at Epinal
- Or need of a **public motor**: such as municipality communities
- Have an **adapted speech**: the wording about IE/IS scares firms
- Importance of the **human contact**: IS are built with trust
- Need of being **fast and reactive**; otherwise the interest of firms will decrease; they have a faster calendar than collectivities or associations
- Have **homogenized tools at a national scale** to capitalize firms’ data in order to have a national global vision

### Role of stakeholders towards implementation

<table>
<thead>
<tr>
<th>Role of stakeholders towards implementation</th>
<th>Suggestions to make IS procedures become more sustainable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Government</strong>: in the “Grand-Est” region, opened approach: aims to lead the inspectors of classed installations to other themes such as energetic efficiency, and maybe IE</td>
<td><strong>Create some exchange at a national scale between regional animations and associations in order to identify more potential synergies</strong></td>
</tr>
<tr>
<td>Partnership with <strong>Water Agency, Region, and DREAL</strong> (regional environment direction): common call for proposals; DREAL provides a non-financial but technical support for IS implementation</td>
<td><strong>Make IS sustainable remains very complicated</strong></td>
</tr>
<tr>
<td><strong>Consular chambers</strong>: also present for enhancing IS, guide territories, and assert firms’ vision within territories</td>
<td><strong>Homogenize tools</strong></td>
</tr>
<tr>
<td><strong>Jurists</strong>, company law specialists can orientate SME about the waste status etc</td>
<td></td>
</tr>
<tr>
<td><strong>Shareholders</strong>: whether they are intimately convinced of the interest of IS, or they are interested by the cost-saving aspect</td>
<td></td>
</tr>
<tr>
<td><strong>Big firms</strong>: they can be very hard to reach, in a closed environment (and in this case SMEs are more accessible); or they can discuss with their suppliers and create links that can lead to IS</td>
<td></td>
</tr>
</tbody>
</table>
| Assessment of IS for SMEs | - **Flow localization** very important: objective of flow exchange at a regional scale (Grand Est? 100-200km? depends on flow types)  
- SMEs are quite easy to reach, rather interested and open-minded, but you need to act fast, present concrete material, adapt yourself to their calendar (often it’s not the right time) → it is a hard work that requires resource  
- when IS is successful: great qualitative and quantitative feedbacks  
- SME’s before all interested by an cost-saving interest  
- example of the autonomous harbor of Strasbourg: firms were invited to the steering committee: this provided them a global vision of their zone  
- willingness of the firms to work in collaboration with firms located close to them → real territorial anchorage  
- micro-enterprises: speech oriented to local craft |
## Appendix 8: Interview report - Benjamin ARNAUD

May 22\(^{nd}\), 2018

<table>
<thead>
<tr>
<th>Name</th>
<th>Benjamin ARNAUD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
<td>Project manager, facilitator</td>
</tr>
</tbody>
</table>

| Company/organization | Centr’Alp (association)          |
| Location             | Rhône Alpes                      |

| Date of creation      |                                 |
| Number of employees   |                                 |

### Type of actions related to IE/IS

Centr’Alp as implemented IS in the Rhone Alpes territory since 2015. The project started from scratch on this theme.

Example of mutualization: a mutualized collect of pallets since 1 year, but the procedure is still long.

Very various sectors of activity of the firms implemented in the zone: makes substitution synergies hard to reach even if the size of the zone is suitable for this kind of procedure.

Centr’Alp has re-launched the directors club: firms visits or breakfast that enables directors to meet.

NISP workshop (based on the English model) is great for communication, even though this method did not succeed yet in launching remarkable synergies and remains too constraining.

Implementation of a mail-add system between firms at the zone scale (firms send emails with their material offer to a mailing list of interested firms)

Association funded by members’ fees, organization of events, and implementation of services for employees (like sport activities)

### Factors encouraging SMEs to implement IS procedures

- Cost saving is the main factor
- Local anchorage: involvement on the territory is a big leitmotiv for SMEs
- Positive environmental impact

### Obstacles/issues towards the implementation

- IS only emerging, low existence of feedback that could motivate the firms
- Difficulty of cooperation between several firms (already hard for them to cooperate at the inter-firm level)
- IS projects are voted at the top level of firms but often the operational actors within are not aware of the launch of these projects
- Substitution synergy: costly in terms of time, human resource, and money
- ROI time not dependent of a single firm and can be long


<table>
<thead>
<tr>
<th>Role of stakeholders towards implementation</th>
<th>Suggestions to make IS procedures become more sustainable</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Role of big firms still emerging, but already present concerning CSR</td>
<td>- find the appropriate interlocutor</td>
</tr>
<tr>
<td>- role of state: not ideally constraining SMEs to implement IS but can help them and support them: especially about the waste status, should facilitate the use of waste</td>
<td>- pedagogy</td>
</tr>
<tr>
<td>- role of ADEME: has financed the facilitator job during 3 years</td>
<td>- target circle zones first before seeking a national scale</td>
</tr>
<tr>
<td></td>
<td>- fundamental role of the facilitator that needs to be sustained</td>
</tr>
</tbody>
</table>

**Assessment of IS for SMEs**

- SMEs are harder to mobilize on the territory compared to big firms that have more time/resources
- Once the synergy is implemented, low risks to see a project fail due to the departure of an involved actor
- the project has been launched only 2 and a half years ago so it’s too soon to draw conclusions and assessments about it