

Strategic niche management for industrial ecosystems: A cross case study on management of synergy based initiatives in Catalonia and Basque Country

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1. Introduction

Industrial production is a crucial human activity especially since industrial revolution and it has been the centre of many academic and policy discourses and discussions. Undoubtedly, sustainability has found a central place in majority of these arguments of the related literature as it has been turned into an imperative to fight against the economic, environmental and social problems in tandem, and to create a more equal and better quality of living standards for today's and future's generations, ever since the concept was first coined in 1972 at Stockholm UN Conference on Sustainable Development. In the meantime, especially at regional and local scales, for achievability purposes, sustainable industrial production initiatives have found a strong emphasis (Gibbs, et al., 2005) from academicians, policy-makers and practitioners.

Subsequently, this study holds an interest in an analysis on integration of industrial production and sustainable development. Such a study may focus on individual industrial firms, collaborations among industrial actors, related institutions, regulations, etc. in an industrial sector or multiple sectors, depending on the specific research interests. In order to have a holistic picture of industrial production and sustainability bricolage, this research takes a *system perspective* and focuses on sustainable development initiatives aiming at transitions to more sustainable forms of industrial production at the system level.

A recent interdisciplinary research field called 'sustainability transitions' provide middle and high level theoretical frameworks to analyse underlying factors for the emergence of new modes of industrial production (Truffer & Coenen, 2012) to achieve such systemic transitions. The field has been developed by scholars from the field of innovation studies (Kemp, et al., 1998; Geels, 2002; Geels, 2004; Schot & Geels, 2008; Smith, 2004; Smith & Raven, 2012; Hekkert, et al., 2007; Markard & Truffer, 2008; Markard, et al., 2012; Truffer & Coenen, 2012) with a general view that systemic and radical improvements have to be realised given the important risks associated with ongoing environmental challenges instead of incremental developments. The interest is on transitions to new socio-technical systems (Truffer & Coenen, 2012), conceptualised as major sustainable changes in technological, organisational and institutional terms under influence of broad range of actors (Farla, et al., 2012).

Thinking more specifically about the emphasis of analysis, this research stresses sustainable transitions for *local industrial production systems* (LIPS). Local level has been chosen for the practicability and operability concerns. This is due to the reason that larger scale industrial production systems can be too complex due to surrounding social, economic, institutional and geographical factors (Lombardi, 2003) and this can make it challenging to have a good quality research.

LIPS are defined, in this research, as systems of industrial production firms (Lombardi, 2003) which are *geographically agglomerated* (Ellison, et al., 2010), in other words composed of clustering of individual industrial organizations (Geng & Hengxin, 2009), working under conventional production methods with linear processes (McManus & Gibbs, 2008). As the idea behind developing industrial agglomerations has been passing through different stages in time, facing new academic debates and changing through the time, the concepts of industrial district, industrial cluster and industrial parks have been used interchangeably (Cote & Cohen-Rosenthal, 1998; Vidova, 2010) referring to LIPS in literature.

LIPS are "perceived as an integral part of regional development strategies of many countries worldwide" (Singhal & Kapur, 2002). The main dynamics behind the decision-making for LIPS development are most of the time related to economical and competitiveness gains for regions and locales. LIPS are real, they are high in numbers, they are distributed all around the world and as specific to Europe they are still seen as important tool and facilities of economic development (UNIDO, 2012; UNIDO, 2014; Vidova, 2010). Furthermore, European Union gives special attention to them, to enhance innovation, research and development activities, and competitive clusters and networks (Ablonczy-Mihalyka & Keckkes, 2015). This is because LIPS, if managed properly, "can mobilise local assets, talent pools, leverage the history and culture of a region and become kernels of growth and innovation" (UNIDO, 2014). Having this high potential for driving innovation, creating new markets and enhancing development, however, LIPS, as stated before, have not paid enough attention to environmental and societal pillars of sustainable development.

With increasing awareness on sustainability concerns, the environmental impacts from a concentration of large number of industries in LIPS have started to be discussed as they can pose a serious threat to regional, national and global sustainable development. The possible negative impacts can be listed as inefficient resource use, use of non-renewable energy sources, contaminated soil and lost future land use, disposal of solid wastes, local nuisances such as noise, exposure to toxic chemicals, risks from hazardous waste, marine pollution, fresh water pollution, air pollution, habitat degradation, ozone depleting and greenhouse gases, and landscape disturbance (Singhal & Kapur, 2002). Considering these threats having negative effect on planet, society and economy, there is a need to address these challenges (UNIDO, 2012). There is a need to transform “the way we think about industrial land uses, for industry to change their industrial processes to reduce waste, make industry fit the environment instead of changing the environment to fit the industry” (Carr, 1998) and the transition to more socio-ecologically balanced industrial systems can result in numerous economic benefits, such as reductions in the resource inputs costs in production, reductions in waste management costs and from the generation of additional income due to higher values of by-product and waste streams, improved relationships with external parties, development of a green image, new products and new markets, etc. (Mirata & Emtairah, 2005).

This research focuses on local and regional level transitional sustainable development initiatives, having an assumption that sustainable LIPS can be significantly realised through physical (resources, materials, water, energy, infrastructure and natural habitat) and/or non-physical (information, knowledge, expertise, management) exchanges between industrial actors of LIPS. This assumption specifies the system perspective mentioned above to be ‘*industrial ecosystems*’ (Adamides & Mouzakitis, 2009) based on synergies through symbiotic relationships between and shared visions of industrial system actors. Then, *industrial ecosystem initiatives* which may lead to sustainability systemic transitions are objects of this research. Initiatives in this study refer to any kind of experiment in a form of project, research, task, mission, etc. which has been initiated and may have been completed with an objective serving for industrial ecosystem development in the concerned region.

In this respect, the research contributes to sustainability transitions literature which has only few studies elaborating on industrial ecosystems (Baas & Huisingh, 2008; Adamides & Mouzakitis, 2009; Gibbs, 2009; Rotmans & Loorbach, 2009; Verguts, et al., 2016).

The nature, techniques, practices, logic, forms and dynamics of such physical and more rarely non-physical exchanges have been widely investigated under ‘industrial ecology’ and ‘industrial symbiosis’ literature (Carr, 1998; Erkman, 1997; Cote & Hall, 1995; Korhonen, 2001; Lowe, et al., 1995; Chertow, 2000; Baas & Boons, 2004; Chertow, 2007; Deutz & Gibbs, 2008; Gibbs, et al., 2005) (Chertow & Ehrenfeld, 2012; Lombardi & Laybourn, 2012; Deutz & Ioppolo, 2015) in the last three decades and recently ‘circular economy’

has received wide attention (Yuan, et al., 2006; Geng & Doberstein, 2008; Mathews & Tan, 2011; Geng, et al., 2012). These literatures have analysed various cases distributed over wide geographies. A considerable amount of this research project draws upon this literature, but not exclusively limited to its general implicit assumption on industrial symbiosis’ ability to bring incremental improvements. Rather this research, holding an essential spatial perspective considering different regional characteristics, is interested in potential systemic nature of industrial symbiosis/ecology to drive for systemic transitions of industrial production systems together with other possible systemic initiatives having similar purposes based on symbiotic relationships between industrial actors. In other words, this research underlines the synergies as forms of systemic innovation (Machiba, 2010; Lombardi & Laybourn, 2012) to bring transitions at the industrial production systems. Thus it forms a linkage of industrial ecology and symbiosis to innovation research and vice versa. Considering the regional context specific to the geographies included in this study, the focus is on a collection of initiatives for the region. Furthermore, it is important to note here that this research, differently from the majority of industrial symbiosis literature, holds an approach that underlines “complex co-evolution of the social and technical” (Gibbs 2009) aspects of such synergies to avoid the general emphasis on potential technical improvements provided in usual work on industrial symbiosis (Gibbs, 2009; Truffer & Coenen, 2012; Smith, et al., 2010) and instead to consider technical as well as institutional and organisational aspects.

Following these, the overarching goal of this research is to understand how industrial ecosystem initiatives for LIPS can unfold and sustain through different spaces. Among many other optional sustainable industrial system initiatives, this research emphasises only the ones aiming at synergies between industrial actors, i.e. industrial ecosystem initiatives, and approaches to these synergies as form of systemic innovation as also suggested by Adamides and Mouzakitis (2009), Machiba (2010) and OECD (2010). Specifically this research elaborates on how management of industrial ecosystem initiatives for LIPS change at different regions.

2. Analytical framework

As the research more aims at better understanding through investigation rather than establishing the truths, an *abductive approach* is employed for the research design. In order to overcome some disadvantages of *inductive approach*, i.e. assumption of general validity of observations concluded from number of cases, and *deductive approach*, i.e. lack of underlying patterns and tendencies, abductive approach has been chosen as it holds some characteristics of both induction and deduction adding some new specific elements (Alvesson and Skoldberg 2009). It focuses on underlying patterns by well-developing the empirical area of application and *refining the theory* specific to the context (Alvesson and Skoldberg 2009). Abduction, alternating between induction and deduction, for this research refers to analysing empirical facts “combining them with studies

of previous theory in the literature; not as a mechanical application on single cases but as a source of inspiration for the discovery of patterns that bring understanding” (Alvesson & Skoldberg, 2009).

Considering the focus of this research project, which is on industrial ecosystem initiatives which may lead to systemic sustainability transitions for LIPS, analytical frameworks of sustainability transitions research line can provide proper grounds for such a study. Yet, this research differs from the related mainstream studies in terms of its focus. Taking a fairly challenging position to this field which is in favour of mainly radical innovations, this research is also generous to incremental innovations which may be brought by industrial ecosystem initiatives, as “sometimes part of, or even a prerequisite, for more systemic changes” (OECD 2010). Incremental innovations can be of particular importance for industry, policy-makers and researchers for a long-term transition towards sustainability (Doranova, et al., 2012; Joller, 2012; OECD, 2009), because “the cumulative effect of incremental innovations on the technological systems into which they are introduced can often be very radical” (Doranova, et al. 2012). A systemic change through industrial ecosystem initiatives may come true through accumulation of incremental and radical innovations for synergies between various industrial actors including both incumbents and new players from different sectors. Yet, studies from sustainability transitions field generally focus on transitions of single specific industrial sectoral systems, composed of industrial actors, institutions, regulations, technology, culture, etc., through radical innovations which are led commonly by new actors playing in niches surviving and surpassing incumbent actors. However, this research’s focus does not focus on transition of single industrial sector, rather it concerns a transition covering wide range of industrial actors from different sectors covering both incumbents and new industrial actors. Because, industrial ecosystem initiatives target not only new comers but mostly the incumbents.

Among the salient theoretical frameworks of sustainability transitions literature, which are : *the socio-technical (ST) systems approach* with a *multi-level perspective (MLP)* (Geels, 2002; Rip & Kemp, 1998), *technological innovation systems (TIS)* approach (Bergek, et al., 2008; Hekkert, et al., 2007) and *strategic niche management (SNM)* approach (Schot & Geels, 2008; Smith, 2004; Smith & Raven, 2012), SNM has been chosen because the objects of this research are industrial ecosystem initiatives rather than the transitions themselves which are studied deeply through MLP and TIS.

SNM has been prominent for analysing niche experiments as a strategy for policy driven regime transition (Kemp, et al., 1998). The core assumption of SNM is that “sustainable innovation journeys can be facilitated by modulating of technological niches” (Schot & Geels, 2008), whereas niches are the locus of innovations at micro-level acting as incubation rooms for novelties and providing locations for learning processes (Geels, 2004). The contextual factors, i.e. preconditions and external environment provided by regional social and material structures, which play a significant role on

the success and failure of the niches, are of primary importance in SNM (Adamides & Mouzakitis, 2009).

These contextual processes bring us to very recent question in sustainability transitions field: “why and how change occurs in socio-technical systems, and why it occurs in some places and not in others” (Raven, et al., 2012). Recently scholars in the field emphasise on looking at if and how spatial contexts matter for sustainability transitions and analysing socio-technical systems wherever they lead (Coenen & Truffer, 2012; Raven, et al., 2012; Truffer & Coenen, 2012), because transitions happen not only in time but at space as well. There is a clear need to consider spatial perspective for elaborating on niche development. This research intends to have this spatial perspective. Consequently, SNM would help to emphasize the underlying regional differences leading to more impactful industrial ecosystem initiatives. Moreover, it can provide some clues or ways of looking at how industrial ecosystem initiatives may deliver instruments for a socio-technical change at industrial systems level. Drawing upon SNM may extend the research’s interpretations on industrial ecosystem initiatives under modulating effect of regional context and may enlarge the vision of the industrial ecology and symbiosis research by letting the research root in SNM analytical frame, which has not been widely used except some studies (Baas & Huisingh, 2008; Adamides & Mouzakitis, 2009; Gibbs, 2009; Rotmans & Loorbach, 2009; Verguts, et al., 2016).

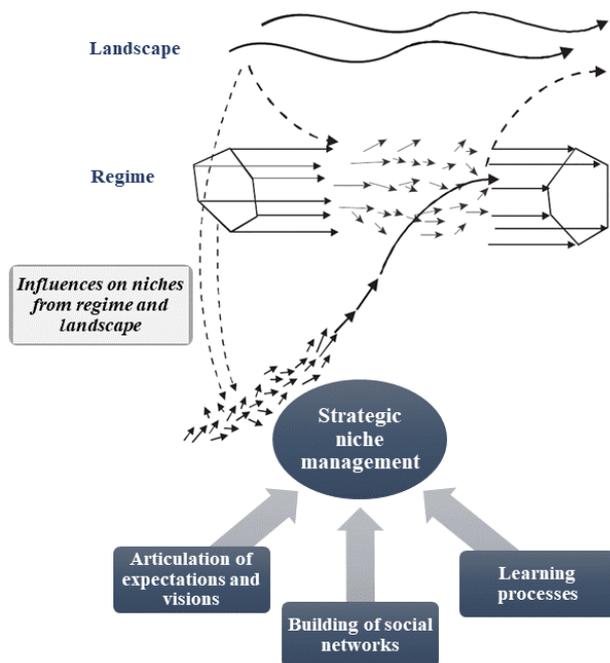
Considering operationalisation of the niche concept within this study we will focus on four processes for successful niche development: (i) articulation of expectations and visions; (ii) building of social networks; (iii) learning processes at multiple dimensions, following Schot & Geels (2008), and indirectly (iv) influence of the established regime and landscape as explanatory variable, following van der Laak, et al. (2007)

The first process, articulation of expectations and visions, is crucial for niche development because it provides the direction for development, brings attention from other actors, and creates the grounds through sharing common understandings for nurturing new experiments (van der Laak, et al., 2007), i.e. synergies between industrial actors. The second process is about building social networks to facilitate interactions between different actors of the system (Schot & Geels, 2008) and it is extremely important for initiatives based on not only non-physical but also physical exchanges such as industrial ecosystem initiatives. Learning process, which is the third process, cannot be detached from any successful innovation and it forms the tangible and intangible knowledge for stakeholders of any initiative.

Finally, the fourth process is the influence from regime and landscape. To explain briefly, regime and landscape concepts together with niches are rooted in MLP which enables studying the interaction between these three heuristic levels of socio-technical systems to understand sustainability transitions. *Landscape* relates to material and immaterial elements at the macro level, i.e. political culture and coalitions, social values, worldviews and paradigms, the macro economy, and the natural environment, etc. (Kemp, 2009), whereas *regime* is

conceptualisation of “semi-coherent” constellations of technological artefacts, infrastructures, regulations and user practices at meso-level (Geels, 2004), it “forms the ‘deep structure’ that accounts for the stability of an existing socio-technical system” (Geels, 2011) and it is the subject to transition (Suurs & Roelofs, 2014). However, getting into deep analysis of the regime and landscape is out of scope of this study. We will focus on the interactions of mainly the first three processes to evaluate various industrial ecosystem initiatives at different regions to elaborate further on spatial perspective of strategic niche management. Analytical framework with four processes is illustrated below at Figure 1.

Figure 1: Processes for successful strategic niche management



Author's own generation based on (Geels, 2011; Schot & Geels, 2008; van der Laak, et al., 2007)

3. Methodology

This research has a *qualitative nature*. This let the researcher “study things in their natural settings” (Denzin and Lincoln 2005) and “allows for ambiguity as regards to interpretive possibilities and let the researcher’s construction of what is explored become more visible” (Alvesson and Skoldberg 2009, 7). Case study research methodology will be used to answer the research question:

How do management of industrial ecosystem initiatives for LIPS change at different regions?

The main reason behind choosing case study method is that it provides proper ground for constructing “context-dependent knowledge” (Flyvbjerg, 2006) which very much relates to the research design of this project looking for knowledge to raise understanding through a scale and space rendered perspective. A research on industrial ecosystems needs an analysis of complex ‘reality’ which can be ‘handled’ by a modest way of reflexive interpretation (Alvesson and Skoldberg 2009) where the focus is not “to summarise and generalise” cases, but

instead creating “narratives in their entirety” (Flyvbjerg, 2006). Furthermore asking “how” questions on industrial ecosystem initiatives and industrial production systems, which are very context dependent contemporary events and realities over which a researcher has no control makes case study a proper methodology (Yin, 2014) for the research study.

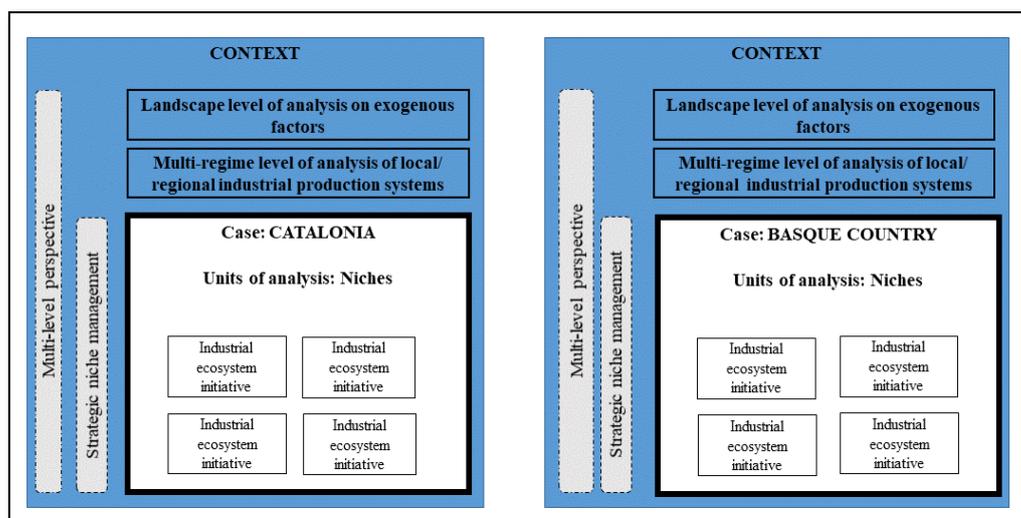
3.1. Case selection and unit of analysis

The empirical setting of this research study is in Spain considering regional scale industrial ecosystem initiatives at two regions: Catalonia and Basque Country. Spain has been considered as the setting for this study due to its diverse social and technical industrial production routines distributed over various regions within the country. Particularly, agglomerated industrial production systems, which can be found under different terminologies such as ‘industrial parks’, ‘industrial districts’, ‘industrial clusters’, ‘industrial polygons’ etc., have been practiced widely. Within this research study, these different terms are assigned to have the same definition as ‘systems of industrial production firms’ (Lombardi 2003) which are geographically agglomerated (Ellison, Glaeser and Kerr 2010) and named under umbrella name LIPS.

Catalonia and Basque Country as regions have been chosen because they are the two most industrialised regions in Spain since the industrial revolution. In both regions, it is observed that there is a regional awareness on industrial ecosystems focusing on LIPS relatively dependent on ‘geographic proximity’ targeting inter-firm synergies. Further considering the research question focusing on regional differences and their impact on emergence and management of the industrial ecosystem initiatives, both regions although being the most advanced ones in terms of industrial development and having an industrial structure of LIPS, differ from each other in terms language, culture, social structure, values, and regional governance. Therefore, these two cases can reflect how two different regions in the same country could manage the development of transitional initiatives in different ways.

As for case design, it has been decided to choose a multiple embedded case study design with two cases, i.e. Catalonia and Basque Country and multiple units of analysis, i.e. various industrial ecosystem initiatives addressing transitions of LIPS into industrial ecosystems and then to “draw a single set of cross-case conclusions” (Yin, 2014). This research study draws upon mainly SNM analytical framework while interpreting the emergence and management of initiatives as niche level with respect to regional visions, actor networks and learning processes. MLP framework is also partly used to analyse the regime and landscape level analysis as the surrounding context having influence on the industrial ecosystem initiatives (see below Figure 2).

Figure 2: Case study design



3.2. Data and insight gathering and construction

Data gathering and constructing level of the case studies is the step where observations to create images of empirical phenomenon, and low degree preliminary interpretations are embedded. As for the *triangulation* of the data and insights, two different sources of empirical material have been planned (see below Table 1). Firstly, secondary data including books, comprehensive sector reports from industry associations and governments and scientific articles on industrial development in Catalonia and Basque Country have been main source to trace the important industrial developments in both regions.

Furthermore, semi-structured interviews with the important actors from the regions have been conducted. As for the identification of the interviewees we used snowball method and started with few well-known experts in both regions and identified other interviewees through these people.

Table 1: Sources of data and insights

Source of Evidence	
Documentation	Formal studies, evaluations, articles appearing in mass media or in community newspapers, comprehensive sector reports from industry associations and governments and scientific articles, books, book chapters on industrial development and specifically industrial ecosystem development in Spain.
Interviews	Semi-structured interviews with important actors from Catalonia and Basque Country

Currently, eight interviews in total have already been conducted with nine key informants from Catalonia and Basque Country, who are listed in Table 2 below.

It is important to note here that during the interviews ‘industrial symbiosis’ terminology has been used instead of ‘industrial ecosystem’ because related actors are more

familiar with this terminology. Data and insight saturation has not been reached yet and we keep on identifying more experts. Once the saturation will be achieved, the number of industrial ecosystem initiatives, i.e. niche experiments, from each region will have been identified as well.

All interviews have been recorded and transcribed considering qualitative data coding for data treatment. The assumption at this stage is that the empirical material collected from document and interview informants, i.e. ‘data’, “are regarded not as ‘raw’ but as a construction of empirical conditions” (Alvesson & Skoldberg, 2009). In other words, the data to be collected is the interpretations constructed by the interviewees and the documents’ authors. Therefore, it is not just data but also insight gathering. The terminology ‘insight’ together with data facilitates to reflect on non-existence of raw data.

Table 2: List of informants

Region	Organisation name	Position of the informant
Catalonia	<i>Government of Catalonia.</i> Secretariat for Housing and Urban Improvement. Department of Governance, Public Administrations and Housing	Chief Officer of European Programmes Director of ‘ <i>ECOSIND Project</i> ’
Catalonia	<i>Simbiosy</i> , a private key player for industrial symbiosis in Catalonia linking municipalities, LIPS and other industrial actors	Founder and Director of the company Manager and coordinator of various industrial ecosystem initiatives in Catalonia including ‘ <i>Manresa en simbiosis</i> ’
Catalonia	<i>Eduard Balcells Architecture, a private architecture company</i>	Director of the company and principal architect of an industrial ecosystem initiative, ‘ <i>The new urban fabric: Torrent</i> ’

<i>Estadella Eco-Industrial Park'</i>		
Catalonia	<i>Universidad Autonoma de Barcelona, The Institute of Environmental Science and Technology</i>	Head researcher of the research group on sustainability and environmental protection (SosteniPrA, SGR) and expert on industrial ecology. Expert in <i>'ECOSIND Project'</i>
Catalonia	<i>Universidad de Guanajuato</i>	Professor at Universitat Politècnica de Catalunya from 1991 till 2008 Co-creator and member of XEI- Industrial Ecology Circle Expert in <i>'ECOSIND Project'</i>
Basque Country	<i>Sprilur</i> , public company of infrastructure Area of the SPRI Group of the Department of Industry, Innovation, Commerce and Tourism of the Basque Government, a public key player in collaboration with Regional Governments, municipal councils and other public and private players, sharing resources	General Director of Sprilur Coordinator of <i>'MITKE Project'</i>
Basque Country	<i>Sprilur</i>	Director of Strategy in Sprilur Coordinator of <i>'MITKE Project'</i>
Basque Country	<i>Sprilur</i>	Project Manager in Sprilur Expert in <i>'MITKE Project'</i>
Basque Country	<i>IHOBE</i> , public agency of environment, under Department of the Environment, Territorial Planning and Housing of the Basque Government	Project Coordinator at Business and Environment Department, in continuous collaboration with Sprilur and other important actors in Basque Country

3.3. Data and insight analysis through reflexive interpretation

The collected data and insights are analysed qualitatively through data coding and content analysis. Interpretation is our main tool through coding and analysis. Major determinants of the interpretation are pre-understanding of the phenomenon under investigation; determinant characteristics of language to be used for writing; and finally the awareness of the theoretical assumptions of the analytical framework and the research. An important note here is to state that analysis and interpretation of the research data is an interpretation of interpretation in the end. Thus, being self-critical on one's own interpretations of empirical material, which are based on

others' interpretations, is one of the intents of this research.

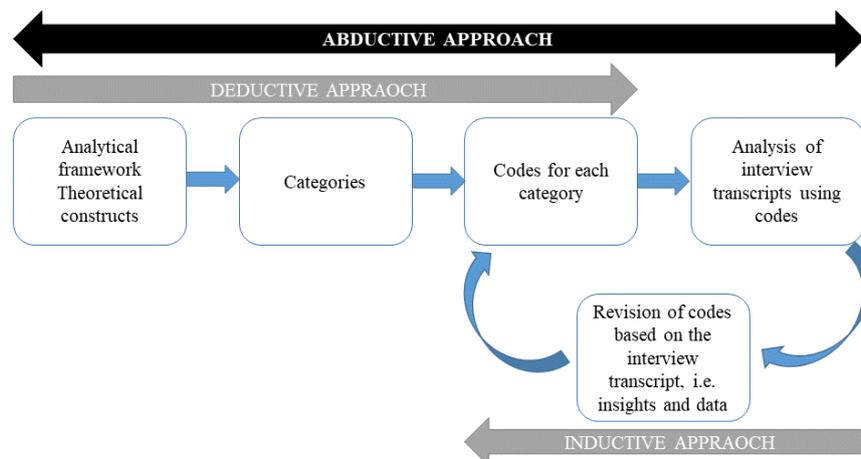
In a little bit more in detail, interpretation of interpretation, basically consists of two levels of interpretation, i.e. (i) data and insight gathering and constructing level and (ii) interpretation level, and may sound as 'double-hermeneutics', as also suggested by Giddens (1976). Reflexive interpretation, as coined by Alvesson and Skoldberg (2009), suggests to have the third and fourth levels to interpretation, which are (iii) ideologically critical interpretation level and (iv) self-critical and linguistic reflection level with critical and postmodernist flavours respectively. Correspondingly we are not in favour of any abstract framework claimed to offer 'a privileged understanding' of the research object. Yet, SNM and MLP here just provide the grounds of interpretation which is later tailored through the gathered insights. In other words, recognising the trick "which is to control theories (interpretive possibilities), without letting them control you" (Alvesson and Skoldberg 2009, 274) is the key element to consider and abductive approach helps us to do so.

In more practical terms, once the data and insights are gathered, individual case reports will be drafted as a result of data coding and content analysis gliding through the interpretation levels described above for both cases. Having each case report and following the multiple case study procedure described by Yin (2014, p. 86) cross case discussion and conclusions will be expounded over related cases and these further tailor the theory under both sustainability transitions and industrial ecosystems literatures making contributions to both research fields.

For this paper one interview from each case was transcribed and coded. Before starting coding we identified categories and codes based on the theoretical constructs in the analytical framework we proposed before data collection thus we relied on theoretical propositions in a deductive way. Yet, for further identifying the codes, we also draw upon the gathered data and insights inductively (see Figure 3). Thus, following an abductive approach, the categories and codes are based on the theory and the gathered data and insights. The same coding procedure will be applied to rest of the interviews for both cases.

Once the categories and codes were identified and reflected on transcribed interviews, to answer our 'how' research questions, we used analytic technique of '*explanation building*' which is a type of pattern matching used to analyse each case by building explanations (Yin, 2014). In more detail, although we conducted '*cross-case synthesis*' for explaining how management of initiatives change at two regions, initially we treated each case as a separate study through explanation building on how industrial ecosystem initiatives are managed in this region drawing upon SNM analytical tool.

Figure 3: Abductive approach for identification of codes and analysis of interviews



3.4. Research validity: Trustworthiness, transferability and dependability

Following Yin (2014) for the sake of *'construct validity'*, all empirical evidence collected from multiple sources are kept for future references and the researcher aims to conduct interviews with multiple actors and provide key interviewees a case report draft for review in order to increase the trustworthiness through minimising the possible mis-interpretations.

Subsequently, as for *'internal validity'*, gathered data and insights have been qualitatively coded using pattern matching in a coherent logic. This research, recognising and ensuring construct and internal validity, gets one step further and closer to Guba and Lincoln's (1994) *'trustworthiness'* approach, which implicitly covers both construct and internal validity issues. Respectively, the research recognises the impossibility of 'researcher perspective free' research itself. To address this problematic actuality, couple of actions have been taken. To begin with, as the basis of data and insight gathering is language-based interaction, a 'free-dialogue' ground has been maintained during the semi-structured interviews. In other words, both interviewer and interviewee have been free to exit from the interaction in case of a perception on misleading or manipulation coming from the other party. In the end all statements should "reflect honesty and sincerity" (Alvesson and Skoldberg 2009, 152). Another way increasing trustworthiness of the research w

Regarding *'external validity'*, which is related to generalisability of the research results, the research stands at a fair distance to this traditional understanding. Because its aim is to generate new knowledge and insights to understand some cases instead of constructing 'truths' which are applicable to all other industrial ecosystem initiatives. However, agreeing with Flyvbjerg (2006) this research follows the claim "that knowledge cannot be formally generalized does not mean that it cannot enter into the collective process of knowledge accumulation in a given field or in a society". From another yet similar perspective Yin (2014) states that

analytical generalisations should be the aim of case study research. Still avoiding the generalisation term and therefore partly agreeing with Yin, this research uses theories in multiple case studies with a replication logic while describing the context and the central assumptions of the research. It is worth to state that the results of this research may (and hopefully) influence other researchers in the field to transfer results of this research to design their studies in a similar manner using similar perspectives and considering similar. Then maybe *'transferability'* terms as suggested also by Guba and Lincoln (1994) would be a better substitute for 'external validity' for this research.

Finally traditional understanding of *'reliability'* which refers to replicability or repeatability of the research with the same results is not considered in this research because this is not possible. Basically we cannot analyse the same thing twice and get the same results because we are analysing two different things. Instead of 'reliability', this research intends to use *'dependability'*, which refers to constantly changing fluid context within which the research occurs. MLP and SNM as analytical tools provide the grounds for considering this liquid context both in terms of their focus on time and space and also their philosophical backgrounds rooted in social constructivist accounts.

4. SNM of industrial ecosystem initiatives in Catalonia

Catalonia is an autonomous region in Spain and it has a long industrial tradition since Middle Ages. It was one the early adopters of British industrialisation model in the nineteenth century. Manufacturing sector has been one of the most employing sectors in the region, i.e. in 1860 when 21% of the total Catalan workforce, in 1930 when 47% of the Catalan workforce, and in 2014, despite of the general de-industrialisation trend and global crisis, when 18.4 % of the Catalan workforce was employed by the manufacturing industry (Domenech & Ramos, 2016).

LIPS has been the most salient form of developing industrial areas and the economic reality of the region

especially since 1980s. Industrial activity in general represents almost 20% of GDP in the region. Thinking more specifically in LIPS, there are more than 40 LIPS including almost 9.000 industrial establishments generating turnover more than 45 billion Euros contributing to estimated 10% of the region's GDP. These LIPS are specialised in various industries which can be listed as: food and drink; textile, clothing and leather; wood, furniture and cork; paper, publishing and graphic-arts; chemicals; plastics; metallurgy and metal products; machinery and mechanical equipment; electrical and electric equipment; and transportation equipment (Hernández, et al., 2005). This richness of geographically agglomerated industries and diversity in them provides a proper background for potential synergies between industrial actors which may create industrial ecosystems composed of these LIPS.

Since the beginning of 2000s the region has been more aware of industrial ecology, industrial symbiosis, and circular economy and has various related initiatives in policy, practice and academic level. One may easily mention variety of actors, promoters of physical and non-physical exchanges between industrial actors, distributed over the region. In this case study we focus on specific regional initiatives and analyse them to picture each case through interpretations of insights from different actors involved in various initiatives in the region.

Maybe as one of the most important actors, Government of Catalonia, has recently taken important actions towards industrial ecosystem initiatives together with its fundamental economic and environmental agencies, (ACCIÓ, Catalan Waste Agency, Catalan Water Agency and Catalan Institute of Energy). In 2015 it became a member of Circular Economy 100, which is an innovation programme initiated by Ellen Macarthur Foundation to enable circular economy practices of members through capacity building, knowledge sharing, networking and collaboration. Furthermore, the approval of the Strategy for Smart Specialization of Catalonia (RIS3CAT) in February 2014 and development of General Waste and Resource Management and Prevention Programme 2013- 2020 with a circular economy approach by the Government stand as important milestones to serve for destabilisation of the LIPS regime and promotion of more industrial ecosystem initiatives, i.e. niches. Although circular economy is like an umbrella and more economic term, as it involves industrial ecosystem principles inside, these kind of institutional steps towards policy and regulation building trigger industrial ecosystem initiatives under more favourable conditions.

In the region industrial ecology and industrial symbiosis started to be discussed through the end 1990s at the academic level with efforts of some professors at Universitat Autònoma de Barcelona (UAB) and Universitat Politècnica de Catalunya (UPC). Consequently, first few initiatives were taken by academy in collaboration with related public agencies.

Please note that only 'ECOSIND' project, which is analysed below, is considered within the paper because only its related interview was coded and interpreted.

'ECOSIND' was one of these few initiatives starting in year 2003 and finishing in a year with funding support from Interreg Programme of European Commission, which was developed as a Community Initiative covering exclusively cross-border transnational and interregional cooperation. ECOSIND was initiated by a Consortium coordinated by Ministry of Environment of Government of Catalonia. The motive behind the initiative was very much created by the *landscape pressure* from **regional policies and regulations** forming Agenda 21 for Catalonia, which was a strategy for regional sustainable development. In line with the expectations created by Agenda 21, the *vision* the ECOSIND initiative was very clear and the *expectations* were positive and high in the beginning: fostering sustainable development of local industrial systems to establish a basis for a new strategy focusing on industrial symbiosis not only for Catalonia but also for other partner regions which were Regional Protection Agency of Environment of Tuscany (Italy), Abruzzo Region (Italy) and Peloponnese Region (Greece). The *motivation and expectation* was to achieve this objective through *collaboration and co-learning* based on industrial ecosystem experiences already existing and to be created in these four regions. Yet, during implementation period, some variations on this **common-ground expectations** appeared and it became difficult to mention a **common vision and common expectations** among partners.

More specifically for Catalonia, as the project was run by Ministry of Environment, even it was challenging to create a common understanding of expected results from the project within the Ministry due to **lack of organisation and experience of region** in similar initiatives. Nonetheless, the initiative helped the regional actors to bring some experience from especially Italian partners which had already been active in industrial symbiosis and developed more experience through the projects funded under this initiative. For Catalan Ministry the project served more for bringing *awareness and expectations* for upcoming industrial ecosystem initiatives, yet with *a blurred vision* because of not having required resources, i.e. time, human resources, funding, motivation to go one step further. One important barrier, and maybe common with many initiatives, was lack of monitoring and follow-up activities which may keep alive the expectations and puts one more brick on creating a common vision. Unfortunately, they generally are not considered during resource allocation of projects initiated by formal institutions under funding of international, national or regional intermediary organisations.

In terms of *networking*, the initiative due its very nature of being a consortium already created a cross-national network between regions in Spain, Italy and Greece. Each partner bringing different backgrounds and experiences was the essential part of *diversity in the network*. More specifically for Catalonia, a **regional initiative based network** was also formed by including: various regional formal and informal institutions, such as Unió de Polígons Industrials de Catalunya (UPIC), Institut Català del Sòl (Incasol); and regional industrial actors especially the LIPS in the region. Yet, it was not a formal network but instead a loose one based on *personal*

efforts of governmental officials involved in ECOSIND. Those officials were the main **learning facilitators** in the region who were not just facilitating the **knowledge dissemination** but also they were **gathering knowledge** through **interactions** with international partners of the initiative and **personal communications** with the **regional academic institutions**. The region luckily had and still have some **strong and insistent industrial ecosystem promoters** from especially UAB and UPC. On the other hand, the industry itself has not presented a solid interest in the meantime except an indirect and very passive involvement through UPIC which has a mission to reduce the environmental and economic costs of the LIPS by means of co-management of these industrial systems. Other means of involvement for the industry was direct application to calls opened under the ECOSIND initiative for realising industrial ecosystem practices. However, most of the accepted proposals were from Italian regions where industrial actors had already been practiced industrial symbiosis and formed a regional experience at both industry and institutional level. **Having shared experiences** with Italian partners, this **learning nurtured an expectation** to the Catalan Ministry: to gain the vision for potential initiatives in the future. This expectation was partly achieved as a result of the ECOSIND initiative. The institution realised that **collaboration with the industry** was key to achieve real experiments in terms of having exemplary cases in the region and **collaboration with other regional and international governmental agencies** facilitated only capacity building through knowledge sharing. Moreover, **choosing right partners** in such kind of initiatives was crucial to use the resources in a more effective way. Having a partner with almost no experience in industrial ecosystem or in general sustainable industrial development caused to lose time and human resources in this specific initiative. And on top of all the lesson learned by doing was to create **a common vision and expectation** among partners but more importantly within the institutions. The initiative coordinator explains this through his frustration and gained experience saying:

“If I start ECOSIND now, as public servant that I am, I would try to put on the same table all the Departments' responsables and start the project together... Now I know the methodology. First thing is to put all the Departments with the same vision and try to achieve a governance model, an organisation model in order to go all in the same direction considering their competences. This is the first step. Other step is to go to the private sector and also integrate industry in this policy. We have a lot of experience here in Catalonia combining private and public sector with the same idea and work together. We have experience in this. We have industrial policies, economic policies for all the sectors in Catalonia. We have experience on this. And we have frameworks to do this.”

In summary, we may **not mention a very effective strategic niche management** for this specific initiative, at least for the time it was planned and implemented. Nonetheless, it is easy to picture a **generated networking and learning processes which brought**

expectations and visions to regime players which then turn to be **niche actors** for the upcoming initiatives in the region.

5. SNM of industrial ecosystem initiatives in Basque Country

Basque Country, another autonomous region in Spain, is located at the northern part of the country with an economy strongly based on industry since the end of 19th century. The region has always fostered investment in industrial development and currently the industry contributed to almost 30% of GDP in the region.

Because of the relatively small and mountainous geography of the region, industrial establishments were designed and constructed in agglomerated patterns, which led to around 110 LIPS with around 9.500 establishments today in which manufacturing has been the core activity representing 85 of the industrial Gross Value Added (GVA) and played an important role in the Basque economy accounting for 20% of its total GVA (Magro, et al., 2016). These LIPS engage 18% of the total regional employed population and involve various industrial sectors as listed for Catalonia (Eustat, 2016).

As a small region which does not have chance to extend its development considering geographical limits, it has key players in academy, institutions and private sector which work for sustainable development of the region in order to keep what they have and improve it with the limited resources. In the recent years many sustainable development initiatives, based on potential synergies between these actors, emerged considering the accumulated industrial actors in the region.

Please note that only ‘MITKE’ project, which is analysed below, is considered within the paper because only its related interview was coded and interpreted.

Basque Government has an agency called Sprilur which is specialised in developing and supporting LIPS in the region. Sprilur works on various initiatives concerning sustainable development of LIPS in terms of planning new ones or retrofitting the existing ones. Sprilur, being both an important **regime player** and **promoter of niche experiments** in the region, takes actions considering the realities and potentials of the region considering not only environmental pillar but also social and on top of these economic pillar. They give importance to competitiveness as much as environmental problems.

In 2008 Sprilur initiated an initiative called ‘MITKE’ under Interreg Programme like ECOSIND. The initiative lasted for 3 years with 11 partners with experience in managing business areas and industrial parks, being 6 of them regional development agencies, 4 business networks and land developers and 1 research centre from Catalonia, and regions of Hungary, Poland, Romania, Italy, United Kingdom, and Ireland. The philosophy of MITKE was the retrofitting existing business and industrial areas and transforming them into sustainable spaces. Synergies between industrial actors was considered as one of realising industrial ecosystems together with other ways like co-management of LIPS. By the nature of the project a **cross-national networking** was achieved with a relatively rich diversity coming

from academy, public agencies and the industry itself. **Learning based on the best practices of partner regions through a pan-European platform** was one of the main outcomes of the project. MITKE has served like **a platform and provided mechanisms for collection, exchange and transfer of knowledge** through the network created. In region specific terms, the initiative helped Sprilur to improve the related **regional policies on sustainable LIPS development** stressing more the **synergy development between industrial actors as well as between regional formal and informal institutions**.

Although it was a crowded consortium with 11 partners, expectations were high and positive since the beginning of the initiative and common-ground for a shared vision was accomplished due to priorities of the project, which were based on learning through knowledge sharing. In the meantime of the implementation, through various knowledge gathering and dissemination tools created by the initiative, **a tailored vision** was engaged by each partner considering benchmark experiments at other regions. In other words visions were developed through **knowledge sharing and co-creation**. Sprilur, as the lead partner, did the same for Basque Country considering **region's own experiences and realities**.

Regional stakeholders from Basque Country also attended to **knowledge dissemination platforms** especially in testing methodologies developed within MITKE. This has improved the regional policies and nurtured other niche experiments to help LIPS better face the sustainability challenges posed by national and global economy. This learning process at institutional level led Sprilur to further develop some strategies, tools and initiatives in the upcoming years. For instance now they have the 'Basque Guidelines' for sustainable development for LIPS projects. It is a tool for the urban design which assesses the level of sustainability of the design, realization and the maintenance of a project of LIPS transformation. Ow Sprilur has a mission to transform old LIPS into more sustainable urban areas (Tarantini, et al., 2013; Loprieno, et al., 2013). The Vice-director of Sprilur explains the motive behind this tool stating:

"We have to change the existing norms. If we have to finance LIPS development, then we have to find ways to finance sustainable development... And now we want to share our will and our objectives."

Independent from the MITKE initiative, key actors in the region, i.e. public agencies and industrial associations, are very active in **networking** and thus **knowledge sharing**. This somehow has always been facilitated by the geographic limitations of the relatively small region. Through these networks they discuss **reflecting to international experiences** with which they have become familiar through various types of **cross-national networks** and then they come to **tailor-made solutions** for sustainable development of LIPS in the region. Still part of the interests of each party may not coincide with one another's and this makes it challenging to take a concrete action. Here comes the importance of the **shared visions and expectations**. MITKE was one piece

of the already existing networking but at the same time strengthened it.

To sum up, MITKE as an initiative was well-coordinated by the Basque partner, Sprilur, with respect to both its design and implementation. Especially considering **network building and learning practices**, we may mention a relatively **successful niche management**. Sprilur learned from MITKE partners to improve its strategies to develop more synergy-based initiatives in the region and retrofit the existing LIPS in a sustainable way. Yet, learning was not limited only at institutional level. Basque Country as a region had already had a networking and co-learning practices among its key players for sustainable industrial development. Having this, Sprilur became the learning facilitator in the region fostering knowledge sharing. This implies the importance of the existing regime actors with respect to their **visions and expectations** built through previous similar niche experiments as well as **regional social, economic and political culture** formed in years under pressure of the national and regional economic system and regional policies and regulations, i.e. the **landscape**.

6. Cross-analysis of experiences from two regions in Spain: How do they differ?

Although being in the same country, various differences in strategic niche management of industrial ecosystem initiatives between two regions, i.e. Catalonia and Basque Country, were revealed during the analysis and interpretation of the insights gathered from the regional actors.

Considering the specific initiatives analysed in this study, a more nurturing process could be mentioned for the case of Basque Country when compared to the initiative in Catalonia. MITKE as an initiative was not only better designed from the beginning but also implemented in a more effective way and resulted in more fruitful consequences for the region. It was also due to the already established networking and learning culture among industrial actors and institutions within Basque Country, which was lacking in Catalonia, considering the specific interests in creating industrial ecosystems out of LIPS existing in the regions which was the objective of ECOSIND initiative. Both regions had the same pressure from international and national landscape as for being in the same country. Yet, this was not the case for regional landscape pressures. As both regions are autonomous within Spain they have regional governments working with different principles.

Moreover, the key player in MITKE initiative, which was Sprilur was taking into account the regional realities more than Ministry of Environment of Catalonia, which was the leading actor of ECOSIND initiative. It is important to mention here the nature of initiatives in terms of how much radical changes they were proposing to the regional industrial development. Clearly, ECOSIND was braver in this respect because this initiative introduced a relatively new concept which was industrial ecology to the region where the target players,

LIPS, had not had any previous experience before. MITKE, on the other hand, held targets for more incremental improvements at the system level. Then the visions were considerably different and so the expectations.

Specifically related to *networking activities*, both initiatives having international partners created a knowledge sharing and creation platforms where they exchanged the experiences. However, the involved actors in Basque country had had already established other in-region platforms which they used also for the dissemination of the knowledge gained through MITKE. This was not the case for ECOSIND, because the Ministry had limitedly involved in related networks. *Learning* can be claimed to be achieved for both cases as both institutions interacted with international partners and experienced synergy based practices by doing and seeing. It is more likely to mention a second-order learning for Basque case because they have continued with similar initiatives after MITKE was finished. For ECOSIND, as the political and institutional structure has changed after ECOSIND, the knowledge gainers from ECOSIND was assigned to work at other unrelated departments or ministries. Thus, a second-order learning involving digestion and practicing of the knowledge gained is difficult to mention for ECOSIND initiative.

The differences in different internal processes serving for strategic niche management are summarised at Table 3.

Table 3: Regional differences

SNM process	Catalonia	Basque Country
Expectations and visions	Difficulty in having common visions and expectations among initiative partners. Aiming a new and relatively radical practice in the region has not helped to create expectations among other actors in the region.	Common grounds for creating common visions and expectations were available for initiative partners. Objectives of the project were likely to be accepted by other regional actors.
Building networks	Having international partners. Loose networks with other regional actors. Very limited involvement from industrial players.	Having international partners. Facilitating involvement of other regional stakeholders involving industrial and institutional players. Already existing networks facilitating co-creating of new networks.
Learning	First-order learning through knowledge sharing within the project. More difficult second-order learning especially by doing and experiencing in the region. Facilitation of knowledge transfer to other actors in the region for upcoming future similar initiatives,	Both first order and second order learning by the initiative leader through digestion and nurturing further knowledge for other actors in the regions.

SNM process	Catalonia	Basque Country
Influence from landscape and regime	A stronger resistance from actors in regime due to lack of previous experience and knowledge. Similar international and national landscape pressure. Regional landscape from Catalan Government.	Regional culture and previous experience more aligned with the content of the initiative. Similar international and national landscape pressure. Regional landscape from Basque Government.

7. Conclusion

In this study we have cross analysed two cases in terms of their difference in strategic niche management for industrial ecosystem initiatives. Using a case study methodology has provided proper grounds considering the need of insights of key players in this kind initiatives.

The results revealed that even two regions which are in the same country differ from each other due to their social, political, technical and economical cultures. That refers to the influence from regime and landscape of the LIPS socio-technical systems in the regions. Furthermore, referring to the core three internal processes of strategic niche management, which are related to expectations and visions, networks and learning processes, the actors in niches can vary from each other as well. Variations can be due to differences in the nature, objective, and implementation of the initiatives.

Considering the specific analytical framework used in this study, niche players have not been categorised widely in the literature which implies an assumption that niches generally are run by new players. However, this may not be the case always. Industrial ecosystem initiatives aiming at improvements in the existing system players needs engagement from the current regime players, especially institutions and incumbent industrial actors. This implies a need for further categorisation in niche actors framing in strategic niche management.

The study can be further extended by focusing on other research contexts similar to industrial ecosystem initiatives which aim transitions at various sectoral industrial systems through engagement of more necessarily the incumbent players.

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