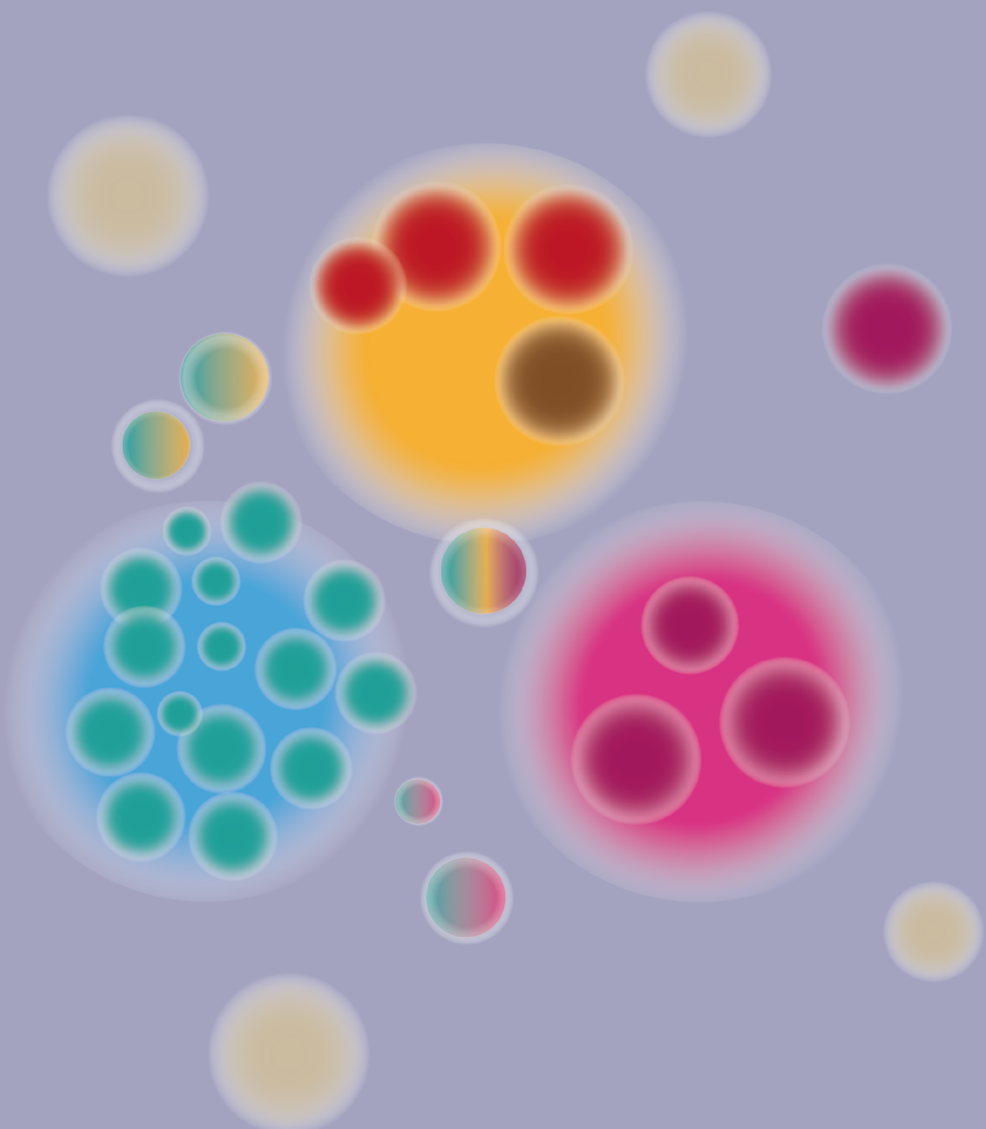
POLITECNICO
DI TORINO

Doctoral Dissertation
Doctoral Program in Management, Production and Design
32th Cycle

Systemic Design for local circular economies:

Designing ecosystems to boost systemic innovation in the manufacturing sector.

From the theoretical framework to the practical application.



By Chiara Battistoni

POLITECNICO DI TORINO

ScuDo
Scuola di Dottorato - Doctoral School
WHAT YOU ARE, TAKES YOU FAR

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Systemic Design for local circular economies: designing ecosystems to boost systemic innovation in the manufacturing sector

From the theoretical framework to the practical application.

By
Chiara Battistoni

—
Supervisor
Prof. Silvia Barbero

—
Doctoral Examination Committee
Prof. Ida Telalbasic (reviewer), Loughborough University London
Prof. Jennifer Siobhane Darzentas (reviewer), University of the Aegean

Politecnico di Torino
December, 2020

To me and my family

Declaration

I hereby declare that, the contents and organization of this dissertation constitute my own original work and does not compromise in any way the rights of third parties, including those relating to the security of personal data.

Chiara Battistoni
December, 2020

*This dissertation is presented in partial fulfillment of the requirements for **Ph.D. degree** in the Graduate School of Politecnico di Torino (ScuDo).

Aknowledgement

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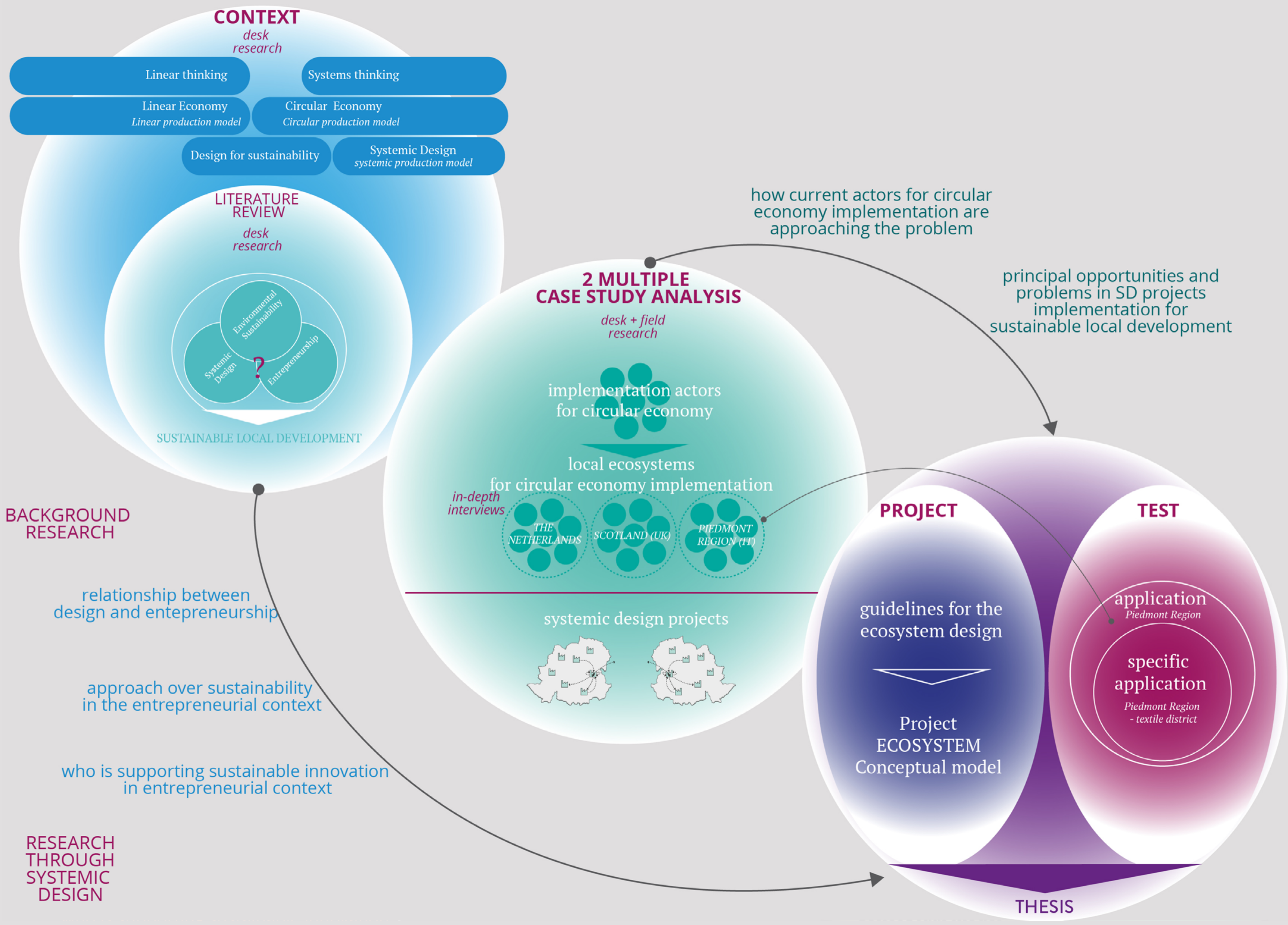
Last, but not the least, a special thank then goes to my family, which is the best!

Abstract

The current global environmental situation needs to be tackled now for its severe consequences on human and planet health. One of the causes identified by scholars is the 'take-make-dispose' model defined by the linear economy, which has affected the production and consumption processes. In this framework, also the design field is called into question for its responsibility in the decisions taken in the design phase of new products and production processes.
Nowadays, alternative economic models are emerging as the Circular Economy (CE) – the base of the European Union economic strategy (Deselnicu, Militaru, Deselnicu, Zăinescu, & Albu, 2018) – and the Blue Economy by Gunter Pauli (Pauli, 2010). However, they required a radical change, especially in the cultural paradigm. Indeed, to tackle the current complexity, holistic approaches are necessary to be put in action (Capra & Luisi, 2014). To meet the challenges for a sustainable future, also the manufacturing sector needs to reconsider its productions models, as it will face a revolution shortly, as stated by Garetti & Taisch (2012).
Systemic Design (SD), an "integrative interdiscipline" (Jones & Kijima, 2018, pg. ix), using the Systems Thinking into the design process and practice, applied in the manufacturing sector has demonstrated to be an approach able to create ecological design and sustainable production processes thanks to the creation of relationships between production processes. Moreover, a method to reach zero waste and a sustainable local development (Bistagnino, 2011; 2017). Also, instead of generating opportunities of innovation as the design discipline taken in general has demonstrated with many contributions - as Bertola & Teixeira (2003), Brown (2009), Celaschi & Deserti, (2007), Franzato & Celaschi (2017), ….. , - the application of SD in the manufacturing sector reveals the ability to create eco-opportunities and eco-innovation which can be exploited by the local entrepreneurial ecosystem. Despite the high value of these projects and the positive impact created at the local environmental level, SD projects implementation is difficult and complex, operating in a framework which implies many changes compared to the current one.
This PhD thesis fits precisely in this context and wants to fill this gap exploring the relationships between SD, environmental sustainability and innovation related to entrepreneurship. It was carried out to answer the following research question: "How SD projects can be implemented and supported by local context in order to boost CEs in Europe?". The goal is to understand the significant eco-entrepreneurial opportunities created by SD projects that can be caught by a new generation of entrepreneurs – the ecopreneurs (Santini, 2017; Gast, Gundolf, & Cesinger, 2017; Holt, 2011; Shaper, 2002) - to overcome the implementation barriers faced, to ease, foster and support their realisation for their important outcomes and positive impact to change the current environmental situation. After this definition, the final "product" designed is the 'best' ecosystem to ease, foster and support the SD opportunities implementation, which can boost local circular autopoietic economies and create a future sustainable local development, based on the quadruple helix model of innovation.
To provide an answer to the research question, first, a literature review was conducted on scientific contributions to understand the current context: from the economic model and the cultural paradigm, to how the manufacturing sector shaped this framework, and which is the role and impact of

design.
Furthermore, starting from the known relationships with design and environmental sustainability, the relationships between design, innovation dynamics and entrepreneurial context were analysed, to finally understand the environmental sustainability in the entrepreneurial context. The research moved on to the current actors working in innovative projects implementation, exploring the differences within large enterprises and SMEs, arriving to the business incubators phenomenon and to the concept of business and entrepreneurial ecosystem, and finally to the quadruple helix model of innovation.
Afterwards, two main multiple case studies analysis were performed.
The first analysis is on previous SD projects where the author was directly involved. With the analysis of the design process, the main enablers and barriers were extracted to understand the significant eco-entrepreneurial opportunities created by SD projects and the implementation barriers met. The second one was focused on understanding which are the actors that are currently working for the CE implementation of projects and new enterprises in Europe, which is the most similar concept to SD for goals and principles. The investigation was subsequently restricted to two European Regions which are defined forerunners in the CE implementation, Scotland and the Netherlands, understanding their main actors and how their local ecosystems were developed, thanks to in-depth interviews and field researches.
The lesson learnt from these two main analyses leads to defining the guidelines useful for the ecosystem design, identifying the main actors involved and the services needed to foster systemic innovation and the creation of interactions between them. This last step lays the foundations for the design of the theoretical model of an ecosystem able to foster systemic innovation with impact al local level and to create circular and sustainable development. In this design phase, first, the requirements for the ‘best’ ecosystem are identified, then the entity was designed: the theoretical model of the Local Systemic Network Booster (LSNB), which acts to facilitate the creation of the ecosystem as an anchor tenant identified in the literature review. Finally, the model is applied to a specific local context to test how it should be shaped in a concrete situation. It was chosen the Piedmont region in Italy, a well-known geographical context for the author, base of the Systemic Design research group and an area where, thanks to the RETRACE project, the local stakeholders were reasoning about the current situation of the local CE. This step has permitted to define how the LSNB should be created, based on the current context characteristics, the active actors and their configurations. This phase has explored the relationships that need to be activated between the components of the regional ecosystem, and which are the potential outcomes for a sustainable local development based on systemic eco innovation for the region. Moreover, due to the complexity and heterogeneity of the manufacturing sector in the region, the application phase was further framed to a specific sector, the textile one which represents an important industrial district for the Region in Biella area.
The result, at design level, is the definition of the theoretical model of the LSNB that can develop and foster SD projects implementation, interacting with the entire local ecosystem composed by the main elements of the quadruple helix model of innovation. Moreover, the application phase demonstrated that at the end also the ecosystem designed is a SD with problems in its implementation, however its creation in Piedmont Region is on the way because it has all the elements to start.
The results of the research phase demonstrated the needs to have the four fields of the innovation helix - university, industry, government and civil society - working together for the transition to a sustainable development of our territories.
This doctoral thesis can be considered a research through SD, from SD and for SD, which can contribute to the development of this discipline, especially in the line of research of “SD for territorial metabolism and flourishing economies”.

Fig. 0 - Graphic abstract of the thesis (next page)


CONTEXT
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Systems thinking
Linear Economy
Linear production model
Circular Economy
Circular production model
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ATECO Classification of Economic Activity (NACE)

BE Business Ecosystem

CE Circular Economy

CEH Circular Economy Hotspot

EC European Commission

EE Entrepreneurial Ecosystem

EU European Union

HD Holistic Diagnosis (see Systemic Design methodology)

IE Industrial Ecosystem

ISTAT Italian national institute of statistics

RETRACE –Interreg Europe project 2016-2020 'A Systemic Approach for Regions Transitioning towards a Circular Economy'

SD Systemic Design

SMEs Small and Medium Enterprises

ST Systemic Thinking

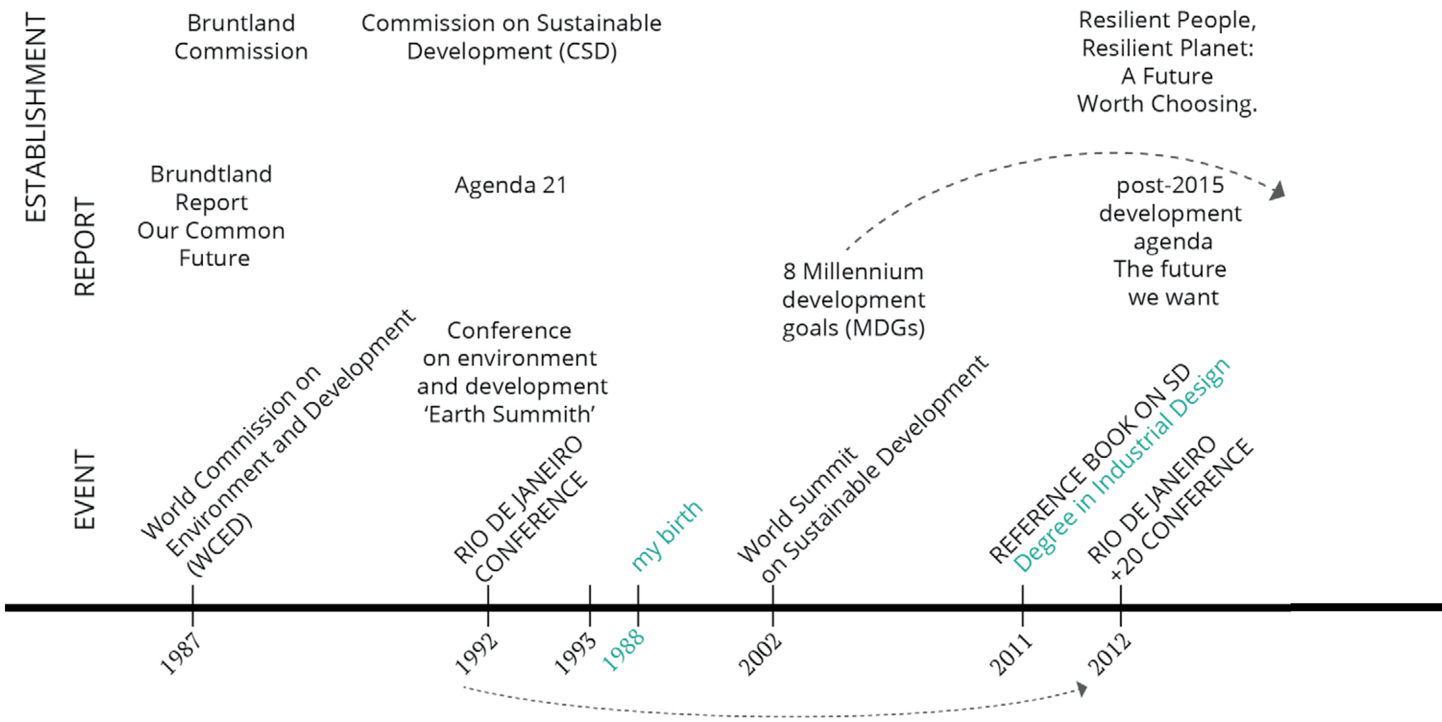
ZERI Zero Emissions Research and Initiatives

ZWS Zero Waste Scotland

Chapter 1

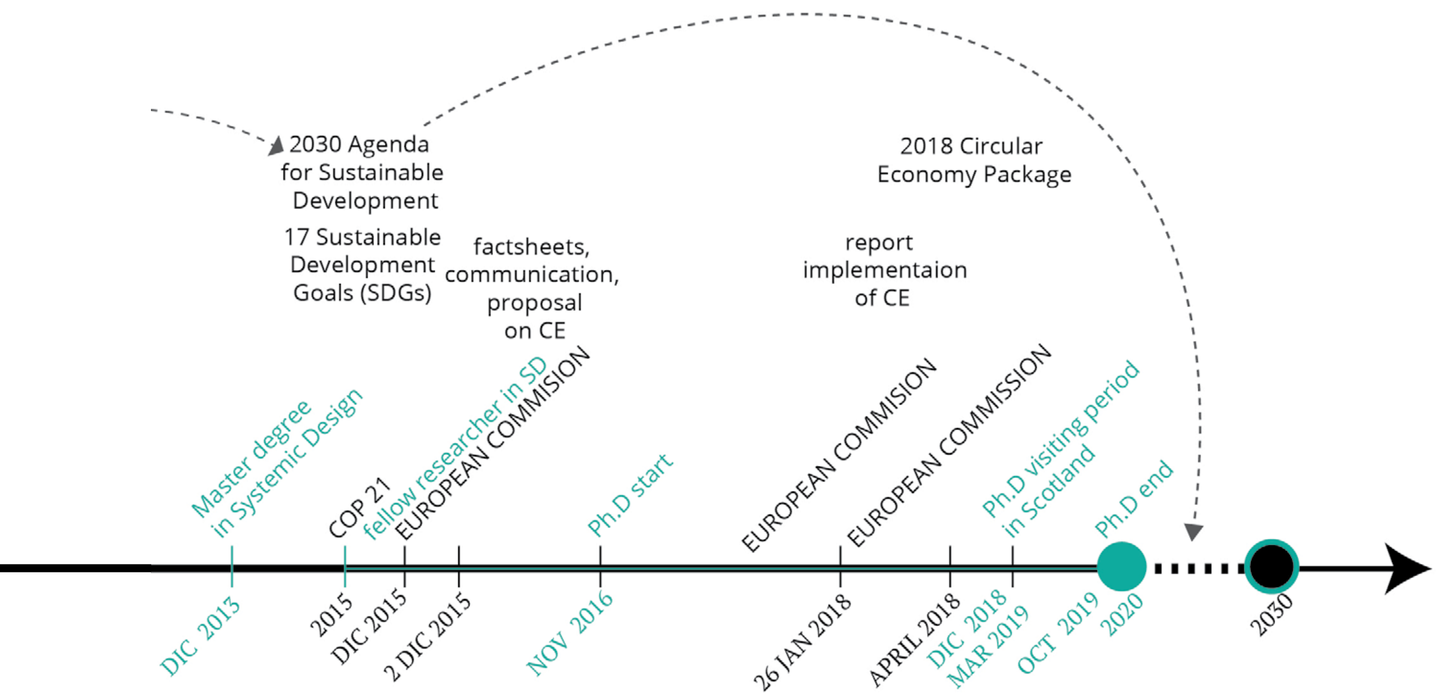
Introduction

Fig. 1.1 - timeline crossing crucial events for the sustainability and my lifetime and Ph.D period



1.1 INSPIRATION AND MOTIVATIONS

Everyday we are constantly reading news about the environmental situation of our planet. It shifts from the increasing of pollution and CO2 emissions, to the unsustainable waste production and difficulties in waste management, to the experiencing of unstable weather conditions and temperature increasing. The situation is defined alarming by many scholars which have identified the year 2050 as point of non-return. This means that it requires to be tackled now. One of the causes identified by scholars is the 'take-make-dispose' model defined by the Linear Economy which has affected the production and consumption processes in the post industrial revolution age. In this context the design phase of the products that we buy, use and dispose, is also called into question, because 80% of the environmental impacts are decided in that stage (Thackara, 2006) which is critical for the decisions that needs to be taken.
The transition to a different economy, as the Circular Economy (CE) model that is at the base of the European economic strategy since 2015 (EC, 2014a), seems requiring holistic approaches to provide changes at systems level, and tackling current complex and interconnected problems and future challenges. The systems thinking (ST) can help to define systemic solutions and provide the basis for a cultural paradigm transition through a different kind of development, sustainable environmentally, and also economically and socially, based on the needs on the human being in line with the one of planet Earth. The Systemic Design (SD) discipline is framed in this context as an *"integrative interdiscipline"* (P. Jones & Kijima, 2018, p. ix) applying the Systems Thinking to the design process and practice. The approach of SD to ecological design and sustainable production processes was defined at Politecnico di Torino in early 2000, and operates through its five principal guidelines and a specific methodology (Bistagnino, 2011). With the goal to create relationships, it works on the input and output of the production processes, designing out waste and producing environmental and economical sustainability at the local level, connecting the resources of the geographical context, design and environmental issues (Bistagnino, 2011). In addition to generate opportunities for innovation, as the design discipline taken in general has already demonstrated (Bertola & Teixeira, 2003; Brown, 2009; Celaschi & Deserti, 2007; Franzato & Celaschi, 2017), the application of SD in the manufacturing sector could create eco-opportunities and eco-innovation



which can be exploited by the entrepreneurial local ecosystem.

This PhD thesis fits precisely in this context and in the research about SD. In the bachelor degree in Design at Politecnico di Torino (Torino, Italy) I've developed a critical thinking about the responsibility of the product design/designer over the environmental situation, and it has become more relevant for me in the master degree in Ecodesign (now called *"Systemic Design, Aurelio Peccei"*). In this educational path, I had the possibility to move from the design of products to the one of processes and systems. In particular I started exploring the SD discipline, which has deeply affected my way of thinking and opened my eyes over many opportunities that are possible to discover thanks to a cultural paradigm shift.
After the graduation, in 2015 I've obtained a research grant to start working with the research group on SD at Politecnico di Torino. In this period, I've developed collaborative projects with international partners like ZERI[1] foundation. Moreover, I've started to tutor many designers in the design of their first systemic projects in the framework of the SD master course (see timeline in fig. 1.1). Thanks to this experience, I've gained more awareness about SD projects characteristics. Especially, I've realized that, although SD is an emerging discipline, the application of SD to real cases of the manufacturing sector permits to have a positive impact at the local level on the environment and on the socio-economic framework. But also that the SD projects implementation is difficult and complex because it operates in a new framework which implies many changes, compared to the current one. This often leads to its failure or to non-realization. However, these projects can create opportunities that can be caught by entrepreneurs to change current production models, and also develop eco-innovative enterprises. Moreover, the projects' high inner value needs to be implemented to start to give a concrete answer to the current request of environmental sustainability and sustainable local development. For this reason, I've decided to undertake the PhD journey to research SD projects, to let emerge their potentialities and ease their implementation phase.
The goal is to provide a significant contribution at the theoretical level for the academic community working on this discipline. And also at a practical level for:

- systemic designers, to understand the complexity that they have to overcome in their work, but also the potentialities of the application of this approach and the importance of their contribution;
- entrepreneurs (present and future ones) that want to act with their daily activity to improve the environmental situation, and to understand what are the opportunities that can be caught from the implementation of SD approach on their business;
- policy makers that manage the local geographical context[2] , in order to develop strategies to sustain the creation and development of economic realities that combine innovation and sustainability, supporting the transition to a more sustainable and circular local development.

1.2 OVERVIEW

"Design in the 21st Century: Intentional Change in an Unpredictable World" Harold Nelson[3]

"Designers have the responsibility to rebalance the ratio between production, environment and society in order to maintain a vivid and mutual connection, as well as a fertile and multidisciplinary dialog among them" Luigi Bistagnino[4]

In a changing situation at environmental and economic level, design has questioned its role and relationships with a more sustainable paradigm and a more sustainable future. The results are the different approaches that have come out, as the Design for sustainability, Design for circular economy, Cradle to Cradle and Systemic Design.

1 Zero Emissions Research and Initiatives, lead by Gunter Pauli, www.zeri.org - see chapter 2.2.2.6

2 In this thesis I will refer to the 'geographical local context' with the term 'territory' which especially in the Italian language 'territorio' refers to a specific geographical area with its characteristics, a place, physical and social environment.

3 https://www.youtube.com/watch?v=mW7p3nixxok&feature=youtu.be

4 http://www.rsd7.org/keynote_speakers/

1.2.1 Design for sustainability

Over the last few decades, design has continuously been related to different aspects of the sustainability dialogue and practice as a primary engine for innovation in our society on industry, local communities, and government (Design Council, 2007; Gruber, de Leon, George, & Thompson, 2015; Meroni, 2007; Ryan, 2008). The manifesto of Danish designers in 2011 *"Design for People, Profit, and Planet"* proclaimed the designer's future role by balancing these three interests for innovation and sustainable development and moving forward a concept that was considered contradictory in the past (Valade-Amland, 2011). Following Go et al. (2015) Design practice in sustainability area has passed from Design for life cycle, to Design for environment (preventive role) to the whole systems Design. This is in line with the recent review presented by Ceschin and Gaziulusoy (2016) which has described the evolution of design for sustainability: from product innovation to product–service system innovation to spatial–social innovation and socio–technical system innovation. This timeframe is perfectly aligned with the trends in design as Papanek predicted: moving towards dematerialization, designing approaching solutions for complex social, environmental, and even political problems (Papanek & Fuller, 1972). Also Buchanan addressed the role of design practices to approach current *"wicked problems"* with the purpose of transitioning towards a more resilient, fair, and sustainable society (Buchanan, 1992). As reminded by Sanders and Stappers (2014), the traditional role of the designers has changed over the years, from exploring *"how to design what the client asked for"*, to *"what to design"* and in the near future the role will be to *"work to help ensure that what is designed makes sense in the future lives of people"*.
Today consequently the designer has changed its role, providing also skills and capabilities to the transition to a more sustainable development (De los Rios & Charnley, 2017) and the design phase is starting to be considered the crucial point to obtain for example a CE, as pointed out by the Ellen MacArthur foundation .
Bhamra et al. (2013) identified between the different approaches that can be used in the process of 'design for sustainability' to obtain more sustainable outcomes, that the system innovation is the higher level, being a radical and strategic approach which involve many stakeholders from companies and customers to communities and government. The prior steps are (fig.1.2):

- improvement (an incremental approach which consists of small modifications to the output of design considering planet, profit, people);
- redesign (an incremental approach, more proactive, it considers the whole life-cycle to change products. It takes into account the redesign strategies defined by Van Hemel (1998) (fig 1.3);
- new concepts (a radical approach, which starts from the design process, considering innovative ways to reach the function required);
- system innovation (a radical and strategic approach, which involves many stakeholders from companies and customers to communities and government).

The design approach of design for sustainability is currently evolving and looking for future evolution, as demonstrated for example from the call of the Sustainability Journal for the Special Issue *"The Future of Design for Sustainability"* published in 2018 with strong statement by the guest editors, Prof. Tracy Bhamra and Dr. Garrath Wilson in the description as: "*Design for sustainability is not the panacea we hoped it would be when it was first introduced in the latter part of the 20th century.Today, the health of both our environment and our societies is at a critical state, at a breaking point [...] it is clear that the role of design for sustainability [...]is not providing the solutions necessary to manifest the level of change required. Traditional approaches are not working*"[5].

1.2.2 Design and Circular Economy

The strategies proposed by the new economic model, the CE, to long lasting the life cycle of products are not far from common strategies related to the eco-design as reuse, repair, separation into components, life extensions, ... proposed by authors as Lanzavecchia, (2012); Vezzoli & Manzini (2007); Van Hemel (1998 cited by Bhamra et al., 2013). These strategies can be found also in the 'circular product design strategies' defined by Bocken, de Pauw, Bakker, & van der

5 https://www.mdpi.com/journal/sustainability/special_issues/Design_for_Sustainability?fbclid=IwAR0LcrYpqXLBHpWxag5gbBhBxtlxCOjgqfjRLZhMZKRhRyBEK-b5PqZ-PKo

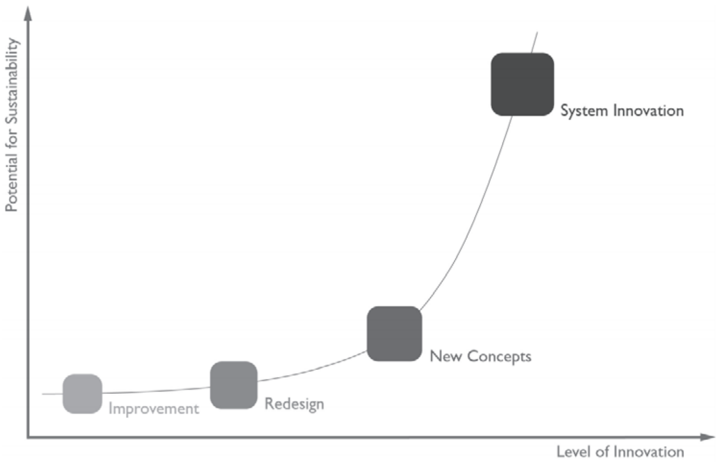


Fig. 1.2 - the relationships among the level of innovation and their potential for sustainability retrieved from Bhamra et al. (2013)

Table 1: Design for Environment Strategies (Van Hemel, 1998)

Strategy 1: Select low-impact materials • Choose clean materials • Choose renewable materials • Choose materials with a low energy content • Choose recycled materials
Strategy 2: Reduction of material usage • Reduction of weight • Reduction of (transport) volume
Strategy 3: Optimization of production techniques • Choose alternative production techniques • Fewer production steps • Low/clean energy consumption • Less production waste • Few/clean production consumables
Strategy 4: Optimizing the distribution system • Little/clean/reusable packaging • Energy-efficient means of transport • Energy-efficient logistics
Strategy 5: Reduction of the user impact • Ensure low energy consumption • Choose a clean energy source • Reduce the amount of consumables required • Choose clean consumables • No waste of energy or consumables
Strategy 6: Optimization of initial lifetime • Increase reliability and durability • Ensure easy maintenance and repairs • Ensure a modular, adaptable product structure • Aim to achieve a classic design • Ensure a strong product-user relation
Strategy 7: Optimization of the end-of-life system • Stimulate reuse of the entire product • Stimulate remanufacturing and refurbishing • Stimulate material recycling • Stimulate safe incineration with energy recovery • Ensure the safe disposal of product scrap

Fig. 1.3 - Design for Environment Strategies (Van Hemel, 1998). tab retrieved from Bhamra et al. (2013)

Grinten (2016):

- Design strategies to slow loops:
  - Designing long-life products:
    - Design for attachment and trust;
    - Design for reliability and durability;
- Design for product-life extension:
  - Design for ease of maintenance and repair;
  - Design for upgradability and adaptability;
  - Design for standardization and compatibility;
  - Design for dis- and reassembly;
- Design strategies to close loops:
  - Design for a technological cycle;
  - Design for a biological cycle;
  - Design for dis- and reassembly.

Indeed, the role of Design is recognised as an essential building blocks of CE by the Ellen MacArthur Foundation, which defines the CE as *"restorative and regenerative by design"*[6] (Ellen MacArthur Foundation, 2017). Indeed this foundation has developed in 2017 with a collaboration with IDEO, an international known Design company, the Circular Design Guide to *"reframe your mindset, ask the right questions, take on projects, and start exploring the extraordinary possibilities"*[7] . Also in the review of the literature by Lieder and Rashid (2016) on CE implementation in the context of manufacturing sector, design is highlighted as one of the essential points for the CE implementation related to the design of products and the choice of materials (considering regenerative design, the cradle-to-cradle, and design strategies as longer-lasting products, modularization and remanufacturing, component re-use, and designing products with less material) and the design of a different supply chain (driven by remanufacturing, resource conservative manufacturing, and closed-loop supply chains). They identified the crucial role of the designers in the development of CE model, but also a current technological barrier in the product design for the lack of circular design (Lieder & Rashid, 2016).

In the literature seems that the contribution of designers is highlighted only relating design to the design of product and not in the design of the entire system around the manufacturing process, considering also production processes and the local context where these processes take place.

1.2.3 Cradle to cradle

'Cradle to Cradle' is a strategy and a design approach in contrast with the current 'Cradle to Grave', where products are created and then disposed at the end of life. It was proposed by the architect McDonough and the chemist Braungart and described as: *"cradle to cradle is the law of return with materials rather than food-crops"* (McDonough & Braungart, 2009, p. 4) in their major publication first published in 2002. The goal is to change the design intentions and consequently the production system, following eco-effectiveness instead of eco-efficiency (not being less bad, but different considering the whole system) and the biological flows of biological and technical nutrients considering waste equals food.
Today in the Netherlands this concept is very diffused, it has a chair for Innovation and Quality in Rotterdam school of management *"combining education and research in design, architecture, and engineering with business and innovation"*[8] and also an innovation institute 'the cradle to cradle products innovation institute'[9] .

1.2.4 Systemic design

In the last years, the Systems Thinking approach has been integrated into design discipline. One of the many reason, as F. Charnley stated, is the need to develop more innovative solutions as a response to complexity on design problems (Charnley, Lemon, & Evans, 2011). Designers indeed are called into this matter being the ones with creative and other multiple skills to approach future scenarios. On that perspective, it is reflected the etymology of the word *"project"* which comes from the Latin word *"pro-iectus"* that contains the concept of projecting forward (Peruccio, 2014).
These concepts inside the design discipline are the starting point for the SD discipline which enlarges the borders of the traditional design discipline producing a step forward from eco-design and design

6 https://www.ellenmacarthurfoundation.org/circular-economy/concept
7 https://www.circulardesignguide.com/
8 https://www.rsm.nl/sustainability/research/cradle-to-cradletm-chair/
9 https://www.c2ccertified.org/ - see chapter 5

for sustainability. With the goal to provide innovative solutions to always more complex future scenarios encompassing economic, environmental and social contexts, the application of an holistic approach permits to have a wider view of the context/scenario in which the project of artefacts and services will be introduced.

SD represents *"an integrative interdiscipline with the potential to implement systems theory with creative methods and mindsets, by bringing deep technical knowledge, aesthetic skill, and creative implementation to the most abstract programmes of collective action"* (Jones & Kijima, 2018, p. ix).

P.H. Jones, a relevant thinker about the SD discipline, outlined SD as a merge between human-centred design and multi-stakeholder service system design. He added that its application has moved from artefacts and communication, products, and services, to organizational transformation and social transformation—four domains that have increased their complexity (Jones, 2014). A systemic designer embodies traditional design competencies—form and process reasoning, social and generative research methods, and sketching and visualization practices—being, moreover, able to *"describe, map, propose and reconfigure complex services and systems … (they view design as) … an advanced practice of rigorous research and form-giving methods, practices of critical reasoning and creative making, and of sub-disciplines and deep skillsets"* (Jones & Kijima, 2018).

In the major book about SD, (Jones & Kijima, 2018, p.ix) recognized the followings as the roots of this discipline:

- *"Design cybernetics, especially second-order reflexivity in design practice (Glanville, 2009; Krippendorff, 2007)*
- *Design thinking for wicked problems (Buchanan, 1992)*
- *Systems-oriented design (Sevaldson & Vavik, 2010)*
- *Systemic design approach to ecological design (Bistagnino, 2011)*
- *Product-service systems (Manzini & Vezzoli, 2003; Morelli, 2002)*
- *Transformation design (Sangiorgi, 2011)*
- *Transition design (Irwin, 2015)*
- *Dialogic design (Christakis, 2006)*
- *Design for conversation (Dubberly & Pangaro, 2015)*
- *DesignX (Norman & Stappers, 2016)"*

Today, SD has a worldwide relevance. An international research networks, the Systemic Design Research Network (SDRN)[10] , has approached the topic since 2012, and the Systemic Design Association (SDA) was created in 2018 and features the involvement of the Oslo School of Architecture and Design, Ontario

1.2.4.1 Systemic design application to anthropic production process[11]

In the early 2000's, a research group at the Department of Architecture and Design in Politecnico di Torino (Italy), developed a particular SD approach: it wants to model production and energy systems after Nature's principles, primarily connecting their outputs and inputs to reach zero emissions in the air, water, and soil designing open systems (fig 1.4) (Bistagnino, 2011). It was developed in strict collaboration with the ZERI foundation[12] from where the Blue Economy was conceived (see chapter 2) and for this reason they share the same principles and goals.

This SD approach was developed around five guidelines defined in the main reference for it by professor Bistagnino (Bistagnino, 2011)(fig. 1.5):

1. *"Output–input: The output (waste) of a system becomes the input (resource) for another one;*
2. *Relationships: These relationships generate the system;*
3. *Autopoiesis: Self-producing systems sustain themselves by reproducing automatically, defining their own paths of action and coevolving together;*
4. *Acting locally: The local context becomes fundamental because it values local resources (humans, cultures, and materials);*
5. *Human at the centre of the project: A human being is considered connected to its environmental, social, cultural, and ethical context, and its needs become central in design requirements"*. (Battistoni et al., 2019)

Indeed SD intends to create relationship based

10 https://systemic-design.net/sdrn/

11 based on: Battistoni and Barbero (2017), Battistoni et al., (2019), Battistoni and Barbero (2019), Battistoni and Barbero (2020)

12 http://www.zeri.org/

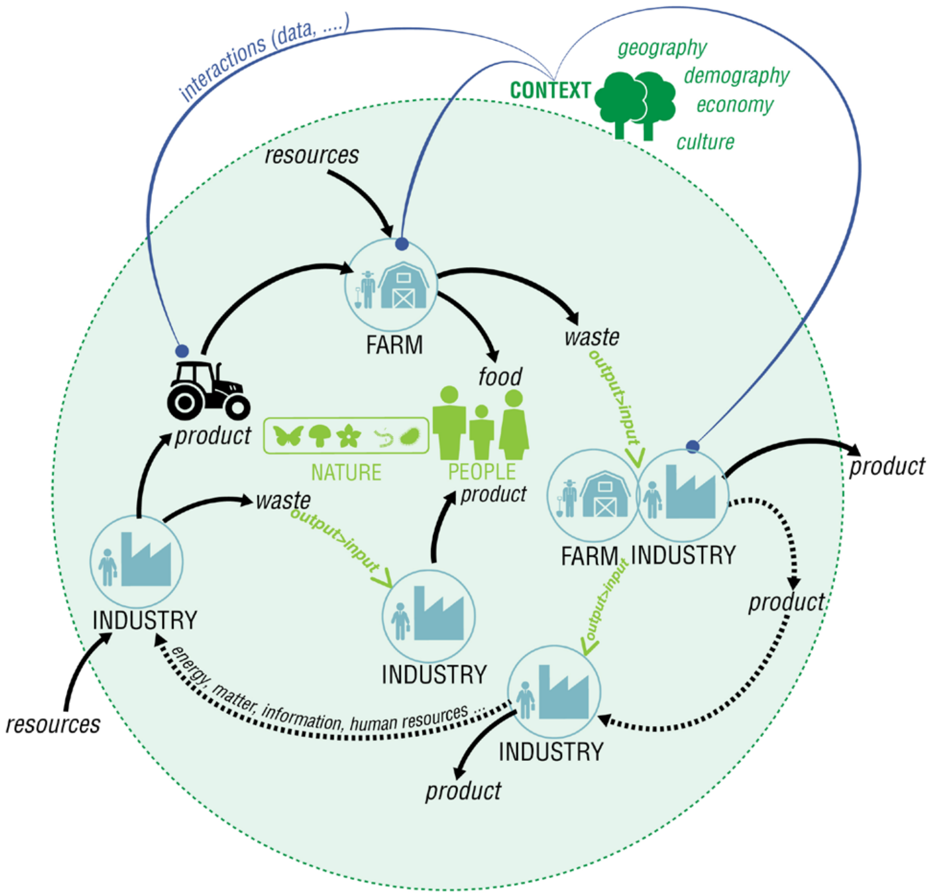


Fig. 1.4 - A graphic visualisation of the the SD approach used at Politecnico di Torino (Italy). Published in Battistoni et al.(2019)

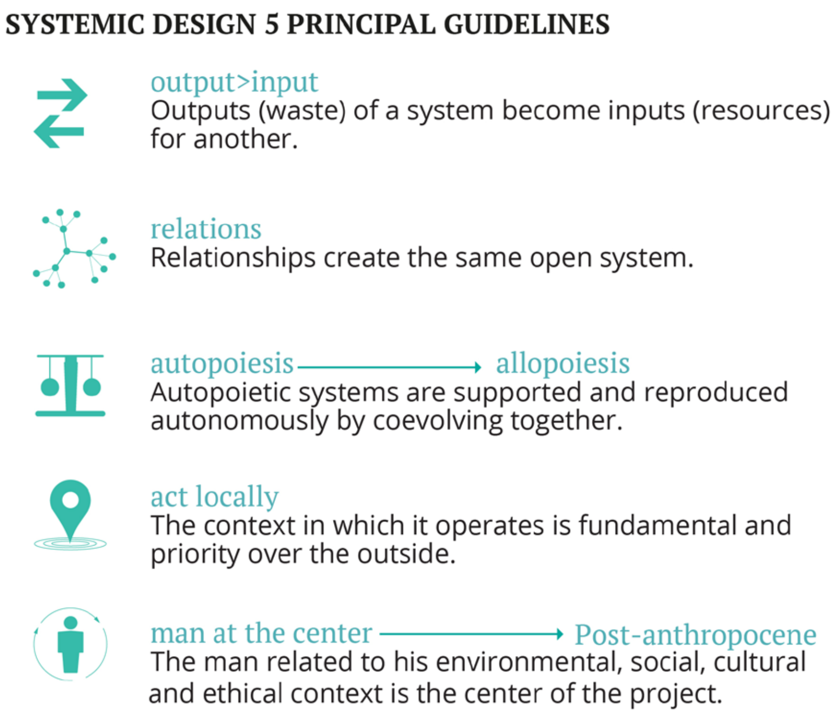


Fig. 1.5 - A graphic visualisation of the guidelines of the SD approach used at Politecnico di Torino (Italy).

Fig. 1.6 - A graphic visualisation of the SD approach used at Politecnico di Torino (Italy). Published in Battistoni et al.(2019)

on *"an output that becomes an input"* for another system/kingdom as happens in Nature. These links are created acting locally and connecting the human being with the context of reference. In addition, the systems created are auto-generating in terms that they are self-reproducing systems.

Although it is common to refer to SD only to these principal guidelines, many other characteristics are included in a SD projects, as reported in the fundamental references for SD (Bistagnino, 2011; Bistagnino, 2017) as:

- design open systems based on the flows of matter, energy, information, money among actors/stakeholders;
- generate a zero waste and emissions production model;
- based on collaboration between subjects;
- the outputs are considered not as waste that should be trashed away, but just as resources with their specific quality to valorise and can become new resources;
- take into account environmental, economic and social aspects creating sustainability;
- based on the holistic diagnosis to have a clear picture of the state-of-the-art and to determine local context and know-how;
- include a new way to act that wants to activate new relations between subjects and to manage resources to create awareness and generate a new economic, productive, ethical system

The use of this approach to design production processes has several positive outcomes as reminded by Barbero (2012):

- Environmental: A lower consumption of local resources and the use of more sustainable production processes;
- Social: The creation of new jobs linked to the cultural and spatial places of belonging;
- Economic: The optimization of resources minimizes costs and increases the competitiveness of companies, as well as new business areas.

SD expertise in the design department in Politecnico di Torino during the development of the course "Open Systems" and "Design by components" from a. y. 2003-2004 by professor Bistagnino (Battistoni and Barbero, 2017), defined a specific methodology to tap into the holistic analysis of these contexts, allowing the design discipline an opportunity to create autopoietic open systems based on contextual assets (Battistoni et al., 2019).

Its principal steps can be divided as follows (Battistoni et al., 2019) (fig. 1.6):

1. Holistic diagnosis (HD) with field and desk research: an analysis and visualization of all the components that define the current scenario, considering both the surrounding context and the flow of energy and matter (see Battistoni et al., 2019 for the definition);
2. Definition of problems and leverages for change: with the complex data collected in HD, it is possible to underline the criticalities which are

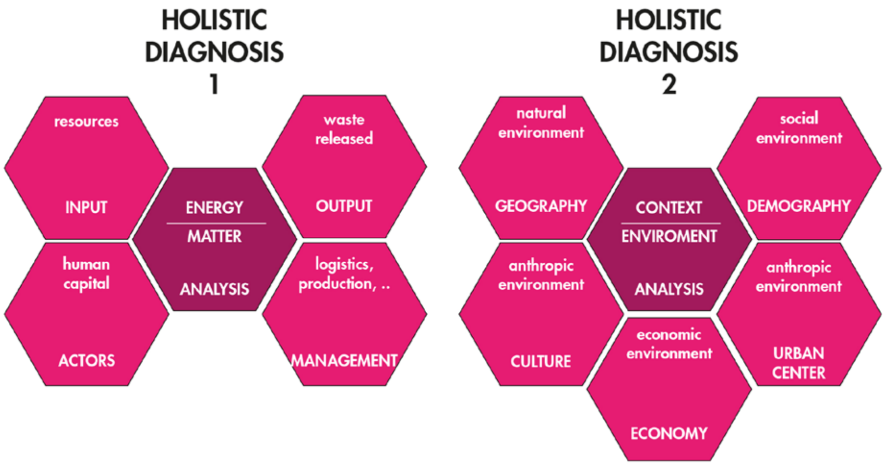


Fig. 1.7 -Graphic visualization of the differences among HD1 and HD2.

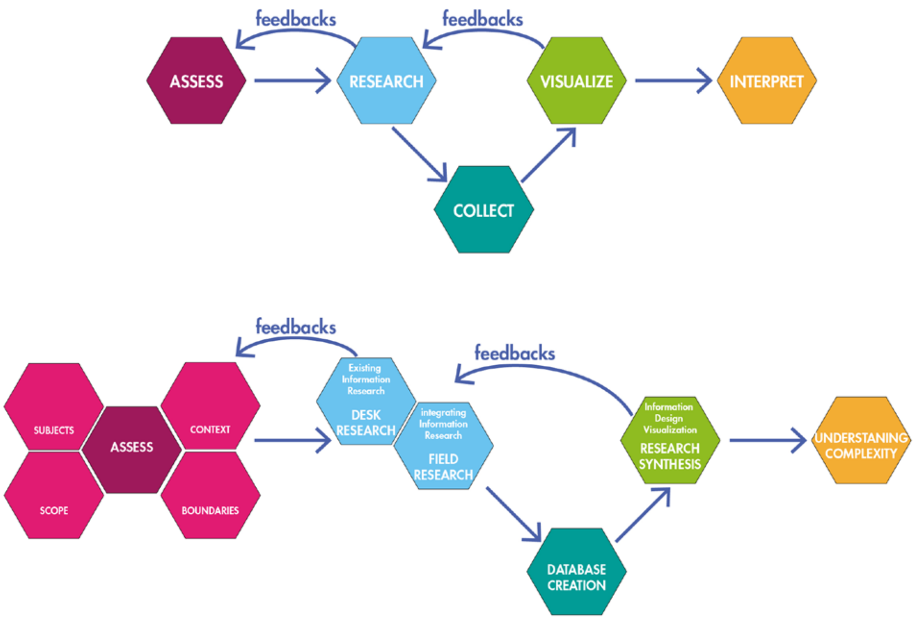


Fig. 1.8 -Graphic visualization of the structured process to perform an Holistic Diagnosis. Published in Battistoni et al.(2019)

turned into potentialities for the definition of the new open complex system;

3. Design of a system: the new production model is designed with the goal to obtain zero emissions. System is created based on relationships between production processes and actors, optimizing the energy and material flows and valorising the waste as resources;
4. Study of the outcomes: preliminary evaluation of the benefits given by the system at environmental, economic, and social level;
5. Implementation: realization of the system in the specific context with the involvement of the new actors and stakeholders;
6. Analysis of the results and feedback: The feedbacks coming from the implementation phase permit the improvement and the evolution of the project, discovering new opportunities and making it autopoietic.

About the methodology, in particular the HD process (fig. 1.7) is an essential part for the analysis of the current situation and the discoveries of new opportunities. A structured process to perform an HD is the ARCVI - Assess, Research, Collect, Visualize, Interpret – which was defined in Battistoni et al. (2019) (fig. 1.8).

HD is defined as a mapping of the state-of-the-art useful for giving indications about the quality and the quantity of what an anthropic process involves. Moreover, to highlight the relationships that are activated, both inside the system and between the system and its environment (as the local context), one can analyse afterwards the implications at each territorial dimension, from regional to worldwide ones. In that regard, HD represents a useful tool to guide the first complete overview analysis of contexts/products/processes/services and define the current state-of-the-art. From this point of view, HD is related to ST, which defines a detailed study on behavioural patterns and interactions. An analysis of this nature is understood as a holistic overview of the components of the system and how their interconnections/relations result in the sum of all parts/subjects that interact between the environment and other systems. To reach an effective understanding of the HD results, visualization tools are required whose main aim is to break down the information of the system. The synthesis of this analysis is represented as a graphical outcome, which is a giga-map (Sevaldson, 2011) that displays all the components of the system and the relationships between them.

In the SD methodology, HD refers to two different levels of analysis: HD1 for energy and matter analysis and HD2 for context/framework analysis. Starting from a deeper analysis on a single production process with a screening on the output (what goes out) and input (what comes in), the view is enlarged to its context of reference to help understand its influences.

<u>Holistic Diagnosis Phase 1: Energy and Matter Analysis</u>

This first phase of the HD entails the analysis of everything used by the production, exchange, and consumption of goods and services, including:

- Input: resources as raw materials, semi-finished and energy, which enters in the process;
- Output: waste and surplus, both matter and energy or data, that is produced or isn't used in the process;
- Final product or service;
- Goods and people management, as well as logistics.

The purpose of HD1 is to analyse in detail all the resources used by anthropic activity. This activity is seen as an open system, where the boundaries are the limits of the production process itself (when the production starts and when it stops), and it contains all the sub-processes inside.

The HD1 is divided into three steps:

- A general overview of the entire anthropic activity (seen as a production process), considering the flows of energy and matter that enter and go out (input and output);
- An analysis of the relationships with other anthropic/natural activities that the input and output generate;
- A detailed analysis of the input and output of every single sub-process involved into the entire process.

HD1 is rooted in other methods, presenting many similarities with them: from niche analysis used in permaculture (Mollison, 1988), to material-flow analysis and substance-flow analysis from urban metabolism (Zhang, 2015); economic-wide Material Flow Account (Eurostat, 2013); input-output analysis (Midmore et al., 2006); stock and flow analysis in system dynamics (Meadows, 2008); urban harvest approach (Agudelo-Vera, 2012); life cycle analysis (Wolf, 2010) and many more.

<u>Holistic Diagnosis Phase 2: Context Analysis</u>

The second phase of HD is an analysis of every relationship generated in a direct or indirect way, including the environment where the system is placed, to discover the relationships in between the activities and the contexts around them. This analysis goes in depth for both territorial considerations and stakeholder involvement. The context is determined from its morphological features and also through its economic, social, and cultural aspects. Attention shifts from natural resources to relevant industrial activities, typical products, folklore, and demographic aspects. Furthermore, to produce an overall analysis, the HD should involve mapping of the different actors and stakeholders involved in the topic of analysis. For example, in the case of production activities, the analysis should be addressed not only to producers and end users but also to the technicians, providers, intermediaries, and other pertinent public and private bodies.

The HD2 is a framework that has been infrequently analysed by scholars over the years. Nevertheless, we can trace its roots using the tools related to giga-map (Sevaldson, 2011); think-map (Oxman, 2004); rich pictures (Berg & Pooley, 2013) and mind map (Buzan & Buzan, 1996).

1.2.4.2 Systemic design and Circular Economy (similarities and differences)

SD and CE have some points of contact, although one is a design approach and the other one is an economic model. However, SD can be considered as one of the approaches to use to ease the transition to a CE and achieve it - as in the application in the European RETRACE project (Barbero, 2017b), and the CE can be seen as one of the goal of the SD and the impact created at economic level.

Another point of contact is represented by the strategies that are proposed to create a CE (maintain/prolong, share, reuse/redistribute, refurbish/remanufacture, and recycle as strategy for putting in circle the technical one) which are the strategies used by the eco-design disciplines, which is the root of the SD, and for this reason are implicitly included.

Instead, the main similarities and differences seem to be:

- Focus on closing loops of the CE VS the attention of SD to create open systems (differences remarked also by Barbero (2017a);
- The focus on closing materials loops of the CE considering the same productive systems VS the focus of SD to use the output as input mainly for the same or another productive sector or for another natural kingdom as it is happening in Nature;
- The focus of SD is to create relationships within different components of the system, which is taken also into consideration by the CE;
- In the CE, the starting point of the loops to close is the end-of-life of the product after the use and consume phase (see butterfly diagrams) while in the SD the focus is on every outputs which cames out from all the production steps (from the extraction of the materials to the production to the consume).

1.3 RESEARCH QUESTIONS

This PhD thesis wants mainly to tackle the problems identified in my working experience in the field of SD. For this reason, the research conducted wants primarily to understand how to support the implementation of SD projects to finally enhance the local context where they are acting and obtain a sustainable local development and a local circular economic model. For this reason, the main research question is:
"How SD projects can be implemented and supported by local context in order to boost CEs in Europe?"

The process to give an answer to this main research question implies also defining from one side the opportunities created by SD projects in the manufacturing sector, their contribution to a sustainable local development and the barriers encountered in their implementation. On the other side, understanding which are the current innovation dynamics, both in terms of existing enterprises and for the creation of new ones, for the implementation of sustainable innovative projects, especially in the manufacturing sector. And also which are the economic models that provide an alternative to the linear economy and who is supporting the transition to a different production model in a diverse economic paradigm to create also sustainable local development?
Due to the wide-ranging nature of the topic research boundaries were set out. The context to focus the analysis of the current situation was restricted to a geographical location, the Europe Union which has decided to base its economic strategy over the Circular Economy (CE) model since 2015. Moreover, it was decided to restrict the analysis to the Piedmont Region in Italy where the SD research group of Politecnico di Torino is located and where, thanks to the European RETRACE project, started the debate about the contribution of SD for the transition of the region to a CE economic model. This specification has also meant to understand in deeply the situation in this Region to find out how a theoretical model can work in a concrete situation with its specific characteristics. To give more results about the application phase, a further restriction was made in terms of productive sector, due to the complex and diverse context about the manufacturing sector in the region: the industrial district in Biella of the textile sector.

In the process of giving an answer to the main research question, indeed other sub-questions emerged:

- **Which are the problems in the implementation of SD projects for the manufacturing sector?**
- **Which are the opportunities created by SD projects for the manufacturing sector and how can the territory benefit from them?**
- **Who are the actors that are playing a role in the support and implementation of economic realities for the transition to a CE in Europe? How are they currently acting? What is their contribution for the implementation of CE in a specific territory?**
- **Which is the configuration of the entity that facilitates the implementation of opportunities from SD projects for the creation of a local CE?**
- **What is the situation in the Piedmont Region (Italy) over the CE implementation? How SD projects be best implemented there? What is the configuration of this entity in this territory?**
- **What is the contribution of SD in the transition to a sustainable local circular economy to design different production and economic models? And in the creation of new entrepreneurial realities?**

To give answers was necessary to expand the research focus from design and SD over several fields which were explored at the beginning of the process in the definition of the context and in the literature review: environmental sustainability, sustainable economic models for zero waste production, sustainable local development, the industrial world (manufacturing sector) and its current innovation dynamics. Fig. 1.9 represents the research fields from where this PhD research started. Indeed in particular it was necessary to explore how the interaction between design and the industry world following the environmental sustainability guide can create sustainable innovation, zero waste production model and sustainable local development in the framework of the CE and Blue economy. The sphere of "business" is focused on the field of entrepreneurship. This last one is intended as the entrepreneurial activity, referring both to the existing enterprises and to the creation of new enterprises.

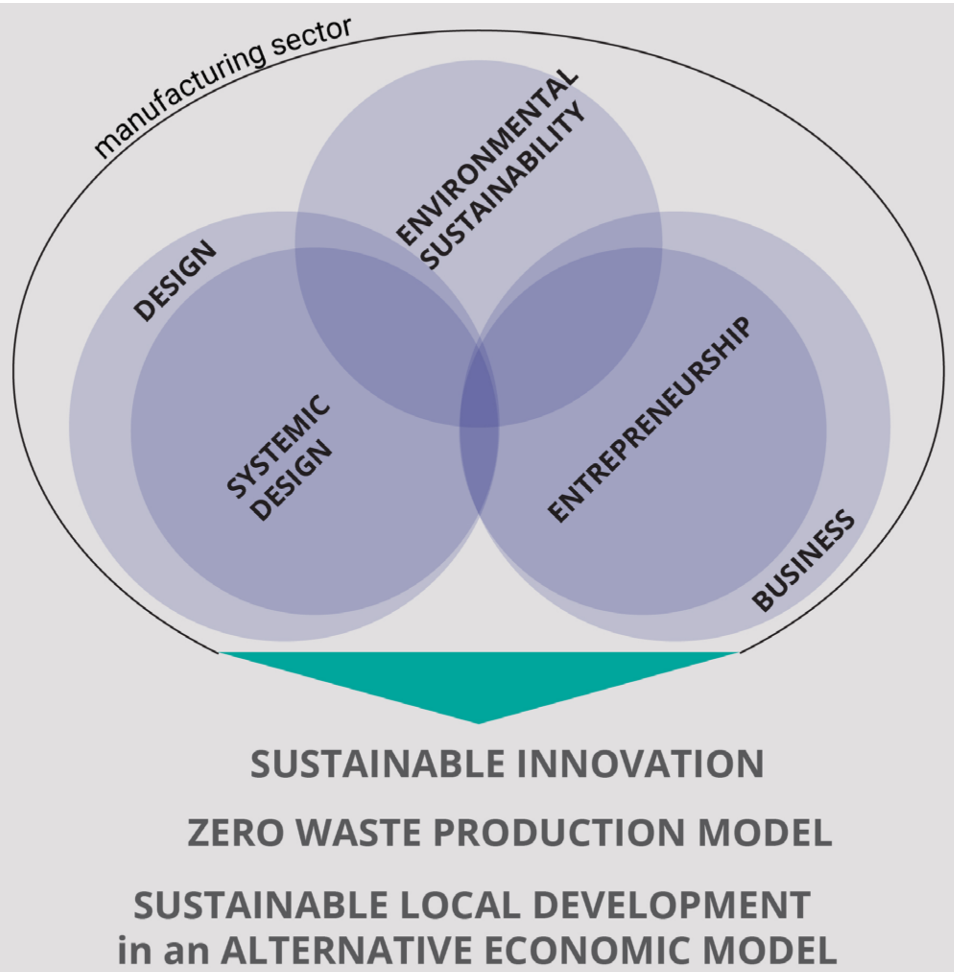
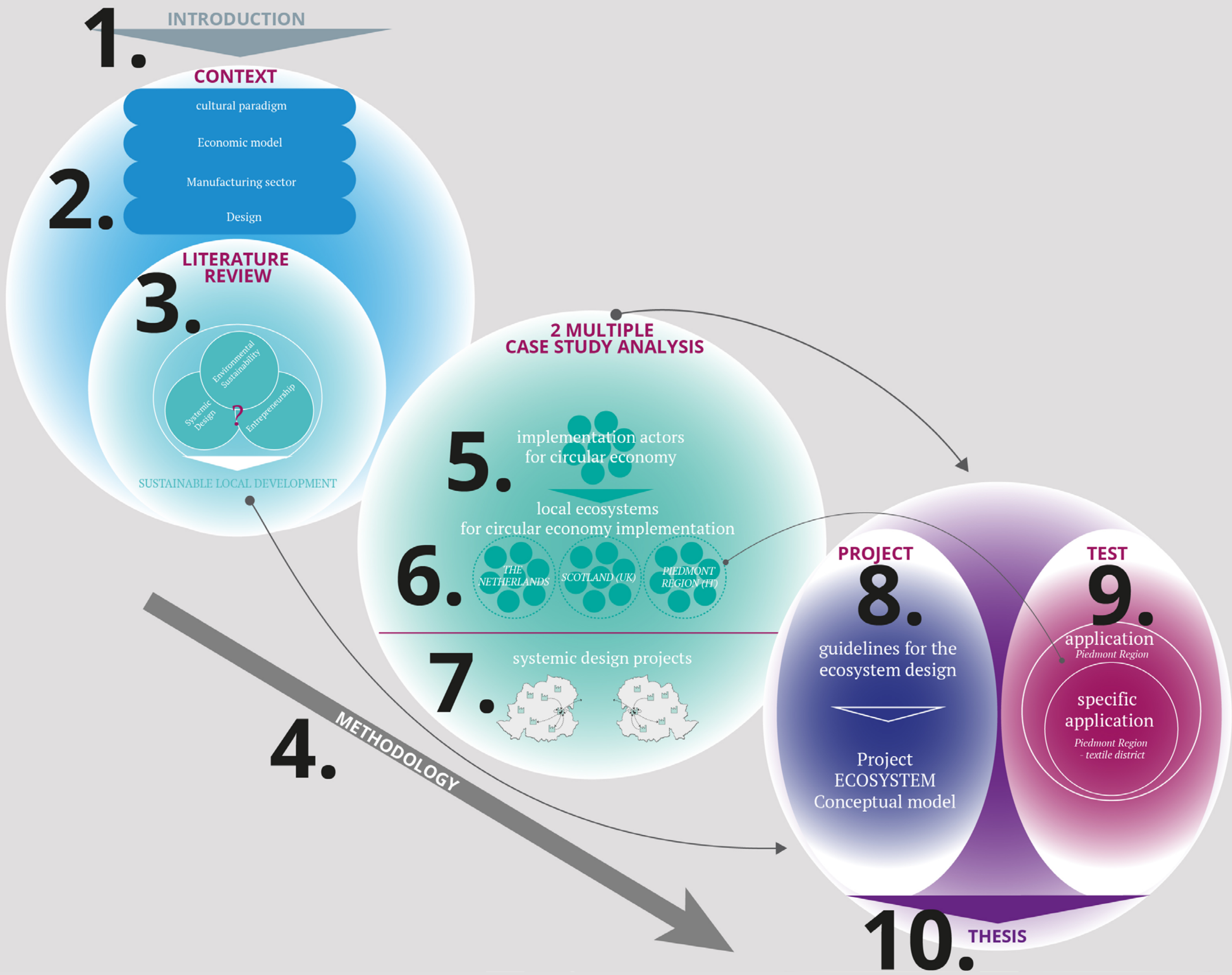


Fig.1.9 -the principal research fields involved in the research

1.4 STRUCTURE OF THE THESIS

The chapters of the thesis, represented in fig. 1.10, are structured to follow the methodological steps used to answer the research questions. Chapter 2 is dedicated to the framing of the context of the research. Chapter 3 is an extensive literature review of the main topics that are crossed by the research question. Chapter 4 explains the overall methodology used to answer to the research questions. Chapter 5-7 are dedicated to the two multiple case-study analysis: one about previous SD projects – chapter 7 – and one about the implementation actors in the CE framework (from single cases – chapter 5 - to ecosystems in specific places – chapter 6). With these chapters the research phase ends and the project phase starts with chapter 8. Chapter 9 is dedicated to the application phase. The discussion of the results and the conclusions are in chapter 10.

Fig. 1.10 - Graphic index of the thesis (next page)


1.
INTRODUCTION
2.
CONTEXT
cultural paradigm
Economic model
Manufacturing sector
Design
3.
LITERATURE REVIEW
Environmental Sustainability
Systemic Design
Entrepreneurship
?
SUSTAINABLE LOCAL DEVELOPMENT
4.
METHODOLOGY
2 MULTIPLE CASE STUDY ANALYSIS
5.
implementation actors for circular economy
local ecosystems for circular economy implementation
6.
THE NETHERLANDS
SCOTLAND (UK)
PIEDMONT REGION (IT)
7.
systemic design projects
PROJECT
8.
guidelines for the ecosystem design
Project ECOSYSTEM Conceptual model
TEST
9.
application
Piedmont Region
specific application
Piedmont Region - textile district
10.
THESIS

Chapter 2

Context

This thesis fits in the framework of the studies to support the transition to a sustainable world.
This chapter is about the framing of the current state-of-the-art. It provides an overlook of the environmental situation and the economic model, understanding the manufacturing sector and the design world in this framework. Despite the critical global environmental situation which some scholars define as the effect of the linear economic model, in the last years different economic models and cultural paradigms have emerged which have also affected the manufacturing sector and the design scene. This shift was defined in this chapter as *"the road to the sustainability"*.

2.1 CURRENT SITUATION

2.1.1 Environmental situation

"We live in a finite planet"

This statement reminds us that on planet Earth such abundance of natural resources is limited. As defined by Rockström and colleagues of the Stockholm Resilience Center[1] , the planet has 9 boundaries, inside of which there is the *"safe operating space for humanity"* (Rockström et al., 2009, pg 472) (fig. 2.1), otherwise we are compromising the durability of the natural resources and the sustainability of our life. They added that the human beings with their activities seem responsible for the unstableness of the Earth environment saw in the last period, that scholars have defined Anthropocene[2] , as an era in contrast with the Holocene, the period of the last 10.000 years of stableness of the planet. Moreover, they advised that this phase can cause catastrophic events in large part of the planet (Rockström et al., 2009).

Today, 10 years later from this study it is possible to state that the catastrophic events are happening, as the melting of the Arctic and the coming of hot waves, and everybody is experiencing them, also in smaller scale. Indeed, scholars agreed that the climate has changed. However, it was predicted in 1972 by the report *"The limits to growth"* by Meadows, Meadows, Randers and Behrens (1974). This group of researchers at MIT analysed 5 factors (population increase, agricultural production, non-renewable resource depletion, industrial output, and pollution

1 https://www.stockholmresilience.org/research/planetary-boundaries.html
2 definition by chemist Paul Crutzen (Crutzen & Parlangeli, 2005)

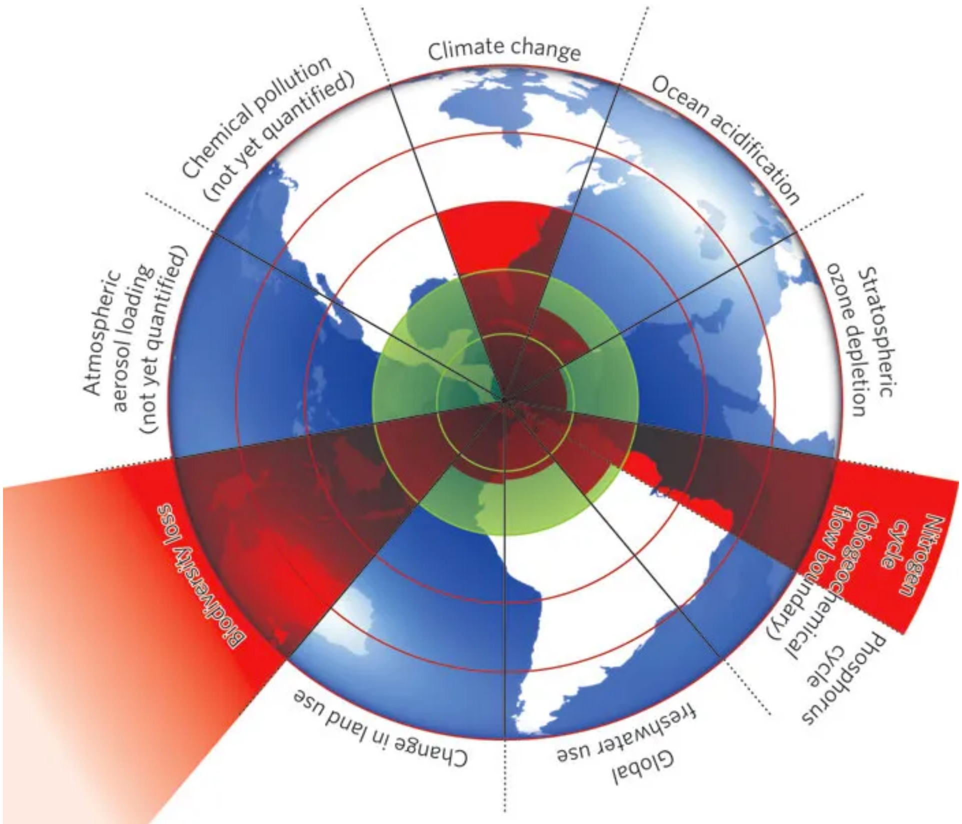


Fig. 2.1 - Representation of the planet boundaries and the safe operating space (in green). Retrieved from Rockström et al. (2009)

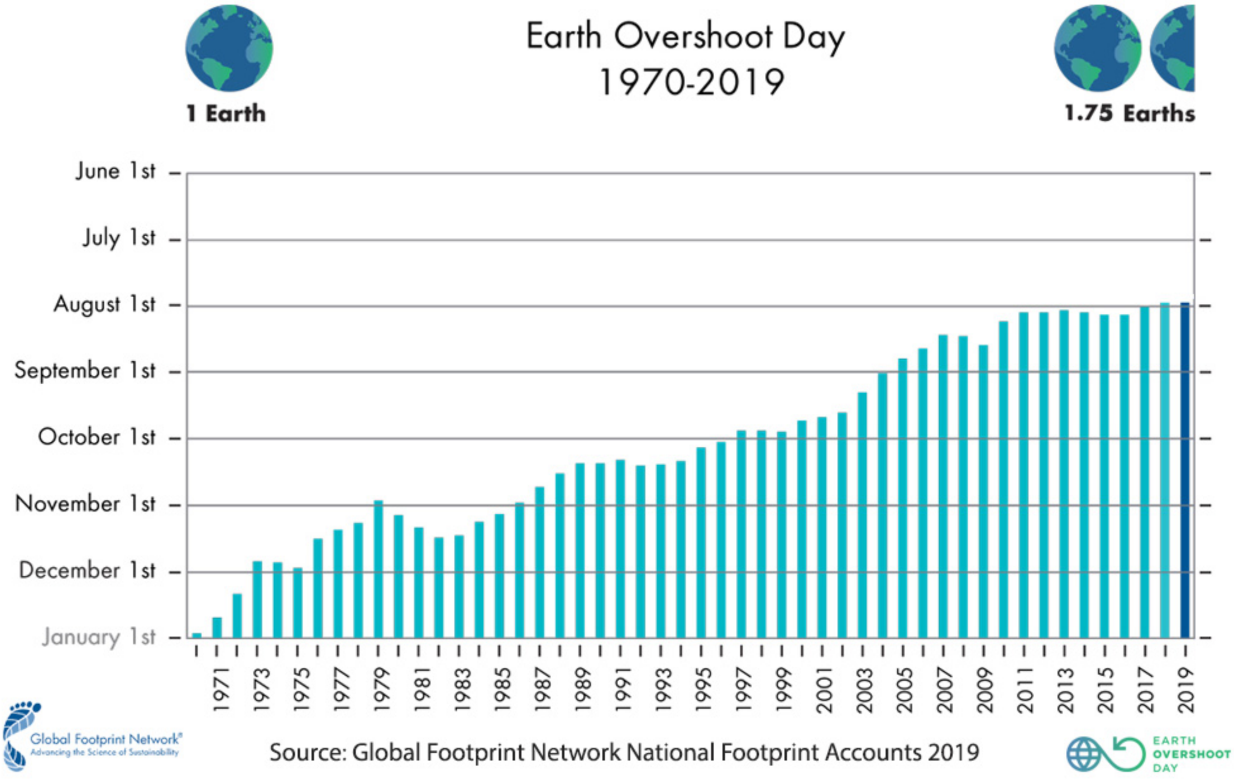


Fig. 2.2 - Representation of the 'Earth overshoot day'. Retrieved from https://www.overshootday.org/content/uploads/2019/07/2019_Past_Overshoot-Days-withlogo.jpg

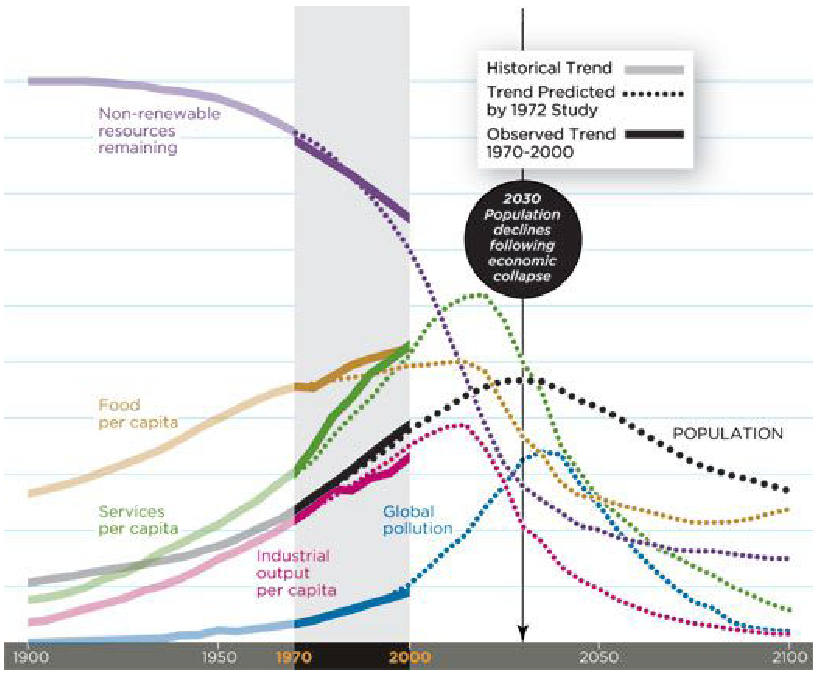


Fig. 2.3 - Representation of the results of the updating of the 'limits to growth'. Retrieved from D. Meadows (2012)

generation) with systems dynamics and alerted with the results - the present populations and economic growth will not be sustainable beyond 2100 - predicting a collapse by about year 2025 (Meadows, 1974)[3] . This report was the first that was done to the Club of Rome[4] , an international association of thinkers founded by Aurelio Peccei to analyse the current situation and encourage debates, which is still ongoing and in 2018 celebrated the 50th years.

Although their work was seen as a very negative vision of the situation, the bad news is that they were almost right. As it is possible to see in figure 2.3, the trend predicted by the study in 1972 is almost equal to the trend observed between 1970-2000, and these information were published by the Meadows and Randers study which updated the report in 2012 (Meadows, 2012).

Each year we hear about the *"overshoot day"*: this day is calculated based on the ecological footprint[5] of each country in the world. In 2019, following the Global Footprint Network[6] , it was in July 29 which means that we have exhausted the *"Earth's budget"*[7] calculated for an entire year in 9 months. Based on the data referring to year 2019, this network estimated that are needed 1,75 planets for the current human demands, and this data exceeds 1 since 1970, as shown in fig. 2.2. This data is another demonstration of the negative impact of human life on the planet Earth. According to the United Nations indeed *"If current trends continue, the global per capita use of*

3 https://www.clubofrome.org/report/the-limits-to-growth/
4 https://www.clubofrome.org/about-us/
5 *"The Ecological Footprint is the only metric that compares the resource demand of individuals, governments, and businesses against what Earth can renew"*. Retrieved from https://www.footprintnetwork.org/
6 https://www.footprintnetwork.org/our-work/earth-overshoot-day/
7 *"the biological resources our planet can renew"* Retrieved from https://www.overshootday.org/

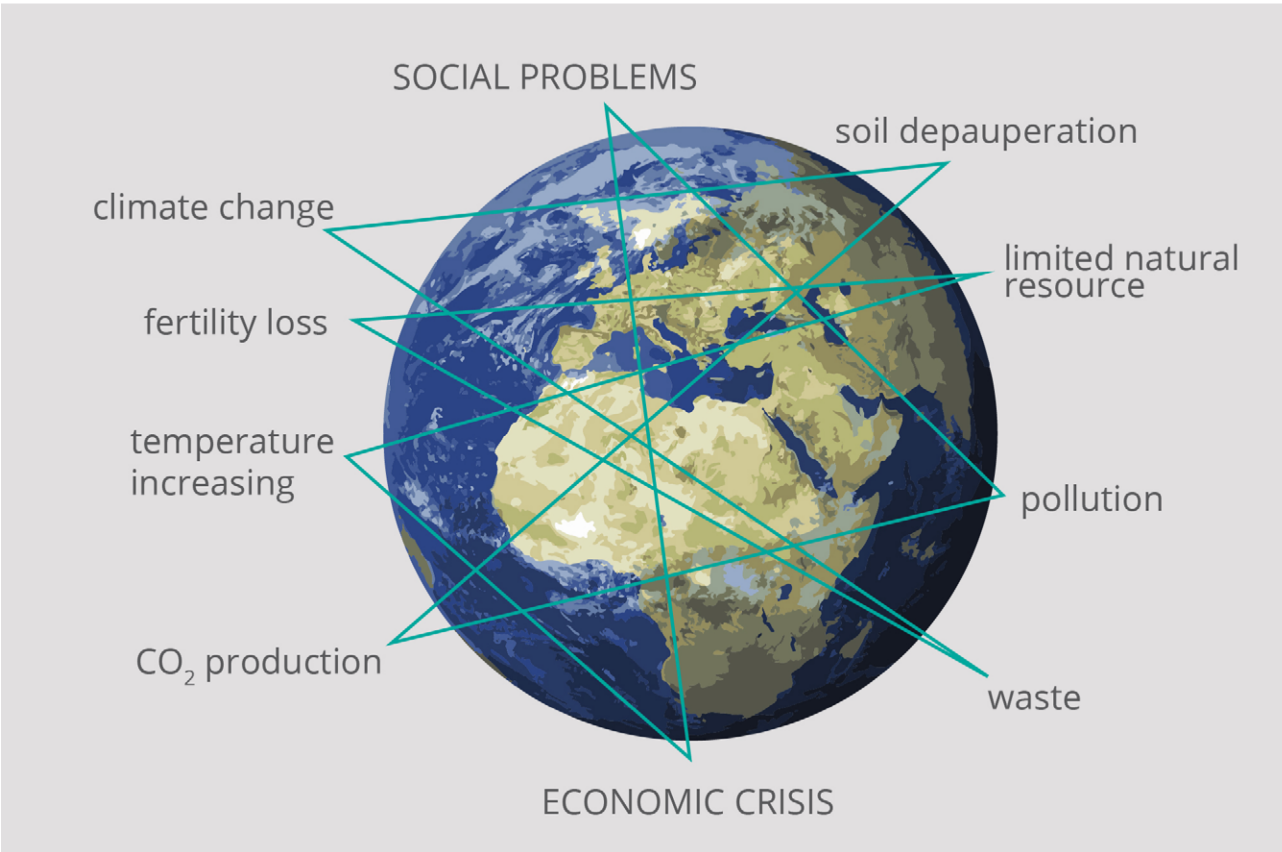


Fig. 2.4 - Visual representation of the interconnected current global problems

natural resources will increase by 70 per cent by 2050”.[8]. Moreover, following Randers and its work in 2012, the year 2052 seems the tipping point of non-return/collapse. Without a change, an increase in temperature of 2° becomes inevitable in the next 30 years (Randers, 2012). And two degrees is considered a lot for the natural ecosystem.

In the Paris Agreement, settled in the Paris climate conference (COP21) in 2015, 195 worldwide countries set out to limit the global emissions and stay below the 2° increase. It is the *“first-ever universal, legally binding global climate deal.”*[9]. However, it was not signed by every country in the world, as USA, even if it is a serious problem affecting on a global level.

The rising of the temperatures and the consequent climate changes is only one of the biggest problems which affects the current situation of our planet. The environmental problems have consequences on the economic and social conditions as well (fig. 2.4). According to Capra & Luisi (2014), the current major problems are related to: Energy, Environment, Climate change, Economic inequalities, Violence and War. And they are interconnected and interdependent. They indeed have effects at global level and are characterized by fast changes which increase the complexity of the situation. They are part of the irresolvable *“wicked problems”* mentioned by Rittel & Webber (1973).

8 https://www.unenvironment.org/explore-topics/green-economy

9 https://ec.europa.eu/clima/policies/international/negotiations/paris_en

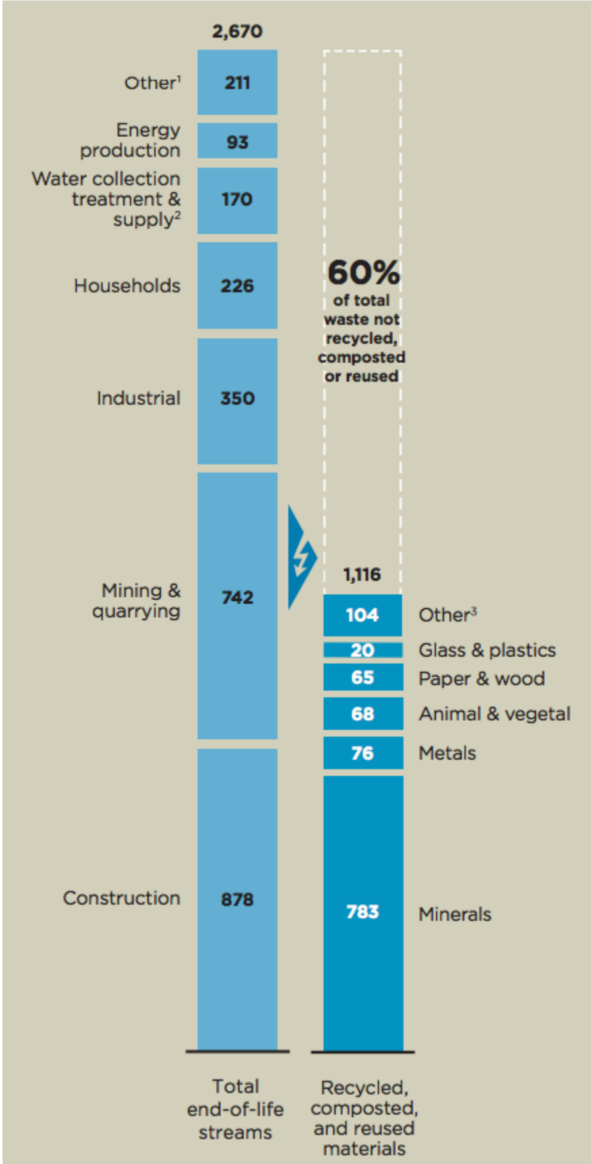


Fig. 2.5 - Representation of the loss of millions of tonnes of materials in Europe. Retrieved from the report by MacArthur, (2013, pg. 16)

Fig. 2.6 - Eurodata on waste generation in EU 28. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/images/8/8b/Waste_generation%2C_excluding_major_mineral_wastes%2C_EU-28%2C_2004-2016_%28million_tonnes%29.png

Waste generation, excluding major mineral wastes, EU-28, 2004-2016
(million tonnes)

	2004	2006	2008	2010	2012	2014	2016	Rate of change 2004 -2016 (%)
Total	940.0	942.3	903.4	863.1	866.0	880.3	904.9	-3.7
Agriculture, forestry and fishing	63.1	57.4	46.2	20.7	21.0	18.3	20.5	-67.6
Mining and quarrying	10.4	7.1	10.1	7.9	7.8	7.9	7.2	-31.4
Manufacturing	271.4	250.5	236.6	200.9	187.5	185.9	191.2	-29.6
Energy	92.2	100.0	88.8	81.6	93.4	90.1	76.1	-17.4
Waste/water	110.9	110.2	130.1	144.8	177.5	209.2	228.0	105.7
Construction	39.3	45.2	38.7	46.0	42.9	41.9	40.9	3.9
Other sectors	147.7	160.9	140.6	146.8	128.5	124.4	132.3	-10.4
Households	205.0	211.0	212.3	214.4	207.4	202.7	208.7	1.8

Source: Eurostat (online data code: env_wasgen)

eurostat

2.1.2 The linear economy and the consequences on the manufacturing sector

One of the enemy of the current environmental situation is identified by many scholars and studies in the economic model which has characterised the last centuries: the linear economy which follows the Take-Make-Waste/Dispose industrial and economic model (McDonough & Braungart, 2009; Ellen MacArthur foundation,2013 ; European Commission, 2014; Stahel, 2019). This economic model has also produced a linear consumption with many limits, as explained by the report of Ellen MacArthur foundation *"Towards the Circular Economy"*: producing waste in the production chain and in the end-of-life of products, loosing tonnes of materials and value (fig. 2.5) and producing the erosion of ecosystem services considering that about 60% of the waste are not recycled, composted or reused (Ellen MacArthur foundation, 2013).
Considering the manufacturing sector, Eurostat reported about 191 millions of tonnes of waste for the 2016 (last data available) (fig. 2.6).
McDonough and Braungart defined this linear model the *"cradle to grave industrial manufacturing model of the Industrial Revolution"* (McDonough & Braungart, 2009, cover) that is *"focused on making a product and getting it to a customer quickly and cheaply without considering much else"*(McDonough & Braungart, 2009, p. 26) producing waste and pollution. For Gunter Pauli it is the *"red economy"*, the economy of scale which caused the global crisis of 2008. In this model, businesses are looking for always cheaper production costs and consumers are pushed to consume and spend always more. It is an economy which borrows from the Nature, the humanity and the common goods without considering how to pay the debt (Pauli, 2010). Kate Raworth in her work, arguing about the overshot of the planet boundaries, indicates one of the causes of the current economic crisis in the economists and their education which is based on old models and the belief in an infinite growth (Raworth, 2017).
The linear economic model has permitted in the last century a great development, however nowadays we are assisting to an economic and ecological crisis, that needs a revolution from the foundations. As represented in fig. 2.7 based on the work of

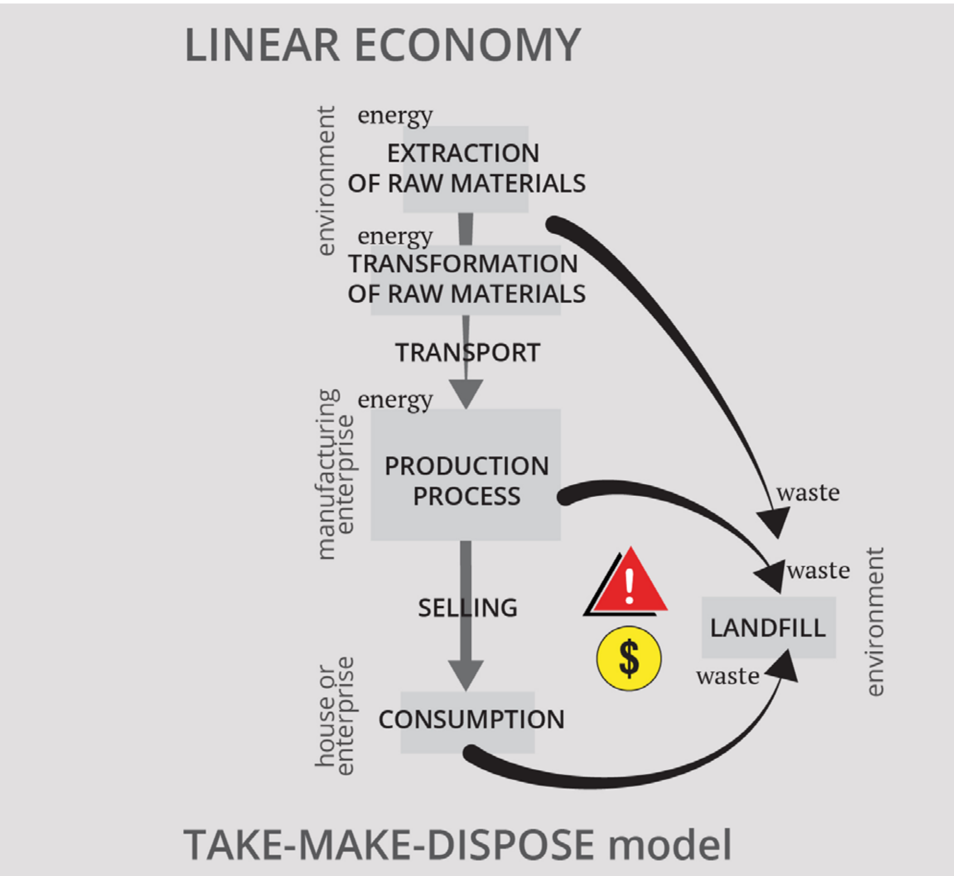


Fig. 2.7 - Visual representation of the linear economic model. Based on the works by McDonough & Braungart (2009); MacArthur (2012) ; Pauli, (2010); Stahel (2019)

(McDonough & Braungart, 2009; MacArthur, 2012; Pauli, 2010; Stahel, 2019), the current economy is a consequence of the productive model which starts from the extraction of raw materials or of buying of semi-finished matter which are transformed by several processes implying tons of energy to produce at the end a final product which is sold to the client. This cycle already involves tons of energy and natural resources and human capital. For example, the industry sector in 2005 used the 17% of the total primary energy consumption of the continent (European Commission, 2006, p.13). Moreover, this model is responsible for the creation of tons of waste, both in the production phase, in the consumption phase and in the disposal phase of the object/product. Moreover, it has high costs, both in terms of money and in terms of ecological costs. As highlighted for example by (McDonough & Braungart, 2009), *"more than 90% of materials extracted to make durable goods in USA become waste almost immediately"* (McDonough & Braungart, 2009, p27).

After the production phase, the object is sold and arrives in the hand of the clients which used it and throw it away immediately when it is no more in line with the fashion trends. This behaviour certainly is fed by the markets and the marketing strategies, and goes in cycles always faster due to the quick development of the technologies in the last century.

2.1.3 Design in the linear economy: impact

In this environmental, economic and social framework, what is the role of design and its impact? Although Design is quite challenging to define for the multiple definitions that over the years many thinkers have adopted, the field related to product design is very close to the manufacturing sector and needs to intermediate among the production requirements and user and market needs. Although the discipline is quite young, only from 1920s-1930s (Margolin, 2010), and has difficult boundaries as Margolin referring to Buchanan stated *"design does not have a subject matter in the traditional sense of other disciplines and fields of learning"* (Margolin, 2010, pg. 71), scholars have also focused on the responsibility of designers in the shaping of the future, as Margolin, Papanek, Thackara, McDonough and Braungart. Margolin insisted on the role of designers, which are trained with contributions by multiple diverse disciplines, in *"building of a more humane world"* and in their essential role in the manufacturing sector *"Companies would have nothing to manufacture without designers, nor would they have services to offer."* (Margolin, 2007, pg. 4). Papanek has added another point in this discussion: in the book *"Design for the real world"* he has put the focus on the responsibility of designers for the harms of the discipline, referring to the impact of decisions taken in the design process to the human being and the implications of the morality of designers (Papanek & Fuller, 1972). In addition to the social responsibility, Thackara has raised the attention on the responsibility of the design process for the environmental situation based on his statement in the introduction:

"Eighty percent of the environmental impact of the products, services and infrastructures around us is determined at the design stage. Design decisions shape the process behind the products we use, the materials and energy required to make them, the ways we operate them on a daily basis, and what happens to them when we no longer need them. We may not have meant to do so, and we may regret the way things have turned out, but we designed our way into the situations that face us today." (Thackara, 2006, pg 1).

Both McDonough and Braungart have discussed about impact of design to environmental situation in their works *"Cradle to Cradle – Re-making the way we make things"* (McDonough & Braungart, 2009). Indeed they stated that the model *"Cradle to grave"* (McDonough & Braungart, 2009, p27) has dominated modern manufacturing sector. This reflects the role of design in the decisions made in the manufacturing sector to avoid that the goods produced with a large amounts of raw materials and energy go to the landfill, increasing the amount of waste produced by the modern society, wasting their values rapidly.

Many other scholars have tried to count the impact of design on the environmental situation:

- *"almost 8% of the costs of product development, manufacture and use are determined in the design stage (Mascle & Zhao, 2008)."*(Bhamra, Hernandez, & Mawle, 2013,pg 2);
- *"More than three out of four decisions directly influencing the final choice of materials and manufacturing processes are made in the design phase."*(Valade-Amland, 2011, p 22)
- *"Amory Lovins calculates that by the time design for most human artifacts is completed, but before*

they have actually been built, 80 to 90 percent of the economic and ecological costs of their lifecycles have already been made inevitable". (McBride, 2011, pg 12 citing P. Hawken, A. Lovins, and L. H. Lovins (1999).)

Design, as traditionally known, is responsible for the high impact on the environment caused by all the phases of the products life cycle, and the design phase is crucial to obtain different results and impacts over the environmental situation, but also over the economic and social ones.

These authors have warned about the responsibility of the design phase. On that scenario, how to deal with the necessity to change the way to design for a complex world to assure a more sustainable future? What strategies for change must designers and industries follow, but also communities and governments? Which paradigm shift should happen? How to deal with such complexity towards a sustainable future for resilient territories where we are living and acting?

box 1.1 the term 'design' in Italian language

In the Italian context, the misunderstandings around the term 'design' are multiplied for a language problem: the term was translated in 'disegno industriale' that can be translated in drawing for the industry, which has reduced the concept only to giving shape to something that need to be produced by the industry. Celaschi remembers that also in English the word is origin of misunderstanding as it is both a name than a verb, so it is both an intention/process than a results/goal using the words of Vilem Flusser (Celaschi & Deserti, 2007,p.22)

2.2 THE ROAD TO SUSTAINABILITY

"People, profit, planet"

They are the three actors usually related to the concept of Sustainability that, according to the triple bottom line definition (McBride, 2011), it has to be pursued at social, economic and environmental level. This concept has contributed to move from traditional business logic that only takes in consideration profit/loss (the bottom line) and it has been central in the international discussions.

The report of the World commission on Environment and Development of 1987, Our common future, started to shape the concept of development with the introduction of 'Sustainable Development' that is defined as *" [...] to ensure that it (development) meets the needs of the present without compromising the ability of future generations to meet their own needs"* (Mitlin, 1992). From this point, it was an argument of central discussion in the next conferences as the United Nations Conference on Environment and Development (Earth summit) in Rio de Janiero in 1992 and in 1993 where the Commission on Sustainable Development was established[10] .

According to the review by Mitlin (1992), the concept started to appear in the 1970s with the report of the Club of Rome *"The Limits to Growth"* (Meadows et al., 1972) that demonstrated/analysed the consequences of pursuing an infinite growth within a finite World. Later, in the 1980s a vivid debate arose around the combination of the concepts of Economic Development and Sustainable Development, also because it involves the understanding of the meaning of development and the conditions necessary for sustainability (Mitlin, 1992).

The reports of the World Bank show how the Sustainable Development starts to become the basement for a new developmental paradigm (The World Bank, 2004; 2007; 2009). In 2012 at the Rio+20

10 *"the United Nations high level political body entrusted with the monitoring and promotion of the implementation of the Rio outcomes, including Agenda 21"* Retrieved from https://sustainabledevelopment.un.org/resourcelibrary

Fig.2.8 - Representation of the 17 sustainable development goals. Retrieved from https://www.un.org/sustainabledevelopment/news/communications-material/

Conference the members expressed the commitment to create the Sustainable Development Goals as a development of the Millennium Development Goals, and a post 2015 development agenda. In 2015 the UN member states adopted the 2030 Agenda for Sustainable Development which is based on 17 Sustainable Development Goals (SDGs)(fig. 2.8) and 169 associated targets as a concrete call to action at global level.[11].

The debate around the concept of *"economic development"* has brought also to the one of on 'local economic development' which indeed focuses the attention on the impact on the local territory. According to the World Bank:

" The purpose of local economic development (LED) is to build up the economic capacity of a local area to improve its economic future and the quality of life for all. It is a process by which public, business and nongovernmental sector partners work collectively to create better conditions for economic growth and employment generation." (The World Bank, 2003).

The territory becomes another main actor in the debate around the concept of development which has focused the attention on it and on the valorisation of its resources.

Recently, the discussions about a more sustainable future have become more frequent for the need to act in the short term. This urgency to act is also reflected by the title of the last report of the Club of Rome, with contributions by most of the members, that is *"Come on!"*. This title is emblematic because, according to them, the humanity has no more time to invert the path that the climate has taken. This report was prepared for celebrating the 50th years anniversary in Rome in October 2019 and it is also about other global issues: the impact of Capitalism, the short-terminism, the exponential growth of the population and even the destruction of the planet if something doesn't change (von Weizsacker & Wijkman, 2017).

It's clear that the current situation is made of the so called *"wicked problems"*, described as a trivial and enduring situation that cannot be solved immediately due to its inner complexity and its exogenous/endogenous relations (Brown & Wyatt, 2010) which have become more interconnected than ever before. This means that the road to a more sustainable paradigm is only possible through a radical transformation in how human society operates (Ramage & Shipp, 2009; Capra & Luisi, 2014).

The positive thing is that many solutions have been presented to change the path and develop a more sustainable strategy for the future. Many alternative models in different fields were proposed: from a cultural paradigm shift, to different alternative economic models to put in practice, to also different approaches to follow and tools to use in the design process for a sustainable production and consumption.

Considering the European context, the European Union has an ambitious target for year 2050: the climate neutral economy[12]

2.2.1 Alternative cultural paradigm

"Systemic and inter-connected problems need systemic and inter-connected solutions." (Brown & Wyatt, 2010).

"To make sense of the complexity of the world, we need to look at it regarding wholes and relationships rather than splitting it down into its parts and looking at each in isolation" (Ramage & Shipp, 2009)

Both these captions are referring to the need of a new approach and cultural paradigm to tackle the current complex situation: a holistic and Systems Thinking (ST), which following Fritjof Capra, one of the major contemporary thinkers on it, it has just represented a *"turning point"* (Capra, 1982) for many disciplines. This holistic and ecological view of life (Capra & Luisi, 2014) can represent a shift from the Cartesian and Newtonian mechanism (linear model) which has affected the way of thinking and of making economy until now. This cultural paradigm has its roots in the contributions of some disciplines such as psychology, biology and e ecology between 1920s-1930s. Later, two schools of thoughts - the General systems theory by L. Von Bertalanffy and Cybernetics mainly represented by Norbert Wiener - have contributed to the starting point of the shift which took place with the discoveries in physic of the quantum theory (Capra & Luisi, 2014). Ramage and Shipp in 2009 collected the major thinkers on ST in the history as it is shown in fig. 2.9 (Ramage & Shipp,

11 https://sustainabledevelopment.un.org/sdgs

12 see https://ec.europa.eu/info/energy-climate-change-environment/overall-targets/2050-targets_en

2009).

The theory of system which suggested that *"the whole is greater than the sum of its parts"* (Aristotle), or better *"the whole is OTHER than the sum of its parts"* (Koffka) from Gestalt theory, has determined a property of systems that have changed completely the way to see complexity.

This thought comes from the knowledge on living systems which applied to other systems created by the human being is able to design something sustainable as the Nature does.

"Thinking in systems means looking at the wholes, going over the single components and focusing the attention on the relationships and connections [...] ST in practical means to zooming out from the single part, considering its relations with its surroundings and other ecosystems, applying a qualitative approach more than quantitative, mapping the situation more than measuring, using a multidisciplinary approach" (Battistoni, Giraldo Nohra, & Barbero, 2019, p.6).

Donella Meadows, one of the author of *"Limits to growth"*, in another work defined ST as *"a way of thinking that gives us the freedom to identify root causes of problems and see new opportunities"* (Meadows, 2011,.p.2) in a world in rapid change and increasing in complexity. Her works explains with simple words many concepts of the System Theory as the concept of system: *"A system is a set of things—people, cells, molecules, or whatever—interconnected in such a way that they produce their own pattern of behavior over time"* (Meadows, 2011, p.2) [...] *"a system must consist of three kinds of things: elements, interconnections, and a function or purpose."* (Meadows, 2011)p.11. She also defined the system behaviour over time with the example of the bathtub for the stock and flows model; the mechanism of feedback loops which regulates the action, balancing or reinforcing it; the system boundaries which create an identity and not isolation although *"systems rarely have real boundaries"* (Meadows, 2011, p. 95), but they are needed by the mankind to define the system according to its purpose otherwise it is an endless concept; the interdependence between each part of a system and between the system and its environment; and so on.. She was also able to define the 12 system leverage point which are the places to intervene in a system from low to high impact (Meadows, 2011)(see tab. 1.1)

In this Anthropocene era, ST as a new cultural paradigm should affect and contaminate both our way of thinking than the economic and productive

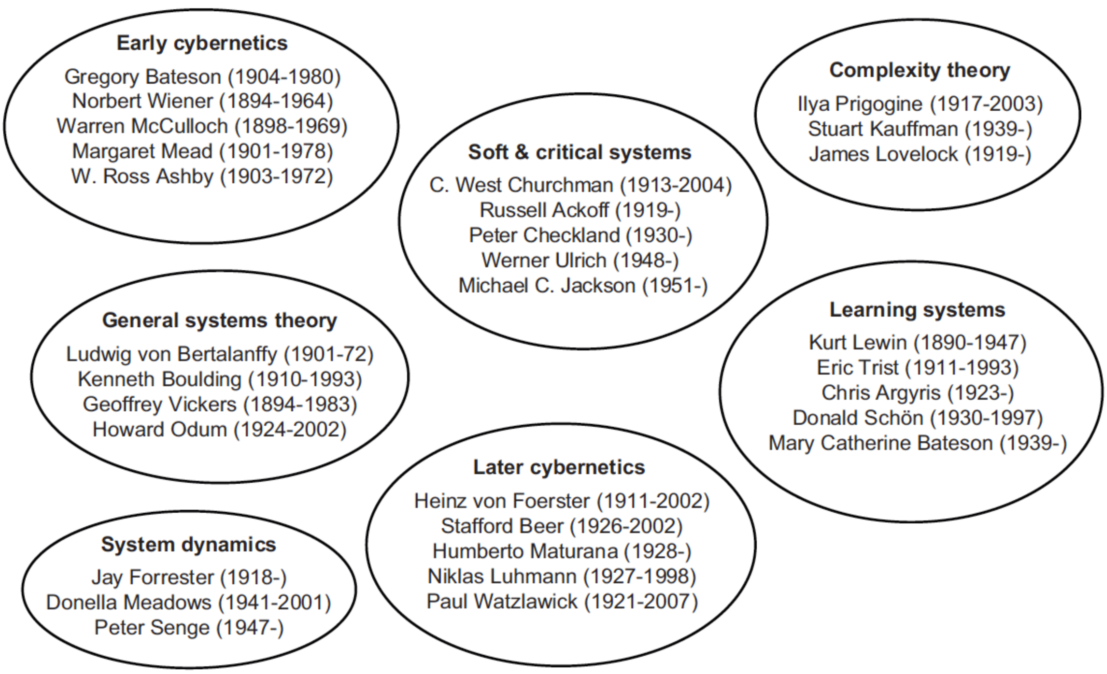


Fig. 2.9 - Representation of the Systems Thinkers. Retrieved from Ramage and Shipp (2009)

Tab. 2.1. the leverage points by Meadows D. (2011)

n°	name	description
12	Numbers	Constants and parameters such as subsidies, taxes, standards
11	Buffers	The sizes of stabilizing stocks relative to their flows
10	Stock-and-Flow Structures	Physical systems and their nodes of intersection
9	Delays	The lengths of time relative to the rates of system changes
8	Balancing Feedback Loops	The strength of the feedbacks relative to the impacts they are trying to correct
7	Reinforcing Feedback Loops	The strength of the gain of driving loops
6	Information Flows	The structure of who does and does not have access to information
5	Rules	Incentives, punishments, constraints
4	Self-Organization	Incentives, punishments, constraints;
3	Goals	The purpose or function of the system
2	Paradigms	The mind-set out of which the system—its goals, structure, rules, delays, parameters—arises
1	Transcending Paradigms	

models. Researchers indeed agree that the concepts of network and interconnection are able to tackle the current complexity and give an answer to the need on sustainability on social, economic and environmental aspects. As P.H. Jones wrote *"Systems theory and its guidelines in practice – Systems Thinking - have been promoted as the best techniques for raising social awareness about interconnected complex systems, which might determine human destiny"* (Jones & Kijima, 2018, p. 92). This approach is also able to activate possible dialogues among different experts as technicians, economists, humanists and many more. Indeed, after the Age of Enlightenment, the division into discrete disciplinary areas increasingly causes a loss in the power to collaborate, something which is, however, required for the road to a more sustainable paradigm.

2.2.2 Alternative economic models

In the last century, many different economic models have come out with different names to try to provide an alternative to the current linear one, as: Green Economy, Bioeconomy, Doughnut Economy, Circular Economy, Blue Economy, Performance Economy,...

2.2.2.1 Green economy

The economic model promoted also by the United Nations Environment Programme is the Green Economy which they defined *"low carbon, resource efficient and socially inclusive"*[13] and according to this in 2008 they launched the Green Economy Initiative. With the raise of this model some new concepts have emerged, as 'resource efficiency', 'green energy', 'greenhouses emissions', which have started to pave the path to a different and sustainable development model which today is not yet widespread. However, as reminded by the economist Gunter Pauli, this model requires to the industrial world big investments without producing the expected diffusion and a kind of insuccess (Pauli, 2010, preface).

2.2.2.2 Bioeconomy

Another sustainable economic model emerged in the last century is the bioeconomy. *"The bioeconomy comprises those parts of the economy that use renewable biological resources from land and sea – such as crops, forests, fish, animals and micro-organisms – to produce food, materials and energy"*[14] is the definition by the European Union, which has adopted a Bioeconomy strategy in 2012: *"Innovating for Sustainable Growth: A Bioeconomy for Europe"*(European Commission, 2012) to prepare the path for a resource-efficient and sustainable economy in EU (fig. 2.10). For the European Commission, this economy can help to tackle different societal challenges: ensuring food security, managing naturals resources sustainability,

13 https://www.unenvironment.org/explore-topics/green-economy
14 https://ec.europa.eu/research/bioeconomy/index.cfm?pg=home

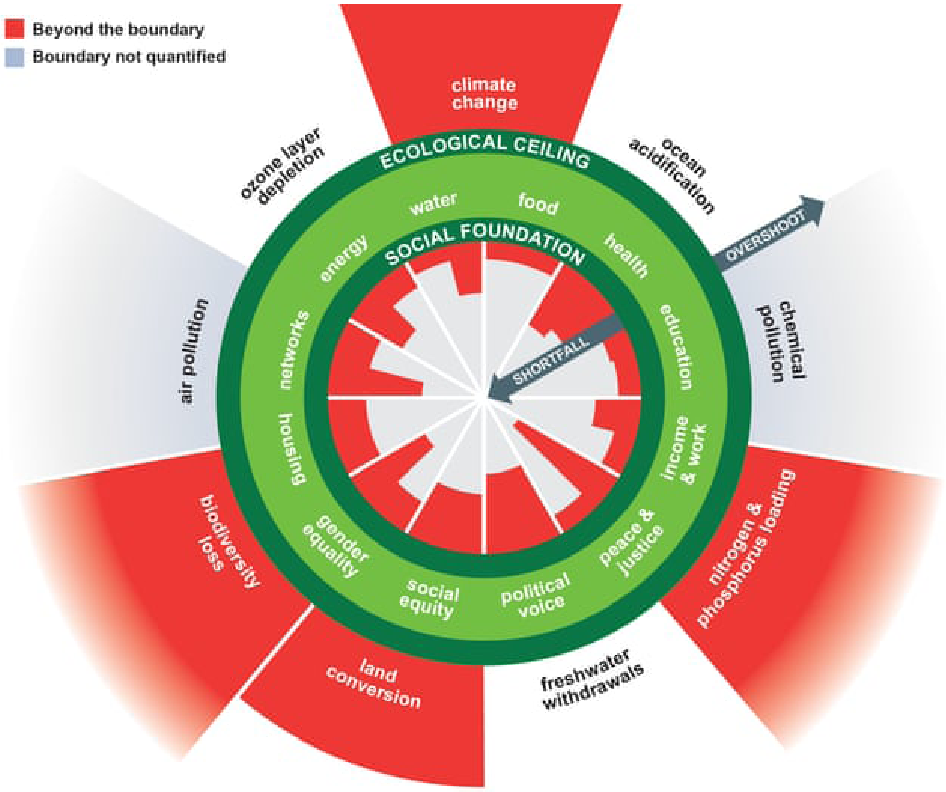


Fig. 2.11 - Representation of the safe operation zone for the humanity in line with the planetary boundaries. Retrieved from https://www.kateraworth.com/doughnut/

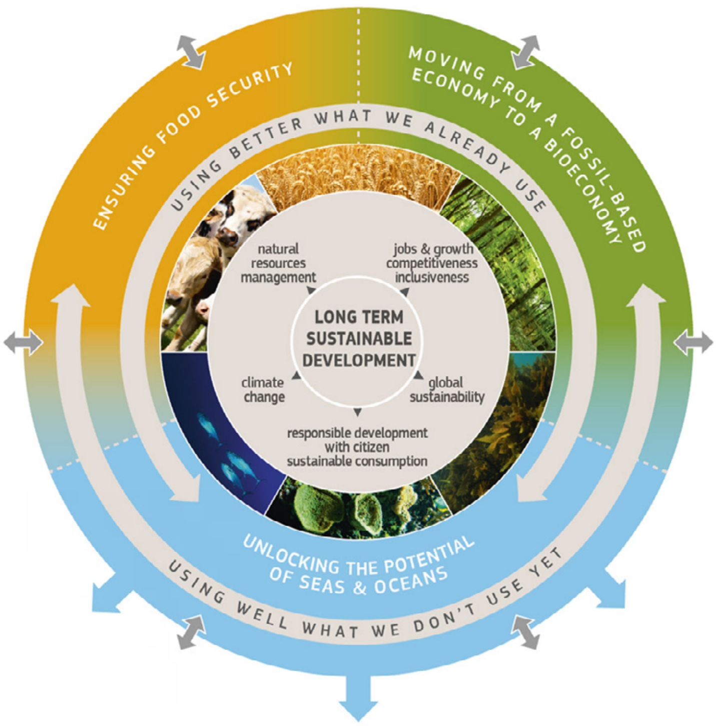


Fig. 2.10 - Representation of the 'bioeconomy' model. retrieved from http://ec.europa.eu/research/bioeconomy/images/bioeconomy_graphic_full.jpg

reducing dependence on non-renewable resources, mitigating and adapting to climate change, creating jobs and maintaining European competitiveness (European Commission, 2012).
The Bioeconomy is based on renewable biological resources and their use as food, feed, bio-based[15] materials and bio-energy instead of fossil-based ones. This approach has let led to the birth of the concept of 'biorefineries'(European Commission & Directorate-General for Research and Innovation, 2014).
One of the most controversial things of the Bioeconomy is the supply of 'biomass'[16] which has become the primary source to replace the fossil fuels. For example, the possibility to produce bio-based materials and energy from biomass as bioethanol from corn, at the beginning has caused a revolution in agriculture, losing lands to produce food, and also in the market where there was a raise in the price of this crop, as demonstrated by the crisis in USA in 2007-2008 (FA0, 2009). However, the quantity of biomass useful to produce energy or bio products can come from many waste produced by some marginal productive chains, like using only stems and leaves, as remembered by the example of Novamont in Italy, producing bioplastic from thistle stems, reported by Gunter Pauli in the last book Pauli (2017). For this reason, the EU has introduced three challenges to unlock the potential of this economy: produce enough biomass without overexploitation; reduce greenhouse gases related to land use and biomass production; ensure economically viable biomass for all operators in the chain (European Commission & Directorate-General for Research and Innovation, 2014).

2.2.2.3 Doughnut economy

Another economic model that has recently emerged is the one defined by Kate Raworth, a member of the Club of Rome, with her book in 2017 (Raworth, 2017): the doughnut economy. With the term 'doughnut' she refers to the safe zone for the humanity where to operate according to the planetary boundaries, represented in green in fig. 2.11, taking this concept from Rockström and colleagues of the Stockholm Resilience Center. This space takes in consideration 12 factors: food, health, education, income & work, peace and justice, political voice, social equity, gender equality, housing, networks, energy and water (Raworth, 2017)..
In her work, she also has identified a problem in the economist education which has remained locked to traditional economic theories. For this reason, she also pushed for a change in the mentality of the 21st-century economists proposing 7 steps (Raworth, 2017) [17] to move from the 20 century mentality:

1. Change in the goal of the economy: from GDP to the Doughnut;
2. Tell a New Story: From the neoliberal narrative to a story fit for our times;
3. Nurture Human Nature: From rational economic man to social adaptable humans;
4. Get Savvy with Systems: From mechanical equilibrium to dynamic complexity;
5. Design to Distribute: From 'growth will even it up again' to distributive by design;
6. Create to Regenerate: From 'growth will clean it up again' to regenerative by design.
7. Be Agnostic about Growth: From growth addicted to growth agnostic

According to these recommendations, she embraced the need of a ST for an economic model that is distributive and regenerative by design.

2.2.2.4 Circular Economy

Since 2014, the European Union has started to talk about a new economic model, the Circular Economy (CE), as demonstrated by the document *"Towards a Circular Economy: A zero waste programme for Europe"*(European Commission, 2014). From this

15 "Bio-based products are products that are wholly or partly derived from materials of biological origin, excluding materials embedded in geological formations and/or fossilised, CEN - Report on Mandate M/429" European Commission, 2012) p.9

16 "Biomass can be of forestry, agricultural or aquatic origin, either virgin or as residue. It is defined by the European Committee for Standardisation (CEN/TR 16208:2011) as material of biological origin excluding material embedded in geological formations and/or fossilized. CEN cites as examples of biomass: (whole or parts of) plants, trees, algae, marine organisms, micro-organisms, animals, etc"(European Commission & Directorate-General for Research and Innovation, 2014)p. 11

17 in her website is possible to find a video animation explanation about it https://www.kateraworth.com/animations/

moment, the EU has exposed an explicit commitment to the CE model including it in its economic strategy in 2015 *"Closing the loop–an EU action plan for the circular economy."* (European Commission, 2015).

"The transition to a more circular economy, where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimised, is an essential contribution to the EU's efforts to develop a sustainable, low carbon, resource efficient and competitive economy. Such transition is the opportunity to transform our economy and generate new and sustainable competitive advantages for Europe". (European Commission, 2015).

This decision has put Europe in a forefront position in fighting waste production and in the will to move to a more sustainable economic model with the consequent impact on the climate change situation. This strategy is mainly based on four topics: the production phase (product design and production processes), consumption, waste management and from 'waste to resources', considering measures as 'waste prevention', 'ecodesign' and 'reuse'. Some studies were developed to understand also the impact of this strategy on the economy of EU, as the one by AMEC (2013): *"[A circular economy] could bring net savings of € 600 billion, or 8 % of annual turnover, for businesses in the EU, while reducing total annual greenhouse gas emissions by 2-4%"* (AMEC, 2013).

Looking for definition of the CE concept unfortunately is an endless process. Many actors and scholars have tried to give one. This has created a concept which is possible to cite talking about many different things, from the simple waste management to the recycle and reuse approach, to the closing of material cycles in productive systems. For example, Lieder and Rashid (2016) identified in a literature review about CE that *"Circular Economy relevant research.... has evolved primarily as research on waste generation, resource use and environmental impact while neglecting business and economic perspectives"* (Lieder & Rashid, 2016, pg. 47). The complexity of this concept is well known among scholars: the review of Korhonen et al. defined it indeed as *"an essentially contested concept"*(Korhonen, Nuur, Feldmann, & Birkie, 2018). They stated that the current literature is focused on practical and technical aspects (tools, instruments, ..) related to the flows of energy and matter in production and consumption systems, while is lacking attention on cultural and social values of CE potential. Finally, they proposed a working definition which includes the material structure and the socio-economic one:
"CE is a sustainable development initiative with the objective of reducing the societal production–consumption systems' linear material and energy throughput flows by applying materials cycles, renewable and cascade-type energy flows to the linear system. CE promotes high-value material cycles alongside more traditional recycling, and develops systems approaches to the cooperation of producers, consumers, and other societal actors in sustainable development work". (Korhonen et al., 2018, p.547)

Since the exposition of the European Union, the scientific literature has seen an exponential increase in contributions about CE over multiple aspects as the definition as Millar et al. (2019), case-studies as Principato et al. (2018) and implementation barriers as Kirchherr et al. (2018). On 16 July 2018 there were 2.597 results in Scopus database and it was already registered an exponential increasing in the contributions over the years (see fig. 2.12-2.14). The analysis of the results by country see China and Europe in the first places and the analysis by subject area demonstrated the multidisciplinary of this subject: from technical area, to social science and economy (fig. 2.14). On 10 December 2018, Scopus database returned about 3.126 results (looking for 'Circular Economy' in Article title, Abstract, Keywords) and Web of Science 2.694 results (looking for 'Circular Economy' in all fields). This phenomenon is still in progress and it currently is a hot topic and sometimes even a 'buzz' word.

One of the most relevant actors which has worked on the definition of the CE concept is the Ellen MacArthur Foundation[18] which has dedicated its website and its work to the building of this concept and the diffusion of it, becoming a relevant reference. They defined this economic model as:

"Looking beyond the current take-make-waste extractive industrial model, a Circular Economy aims to redefine growth, focusing on positive society-wide

18 Ellen MacArthur is the founder, a retired sailor women, that in 2010 launched this charity foundation (see chapter 5 for more

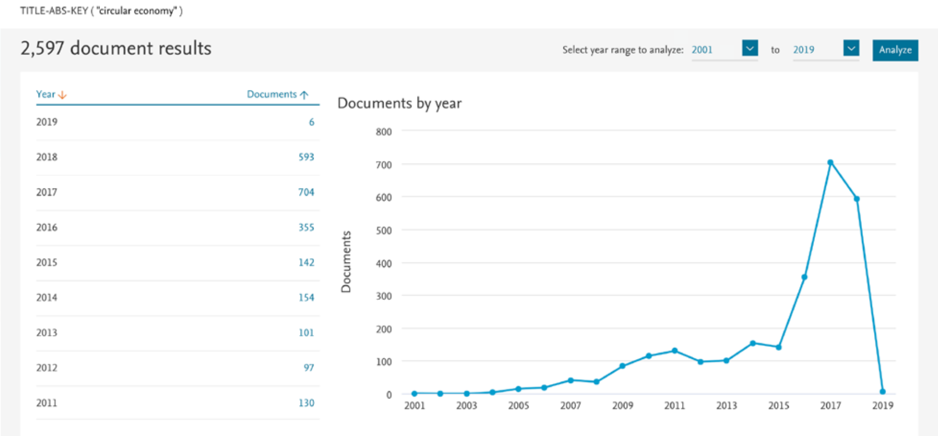


Fig. 2.12 - the increasing of results for the research of ‘Circular Economy’ in Scopus database. Graph retrieved by Scopus website based on the results of the 16 July 2018.

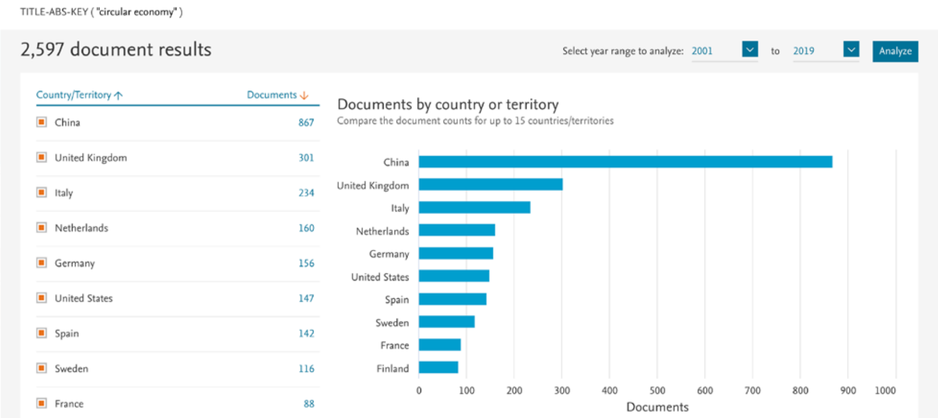


Fig. 2.13 - the results for the research of ‘Circular Economy’ in Scopus database divided for country. Graph retrieved by Scopus website

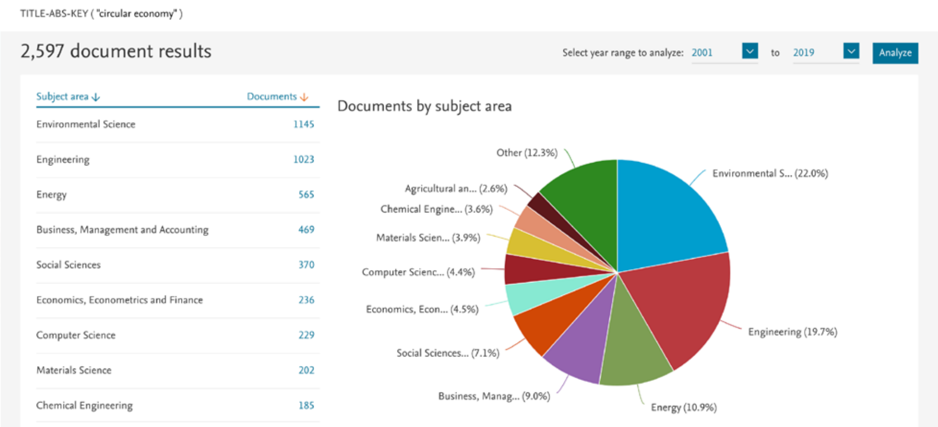


Fig. 2.14 - the results for the research of ‘Circular Economy’ in Scopus database divided for subject area. Graph retrieved by Scopus website based on the results of the 16 July 2018.

benefits. It entails gradually decoupling economic activity from the consumption of finite resources, and designing waste out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital."[19] . They underlined that this model is in contrast with the linear paradigm previously defined in chapter 2.1.2 . Indeed, this concept, so common nowadays, has the roots in these preceding schools of thought : Cradle to Cradle, Performance Economy, Biomimicry, Industrial Ecology, Natural Capitalism, Blue Economy and Regenerative..

Ellen MacArthur Foundation played an important role in the definition of the three basic principles on what the CE is based[20]:
- *"Design out waste and pollution;*
- *Keep products and materials in use;*
- *Regenerate natural systems"*

Moreover, they defined the essential building blocks of this concept[21]:
- Circular Economy design;
- new business models;
- reverse cycles;
- enablers and favourable system conditions.

The point on what they insisted more is *" A Circular Economy is one that is restorative and regenerative by design"*[22] . As it is possible to notice, the role of design is mentioned as essential. Indeed, for the implementation of this economic model becomes fundamental a different way to conceive the products in order to facilitate circular business models: reuse, share, maintain, remanufacture and recycle. They also developed the Circular Design Guide in collaboration with IDEO (see chapter 3.2.3.2.).

It has become common to use their 'Butterfly diagram' in presentations to explain what the CE is (fig. 2.15), it comes from Braungart and McDonough of the cradle to cradle concept. In it is possible to see how they distinguish between technical (blue) and biological (green) cycles, proposing strategies as:
- maintain/prolong, share, reuse/redistribute, refurbish/remanufacture, and recycle as strategy for putting in circle the technical elements,
- cascades, extraction of biochemical feedstock, regenerating and farming/collection for the biological one.

Many other graphical representations of the CE can be found, as the one by the journal Nature (fig 18) where they highlight how this economic model change all the phases of the value creation chain: resources extraction, manufacturing, distribution, use and innovation

According to this scheme, for example the manufacturing needs to renew used products which reduce the need to make new one from extracted resources. This can be seen as one of the aspects, however the transition to a CE will affects more greatly the manufacturing sector, which according to Garetti & Taisch (2012), due to its models related to old paradigms, will face a revolution in the near future for sustainability issues (Garetti & Taisch, 2012).

This economic model for its implementation requires indeed a profound radical change from the beginning of the process and at system levels. *"In order to change the system, you need to go to the root cause"* [23] .

The analysis about the CE was delved in this thesis for its importance in the European context and the sharing of goals with the SD approach. The actors that are currently working in the CE implementation and what are the barriers faced by this process were extrapolated in the next chapters.

2.2.2.4.1 Circular Economy in Italian Context

Italy, as the other European countries, has published a plan which includes the transition to a CE *"Verso un modello di economia circolare per l'Italia. Documento di*

information).

19 https://www.ellenmacarthurfoundation.org/circular-economy/concept

20 https://www.ellenmacarthurfoundation.org/circular-economy/concept

21 https://www.ellenmacarthurfoundation.org/circular-economy/concept/building-blocks

22 https://www.ellenmacarthurfoundation.org/

23 https://www.linkedin.com/feed/update/urn:li:activity:6489504501651902464

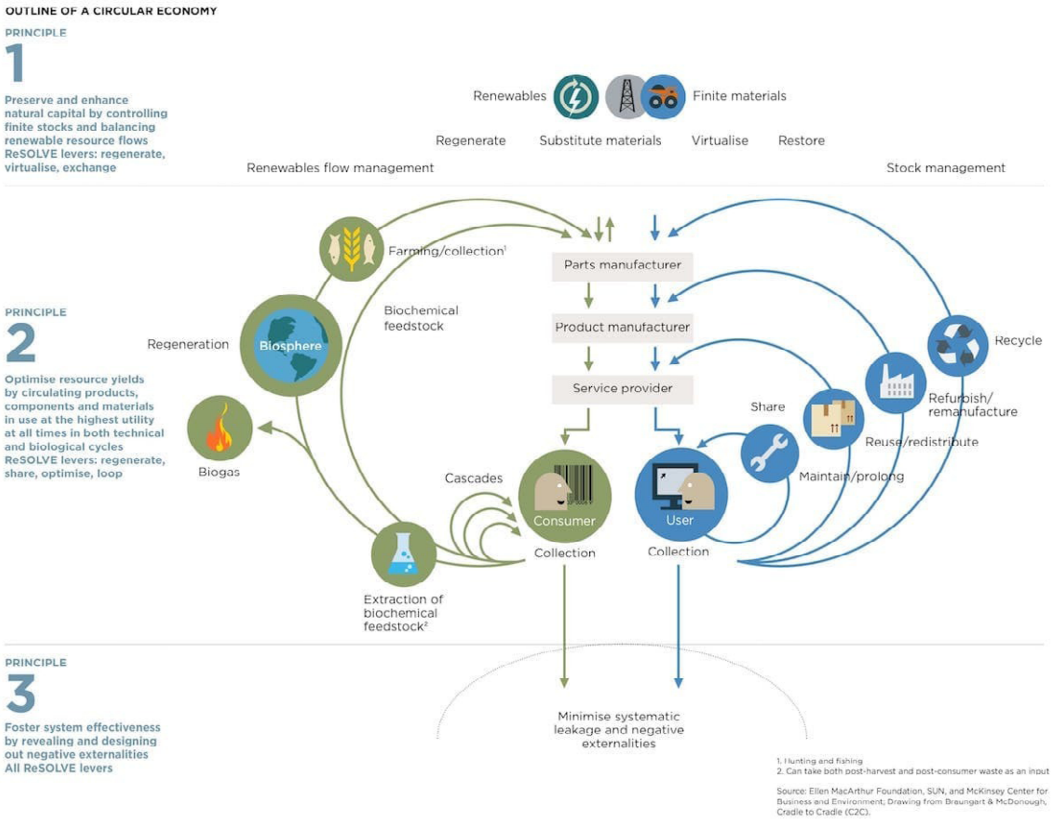


Fig. 2.15 -the butterfly diagram of the CE. retrieved from https://www.ellenmacarthurfoundation.org/circular-economy/infographic

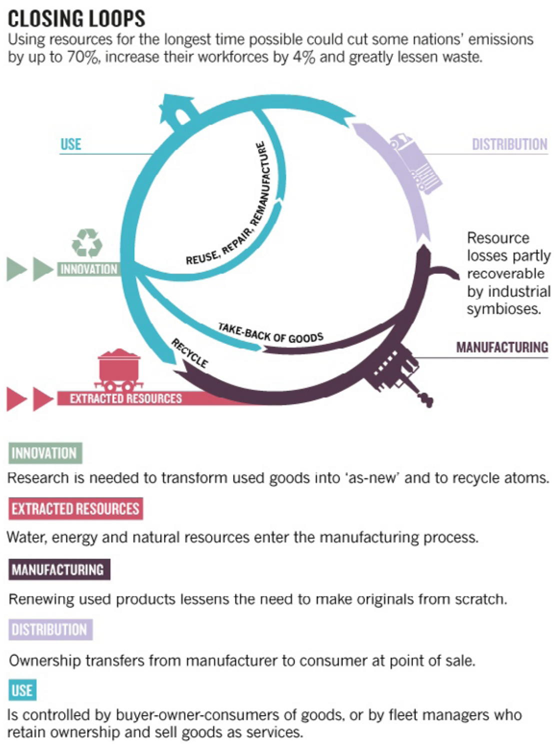


Fig.2.16 - the different elements involved in the Circular Economy. retrieved from https://www.nature.com/news/the-circular-economy-1.19594

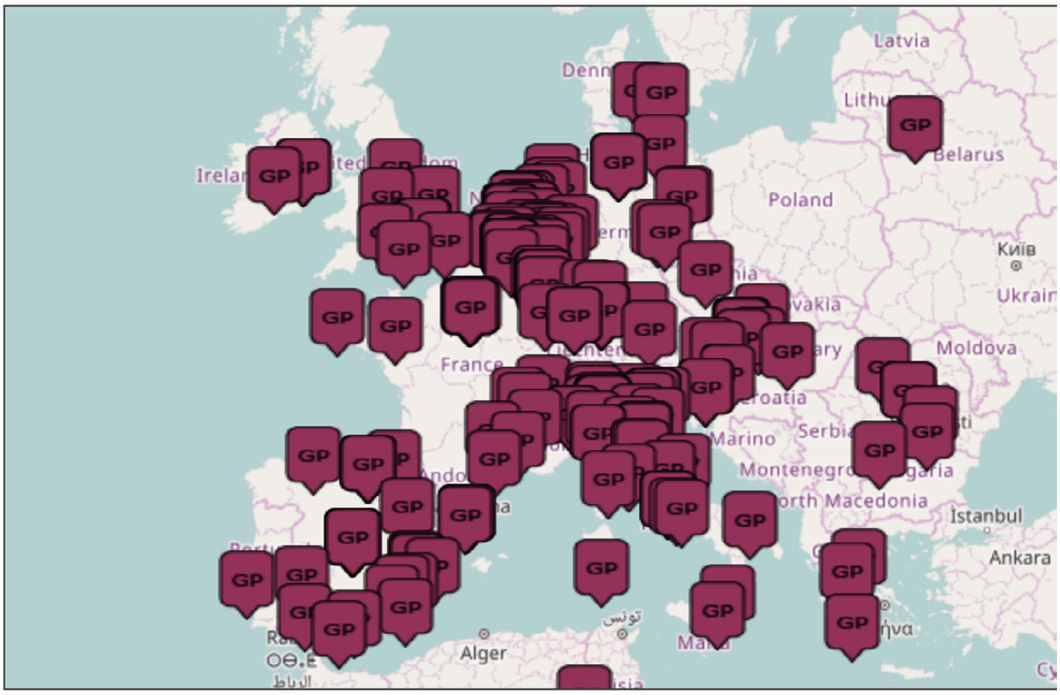


Fig. 2.17 - Map representing the Good practises of Circular Economy in Europe. Retrieved from https://circulareconomy.europa.eu/platform/en/map-search?type=cecon_good_practice&key_area=All&title=&submit=Search

inquadramento e di posizionamento strategico"(2017)[24] where it is underlined the necessity to work on it with the following strategies: regulatory revision, economic instruments, communication and awareness raising and research promotion. However, it was published only in November 2017 and very few actions were seen afterwards, maybe due also to the Italian political instability of the last years. In 2018, thanks to the minister of the environment Costa some changes have happened. Costa is the first to talk about it since his mandate in May 2018, which is quite in late in comparison to the European strategy. His works is contributing to the diffusion of this concept among the common citizens, which level of awareness, according to what I have perceived, remains very low.

In the Italian context, the concept of CE has started to be known outside the government in 2016 thanks to the book by Emanuele Bompan *"Che cosa è l'economia circolare"* (Bompan, 2016) published by Edizione Ambiente. This author, a geographer and journalist, became as a point of reference in Italy for this concept and he is attending many conferences as expert. Today he is the responsible director of 'Materia Rinnovabile/Renewable Matter'[25] , a magazine of Edizione Ambiente which has become the point of reference for article regarding topics as CE and sustainability in general.

In 2018 it was created also the 'circular economy network'[26] by Fondazione per lo sviluppo sostenibile, a foundation promoted by some Italian companies which is organizing national conferences, distributing an award and producing the report about the Italian situation about the CE since 2019.

The low political commitment seems balanced by the industrial sector which is moving in this direction: in the European database on the *"Good practises of Circular Economy in Europe"*[27] , a tool of the *'European Circular Economy Stakeholder Platform'*[28] , a research done on 17 June 2019 extracted among 230 practises

24 [Towards a circular economic model for Italy. Framework and strategic positioning document] Document retrieved from https://circulareconomy.europa.eu/platform/sites/default/files/national_strategy_for_circular_economy_11_2017_it1.pdf

25 http://www.renewablematter.eu/it

26 https://circulareconomynetwork.it/network-economia-circolare/

27 https://circulareconomy.europa.eu/platform/good-practices

28 A joint initiative by the European Commission and the European Economic and Social Committeehttps://circulareconomy.europa.eu/platform/en

published on the website, 37 of which are in Italy (fig. 2.17). This can reflect a diffusion of the concept between the industries in line with the rest of Europe, in contrast to a low interest and knowledge demonstrated by the citizens and political parties.

2.2.2.5 Performance economy

Walter Stahel, an architect founder and director of the Product-Life Institute in Switzerland, proposed the economic model of the ‘performance economy’ as a solution to transition from Linear Industrial Economy to Circular Industrial Economy (CIE) (Stahel, 2008; 2019). Since the linear industrial model ends at the point of sale, where the responsibility of the final product is transferred to the consumer. In this situation, the economy measures its success only in terms of gross national product (GDP), and the nation is not aware if its wealth is produced or not by the industrial flows. In the CIE framework the point of sale is a starting point and the goal is to maintain as much as possible control over all the life-cycles of stocks (objects or materials) produced by mankind. Moreover, the performance economy is the most sustainable business models of the CIE, where the economic actors sell services more than objects and entrepreneurs increase competitiveness reducing resource comsumption, without extrenalizing costs for waste management and risks (Stahel, 2019; 2008). However, *“The change from an industrial to a performance economy is full of opportunities but also obstacles.”* (Stahel, 2008).

2.2.2.6 Blue economy

“Let us not demand more of the earth. Let us do more with what the earth provides.” [29] (Gunter Pauli)

This economic model is inspired by how Nature works and has the goal to create profits and job places based on the abundance of the resources that Nature provides us at local level and the relationship among the 5 natural kingdoms (Pauli, 2010). *“The Blue Economy is Zeri*[30] *´s philosophy in action. Is where the best for health and the environment is cheapest and the necessities for life are free thanks to a local system of production and consumption that works with what you have”*[31].
It follows some basic principles which were published in the official website [32](see box 2.1)

This approach changes completely the current way to do economy, providing new definitions for example for innovative business models and competitiveness:

- *“Innovative Business Models are capable of bringing competitive products and services to the market responding to basic needs while building social capital and enhance mindful living in harmony with nature’s evolutionary path”* .
- *“Competitiveness is harnessing and optimizing the innate virtues and values connecting untapped local potential - like a natural system, where the seeds lie fallow only to sprout with amazing vigor at the first rain unleashing joy and happiness as the conditions for mind full-living are met in balance and in harmony”*[33] .

This economic model was defined by Gunter Pauli, a man member of the Club of Rome who is travelling the world inspiring millions of entrepreneurs everywhere to take action. In his first book, a report to the Club of Rome, he presented more than 100 innovations which in 10 years have produced 100 millions of job places. They are also published in open source in the website[34] where today there are 112 examples: from the multiple business opportunities derived from

29 http://www.rsd7.org/keynote_speakers/
30 Zero Emission Research and Initiatives foundation http://www.zeri.org/
31 https://www.theblueeconomy.org/principles.html
32 https://www.theblueeconomy.org/principles.html
33 https://www.theblueeconomy.org/principles.html
34 https://www.theblueeconomy.org/innovations.html

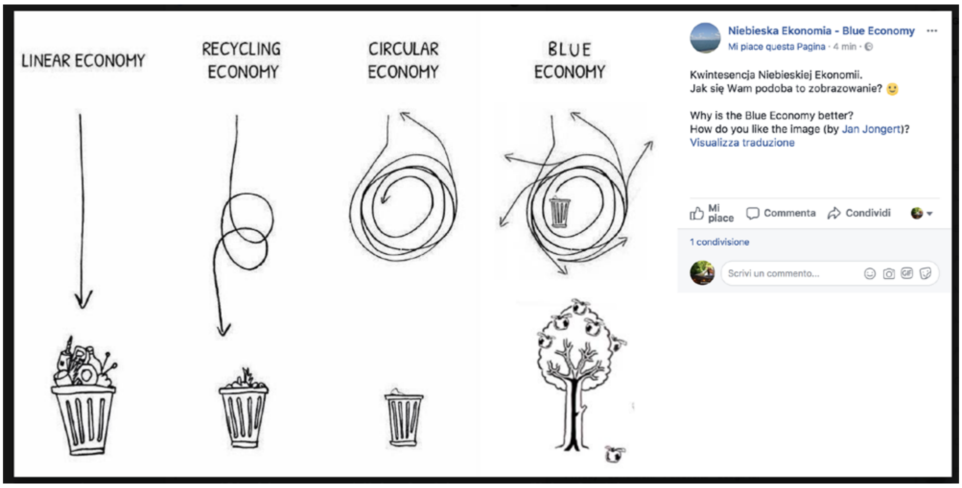


Fig. 2.18 - The differences between the linear economy, the CE and the blue economy. Retrieved from the facebook page of 'niebieska ekonomia-blue economy'. Images by Jan Jongert.

Box. 2.1 - The Blue Economy principles. Retrieved from https://www.theblueeconomy.org/principles.html

"The Blue Economy respond to basic needs of all with what you have, introducing innovations inspired by nature, generating multiple benefits, including jobs and social capital, offering more with less.

- *Solutions are first and foremost based on physics. Deciding factors are Pressure and Temperature as found on site.*
- *Substitute something with Nothing – Question any resource regarding its necessity for production.*
- *Natural systems cascade nutrients, matter and energy – waste does not exist. Any by-product is the source for a new product.*
- *Nature evolved from a few species to a rich biodiversity. Wealth means diversity. Industrial standardization is the contrary.*
- *Nature provides room for entrepreneurs who do more with less. Nature is contrary to monopolization.*
- *Gravity is main source of energy, solar energy is the second renewable fuel.*
- *Water is the primary solvent (no complex, chemical, toxic catalysts).*
- *In nature the constant is change. Innovations take place in every moment.*
- *Nature only works with what is locally available. Sustainable business evolves with respect not only for local resources, but also for culture and tradition.*
- *Nature responds to basic needs and then evolves from sufficiency to abundance. The present economic model relies on scarcity as a basis for production and consumption.*
- *Natural systems are non-linear.*
- *In Nature everything is biodegradable – it is just a matter of time.*
- *In natural systems everything is connected and evolving towards symbiosis.*
- *In Nature water, air, and soil are the commons, free and abundant.*
- *In Nature one process generates multiple benefits.*
- *Natural systems share risks. Any risk is a motivator for innovations.*
- *Nature is efficient. So sustainable business maximizes use of available material and energy, which reduces the unit price for the consumer.*
- *Nature searches for the optimum for all involucrated elements.*
- *In Nature negatives are converted into positives. Problems are opportunities.*
- *Nature searches for economies of scope. One natural innovation carries various benefits for all".*

coffee grounds, to the fish farming without feed, to the cleaning of water without sewer, and many more. His efforts to spread the message that a different economy is possible without theories but with concrete examples is continuing and evolving. In 2017 in the new book *"The Third Dimension"* he introduced 12 trends to construct a better strategy for the future with the goal to inspire entrepreneurs to change and act following a specific line: *"This is a strategy that's cheaper and more productive, creates resilience, and builds social capital. It offers a new dimension that was there all the time, but we never noticed it. We need better solutions, because business as usual is not an option. Simply improving on the fringes, and carefully reducing the negatives while shaving off the brute edges and acting politically correct, is not going to get us to a better place. We need breakthroughs!"*(Pauli, 2017, p.17)

This model can be considered an evolution of the green economy and CE with some points in contraposition as represented in tab 2.2 and fig. 2.18

12 TRENDS:
1. From 2D to 3D
2. From use what you can get to use what you have
3. From producing the cheapest to delivering the most value
4. From profits for a few to multiple benefits for all
5. From maximize to optimize
6. From standardization to diversity
7. From chemistry and genetics to physics
8. From biodegradable and sustainable to renewable
9. From control to resilience
10. From scarcity to abundance
11. From protecting nature to regenerating ecosystems
12. From the divide between the good and the bad to always being able to do better

Tab. 2.2 - The differences between the green economy, and the blue economy. Information Retrieved from youtube video https://www.youtube.com/watch?v=YYxEfhM10xs min 32:20

Green economy	**Blue economy**
Expensive	innovation
subsidies	competition
taxes	jobs
Cost reduction	Add value

2.2.2.7 Industrial ecology

Although it is not an economic model, the industrial ecology is recognized as one of the schools of thoughts behind the CE concept, as stated by the Ellen MacArthur Foundation[35] . Although it didn't produce a real economic model, it has many effects in changing the production models. Yet in the 90's many authors started to work on it, and the most famous cases of industrial ecology in action is the Kalundborg district in Denmark according to Korhonen (2001), analyzed by Ehrenfeld and Gertler in 1997.

According to Korhonen (2001), this concept emerged from scientific articles by Frosch and Gallopoulos (1989), Ayres and Ayres (1996) and Ehrenfeld and Gertler (1997) and refers to the analogy of ecosystem to industrial systems: *"Ecosystems are 'masters of recycling', recycling of matter and cascading of energy. The only input to the system is the solar energy from the sun and hence in theory the ecosystem metaphor provides a sustainable model of system development for industrial systems.". The industrial ecology has put the attention on regional industrial systems applying a systems approach: "we understand IE as a systems approach for facilitating cooperative regional industrial systems"* (Korhonen, 2001).

The part of industrial ecology that is concentrated on flows of energy and matter between industrial realities is called industrial symbiosis (fig 2.19). Many others contributions over industrial symbiosis have been published as the one by Chertow (2000) understanding industrial symbiosis literature and taxonomy.

2.2.3 Alternative design approaches

"Design in the 21st Century: Intentional Change in an Unpredictable World" Harold Nelson[36]

"Designers have the responsibility to rebalance the ratio between production, environment and society in order to maintain a vivid and mutual connection, as well as a fertile and multidisciplinary dialog among them" Luigi Bistagnino[37]

In a changing situation at environmental and economic level, design has questioned its role and relationships with a more sustainable paradigm and a more sustainable future. The results are the different approaches that have come out, as the Design for sustainability, Design for circular economy, Cradle to Cradle and Systemic Design. (see overview paragraph in chapter 1.2)

35 https://www.ellenmacarthurfoundation.org/circular-economy/concept/schools-of-thought

36 https://www.youtube.com/watch?v=mW7p3nixxok&feature=youtu.be

37 http://www.rsd7.org/keynote_speakers/

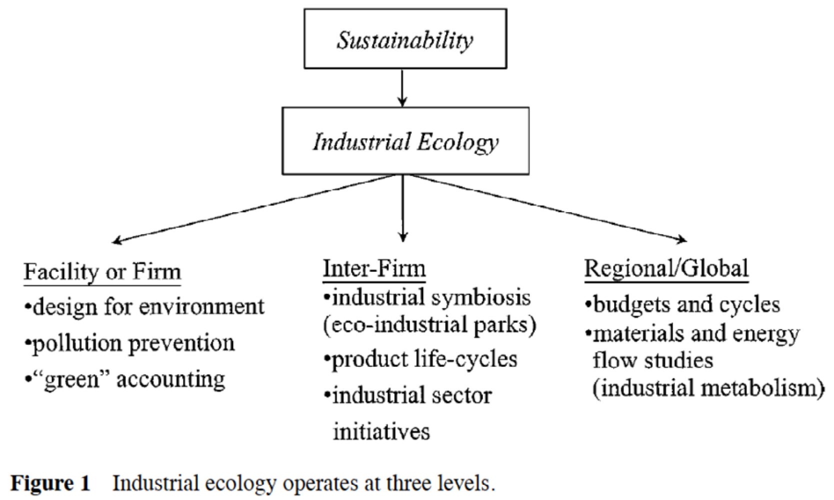


Fig. 2.19 - A figure retrieved from Chertow (2000) about the levels of operation of industrial ecology

2.2.4 The manufacturing sector in an alternative economic model

In this Anthropocene era, the consumption and the production models should be reconsidered and redesign to meet future challenges and the need of sustainability at economic, social and environmental level to answer today problems and transit to an era where Gaia, our planet, is at the centre and we are not compromising its balance.
For this reason, also the manufacturing sector is involved. Garetti & Taisch (2012) identified it as one of the most affected by this change and that that will face a revolution in the near future especially in the production models.
Some studies have identified solutions and challenges to the transition to a sustainable manufacturing.
For example, Garetti & Taisch (2012) defined in their study the research challenges for a sustainable manufacturing (see tab 2.2). At the end, they claim for the need of attention on norms and standards which can have a great effect on the growth of the economy. Moreover, also on education and social sciences in sustainability to understand the consequences of their behaviours with actions for example as:

- the spreading of the concept of sustainable development at all level of the enterprise, from top management to operational level;
- introduction of education for sustainability at all level;
- introduction of education on sustainable manufacturing in the engineering schools.

Following other scholars as Lieder and Rashid (2016) and their review on the CE implementation in the manufacturing sector, they proposed a strategy which required top down approaches by public institutions and bottom-up by industries (Lieder & Rashid, 2016, p. 47) (fig. 2.20):

- Top-Down:
  - Legislation and policy;
  - Support infrastructure;
  - Social awareness;
- Bottom-Up:
  - Collaborative business models;
  - Product design;
  - Supply chain;
  - Information and communication technology.

They proposed this strategy for the diverse motivations about CE by the different stakeholders that needs to converge: governmental actors from one side and manufacturing companies on the other side. *"Governmental bodies and policy makers advocate a collective consciousness about environmental issues as well as societal benefit of industrial activities. Hence, there is a notion of maximizing environmental benefits by strict control of industrial businesses. On the contrary, manufacturing companies possess potential awareness about environmental impacts of*

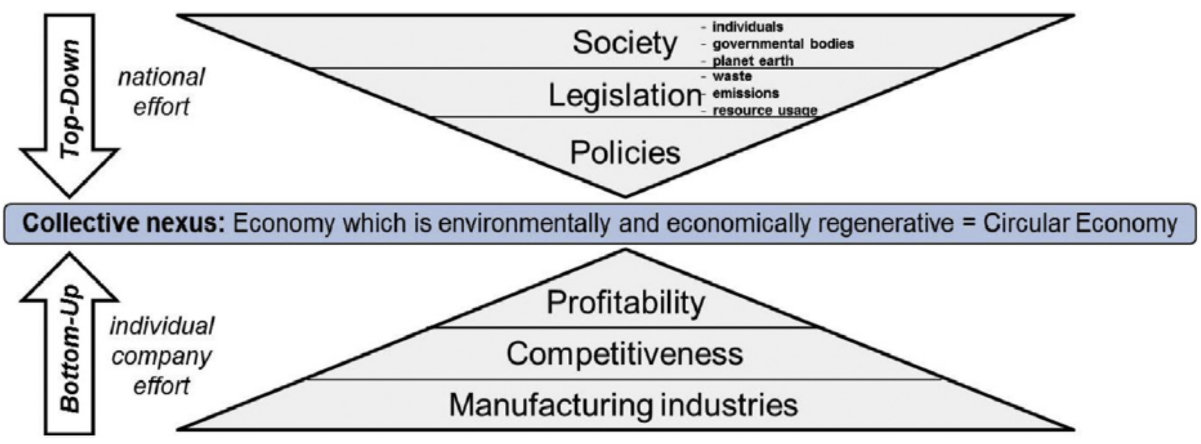


Fig. 6. Proposed CE implementation strategy applying top-down and bottom-up approach.

Fig. 2.20 - CE implementation strategy proposed by Lieder & Rashid (2016). Retrieved from Lieder & Rashid (2016)

Tab. 2.3 - the research challenges for a sustainable manufacturing defined by Garetti & Taisch (2012)

Business models and processes	Sustainable business	New business models based on product service systems	
		Sustainable mass customisation	
		Sustainability metrics	
	Sustainable supply chain	Multidimensional inventory management	
		Interoperable production planning and control	
		Sustainable supply chain design	
Asset and product life cycle management	Sustainable product design and sustainable life cycle management	Product design for sustainability	
		Integrated product data management system	
		Intelligent product	
	Maintenance and asset life cycle management	Asset life cycle management	
		Sustainable predictive	
		maintenance of production equipment	
		Mobile and remote maintenance	
Resource and energy management	Reduced use of scarce resources	New recycling technologies and material uses	
		Remanufacturing	
		Sustainable packaging	
		Resource recovery from alternative fuels and raw materials	
	Energy efficient manufacturing	New energy sources for factories	Energy autonomous
			Energy harvesting for powering devices in manufacturing processes
		More efficient production processes	Energy efficient particle size reduction
			Efficient use of raw materials
		Energy utilisation in collaborative frameworks	Technological assets to waste for enhanced utilisation
			Intelligent utilisation of waste heat
		Management and control of energy consumption	Energy aware production planning and control
			Energy product tags for holistic value chain improvement
			Advanced automation for demanding process conditions
Enabling technologies	New production processes	Manufacturing adaptability, re-configurability and 'brown field' re-engineering	
		Ecofactory	
		Management of hazardous substances in manufacturing	
		Minimal manufacturing	
	Advanced manufacturing technology	Additive forming processes for manufacturing	
		Mechanical micro-machining	
		High performance and quality embedded manufacturing	
		Emission reduction technologies	
	ICT for manufacturing	Model based manufacturing	
		Semantic and ontology based engineering	
		High accuracy modelling of companies	
		Application services for embedded devices	

their industrial activities. However, due to competitive pressure environmental impacts will most likely remain unconsidered as primary focus is put on economic benefits and growth."(Lieder & Rashid, 2016,p. 47)

The scientific contributions about sustainability in industrial production processes have also fed the debate about the concept of *"by-products"* and the differences between them and *"waste"*. Indeed, the potentialities related to the matter that is not used by a particular production process is huge in terms of environmental and economic benefits, as witness by many contributions as Anal (2018); Mirabella, Castellani, & Sala, (2014); Oreopoulou & Russ, (2007) and can help to start the transition to more sustainabale production models. According to the definition introduced by Legislative Decree 3 April 2006, n.152, *"Rules on environmental matters"*, (or the communication by EU (Commission of the european communities, 2007), *"the by-product is a product of the company which, although not constituting the object of the main production activity, is constantly produced by industrial process and is intended for further use or consumption and, in general, its use is linked to its intrinsic, nutritional, environmental and economic value"*(Battistoni, Dominici, Barbero, Comino, 2020).

2.2.5 Contribution of systemic design to the transition to a sustainable manufacturing sector and the enhancement of the local territory

SD approach applied to the single manufacturing activities permits to change their core business, improving and increasing their incomes, developing a new productive, economic and consumption model strongly rooted in the territory where it is located. Moreover, this approach permits the creation of new products and other opportunities that can be caught by the entrepreneurial world that in some cases let the birth of new economic realities. This process of generation can be related to the property of the system, the autopoiesis typical of the natural systems as defined by Maturana and Varela referring to the continue learning, adaptation and self-generating and self-balancing (Capra, 2014).
Currently, some enterprises are working on the implementation of new opportunities generated for example from a specific outputs, as RotterZwam[38] , Orange Fiber[39] , Vegea srl[40] , Morecircular[41] , acting individually and supported by the personal motivation of the entrepreneurs. Imagining this process of creation applied to a single territory taken in consideration, it can create new relationships between the different actors, productive sectors and inhabitants, reactivating the local economy and the social cohesion, increasing the sense of belonging. The local territory, the place where the human beings lives every day, is spotlighted enhancing its cultural and natural resources, indeed of considering it as a place where the products are manufactured, travel everywhere and leave only waste.
Despite their high value, the implementation of these projects is difficult however their realisation it's essential for their role in boosting local economies preventing waste creation and release in the environment (air, soil, water).
From this main problem, started this PhD research.

38 production of mushrooms from coffee grounds. See http://www.rotterzwam.com/. Last access April 23, 2018
39 production of fabrics with textile fiber from unsold orange. See http://orangefiber.it/en/fabrics/ Last access April 23, 2018.
40 production of leather from the biomass of wine making. See https://www.vegeacompany.com/ Last access April 23, 2018.
41 Production of lamp from construction waste as plasters https://morecircular.com/. Last access April 26, 2019.

2.3 CONCLUSIONS

The current environmental situation defined alarming by many scholars which have identify the year 2050 as point of non-return, requires to be tackled now for its severe consequences on human and planet health. The environmental issues have to raise the attention of everyone due to their potential danger. And of every productive sector for being one of the major causes of their creation.

Indeed, one of the causes identified by scholars is the 'take-make-dispose' model defined by the linear model of the current economy, which has affected the production and consumption processes, creating tons of waste and pollution. In this framework, also the design field is called into question for its responsibility in the decisions taken in the design phase of new products and consequences on the production processes.

Nowadays, alternative economic models are emerging as the CE at the base of the European Union economic strategy and the Blue Economy by Gunter Pauli, although they required a radical change especially in the cultural paradigm. The road to a sustainable model indeed requires a different way to tackle the current complexity of the worlds. It requires changes in the cultural paradigm, from a linear to a systemic thinking, and the revision of the economic models which is happening as witnessed by the many economic models mapped in this chapter. To meet the challenges for a sustainable future, also the manufacturing sector needs to reconsider its productions models. The design field can provide useful methods and tools to foster this transition with the emerging of new approaches as design for sustainability and Systemic Design, moving from product to system innovation. Systemic Design in particular can provide the creation of opportunities for eco-innovation however this potential needs to be assessed and understand how it can be facilitated.

Chapter 3

Literature review

This chapter is about the literature review that was performed to delved all the theoretical concepts which are at the base of this PhD research, in order to find theoretical gaps. The goal was to explore how currently the implementation of sustainable new products/services/processes (sustainable innovation) is happening in business context and which are the actors that are fostering this process for the transition to a Circular and Blue economy in a local territory. Moreover which is the role of design in this process.
Based on my precedent knowledge about Design, Ecodesign and SD given by my educational path, the literature review started on the exploration of the business world and in particular, the concept of innovation and entrepreneurship for the scope of this thesis. This has permitted to understand the current innovation dynamics, (both in terms of existing enterprises and for the creation of new ones) and which are the actors that currently are fostering the creation of innovation, identified in the business incubators and in the innovation ecosystems. Afterwards, a specific literature review was focused to discover their relationships with sustainability concepts and the current barriers for the implementation for the Circular Economy in industrial context. Special attention was paid to understand if they consider the impact on the local territory and its enhancement. Along with this exploration, it was looked for the role of design in innovation creation. This review concludes with the theoretical relationships among design, innovation, entrepreneurship and environmental sustainability and the gaps find about it.

3.1 METHODOLOGY

This literature review started from the understanding of basic concepts as innovation and entrepreneurship, to afterwards move in depth to the relationships between entrepreneurship, design and environmental sustainability.
The situation at the beginning of the review was the one shown in fig. 3.1, with many questions about the relationship among the different research fields and their approach and contributions to the reach of environmental sustainability, with a special attention to the entrepreneurial context.
This process was conducted with a desk research mainly based on contributions in Italian and English language. It started from books and national and international official reports find in online database and in the Politecnico di Torino and Strathclyde University libraries to create the basic knowledge over the topic. Some of the courses attended during the PhD program and the conferences have also contributed to discover references. Afterwards a simplified systematic specific literature review was conducted on articles in scientific journals, found in databases as Scopus, Web of Science, Elsevier, Google scholar to explore specific topics and

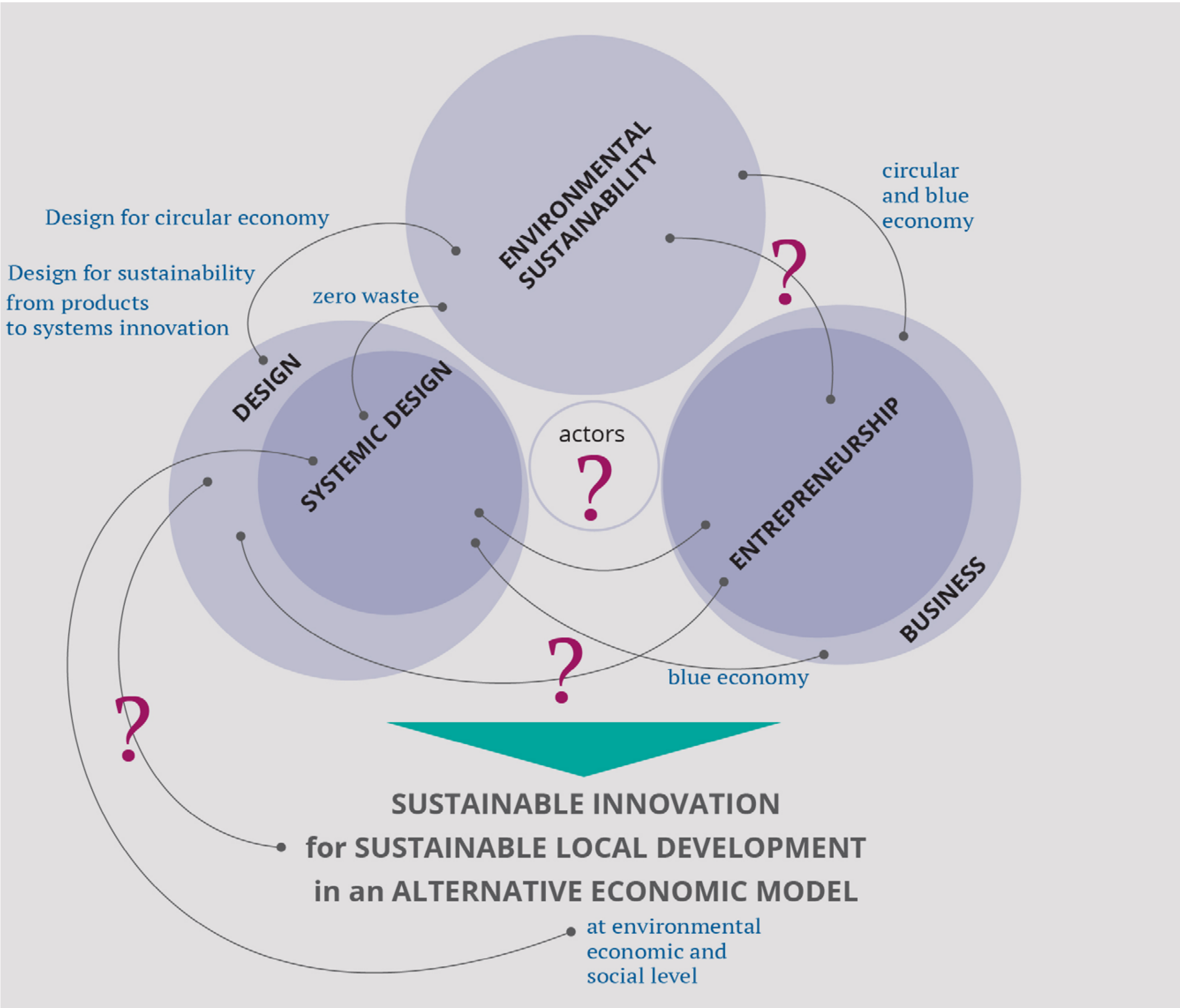


Fig. 3.1 - graphic representation of the main gaps to fill with the literature review

relationships - the one between entrepreneurship and environmental sustainability, and the barriers faced by CE implementation -. It was also applied a snow-ball approach, analysing also the references cited by the main articles previously found.
This exploration has created at the end a collection of contributions from various disciplines. Thank to this, it was possible to distinguish the point of collisions among disciplines which is not a common work. This has created also many obstacles and limits to this process because it could be endless for the quantity of contributions that nowadays is possible to find thanks to the role of internet in the research context. And this aspect, multiplied for three main areas of research, has possibly created a superficial exploration of some of the concepts, but it was limited by short period of time available. Moreover, some concepts as the CE are very current issues constantly in progress so it has required a constantly update of the research, which indeed was performed not only in the first year of the PhD program, but also in the second year and third year (from November 2016 to July 2019).

3.2 BASIC CONCEPTS

3.2.1 Innovation

According to many scholars as Baregheh, Rowley, & Sambrook (2009) with their work *"Towards a Multidisciplinary Definition of Innovation"*, the concept 'innovation' has been defined many different times. Following their final definition which crosses all the different definitions *"Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace"* (Baregheh et al., 200, p.1334). The innovation indeed is a process which was explored by many disciplines and is related mainly to the implementation and commercialisation of something new, from products to services. It is also a process related to creation of new opportunities based on the exploration of the existing situation. For example, following Bessant & Tidd (2015), one of the author cited by Baregheh et al.(2009), innovation is about:

- Identifying or creating opportunities;
- New ways of serving existing markets;
- Growing new markets;
- Rethinking services;
- Meeting social needs;
- Improving operations – doing what we do but better.

3.2.2 Entrepreneurship

Entrepreneurships is a trivial concept and often this term is used as synonymous of 'self-employment' or it is used to identify the entire category of the entrepreneurs or the broad phenomenon of the start-ups. Following Ahmad and Seymour (2008) and their OECD Statistics Working Paper, the lack of a common definition is due to the different roots of this concept: from anthropology, to social sciences, to economics and management. And moreover to the subcategories that have emerged as corporate entrepreneurship, intrepreneurship[1] , venturing … Indeed many definitions of 'entrepreneurship' have been proposed by many scholars and international studies as the following ones.
For example, according to the Global Economic Forum experts' entrepreneurship is a driver of economic value creation and it can be expressed in a new start-up or in an established company[2] . For the European Commission: *"Entrepreneurship is an individual's ability to turn ideas into action. It includes creativity, innovation, risk taking, ability to plan and manage projects in order to achieve objectives"*.[3] .
Therefore 'Entrepreneurship' seems an umbrella concept usually connected to many concepts as[4] :

- self-employment (David & Hamburg, 2017);

1 Ahmad and Seymour refer to intrepreneurship, although it is possible that they would have refer to 'intrapreneurship'
2 https://intelligence.weforum.org/topics/a1Gb0000000LGqtEAG?tab=publications
3 https://ec.europa.eu/growth/smes/promoting-entrepreneurship_en
4 they were cited by many authors but in particular by the one cited

- driven by the 'pursuit of profit';
- an *"attitude"* (David & Hamburg, 2017);
- risk and failure, more than connoted by success (David & Hamburg, 2017);
- decision-making and attitude to risk (Casson, 2006);
- based on the context cultural circumstances (David & Hamburg, 2017);
- discovering of opportunities;
- offer to the market and customers new or renewed idea or solutions (David & Hamburg, 2017);
- human capital (Casson, 2006);
- define the path from opportunity to action (Rae, 2007);
- ability of entrepreneurs to be flexible, fearless and experimental that can create change (David & Hamburg, 2017);
- recognition of opportunity with value (Shane & Venkataraman, 2000);
- related to unemployment , a 'fall-back' option (David & Hamburg, 2017);
- relation to individual differences which created different ways to see opportunities and ways of exploitation (Shane & Venkataraman, 2000);
- key to promote innovation and change (*"crucial engine driving the change process" for Schumpeter (1934)"* (Shane & Venkataraman, 2000);
- key ingredient for the development of a region (Malecki, 1994; Metcalfe, 2004);
- creation of new companies, opening up new markets, and nurturing of new skills (European Commission)[5] ;
- exploitation of opportunities in a new firm or in existing organizations or in on behalf of their existing organizations (Shane & Venkataraman, 2000)

In general, everyone agreed in relating this field to the creation of new opportunities and the ability to turn them into action with business realities. However, for example García, Deserti, & Teixeira find a gap in the methods to define opportunities by the entrepreneurial world which they defined *"undeveloped"* (García, Deserti, & Teixeira, 2017, p. 65).

For this ability in creating and exploiting opportunities, many studies have been concentrated on the framing of the figure of 'entrepreneur' as the person with specific characteristic able to create this implementation process and taking the risk:

"entrepreneurs unleash the forces of creative destruction to transform existing industries and create new ones; entrepreneurs can also serve as arbitragers, capable of bringing markets back into competitive equilibrium."[6]

"those persons (business owners) who seek to generate value, through the creation or expansion of economic activity, by identifying and exploiting new products, processes or markets" (Ahmad and Seymour, 2008).

In addition, entrepreneurship is starting to be recognized as an important skill and studies as (David & Hamburg, 2017) insisted on importance to develop this skill in Europe for individuals and societies. In the European context, indeed it was noticed the difference between other countries in considering entrepreneurship *"Only 37% of Europeans would like to be self-employed, compared to 51% of people in the US and China"*[7] . For this reason, the European Union decided to promoted entrepreneurship, in an *"Entrepreneurship Action Plan"*[8] adopted in January 2013, especially over these points[9] .:

5 https://ec.europa.eu/growth/smes/promoting-entrepreneurship_en
6 https://intelligence.weforum.org topics/a1Gb0000000LGqtEAG?tab=publications
7 https://ec.europa.eu/growth/smes/promoting-entrepreneurship_en
8 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52012DC0795
9 https://ec.europa.eu/growth/smes/promoting-entrepreneurship_en

box 3.1 - the translation of 'entrepreneurship' in Italian language

In the Italian language exists two words related to the translation of 'entrepreneurship', "imprenditoria" and "imprenditorialità", which are defined by the Treccani vocabulary as:
- "Imprenditorìa", which refer to the category or the activity by entrepreneurs;
- "Imprenditorialità": the number of characteristics of the entrepreneurs.

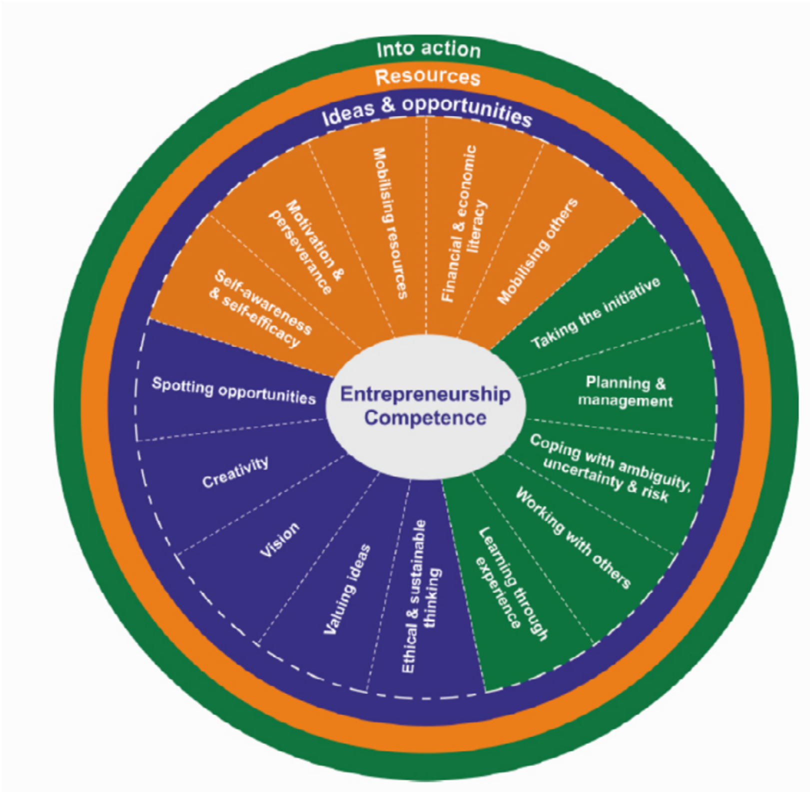


Fig. 3.2 - the EntreComp framework. Retrieved from https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/entrecomp-entrepreneurship-competence-framework

- educating young people about entrepreneurship;
- highlighting opportunities for women and other groups;
- easing administrative requirements;
- making it easier to attract investors.

The sense of initiative and entrepreneurship indeed is recognized by the European Commission one of the 8 key competences necessary for a knowledge-based society[10]. Considering entrepreneurships as a competence, in Europe the EntreComp framework was developed which relates the competences with 'Ideas and opportunities', 'Resources' and 'Into action' (fig. 3.2)

3.2.3 The relationships among innovation and entrepreneurship

Many authors have contributed to define the relationships which exist between innovation and entrepreneurship, considering one as essential for the other one. Mainly they refer to Schumpeter as the first which identified the innovation process as necessary for the entrepreneurial world: *"Schumpeter (1934) isolated entrepreneurially driven innovation in products and processes as the crucial engine driving the change process"* (Shane & Venkataraman, 2000, p.219).

The work by Bessant & Tidd (2015), recognizes innovation as a tool for entrepreneurs to *"exploit change as an opportunity for a different business or service."*. Bessant & Tidd (2015) citing Drucker, (2014, p.11). Also, the book by Drucker had the goal to strict the relationships between innovation and entrepreneurship, considering this last one as the process to manage innovation (Drucker, 2014). For

10 https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/entrecomp-entrepreneurship-competence-framework

Shalley et al. (2015), entrepreneurship is a specific form of innovation in relation with the development of new ventures referring to the application of new ideas to new ventures, including the creation of new markets, products, services and firms.

box 3.2 - the definition of 'entrepreneur' in Italian language

In the Italian context, the definition of 'entrepreneur' doesn't refer to innovation but is simply referred to someone that practice an economic activity to produce or exchange goods or services .

Per il Codice Civile (art. 2082 C.C.): *"È imprenditore chi esercita professionalmente una attività economica organizzata al fine della produzione o dello scambio di beni e di servizi"*

3.3 ACTORS ROLES IN THE SUPPORT IN THE CREATION OF INNOVATION

Currently, innovation is happening in different contexts, which have significant differences among them. On one hand inside the enterprises, which based on their characteristics have different innovation dynamics. On the other hand, in the last years the phenomenon of the business incubators has imposed these actors as fundamental in the creation of innovation. They are focused to the development new firm/start-up which deliver new businesses based on new products or services. For the goal of this research, the attention was focused to the business incubators, for the need to understand how to support the creation of innovative projects. For this reason, afterwards an in-depth review was conducted to identified the main typologies of BIs and which are the services provided by them.

3.3.1 Innovation dynamics in enterprises

Many studies have been concentrated on the distinction between 'small business venture' and 'entrepreneurial venture' (Krueger, 2002; Burns and Dewhurst, 1999; Beaver, 2002) and this difference has roots in the differences between entrepreneurs, manager and business owner (Beaver, 2002 citing Gerber, 1995). Because an entrepreneur, as said in the previous paragraph, is guided by an innovative behaviour, however, this distinction is not approved by all the studies on the fields (Krueger, 2002).

Both Krueger (2002), Burns and Dewhurst (1999) and Beaver (2002) cited the work of Carland et al. (1984) for the definition of this distinction:

- *"small business venture: any business that is independently owned and operated, not dominant in its field, and does not engage in any new marketing or innovative practices;*
- *entrepreneurial venture: engages at least one of the Schumpeter's four categories of behaviour; that is, the principal goals of an entrepreneurial venture are profitability and growth and the business is characterized by innovative strategic practices"*.

Many indeed agree on defining an entrepreneurial venture bases on the categories of behaviour for Schumpeter (1934; cited by N. F. Krueger, 2002):

- Introduction of new goods;
- Introduction of new methods of production;
- Opening of new markets;
- Opening of new sources of supply;
- Industrial reorganization.

3.3.1.1 Large Enterprises vs Small and Medium Enterprises

Large enterprises (LEs) and Small and Medium Enterprises (SMEs) have a very different potential and behaviour towards innovation. The reason is because in firms, according to the review by Pittiglio,

Sica, & Villa (2009), it is connected with internal factors, as firm's characteristics, and external factors, as the flows of ideas within a country and from abroad. For this cause, the SMEs innovative effort is limited by small internal human and financial resources, which force them to not operate alone as the LEs, but creating links with external actors as other enterprises or public research organizations (Pittiglio, Sica & Villa, 2009). Even though the SMEs are considered *"agents of change through innovative activity"* (Audretsch, 2002, pg. 17), and they have a role in in regional revitalization *"the innovative potential of SMEs is co-determined by the regional incubator profile at hand"* as argued by Fischer and Nijkamp (1988).
In the European context this is an important aspect to take in consideration as the SMEs are the majority and represent the base of the economy according to EU: *"Small and medium-sized enterprises (SMEs) represent 99% of all businesses in the EU"*[11] [...] *they are the "most important sources of employment"*[12] .[...]*"Maintaining a broad base of SMEs is very important for the economic development, wealth and sustainability of a region "*[13]. EU has dedicated a specific area of its funding - European regional development fund (ERDF) - to the competitiveness of SME sector[14] . Also a section of the horizon 2020, the EU Research and Innovation programme with about €80 billion of funding available for the period 2014-2020, is specifically dedicated to innovation in SMEs[15] .

3.3.2 Business Incubators

From late 1900s the American phenomenon of Business Incubators (BIs) has also emerged in the European context after the spreading there . In the American context, they have been started by governments and agencies, and about 20% are related to universities/science parks (CSES, 2002). A great success is related to Stanford Research Park and Research Triangle Park in North Carolina in the 1950's, the precursor of the creation of public-private *"hub of technological innovation"* (CSES, 2002). BI's development in USA was related to policy makers and universities and especially to the release of the Bayh-Dole Act that has left the property rights to public research institute for research supported by

11 https://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition_en
12 https://ec.europa.eu/growth/smes/promoting-entrepreneurship_en
13 https://ec.europa.eu/growth/smes/business-friendly-environment/regional-policies_en
14 https://ec.europa.eu/regional_policy/en/funding/erdf/
15 https://ec.europa.eu/programmes/horizon2020/en/h2020-section/innovation-smes

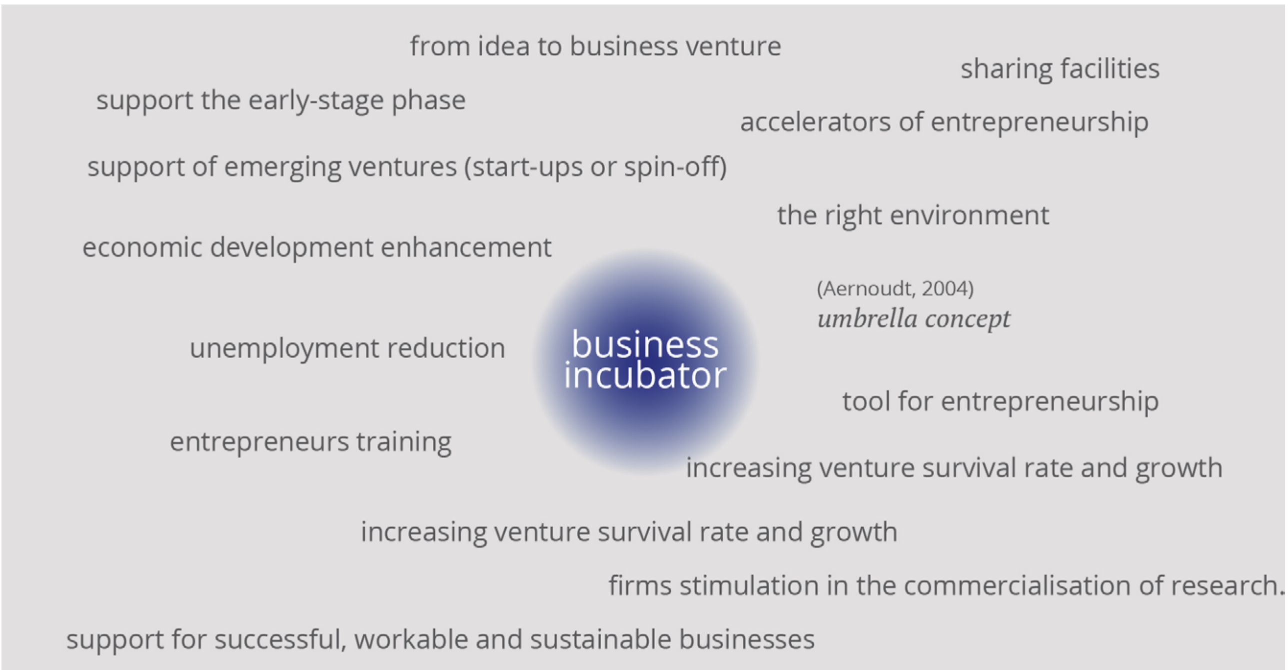


Fig. 3.3 - graphic representation about the multiple definition of the Business incubator concept

the government (Caiazza, 2013).
Daskalopoulou et al. (2010) identified Europe has leading in the development and number of BIs, outside American context. In this context Daskalopoulou et al. (2010) recognized that some countries adopted the third generation of BI while the developing of the original model (see chapter 3.3.2.2.).

Many different definitions of BI concepts can be found from the references that were analysed (CSES, 2002; Tötterman & Sten, 2005; Al-Mubaraki, Al-Karaghouli, & Busler, 2010; Bergek and Norrman, 2008; 'entrepreneur' website[16] ; Aernoudt, 2004) (fig. 3.3).
Mainly they are referred as organizations which help entrepreneurs in transforming idea (from inception to commercialization) into business realities through different resources and services. CSES (2002) adds the importance on the environment created by the BIs which help the entrepreneurs, and in the sharing of facilities that helps to reduce costs in the delicate moment of the early-stage development. Tötterman & Sten(2005) focused also on the support, the useful networks and on the give of credibility. NBIA cited by Al-Mubaraki, Al-Karaghouli, & Busler (2010) highlights the BIs support in creating "successful, workable and sustainable businesses". Bergek and Norrman (2008) put the attention on the concept of BI which is often used for organizations that in general support the development of firms creating the right environment. Moreover they add that policy makers see them as *"tool for promoting economic development*...for *"tired" regions"*. In their review they defined the two main goals of BIs as:

- *"enhancing economic development and/or reduce unemployment in a region by facilitating the start-up of new companies, increasing their survival rate and growth and, more generally, by training entrepreneurs;*
- *stimulating firms involved in emerging technologies or the commercialization (or transfer) of research done in universities, research institutes and firms"*(pg. 22.)

However, they underlined that is difficult to divide

16 https://www.entrepreneur.com/encyclopedia/business-incubator

Tab.3.1 - Summary of the key conclusions of the benchmarking on European business incubator identified by CSES (2002)

setting up and operating business incubators	Need to be part of a broader strategic framework (territorially orientated/ focused on particular policy priorities / combination of these factors)
	Need inclusive partnership of public and private sector stakeholders
	The market and the business plan should be tested
	Public support is critical (average funds is around €4 million, the average operating costs is around €500,00 per annum: staff 41%, client services 24%, maintenance of buildings and equipment 22%, and other costs such as utilities 13%)
incubator functions	Important is the providing of physical space (around 5.800 sq for 18 firms)
	The services provided are the quality of the incubator. Mainly they are: entrepreneur training (often 'pre-incubation'), business advice, financial support (from incubator seed/venture capital funds or external providers), and technology support.
	The services should cost but "*minimise the risk of 'crowding out' private sector providers"(for 34% the cost is below market level)*
	Clearly define the target market and the admission criteria
	Be selective also if high occupancy is important for the income
	Ensure turnover of clients with exist criteria (around 3 to 5 years)
	After care services are important
	High quality of management team (average ration with tenants 1: 3,2)
	Differentiate incubators by typology of companies
evaluating incubator services and impacts	The performance need to be judge by the results (in Europe usually are generating around 30.000 gross new jobs per annum)
	Need to obtain feedbacks by tenants that should be taken in consideration in the impact evaluation
	Need a distinction between net and gross impact
	Need an exchange of experience between new and traditional one
	The business models should reflect local, regional and national circumstances and priorities
	there are differences between European and US incubators.

them in categories because each BI is different from the other one.

These multiple definitions are in line with Aernoudt, (2004) which has defined the BI as an 'umbrella' concept for the multiple characteristics related to it. Moreover, BI is often used as a synonym of science parks, technology parks, and also places with no physical location that manage a network of enterprises (Lindelof and Loftsen, 2004 cited by Caiazza, 2013). According to Bergek and Norrman (2008) referring to Brooks (1996), there is the need to distinguish between BIs and technology/science park as different entities because BI are concentrated on the phase between the business idea and *''the attempt stage"*, the immature early-phase of the idea that is becoming a new venture idea, while the other one on more mature firms.

Over the years multiple studies have been conducted on the phenomenon and many scholars are questioning the role of BIs in economic development as Allen & Rahman (1985), or their success as Burger(1999) or their relationship with entrepreneurship as Aernoudt (2004) and their usefulness to entrepreneurs as Albort-Morant & Oghazi (2016).

Along to the concept of BIs, is often cited the one of 'accelerator', which is considered *"a new generation incubation model"* for the review by Pauwels, Clarysse, Wright, & Van Hove (2016) which seems concentrated on yet created firms to develop according to Clarysse & Yusubova (2014), however for example Pauwels et al. (2016) identified that *"only limited insight into their distinctive features"* has been provided.

The benchmarks by the CSES distinguished that in Europe in 2002 the BIs were around 900 in contrast to the 3.000 presents in America. They create around 40,000 new (net) jobs every year, and the average ration between BI and SMEs in Europe is 1:19, while in Italy is 1:67 (CSES, 2002). According to their research, in conclusions they delineated some elements useful for understanding the phenomenon and also develop further reasoning. (tab 3.1.). Their overall conclusion is that *"business incubators are a very cost-effective instrument for the promotion of public policy objectives"*.

3.3.2.1 Business incubators: typologies

Many authors over the years have concentrated their researches in understanding the BIs phenomenon, and someone has classified them in typologies according to their scope.

Barbero, Casillas, Ramos, & Guitar (2012) with a complete literature review provided a classification by authors, shown in fig. 3.5. They finally identified the following typologies:

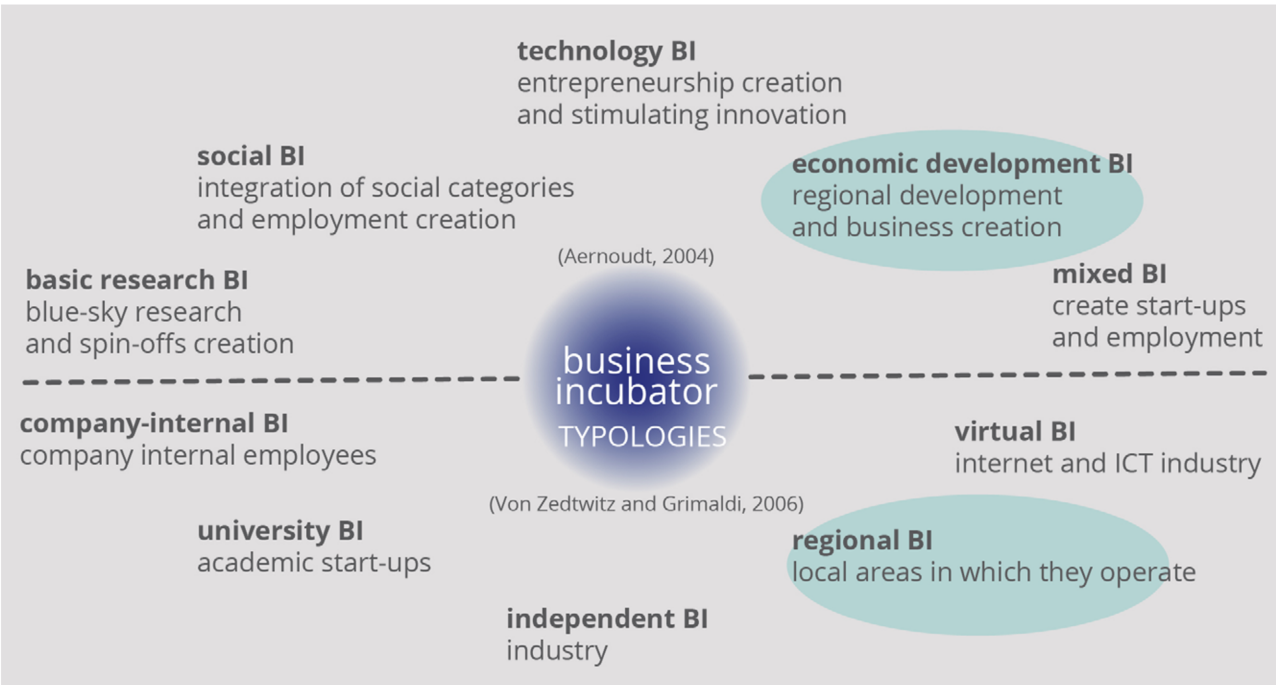


Fig. 3.4 - graphic representation about the multipletypologies of BIs

Table 3
Summary of archctypal incubators found in Spain.

Types of incubator	Description	Authors describing archetype
Basic research incubator	Links incubation with fundamental research. Promotes the generation of technology ventures in strategic sectors. Access to specific sector resources. Technologies developed take the form of IP to be licensed by commercial partners or exercised by spin off companies.	Aernoudt [4]
University business incubator	Mixed (public/private) nature. Incubatees use extensively non-financial resources part of the university's infrastructure in the form of tangible and intangible assets. Does not necessarily have a technology focus.	Mian [2,18]; Grimaldi and Grandi [6]; Von Zedtwidt and Grimaldi [15]
Economic development incubator	Publicly funded entities. Purpose is the dynamization of the economic development of the area through incubation of SMEs. Mainly provides physical rather than intangible assets.	Aernoudt [4] Von Zedtwidt and Grimaldi [15]
Private incubator	Private and corporate nature. Purpose is to adopt a professionally organized knowledge flow" to obtain profits from venture management. Contribution of capital and high value intangible assets (managerial talent and QSEs, external partners, etc.)	Allen and McCluskey [5]; Grimaldi and Grandi [6]; Becker and Gassman [7]

Fig. 3.5 - Business incubators typologies retrieved from Barbero et al. (2012, p 894)

TABLE I
Typology of business incubators

	Main philosophy: dealing with	Main Objective	Secondary	Sectors involved
Mixed incubators	Business gap	Create start-ups	Employment creation	All sectors
Economic development incubators	Regional or local disparity gap	Regional development	Business creation	All sectors
Technology incubators	Entrepreneurial gap	Create entrepreneurship	stimulate innovation, technology Start-ups and graduates	Focus on technology, recently targeted, e.g. IT, speech-, biotechnology
Social incubators	Social gap	Integration of social categories	Employment creation	Non profit sector
Basic research incubators	Discovery gap	Bleu-Sky research	Spin-offs	High tech

Fig. 3.6 - Business incubators typologies retrieved from Aernoudt (2004, p. 128)

Table II
Differences in strategic objectives induced differences in managerial focus

	Regional business incubator	University incubator	Independent incubator	Company-internal incubator	Virtual incubator
Mission	Not-for-profit; develop regional economy	Not-for-profit; promote academic entrepreneurship	For-profit; create successful startups	For-profit; exploit or leverage internal ideas	For-profit; support would-be entrepreneurs
Competitive focus	Geographic (local areas in which they operate)	Academic start-ups	Industry	Mostly company-internal employees	Internet and ICT industry
Funding	National, public	Regional, public	Private	Private	Private
Physical infrastructure	Below-market price	Provided	Some provided	Some provided	None or little
Office support	Provided	Provided	Provided	Some provided	None or little
Access to capital	External	External	Internal investment	Internal	Internal and external
Process support	Often outsourced	Some internal, some external, internal scientific advice	Strong internal consulting capacity, dedicated project management, hands-on	Strong in-house technical skills	Process guidance, management consulting, market research
Networking	Local, informal, networks	Strong within-university network; business plan competition	Strong industry network and partnerships	Company-internal leads	Regional, online

Fig. 3.7 - Business incubators typologies retrieved by Von Zedtwitz and Grimaldi, (2006, p. 466)

- regional business and university are of a not-for-profit nature;
- independent commercial and company internal are private one;
- virtual type is characterized by a for-profit nature, a lack of physical location and preference for online services;
- the independent commercial type invests in high-tech sectors, is located in industrialized areas and is managed by individuals committed to their ventures who rely on private funding;
- company internal types host ventures whose core is related to the parent company and receive funding (Barbero et al., 2012).

Aernoudt (2004) defined different types of BIs based on the evaluation of their impact (fig. 3.6) :

- basic research incubators focused on blue-sky research and spin-offs creation;
- social incubators on integration of social categories and employment creation;
- technology incubators on entrepreneurship creation and stimulating innovation;
- economic development incubators focused on regional development and business creation;
- mixed incubators with the goal to create start-ups and employment .

Another classification is the one by Von Zedtwiz and Grimaldi who found 5 incubator archetypes (fig. 3.7) (Von Zedtwitz & Grimaldi, 2006) :

- regional business incubators focus on local areas in which they operate;
- university incubators on academic start-ups;
- independent incubators on industry;
- company-internal incubators on mostly-company internal employees;
- virtual incubators on internet and ICT industry.

The different typologies identified by these scientific contributions can be summarized in fig. 3.4. Interesting for the thesis scope is the typology of BI focused on regional development because they are concentrated on the economic development of the local area where they act. According to Von Zedtwitz and Grimaldi (2006) they are not-for-profit and receive national and public funding. For Aernoudt (2004) they deal with regional or local disparity gap and have the focus on business creation. However, Barbero J. L. et al. (2012) argue that private, basic research and university archetypes are meeting their objectives in contrast of the regional development archetype.

3.3.2.2 Business incubators: services

To understand how the BIs are supporting innovation

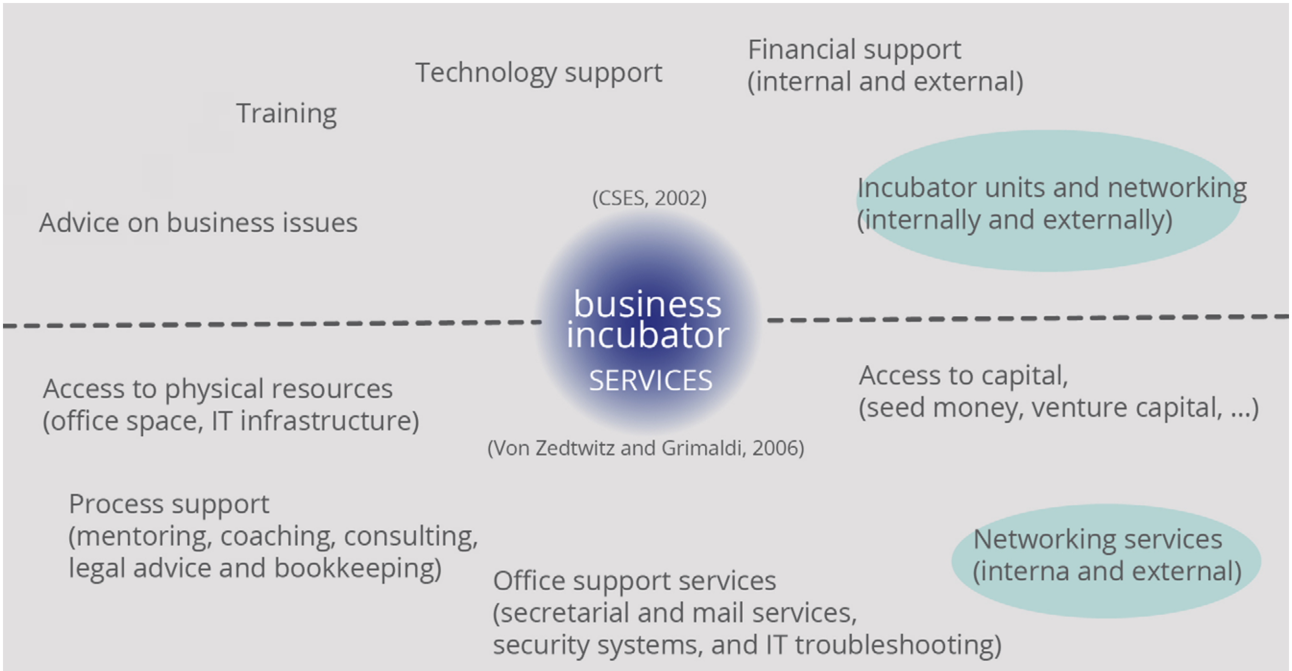


Fig. 3.8 - graphic representation of main services provided by BIs

and business creation, the review focused on the BIs services, a topic on what many authors have focused their researches.
The benchmarking on BIs performed by the European Commission identified three categories of business support services (CSES, 2002).
1. training;
2. advice on business issues;
3. financial support (either from an incubator's own sources or from external providers, i.e. financial institutions), and technology support".

Moreover in the report they added that the provision of space and networking services are also part of the basic features (CSES, 2002).

The review by Von Zedtwitz and Grimaldi (2006) identified the BI services in literature as:
1. Access to physical resources such as office space and IT infrastructure;
2. Office support services such as secretarial and mail services, security systems, and IT troubleshooting;
3. Access to capital, including seed money, venture capital, etc;
4. Process support such as mentoring, coaching, consulting, but also legal advice and bookkeeping;
5. Networking services, both incubator internal as well as external with customers, collaborators, and potential investors.

They highlighted also the minimum conditions to be a BI is having four of these five services, otherwise they can be *"real-estate agents, pure-play venture capitalists, technology transfer offices, or business angels"* . Moreover, they criticized the fact that the services most of the time are not in line with the incubator goal, also because the goal depends on public or political demands, while the services for the management team (Von Zedtwitz & Grimaldi, 2006).
Bergek and Norrman (2008) identified four elements:
1. shared office space, which is rented under more or less favourable conditions to incubates;
2. a pool of shared support services to reduce overhead costs;
3. professional business support or advice (''coaching'');
4. (network provision, internal and/or external.

Moreover, they identified the main element of incubator model in in the selection phase, the support and the mediation , that they defined:
- selection: *"is a challenge which requires a sophisticated understanding of the market and the process of new venture formation...with specific selection criterias and selection strategies"*;
- Business support: *"generally identified include: entrepreneurial training and business development advice and general business matters such as accounting, legal matters, advertising and financial assistance...the success depends on time intensity, comprehensiveness and degree of quality..."*;
- mediation: *"The incubation process transcends the incubator ... One important incubator role is, therefore, to act as an intermediary—or mediator—between incubatees and relevant innovation systems...The incubator thereby provides a ''bridge'' between the incubatee and its environment, with the purpose of leveraging entrepreneurial talent and/or resources "*(Bergek and Norrman, 2008, p. 23-24).

Lalkaka (2002) traced the evolution of BIs in three generations, from the sharing of spaces and facilities (1°), to the provision of dedicated services to fill the lack of entrepreneurs (2°) to the grow of tech-based ventures (3°).

Interesting for the research scope of this thesis was the discovering of the 'networking services' which aims to stimulate relationships, both internal between BI tenants and with external actors as customers, investors, universities, enterprises. (fig. 3.8).

The review on BIs typologies and services (also published in Battistoni and Barbero, 2019) identified a multiple faced phenomenon, with multiple typologies - from company internal to technological Bi and to regional ones with the focus on the area where they are operating - and multiple services - from a physical space to different kind of trainings and financial support -.
Although their clear role for the new ventures creation and development and in the assessing and boosting of economic sustainability, in the review about scientific literature was found a gap related to the BIs engagement in the will to assure the environmental sustainability of the business system and evaluating their environmental impact in the local area. Indeed their attention seems based on assuring the economic sustainability of the new venture in the long term through attention to the business model definition and financial assistance.

Fig. 3.9 - graphic representation of the gaps present in the literature review on BIs

Currently, they seem to have reductive services to assure the environmental, social and environmental sustainability of the new business that will operate in a particular geographical area (fig. 3.9). Recently, another typology of Bi emerged: the one was their recent engagement in social innovation[17] (Zahra & Wright, 2016). It is a very interesting case for the shift of the focus from individual benefits to the entire society although it is not certain that a venture it is also operating for the respect of the natural environment and for the sustainable development of the local context.

3.3.2.3 Business incubators in Italy

A special attention was dedicated to understanding the situation in Italy for the geographical boundaries given to this thesis. The current state is analysed by the social innovation monitor. The report released about the situation in 2018 (Social innovation monitor, 2018) recognized 171 BIs which are diffused in a not homogeneous way in the different regions: the 60% are in the North. After the Lombardy with 43 incubators, all the other regions are below the 20 incubators. About the analysis over the start-ups, the geographical location of the incubators is reflected in the numbers of start-up incubated for regions: most of the 70% are in the North part (fig. 3.10).

Among these 171 incubators, the majority are private (106), then 21% are a mix of public and private and 14% are public. They recognized also another distinction from incubator: the traditional business incubator, the social incubator[18] and the mixed incubator[19]. According to the sample that they have analysed, the 50% are traditional, while the other 31,9% are mixed and 18,1% are social incubator.

In 2017 their turnover was about 220 millions of euro. Most of the incubators (59,3%) were born after the 2012, so the phenomenon seems recent and growing. The report identifies a peak in 2013 which was due to the ‘Decreto Crescita 2.0’ that regulated the ‘innovative start-ups’ (see box 3.3).

Regarding the dimension, the average BIs are small-medium and the 84% have less than 8 employees.

The number of total start-ups were 1348 in 2017, and the average number by incubator is 20. The majority of start-ups incubated in 2017 are for-profit, while very few are non-profit or hybrid[20].

Other results of the report are:

- the majority of incubators make effort to create a community,

17 “a novel solution to a social problem that is more effective, efficient, sustainable, or just than existing solutions and for which the value created accrues primarily to society as a whole rather than private individuals” (Phills et al., 2008).

18 with over 50% of social impact venture

19 with 0-50% social impact venture

20 for profit but the profit are for social purpose or they have social objectives.

box 3.3 - The legislative framework in the Italian context for start-ups

The legislative framework in the Italian context:

- D.lgs 197/2012 (known as Decreto Crescita 2.0) manage the ‘innovative start-ups’ and the certified incubators;
- the law 221/2012 define the ‘innovative start-ups’ and their differences with the not innovative one.

An Innovative start-up must:

- have less than 60 months;
- be based and operates in Italy;
- have last balance sheet is less than 5 millions of euro;
- do not distribute profits;
- develop, produce and sell products/services with high technological value;
- not be generated by a fusion or division of an enterprise;
- have r&D expenses are equal of more than 15% or 2/3 of the personnel have a master degree or higher or have a patent.

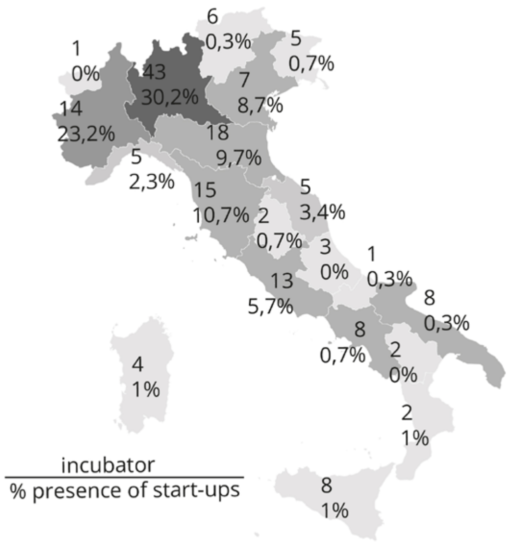


Fig. 3.10 - diffusion of incubators and start-ups over the Italian country.

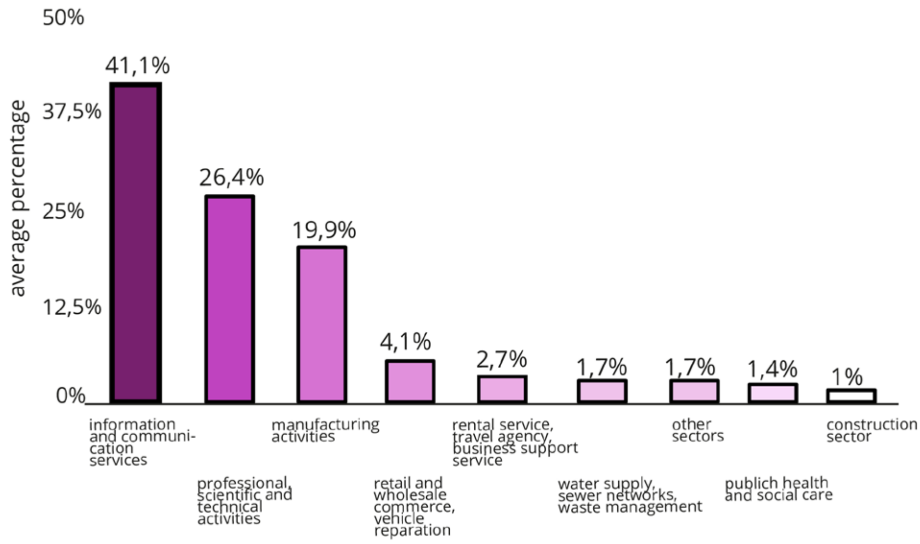


Fig. 3.11 -typologies of activities incubated

- the 84,2% of the costs are divided for: around 32% for the cost of the physical space, about the 32% are for services on business advice, about 18% for training, and about 16% for other services;
- the revenues come mainly from: rent (29%), others (23,5%), services (22,5%), grant and calls (13,3%), investments (5,8%) and donation (5,8%.)
- considering the sector, most of them are about information and communication services (41%), and only about 20% are on manufacturing activities (Fig. 3.11). The number of employees in the 85% of the cases is below 5 people. The turnover, in around 44,3% of the start-ups stay under 25.000 euro, and for the 68% it is under 100.000 euro.

In this report, they explored also which are the services recognized relevant by the Italian incubators and the results are:

- relevant:
  - managerial support;
  - physical space;
  - support in the research of funding;
  - support in the development of relationships;
  - training on entrepreneurship and management;
- enough relevant:
  - administrative services;
  - support in the management of the intellectual properties;
  - support in the development and technology scouting;
- not relevant:
  - services related to evaluating the social impact;
  - training and consulting on CSR and ethics.

It this report, along the traditional business incubator they reported the typology of the social incubator focused on social impact venture. For this reason, in the services are reported also the one focus on the social impact evaluation and the support on CSR and ethics. However, it is very surprising that these services, which represent the one related to the social and environmental sustainability of the ventures, are not considered important by the Italian incubators.

3.3.3 Ecosystems

The idea of a company or a BI as the actors operating individually for innovation and entrepreneurship development in a specific geographical context is restrictive. Indeed, introducing the concept of ecological ecosystems – a community of actors which interact in a specific location in a complex system - in business has led to the creation of the ‘business ecosystem’ (BE) concept (Bassis & Armellini, 2018). This approach has the roots in multiple precedent concepts: innovation systems, clusters, networks, industrial districts, social capital (Colombelli, Paolucci & Ughetto, 2019). The individual businesses indeed have a strict relationship with the ecosystems where they are nested and are influenced by the environmental conditions. Two recent literature reviews have tried to define the concept of the ecosystem in the business environment, Bassis & Armellini (2018) and Scaringella & Radziwon (2018) which both recognize the multiple ways in which the concept is used.

For the literature review by Bassis and Armellini (2018), Moore coined the term Business Ecosystem with the works in 1993 and 1996, defining it as *“an economic community supported by a foundation of interacting organizations and individuals — the organisms of the business world”*(p. 1016) and introducing the concept in the management field. Moore used the biological ecology as a metaphor, comparing the business environment with the biological ecosystem, claiming for interactions between existing business in search of innovation (Scaringella & Radziwon, 2018). As witnessed by the Moore book’s title *“The death of competition: leadership and strategy in the age of business ecosystems”*, this work leads the transformation from competition to collaboration between businesses. This theory is focused on the firm itself, and the boundaries of the ecosystem are globally seen.

During the years, the concept of BE has evolved and the analogy with an ecosystem has created more concepts as ‘industrial ecosystem’, ‘innovation ecosystem’, ‘digital business ecosystem’ and ‘entrepreneurship ecosystem’ (Bassis and Armellini, 2018; Scaringella and Radziwon, 2018), but none of them has links to Moore’s theory of IE as Bassis and Armellini (2018) state.

In table 3.2 is present a synthesis of the main concepts related to the different typologies of ecosystems referring to the work of Scaringella and Radziwon (2018) and Bassis and Armellini (2018) citing Pilinkienė and Mačiulis (2014). In these researches, they identified the main actors and stakeholders, the principal goal, and they also tried to identify the

Tab. 3.2 - Ecosystem typologies and their characteristics

ECOSYSTEM TYPOLOGY	ACTORS AND STAKEHOLDERS	GOAL (Scaringella and Radziwon, 2018).	BEHAVIOUR (Scaringella and Radziwon, 2018).	ENVIRONMENT (Bassis and Armellini, 2018)	TERRITORIAL SIZE (Scaringella and Radziwon, 2018)	INDUSTRY (Scaringella and Radziwon, 2018)
BUSINESS ECOSYSTEM	*Suppliers; distributors; outsourcing firms; products and services makers; technology providers; host of the organizations; customers; competitors; other stakeholders.* (Scaringella and Radziwon, 2018).	*Members share the fate of the network as a whole*	*They coevolve their capabilities and roles, they align to more central companies*	-	*Close proximity: inherently local*	-
ENTREPRE-NEURIAL/ ENTREPRE-NEURSHIP ECOSYSTEM	*Individual elements: leadership, culture, capital markets, open-minded customers. // Various stakeholders: entrepreneurial team, firms, supporting organization, private and social actors* (Scaringella and Radziwon, 2018). *Financial capital; educational institutions; culture; support measures; human capital; markets; government institutions; nongovernment institutions; entrepreneur; large and small* (Bassis and Armellini, 2018)	*Market-based ecosystem; create wealth; economic growth*	*They act together…They combine in complex way, symbiotic relationships, they coexist and complementing each-other goes beyond the traditional triple helix relationship (Etzkowitz and Leydesdorff, 2000) and leads to establishing a quadruple helix*	*Local; specific location*	*The country or region*	*Disruption of existing industries and creation of new ones*
INNOVATION ECOSYSTEM	*Different companies; non-governamental and governamental organizations; Resources providers (like funders)* (Scaringella and Radziwon, 2018). *Entrepreneur; large and small enterprises; educational institutions; research institutions and laboratories; venture capital firms; financial markets; government institutions* (Bassis and Armellini, 2018	*Firms combine individual offerings for same solution; interdependence*	*The ecosystem can be virtual. They use Information technologies, important is understanding the value creation/capture*	*From local to global; inter-organizational, political, economic and technological environment*	*Spatial proximity in case of innovative business ecosystem) or/and virtual spaces*	*Wide ranges of industries*
KNOWLEDGE BASE ECOSYSTEMS	*Tacit knowledge; Personnel; Local universities; Public research organization.* (Scaringella and Radziwon, 2018).	*Advancing technological innovation*	*Flow of tacit knowledge and mobility of personnel*	-	*Close proximity*	*Technological clusters*
INDUSTRIAL ECOSYSTEM (emerging stream)	*Manufactures and consumers* (Bassis and Armellini, 2018)	*Transformation of unsustainable industrial systems*	-	*Local; industrial environment*	-	-
Technology/DIGITAL ECOSYSTEM (emerging stream)	*Research and education organizations; innovation centres; small and large enterprises with their associations; local government and public administration* (Bassis and Armellini, 2018	*Emerge in computer science and thus refer to computer networks*	-	*From local to global; digital eenvironment*	-	-
SERVICE ECOSYSTEM (emerging stream)	-	*Focus on firms' direct customer-supplier network and deprioritize other stakeholders.*	-	-	-	-

behaviour, the environment, the territorial size and the relationships with the industry.

For the scope of the research, the industrial ecosystems (IE) and innovation ecosystem and entrepreneurial ecosystems (EE) are considered very interesting, and the concepts were deepened.

3.3.3.1 Entrepreneurial ecosystems

Many studies have focussed on the definition of the components of the EE.
For Neck et al. (2004) cited by Cohen (2006) the system components are:

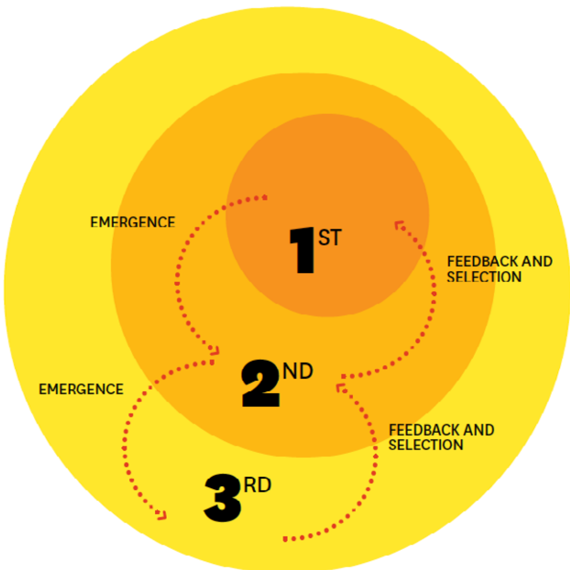
- social networks;
- informal networks (families and informal relation with companies);
- formal networks (actors in the economic community: research university, government, professional and support services, capital services, talent pool, and also large corporations, technological parks, physical infrastructure and community culture).

For Spigel (2015) that ecosystems are composed of 10 elements that give entrepreneurs the resources needed and they are created by the relationships among them (p.8):

- *"cultural: supportive culture, histories of entrepreneurship;*
- *social: worker talent, investment capital (family, angel investors, venture capitalist), networks, mentors and role models;*
- *material: policy and governance (providing funding or regulations), universities (train entrepreneur and produce knowledge), support services (as the BIS), physical infrastructures (office, telecommunication, transportation), open markets".*

The work by Pilinkienė and Mačiulis (2014) recognized:

- Financial capital;
- educational institutions;
- culture;
- support measures;
- human capital;
- markets;
- government institutions;



LEVEL	NATURE	BUSINESS
FIRST	**THE POPULATION** INDIVIDUAL ORGANISMS OF THE SAME SPECIES	**THE COMPANY** INDIVIDUAL EMPLOYEES
SECOND	**THE NATURAL ECOSYSTEM** POPULATIONS OF SPECIES THAT DEPEND ON AND COMPETE WITH ONE ANOTHER	**THE BUSINESS ECOSYSTEM** COMPANIES THAT DEPEND ON AND COMPETE WITH ONE ANOTHER
THIRD	**THE BROADER NATURAL ENVIRONMENT** NEIGHBORING ECOSYSTEMS AND NONBIOLOGICAL ELEMENTS, SUCH AS THE CLIMATE	**THE BUSINESS ENVIRONMENT** OVERLAPPING ECOSYSTEMS AND OTHER STAKEHOLDERS, SUCH AS NGOS, GOVERNMENT ENTITIES, AND CIVIL SOCIETY

Fig. 3.12 - representation of the different systems where a company is nested. Retrieved from Reeves et al.(2016)

- nongovernment institutions;
- entrepreneur;
- large and small firm

They mainly refer to Isenberg's six pillars that are:
1. Policies: Support from the Administration and public bodies, both at the legislative level and creating regulations and initiatives that foster entrepreneurial activity;
2. Financing: Easy and fast access to financing, both banking and private;
3. Culture: Giving diffusion and visibility to success stories, and a good reputation to entrepreneurs;
4. Support: All those services, resources and initiatives to support the entrepreneur;
5. Human Capital: Educational Institutions,

Tab . 3.3 - the attributes of the entrepreneurial ecosystem following Spigel (2015). Retrieved from Spigel (2015, p.8)

Type of attribute	Attitude	Description
Cultural	Supportive culture	Cultural attitudes which support and normalize entrepreneurial activities, risk taking, and innovation
	Histories of entrepreneurship	Prominent local example of successful entrepreneurial ventures
Social	Worker talent	Presence of skills workers who are willing to work at startups
	Investment capital	Availability of investment capital from family and friends, angel investors, and venture capitalists
	networks	Presence of social networks that connect entrepreneurs, advisors, investors, and workers, and that allow the free flow of knowledge and skills
	Mentors and role models	Local successful entrepreneurs and business people who provide advice for younger entrepreneurs
Material	Policy and governance	State-run programs or regulations that either support entrepreneurship through direct funding or remove barriers to new venture creation
	Universities	Universities and other higher education institutions which both train new entrepreneurs and produce new knowledge spillovers
	Support services	Firms and organizations that provide ancillary services to new ventures, for example, patent lawyers, incubators, or accountancies
	Physical infrastructure	Availability of sufficient office space, telecommunication facilities, and transportation infrastructure to enable venture creation and growth
	Open markets	Presence of sufficient local opportunities to enable venture creation and unimpeded access to global market

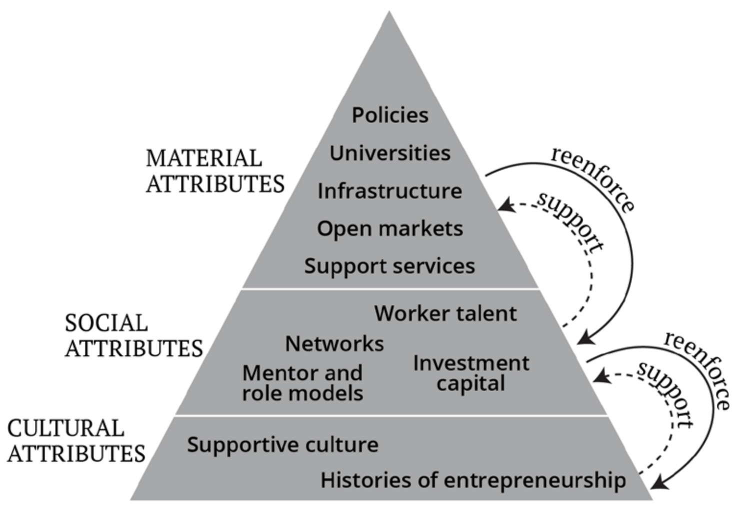


Fig. 3.13 - the relationships among attributes of the entrepreneurial ecosystem following Spigel (2015). Visualisation based on Spigel (2015, p.9)

Universities and training for entrepreneurs;
6. Markets: Establishment of entrepreneur networks, the existence of first customers that test beta-products (early adopters) and from which feedback can be received.

These are also in line with the one recognised by the World Economic Forum (2013, pp. 6–7):

- accessible markets (domestic and foreign);
- human capital/workforce;
- funding and finance (from family to angel investor and venture capital); support systems (from mentors to services and BI);
- government & regulatory framework (from friendly policies and tax exemption to the provision of infrastructure);
- education and training (from university to specific training to entrepreneur);
- major universities as catalysts (key role in idea-formation, entrepreneurship culture and providing skilled people);
- cultural support (from risk and failure tolerance to successful stories and research attitude)

In a recent review on EE, Cavallo et al., (2018) define it as a *"systemic view of entrepreneurship"* because of the interactions between systems conditions and framework conditions: *"in entrepreneurship, the systemic conditions, such as networks of entrepreneurs, leadership, finance, talent, knowledge and support services, are considered to be at the heart of the entrepreneurial ecosystem, while the framework conditions entail a social context that enables or constrains human interaction"* (Cavallo, Ghezzi, & Balocco, 2018).
A recent study by van Weele et al. (2018) is essential to understand the role of BIs in EE. They identified three different way in which BIs can support start-ups creation: from the first generation of BIs providing shared offices and tangible resources, to the third generation with *"act as node"* (van Weele et al., 2018, pg. 1181) in the entrepreneurial system, facilitating the relationship between the entrepreneurs and other actors in the ecosystem. They also call for the fourth generation of incubators: *"the 'systemic' incubators that aim to transform or create institutions to strengthen the entrepreneurial ecosystem (DiMaggio 1988). By doing so, these incubators would have the potential to improve the entrepreneurial ecosystem as a whole".* (Van Weele et al., 2018, pg. 1181).

In the EE, the role of entrepreneurs (and their team) is vital to create a healthy ecosystem (Stam, 2015). In tracing the differences with the other ecosystems, Scaringella and Radziwon (2018) focused on the role of government that should sustain EE with direct or indirect support. For its goal – economic growth - the EE emerges through interactions of various actor and stakeholders, at national and individual level. Moreover, they create an intersection between cultural, political and legal systems which goes beyond the triple helix model of innovation leading to the quadruple helix model which consider the civil society (Scaringella and Radziwon, 2018).
Another important aspect was the discovery of the territorial approaches related to these concepts (Scaringella & Radziwon, 2018). Cavallo et. al (2018) citing (Cohen, 2006) insisted on how the territorial context has an impact on entrepreneurship and that it takes place in a precise geographical area with the coordination of multiple actors. For Audretsch, Falck, Feldman, & Heblich (2012) the regional characteristics have effects on the EE: *"regions provide locational factors which determine the industry structure and with it entrepreneurial opportunities whose exploitation influences regional dynamics".*
Along with the definition of EE, studies have highlighted the relationships between EE and policy makers. Kautonen, Pugh, & Raunio (2017) for example define the innovation BIs as an instrument of regional innovation policy, because BIs are moving from the traditional approach of offering physical infrastructure and high technology to more linked to *"participatory and social mode of innovation, in line with broader developments in innovation policy and theory".* According to Cavallo et. al. (2018) today policymakers are making an effort to find the right measures to support entrepreneurship. And for Stam (2015), regional policies for entrepreneurship are facing a transition, from increasing the quantity to increasing the quality, and in the future *"from entrepreneurship policy towards policy for an entrepreneurial economy."* (Stam, 2015, p. 1759). In EE indeed government seems to play a fundamental role, also as a *"feeder"* citing the words of (Stam, 2015, p. 1761) for *" adjusting laws and regulations"* .

3.3.3.2 Regional and industrial ecosystem

Among the ecosystems typologies, the one of IE results interesting for the scope of this research.

Indeed, IEs are identified in the eco-industrial parks where clusters of enterprises are examined as complex systems, following the industrial ecology concept (Chertow, 1999, 2000; Costa, 2011).
In the review by Ines Costa of the book *"The Dynamics of Regions and Networks in Industrial Ecosystems"* edited by Ruth and Davidsdottir in 2009, IEs are identified in the eco-industrial parks created following the industrial ecology concept, the science of sustainability where the industrial ecosystems are examined as complex systems (Costa, 2011). In the contribution by Chertow (2000) over industrial symbiosis literature and taxonomy, she cited her previous study (Chertow, 1999) where she identified a taxonomy of 5 different material exchange types as the roots of the industrial symbiosis:

- Type 1: through waste exchanges;
- Type 2: within a facility, firm, or organization;
- Type 3: among firms collocated in a defined eco-industrial park;
- Type 4: among local firms that are not collocated;
- Type 5: among firms organized "virtually" across a broader region.

Discussing also on how these symbiotic relationships can be created and speed up, she proposed three different evolutionary approaches (Chertow, 2000):

1. already existing exchange of matter or energy;
2. pre-existing organizational relationships and networks;
3. the anchor tenant model, where everything start from the one or two large industries.

A table by Korhonen (2001) is very explicative about the Ecosystem metaphors in industrial systems. (see tab 3.4)

3.3.3.3 The ecosystem facilitator: the anchor tenant [21]

Arguing about the governance of BEs and EEs, the scientific literature identifies the figure of the 'anchor tenant' as the facilitator for the growth and evolution of the ecosystem. A review of this concept in the Scopus database, updated in September 2019, reveals the roots of this terminology in the strategies for opening new large department stores around a famous shop (Agrawal & Cockburn, 2003). Following Agrawal and Cockburn (2003), who explored the hypothesis in regional innovation systems, the anchor tenant is played by a *"large, local R&D-intensive firms"* able to use and push the university research and other local industries, recognising the key role of university research in the regional

21 Based on what published in Battistoni and Barbero (2020)

Tab . 3.4 - the differences among a natural ecosystem and an industrial ecosystem by Korhonen (2001). Retrieved from Korhonen (2001)

Ecosystem		**Industrial ecosystem**	
Roundput	Recycling of matter	Roundput	Recycling of matter
	Cascading of energy		Cascading of energy
Diversity	Biodiversity	Diversity	Diversity in actors, in interpendency, in cooperation
	Biodiversity in species, organism, interpendency		Diversity in industrial input, output
	Diversity in information		
Locality	Utilizing local resources	Locality	Utilizing local resources, wastes
	Respecting the local natural limiting factors		Respecting the local natural limiting factors
			Cooperation between local actors
Gradual change	Evolution using solar energy	Gradual change	Using waste material and energy, renewable resources
	Evolution through reproduction		Gradual development of the system diversity
	Slow time rates in the development of system diversity		
	Cyclical time, seasonal time		

innovation performance. Referring to the regional material and energy flow, Korhonen (2001) and Korhonen and Snäkin (2001) identified this actor in the powerplant of heat and energy co-generation. The review of the concept by Niosi and Zhegu (2010) find different typologies of anchor tenants, including large innovative firms, research universities or public laboratories. In addition, concerning the governance of EEs, Colombelli et al. (2019) refer to the concept of anchor tenants, individuating its transforming role - from a hierarchical role in the birth phase to a more relational role in the consolidation phase -. Moreover, they comment that *"the role of an anchor tenant changes over time"*(Colombelli et al., 2019, p. 508). Many contributions also link this concept to the industrial symbiosis and eco-industrial parks; for instance, Sun, Spekkink, Cuppen and Korevaar (2019) focussed more on anchoring as an activity (institutional or physical) than as an actor, while Burström and Korhonen (2001) identified it in the municipality. The review has illustrated the effectiveness of anchoring activities, both for the development of traditional and sustainable BEs, and it has been selected as an approach to be used in this research. Other disciplines refer to facilitator actors involved in the initiation and development of complex processes, such as co-design processes. In this last case, the facilitator actor is the designer (Lee, 2008).

3.3.4 Innovation models: from the triple to the quadruple helix

As mentioned in the review about the ecosystems, according to Scaringella and Radziwon (2018) EE emerges through the interactions of various actors, stakeholders and systems comprehended in the quadruple helix models of innovation. Indeed, according to Pique, Berbegal-Mirabent & Etzkowitz (2018), the Triple Helix model by Etzkowitz & Leydesdorff is "*one of the most referenced models used to characterize an innovation ecosystem" (*Pique, Berbegal-Mirabent & Etzkowitz, 2018, pg. 5).

This concept was defined mainly thanks to the Stanford University research group which identified the models of innovations in the evolution from the dyad as a linear model of innovation to the triple and quadruple helix (Stanford university website[22]). In the definition of these concepts the Stanford university cited the works of Etzkowitz (1993) and Etzkowitz and Leydesdorff (1995), with elements of previous works by Lowe (1982) and Sábato and Mackenzi (1982). From the intersection between government and industry to create the industry society, the Triple Helix see the intersection between industry, university and government level to create the knowledge society and innovation and economic development.

Recently, some studies on the evolution of this concept were published:

- Triple Helix Systems of innovation: introduced by Ranga and Etzkowitz (2013) as *"an analytical framework that synthesises the key features of Triple Helix interactions into an 'innovation system' format, defined according to the Systems Theory as a set of components, relationships and functions"* (Stanford university website);
- Quadruple Helix Model: by Carayannis and Campbell (2012) which adds civil society to government, university, and industry (Scaringella and Radziwon, 2018);

A graphic representation of the evolution is present in fig. 3.14.

Very interesting for this study is especially the Triple Helix Systems of Innovation which considers the triad acting as a system with systemic and non-linear interactions between actors creating a circulation of knowledge flows and resources with as result a *"new combinations of knowledge and resources that can advance innovation theory and practice, especially at the regional level"* (Stanford university website).

22 https://triplehelix.stanford.edu/3helix_concept

3.4 SUSTAINABILITY IN ENTREPRENEURIAL CONTEXT

3.4.1 Review

To obtain an overlook of the concept of sustainability in the entrepreneurial context, a simplified systematic specific literature review was performed in September 2017 and updated in September 2018 to look for the significant scientific contributions in the two main databases for scientific community, Scopus and Web of Science. The results were find crossing the two main keywords "entrepreneur*" and "business incubator*" with the research fields identified in the review of the context (see chapter 2):

- the economic paradigm foster by SD: green economy, CE, BE;
- the same goal of SD projects: sustainable development, sustainability, environmental sustainability, ecology, green (in general);
- the same cultural paradigm of SD as "holism".

Discussing about the numeric results (see fig. 3.15), is possible to state that:

- the contributions over the keyword "entrepreneur*" is much more diffused than "business incubator", about 50.000 vs 500;
- apart from sustainable development, ecology and sustainability, the other topics are not very diffused in the scientific production;
- there are significant quantitative differences between the two central themes looking for example at the green and CE
- there are no results crossing BI and CE and BE.

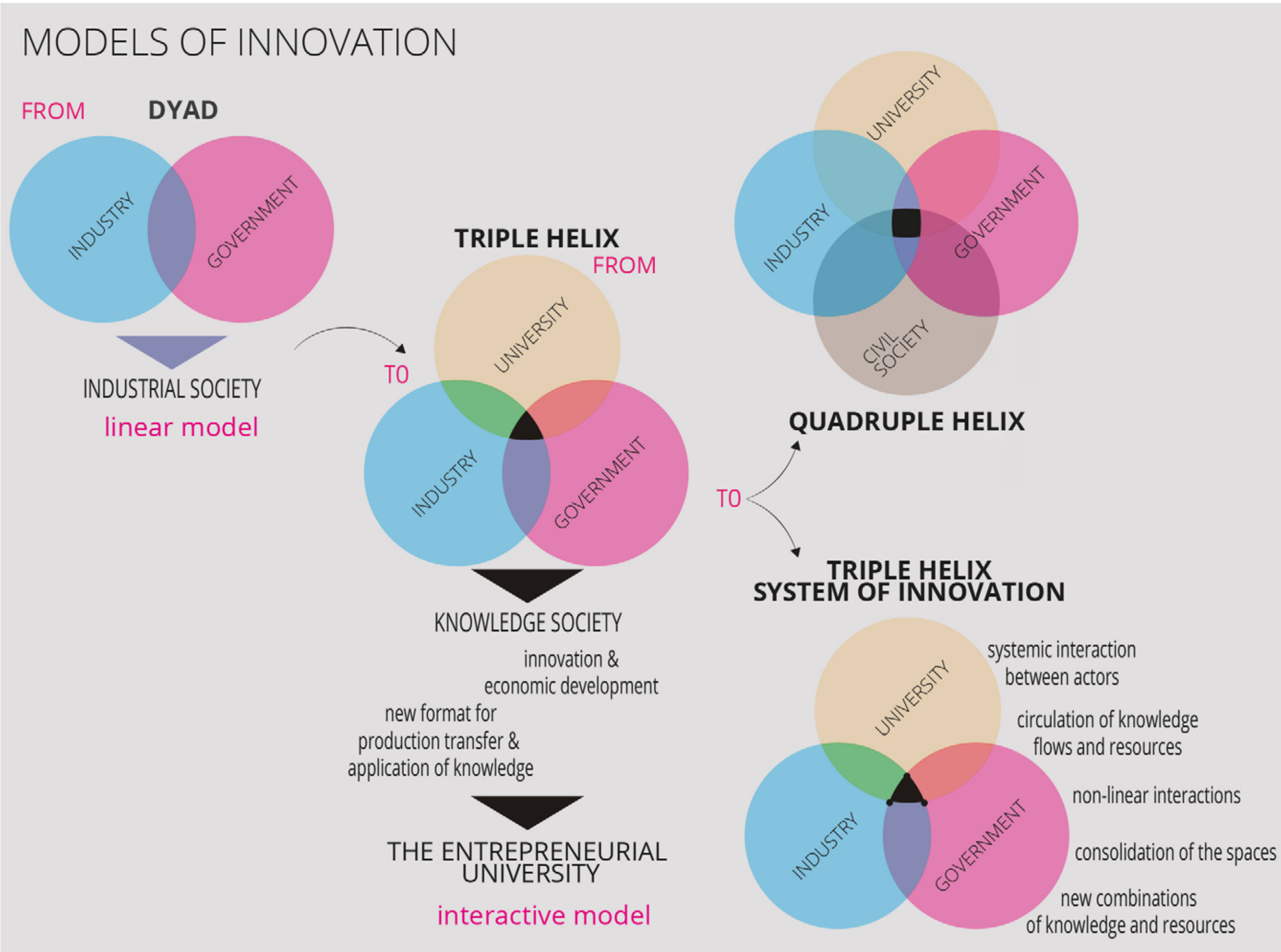


Fig. 3.14 - graphic representation of the evolution from the Dyad, to the triple helix and quadruple helix. Published in Battistoni and Barbero (2019; 2020)

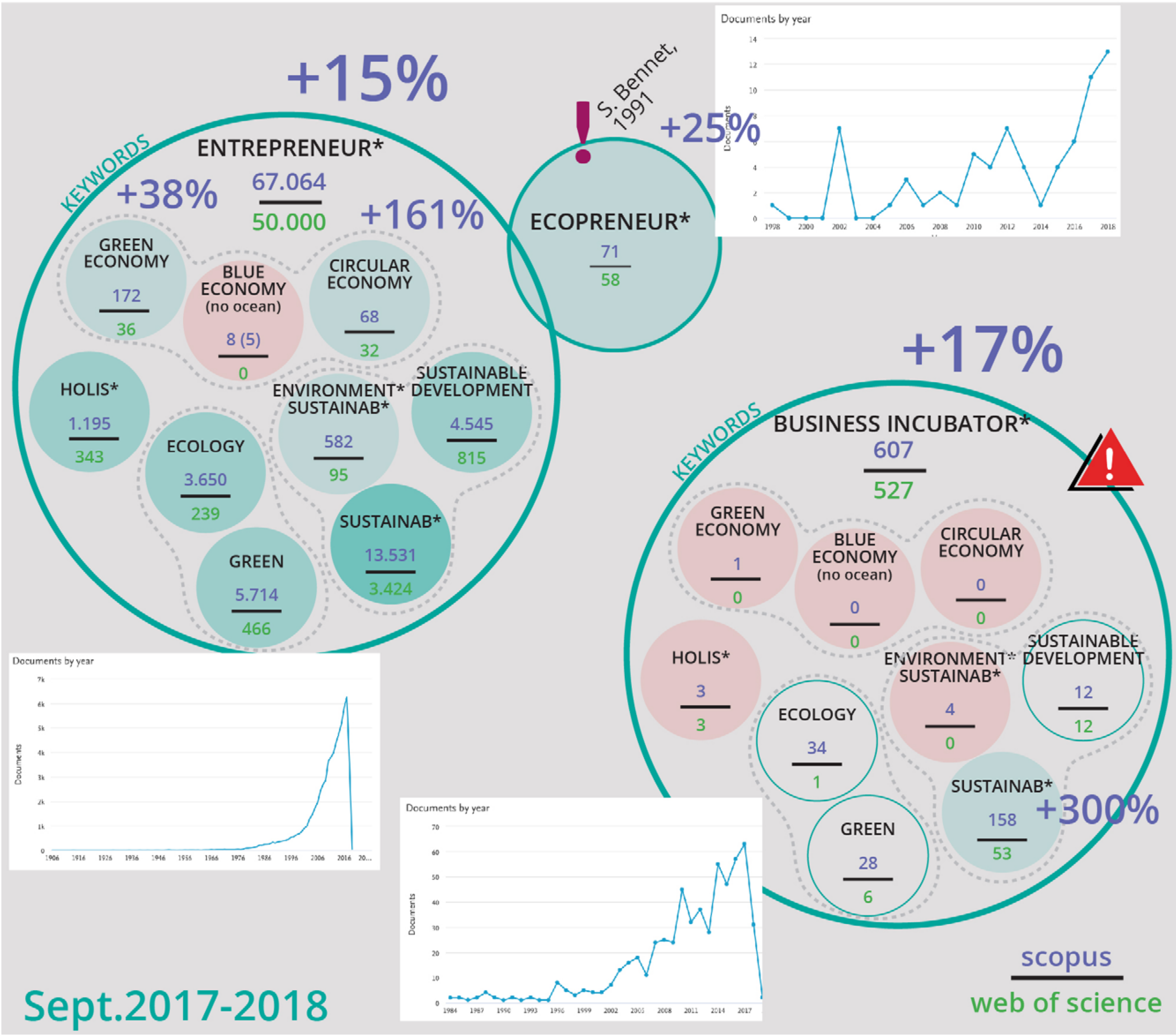


Fig. 3.15 - graphic visualization of the results of this specific literature review

As it possible to notice from the results graphically represented in fig. 3.15, topics around environmental issues are not diffused in the scientific production around BIs, neither the concept of CE which nowadays is very diffused. The results crossing “business incubator* and “environment* sustainab*” in Scopus are 4: Portuguez Castro, González, & Corona (2018); Bezerra, Borges, & Andreassi (2017); Parakhina, Boris, & Midler (2015); Lai & Lin (2015). Reviewing their abstract, they are not contributing to this relationships. Based on these results, the one referring to “sustainab*” can possibly refer to the economic sustainability which, as seen in the previous paragraphs, is an aspect very diffuse among BIs.

The review was repeated two times over the first two years of the doctoral programme, and the comparison of the results is present in fig 3.15. It is possible to notice that both the two main concepts increased in contributions. It is in line with the trends of development of the three key concepts, however the situation over the looking for points of contact between the BI phenomenon and especially the CE, remains equal.

Looking over the results for the entrepreneurship phenomenon, the increasing of results that cross

Fig. 3.16 -graphic visualization of the two main typologies of eco-entrepreneurs

entrepreneurship and CE reflects the growing attention on this concept. The main finding is the identification of a subfield in the entrepreneurial context, the 'Ecopreneurship', which was afterwards studied in-depth.
Moreover, looking for the actors to understand how they are working, during the review on scientific contributions crossing the keywords "business incubator*" and concepts around the environmental sustainability in 2018, only this actor came out: the 'Green Garage' in Berlin, cited by Bank & Kanda, (2016) and Bank, Fichter, & Klofsten (2017).

3.4.2 Environmental entrepreneurship

The intersection between entrepreneurship and environmentally and socially responsible behaviour is identified in 'ecopreneurship' referring to the movement defined by S. Bennett in 1991 (Holt, 2011). Gast, Gundolf, & Cesinger (2017) in the first systematic review of the literature on ecological sustainable entrepreneurship, find a fragmented and inconsistent research field which is reflected in the variety of terms used: 'sustainable entrepreneurship', 'ecopreneurship' , 'environmental entrepreneurship/ enviropreneurship', and 'green entrepreneurship'. They moreover identified two categories of entrepreneurs (fig. 3.16):

- environmentally oriented entrepreneurs *"follow their motivation to earn financial benefits by helping to decrease environmental problems and ecological degradation"*;
- sustainability-oriented entrepreneurs *"typically seek to solve societal and environmental problems through their entrepreneurial activities. As such, they are likely to focus on environmental, social, and economic issues simultaneously"*.

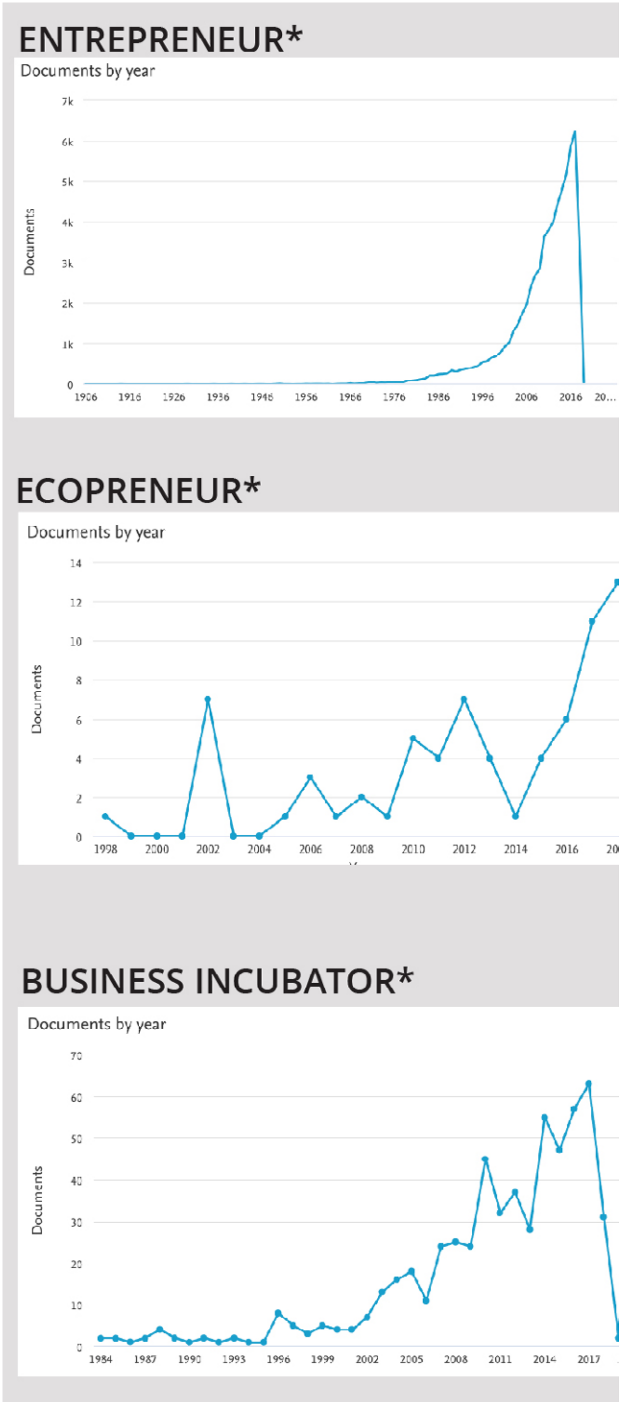


Fig. 3.17 -evolution of the scientific contributions about the three main concept . Graphs gnerated by Scopus database website

They defined also the concept of 'ecological sustainable entrepreneurship' as *"the process of identifying, evaluating and seizing entrepreneurial opportunities that minimise a venture's impact on the natural environment and therefore create benefits for society as a whole and local communities"* (Gast et al., 2017). Their literature review moreover pointed out other interesting information about the topic as the relevance of the *"Sustainability-related entrepreneurship"* in the entrepreneurship research and the identification of the four major motives for ecological sustainability *"regulation, public concern, expected competitive advantage, and top management commitment"*. Finally they advised entrepreneurs about the *"need to take an active role in seeking to balance economic goals with sustainability and environmental goals"* (Gast et al., 2017).
A contribution focused on ecopreneurship is the one by Santini (2017) who provides also the limits, trends and characteristics of this movement that she has identified in a previous specific literature. The principals were identified as:

- the ability of ecopreneurs to shape the face of companies according to the belief set and motivations;
- the inner tension experienced in companies between making profits or going green;
- the role of ecopreneurs as a change agent;
- the ability of ecopreneurs to establish relationships with multiple stakeholders;
- the openness of ecopreneurs towards ecological and social responsibilities;
- co-creation as a key issue and opposite to customisation, characterised by a high degree of creativity, collaboration and by a societal orientation.

3.4.3 Circular Economy implementation barriers

To enhance the understanding of the implementation phase in the CE context, a systematic specific literature review was performed in the database Scopus which turned out to be the one with more contributions in the previous research. In the results over the 'circular economy' keyword, it was looked for 'barriers' and 'drivers' in the implementation. Over a total of 3126 results only on "circular economy", 849 contributions are focused on 'implementation'

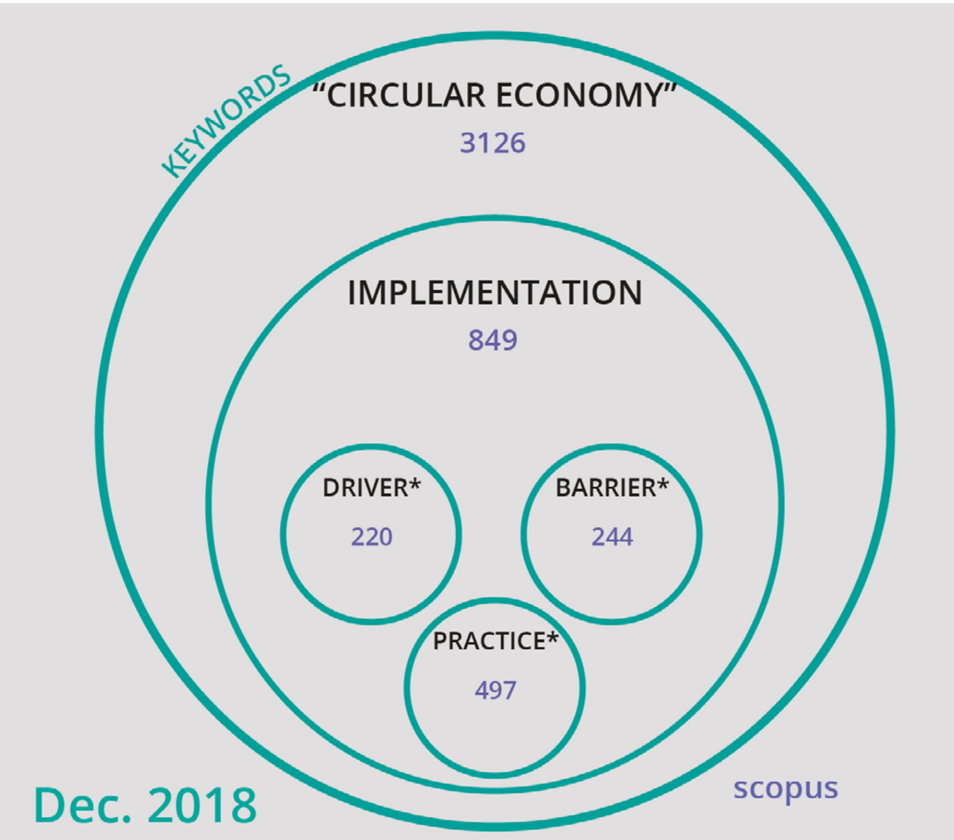


Fig. 3.18 - results of the literature review in Scopus databsse, updated the 10th December 2018

area (see fig 3.18) and in this sphere, 244 are about 'barriers'.
Analysing the results, the graphs retrieved by Scopus database show that there was an exponential increasing since 2015, which is the year of European economic strategy in Europe (fig. 3.17). It confirms that this topic is a very current open debate and in continuous evolution. The decline in 2019 can be due to the date chosen for the research, the 10 December 2018.
Looking over the literature on CE implementation barriers, the most recent study at that time published in scientific journals was the one from Kirchherr et. al (2018). Their research is crucial because it represents in addition a literature review of this topic, identifying more than 30 studies on CE barriers. Afterward, they put in relation their results with previous one and making comparisons. They adopted the distinction made by de Jesus and Mendonça (2018) in cultural, regulatory, market and technological barriers, and identified 15 more sub-categories putting them in a different order of importance (cultural, market, regulatory and technological). (see tab 3.5). They find that mainly the cultural barriers are the one considered more important by businessman and policy makers, while the technological one are not *"pressing"*. And moreover that for the moment it is *"niche discussion among sustainable development professionals"* (Kirchherr et. al, 2018).
Another recent study, mentioned also by Kirchherr et. al (2018) is the one made by de Jesus and Mendonça (2018). They refers to the work of Preston (2012), Vanner et al. (2014) and Rizos et al.(2015). They found that CE is driven by soft factors " (i.e. social, regulatory or institutional) where public agencies have a crucial role, however, the hard barriers

tab. 3.5 - Barriers by Kirchherr et. al (2018)

cultural	lacking awareness and/or willingness to engage with CE	hesitant company culture
		limited willingness to collaborate in the value chain
		lacking consumer awareness and interest
		operating a linear system
market	lacking economic viability of circular business models	low virgin material prices
		lacking standardization
		high upfront investment costs
		limited funding for circular business models
regulatory	lacking policies in support of a CE transition	limited circular procurements
		obstructing laws and regulations
		lacking global consensus
technological	lacking (proven) technologies to implement CE	lacking ability to provide high quality remanuctured products
		limited circular designs
		too few large –scale demonstration projects
		lack of data e.g. on impacts

tab.3.6 -Barriers by de Jesus and Mendonça (2018) Retrieved from table 2 in pg. 78.

social/cultural	rigidity of consumer behavior
	business routines
economic/financial/market	large capital requirements
	significant transaction costs
	high initial costs
	asymmetric information
	uncertain return and profit
institutional/regulatory	misaligned incentives
	lacking of a conductive legal system
	deficient institutional framework
technical	inappropriate technology
	lag between design and diffusion
	lack of technical support and training

(technical solutions and financial factors – economy and market) can obstruct its development. They also underlined that *“although academic literature still focuses mostly on technologically- based innovation, grey literature sources (and in particular EU reports) increasingly refer to systemic innovation.“* (de Jesus and Mendonça, 2018). They identified multiple barriers (see tab 3.6).
Another review recognized important for the PhD research goal is the one by Rizos et al. (2015) which refer to the CE business model implementation barriers and enablers in the SMEs context.
They categorized barriers in:
- company environmental culture;
- lack of capital;
- lack of governmental support/effective legislation;
- lack of information;
- administrative burden;
- lack of technical and technological know-how;
- lack of support from the supply and demand network.

They also find and categorized enablers in:
- company environmental culture;
- networking;
- support from the demand network;
- financially attractive;
- recognition;
- personal knowledge;
- government support.

Thanks to a survey, Rizos et al. (2015) understood the barriers and enablers main cited by the European SMEs: the “company environmental culture’” as enablers and “lack of support supply and demand network” and “lack of capital” among the barriers.

Translating the main conclusions in recommendation for the policy makers, they recognized the need to focus on *“greening consumer preferences, market value chains and company cultures, and support the recognition of SMEs’ green business models”* indicating *“the creation of dedicated marketplaces and communities of practice”* as the means to reach them (Rizos et al., 2015)
As results of the analysis of these very recent literature reviews, the many implementation barriers recognized and sometimes repeated by authors, can be grouped in (see fig 3.19):
- cultural;
- economic;
- technological;
- about products;
- about the market;
- about the regulatory system.

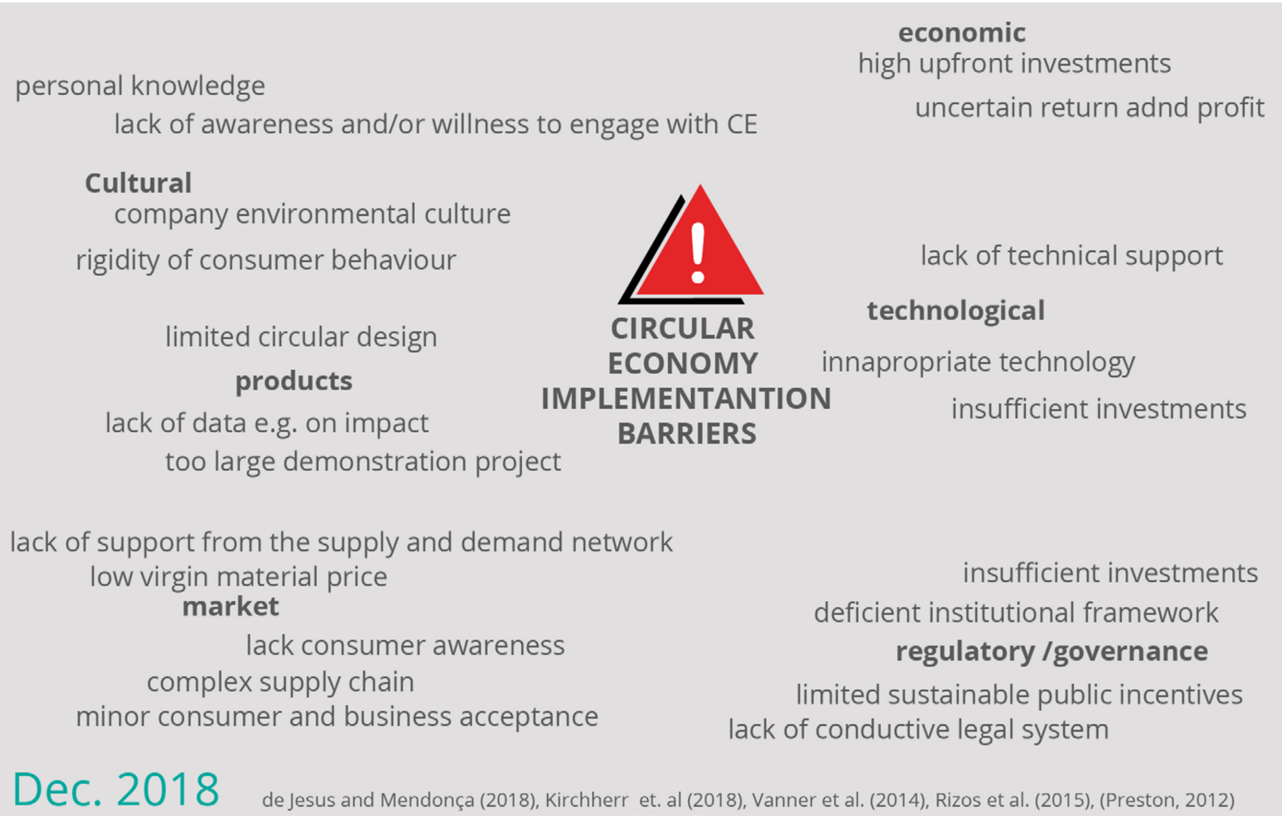


Fig. 3.19 - graphic representation of the CE implementation barriers found in the literature

3.5 DESIGN AND INNOVATION

The design discipline with its methodology and approaches has confirmed through some studies and different applications to be a strategic approach for innovation creation (Korhonen & Snakin, 2001; Brown, 2009; Celaschi & Deserti, 2007; Franzato & Celaschi, 2017). Moreover, Design has also shown its role in the valorisation of the local material culture and know-how and in the increasing of the value of a certain territory, especially among the Italian scholars as (Bozzola & De Giorgi, 2016; Catania 2011).

Deserti and Celaschi in Politecnico di Milano (Italy), arguing about the role of design in the production of innovation, identified the principal phases of an innovation process design-driven (Celaschi & Deserti, 2007, pg 23) which consist of:

- problem finding;
- problem setting;
- problem solving;
- spreading.

These phases are interconnect in the 2 steps of process for design-driven innovation: the meta-project phase (the ideation of the research and design process performed through desk and field research) – the innovation instrument - and the project phase (Celaschi & Deserti, 2007, pg.40). They also underlined as find in the design for sustainability evolution (see chapter 1.2), that innovation is passing from the product innovation, to process innovation (process as communication, distribution, immaterial interface, distribution, assistance,..) to system innovation which includes transformation in the all value chain, overpassing the production process and involving also the behaviour of production, exchange and consumption of the entire complex system (Celaschi & Deserti, 2007). According to them, moreover the innovation process involves many actors with different competencies as "mediator actors" (4 main categories: pre-design research, designers, communicators and distributors[23]), the

23 translation of Italian: pre-progettisti, progettisti, communicatori, distributori

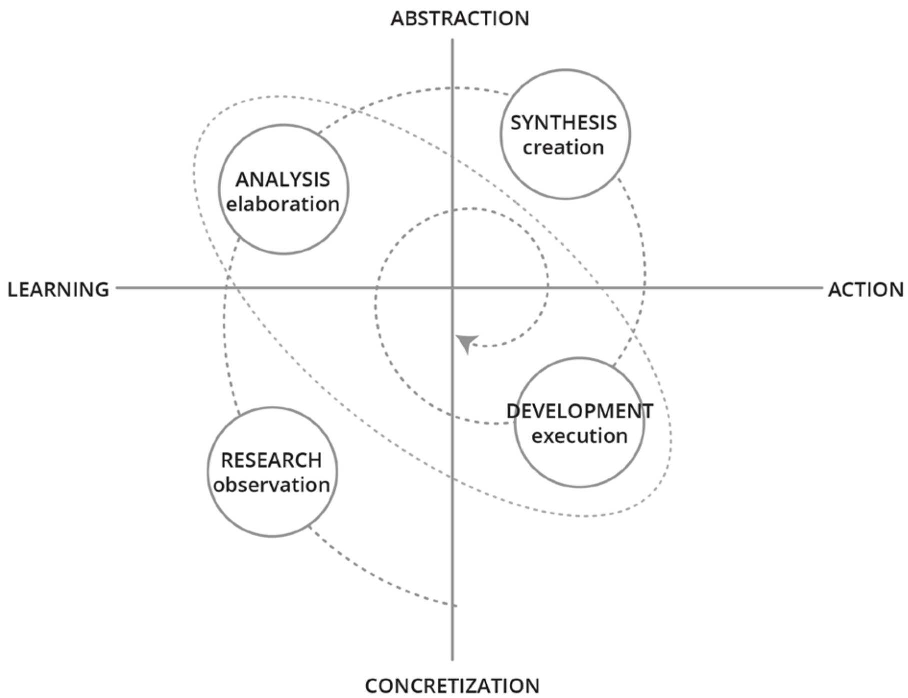


Fig. 3.20 - process for product-system innovation. Based on what published in Celaschi & Deserti (2007), fig. I.12

collaborative work of which is fundamental for the success of the enterprise. Their focus on the Italian framework highlights the lack of these professional figures in many of the economic realities, due mainly to the limited human resources in most of them (small dimension), and their traditional strong relation to the technical, productive and logistics phase of the production process which in the past defined the success of the enterprise.

Bertola & Teixeira (2003) defined the *"design as knowledge agent [...] embedded into organizations to foster innovation"* distinguishing that is role change among global corporations and local companies:

- a 'knowledge integrator' in global corporations *"by mediating through formal and structured methods, the knowledge contained in distinctive domains"* (pg.186);
- a 'knowledge broker' in local companies *"promoting knowledge flow from outside to inside organizations"* (pg. 189) and *"organizing and adapting business processes to support the development of innovative product concepts based on potential or emerging social and cultural changes"* (pg. 190)

Moreover, they contributed to the definition of the role of design in innovation, both related to product and/or process: *"design as a multi-functional activity, capable of flexibly adapting to specific contextual factors and contributing to the development of product and business innovation in any given situation"* (Bertola & Teixeira, 2003).

Also the EU commission has recognized the role of design in innovation policies with the 'Action Plan for Design-driven Innovation' (European Commission, 2009). Moreover, EU stated the importance of design in the innovation environment for European industries with the working document entitled *"Design as a driver of user-centred innovation"* published in 2009. The results of this study demonstrated that design has a positive influence in national competitiveness and also on the companies: *"the companies that invest in design tend to be more innovative, more profitable and grow faster than those who do not"*(European Commission, 2009). Also Bruce (1999) remembers the positive role of the use of design in small companies, pointing out the problems of awareness that design investment can create on business performance. The work by Deserti (2009) focused on the strategic role of design in the Italian case, finds that some Italian SMEs are design-oriented, where there is a direct relationships between designer and entrepreneur. In their discussions start the development of new products/market strategies/solutions and in this case *"design plays a role of mediation in the relation between company and market, developing what we are used to call a strategic approach"* (Deserti, 2009, pg. 64). However, non presence of design in the university in a structured way create difficulties and the designer *"initially is not a "visible" player within the system."* (pg. 64).

The EU report recognized the limits of the traditional thinking about design which relate it to the aesthetic of products, and the broader application of this concept, from products to service and systems, but also strategic design, design management and design thinking. It also recognized barriers in the development of design for innovation in Europe as the little attention by politics and the lack of experience in design by SMEs (European Commission, 2009). The strategic role of design for the enterprises has indeed enlarged the design disciplines from product design into new specializations as:

- Strategic design;
- Design management[24] .

Following the review by Franzato (2010) Strategic design has assessed the potential of design in corporate strategies at multiple level: at operational level (project), organizational level (department) and strategic level (mission). This aspect of design is today also a scientific journal *"Strategic Design Research Journal"*. Design management instead is more focus on business professionals on integrating business issues in design thinking following (European Commission, 2009) *"Design management as a discipline aims to raise business professionals' awareness of how to integrate and manage design, and to integrate business issues, methods and understanding in design thinking"* [25].

Design methods were also transformed in the Design Thinking approach which let it be applicable by many other disciplines to foster innovation, as Brown remind also with the title of his book

24 http://revistas.unisinos.br/index.php/sdrj

25 *"The American Design Management Institute (DMI) is an important promoter of design management, also promoting design among non-design executives. In Europe, design management has been encouraged by the Design Management Europe (DME) Award"*

"Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation" (Brown, 2009). However, as reminded by many scholars as Deserti & Rizzo (2014) is wrong to disconnect design thinking from 'design doing' and that there are *"wicked problems in design thinking approach"* (Buchanan, 1992).
Design for sustainability, as seen in chapter 1.2, is an approach to design process to reach sustainable outcomes, it is moving from product innovation to system innovation and its strategy were analysed in the literature. Instead for Systemic Design – specific approach in Politecnico di Torino about production processes - the potential of creating opportunities for eco-innovation was not deepened in literature.

3.6 THE RELATIONSHIPS AMONG DESIGN, INNOVATION AND ENTREPRENEURSHIP

The Oxford University press dedicated in 2015 an entire handbook to the relationships between creativity, innovation and entrepreneurship, finding parallels in the researches in the three areas. According to Shalley, Hitt, & Zhou (2015):

- creativity, involving the generation of new ideas, is the precursor of innovation and entrepreneurship;
- innovation is the implementation of ideas;
- entrepreneurship is a specific form of innovation and also the identification of new opportunities and opportunity exploitation for the creation of new ventures.

From a designer point of view, the concepts of creativity and innovation have point of contacts: traditionally, design is the creative process to conceive new products. Also the creation of new opportunities, as identified before. This potential in opportunities creation and in the production of innovation represent the point of collision between the design discipline and the entrepreneurial context. Indeed, it was started to be explored by literature. One example is the study by García et al. (2017) which identified that the design process and the entrepreneurial one can feed each other (fig

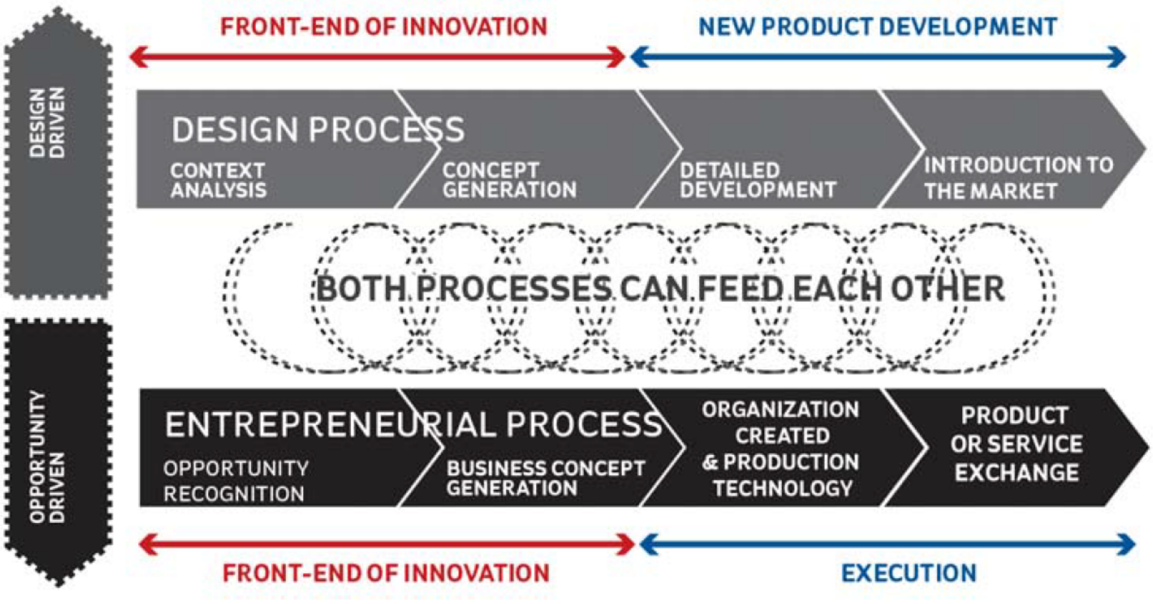


Fig. 3.21 - the differences among the design process and the entrepreneurial process. Retrieved from García et al.(2017)

3.21). Especially *"Design, especially service design, possesses instruments that allow for the framing, development, co-designing and prototyping of complex intangible projects thus potentially being a powerful ally to entrepreneurs"*. However, they recognized that this relationship was not explored: *"Although many authors acknowledge creativity as an important factor in the generation of entrepreneurial opportunities, none of them acknowledges any contribution from design"*(García et al., 2017, p.64).

3.7 RESULTS OF THE LITERATURE REVIEW: GAPS IN THE THEORETICAL CONTEXT

Starting from the relationships between design and environmental sustainability - eco-design, Design for sustainability, SD, and the new research fields on design for CE - (see overview in chapter 1) - this literature review had the scope to enlarge my knowledge on the research fields related to 'entrepreneurship' to finally understand which are the relationships between it and design and environmental sustainability and the sustainable local development. An interesting finding was the point of collision among design and entrepreneurship represented by opportunities recognition and innovation creation, although it is not yet well discovered the contribution that design can create (García et al., 2017). This potential is also not explored if talking about SD (for the manufacturing sector) which is a niche discipline. Moreover, while design has recognized its role and contribution for the creation of environmental sustainability, this relationship is not well explored in the field of entrepreneurship which is focused on the economic part. The relationships between entrepreneurships and environmental sustainability is low explored and cited by the research community, however, in literature it was find 'ecopreneurship' as an emerging movement where entrepreneurs seek to balance economic goals with sustainability and environmental goals that is emerging. This gap is found also in the literature about the BIs, considered principal actors in entrepreneurship creation and also, in some cases, focused on the local area where they are placed. Although they have a clear role in development of business opportunities and new ventures creation the gap is on the BIs engagement in the will to assure the environmental sustainability of the business system and their environmental impact in the local area. Also they seem to have reductive services to assure the environmental sustainability of the new businesses. In addition, the literature is focus on BI working for the current economic system, missing contributions over BI for an alternative economic model as the CE. In the process of looking for the actors to understand how they are working to support the implementation of a different economic model, the CE framework, it wasn't find contributions in the literature about BIs. One of the reason can be the little interest by the academic/research sector on this topic or too recent phenomenon about CE framework. Many contributions indeed are found on the implementation of CE with contributions that highlights the barriers find in this implementation process (from investments, to technical, to cultural, and also related to market and the regulatory system) referring to studies on existing companies especially on the SMEs sector.

Referring to the creation of local sustainable development, which is the goal of the SD approach, design has focused its attention on the enhancement of the 'territory' especially regarding the material culture and working with local resources. In the case of entrepreneurship, territorial approaches were find in the concept of 'ecosystems' referred to business field in general making the analogy with the natural ecosystems, where many actors work for the same goal and have relationships. In the case of BIs the research has revealed as they can act as a central node in the entrepreneurial ecosystems. Considering innovation ecosystems in general, they consider the interaction of the various actors of the helix model of innovation: from businesses, universities, government and the civil society.

Design is starting to be considered a crucial point to obtain a CE, however it is yet defined very related to product design innovation instead of system innovation, which is the focus of SD approach.

In this case, contributions are missing on how to support the creation of innovation not only linked to the final product, but to the entire process of production and assure a positive environmental impact on the local context. It is missing the connection among the four principal elements investigated: Systemic Design, Entrepreneurship, Environmental sustainability and the sustainable local development.

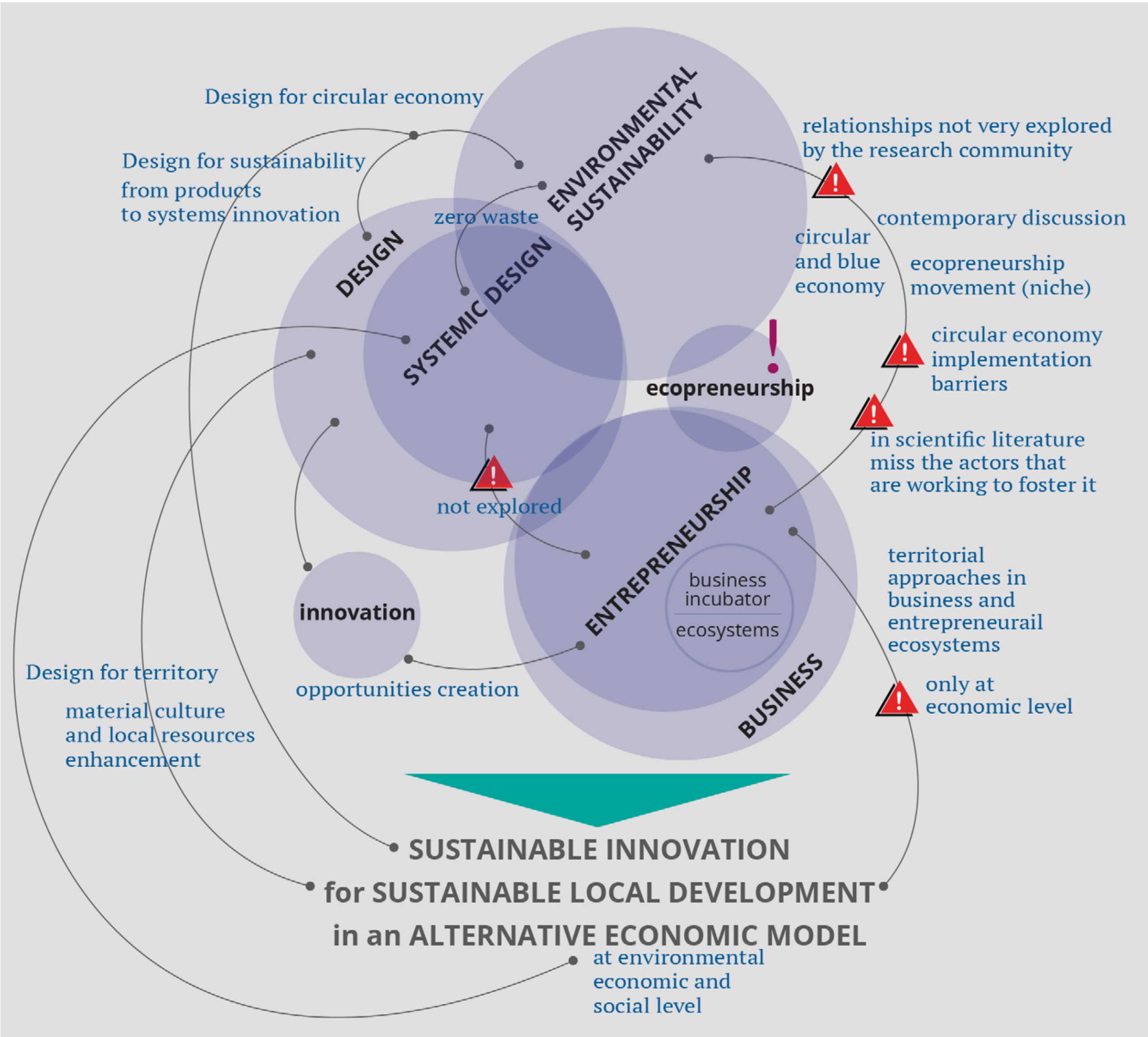


Fig. 3.22 - visualization of the results of the literature review: point of collisions and gaps

Chapter 4

Methodology

This chapter explains the epistemological foundation of this doctoral thesis in Design, and the methodology used to answer the research question initially identified in chapter 1,
“How SD projects can be implemented and supported by local context in order to boost CEs in Europe?”.

4.1 DOING RESEARCH IN (SYSTEMIC) DESIGN

Victor Margolin argued about doctorate in design in 2010 finding problems and unclearness. In his opinion, they can be a consequence of the many definitions related to 'design': indeed in design there is always a tension between research and practice. Moreover, it is not a fixed discipline but always in continuous development, which starts from the study of human actions that are rooted in the social system and it has not a fixed subject matter as the other disciplines or fields (Margolin, 2010). Moreover, design is a relative young disciplines as the doctoral education in design (Margolin, 2010).
Although these problems, approaches have been developed to combine the research field and design (practice). In literature, research methods were defined to study the design activity (Manzini, 2015, p. 39):

- research for design: producing tools for the design activity;
- research on design: researches about the nature of design;
- research through design (RtD): using methods of design culture and practice, which imply a more subjective dimension.

The study by Clemente, Tschimmel, & Pombo (2017) recognized also the category of research 'from' design, which is along the research through design. In research through design, the practice arrives after the theoretical definition. In research from design, the theory arrives after the practice.

RtD, according to Zimmerman and Forlizzi, follows the suggested methodology composed of the following steps: select, design, evaluate, reflect, disseminate, repeat (Zimmerman & Forlizzi, 2014). Maher et al. (2018) proposed this RtD methodology for "Integrating design thinking with sustainability science" with the following steps putted in cycle: (re)framing the problem/opportunities, designing possible solutions, testing them collaboratively, reflecting critically.
However, design practice is shifting from product and visual communication to "Complex systems and environments" as identified by Buchanan (1992) and shared by many scholars. Based on it, Jones (2014) for example identified 4 stages of evolution of design: from Design 1.0 about Artifacts and communications and Design 2.0 about Products and services, to Design 3.0 about Organizational transformation and Design 4.0 about Social transformation. In particular, Design 4.0 is "*complex, unbounded*" and "*for complex societal situations, social systems, policy-making, and community design*" (Jones, 2014, p.8). From Design 3.0, the design context becomes a complex system, which requires a different mind-set, skills and methods. This understanding has put the basement for the integration with design and systems thinking with the birth of SD: "*It adapts from known design competencies - form and process reasoning, social and generative research methods, and sketching and visualization practices - to describe, map, propose and reconfigure complex services and systems.*" (Jones, 2014, p.2). Jones identified the research methods of SD which come from design and visual, cybernetic, evaluative, social/participatory and are based on "*4 intents of system practice*" (Jones, 2014 b) (fig. 4.1): understanding, design, prediction, change.
Another author which was trying to define SD methodology is Ryan (2014) which define the following main steps: "*framing, formulating, generating, reflecting, inquiring, and facilitating*" (fig. 4.2). Moreover, he focused on the mindset that is needed to deal with complex systems design which is "*inquiring, open, integrative, collaborative, and centred*". He also added that methods should be "*flexible and open-ended*" to facilitate group collaboration.

The Politecnico di Torino has developed a specific methodology for the design of a system following SD approach (fig. 4.3). These methodologies on SD are in line as they identify the need for a deep understanding phase of the current situation. The SD methodology in Torino starts with the deep and holistically understanding of the current situation, the Holistic Diagnosis (HD). After this phase there is a proper design phase able to predict the new scenario and implement changes. The Holistic Diagnosis (HD) is performed with field and desk researches about the context of reference and the interactions/fluxes among the components of the system taken in analysis. Afterwards, the problems distinguished in the analysis are defined and starts the identification of the leverages for change to design the new system. Finally, the outcomes are studied, the implementation phase is performed, the results generated are analysed and feedbacks from each phases are used to evolve and improve the system (Battistoni, Giraldo Nohra, & Barbero, 2019) (see fig 1.6 and chapter 1.2.4.1 for more information)

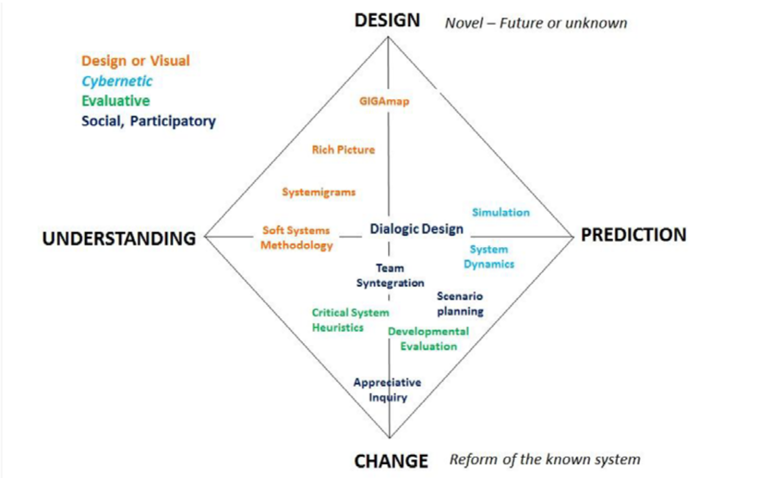


Fig. 4.1 - The 4 intents of system practice and methods used. Retrieved from Jones, (2014 b)

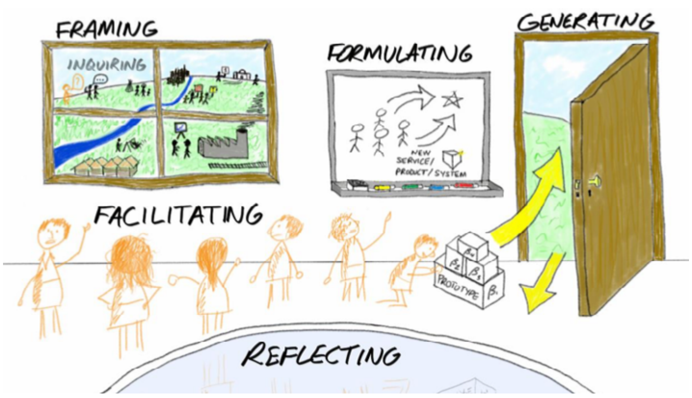


Fig. 4.2- SD methodology retrieved from Ryan (2014)

Fig. 4.3 - SD specific methodology in Politecnico di Torino. Retrieved from Battistoni, Giraldo, Barbero (2019)

4.2 SPECIFIC RESEARCH AND PROJECT METHODOLOGY USED

For the purposes of this thesis, and to answer to the research questions, the methodologies previously reported were adapted to the research scope. The methodology used is the result of the research as an academic activity and the RtD, or better through SD (RtSD).

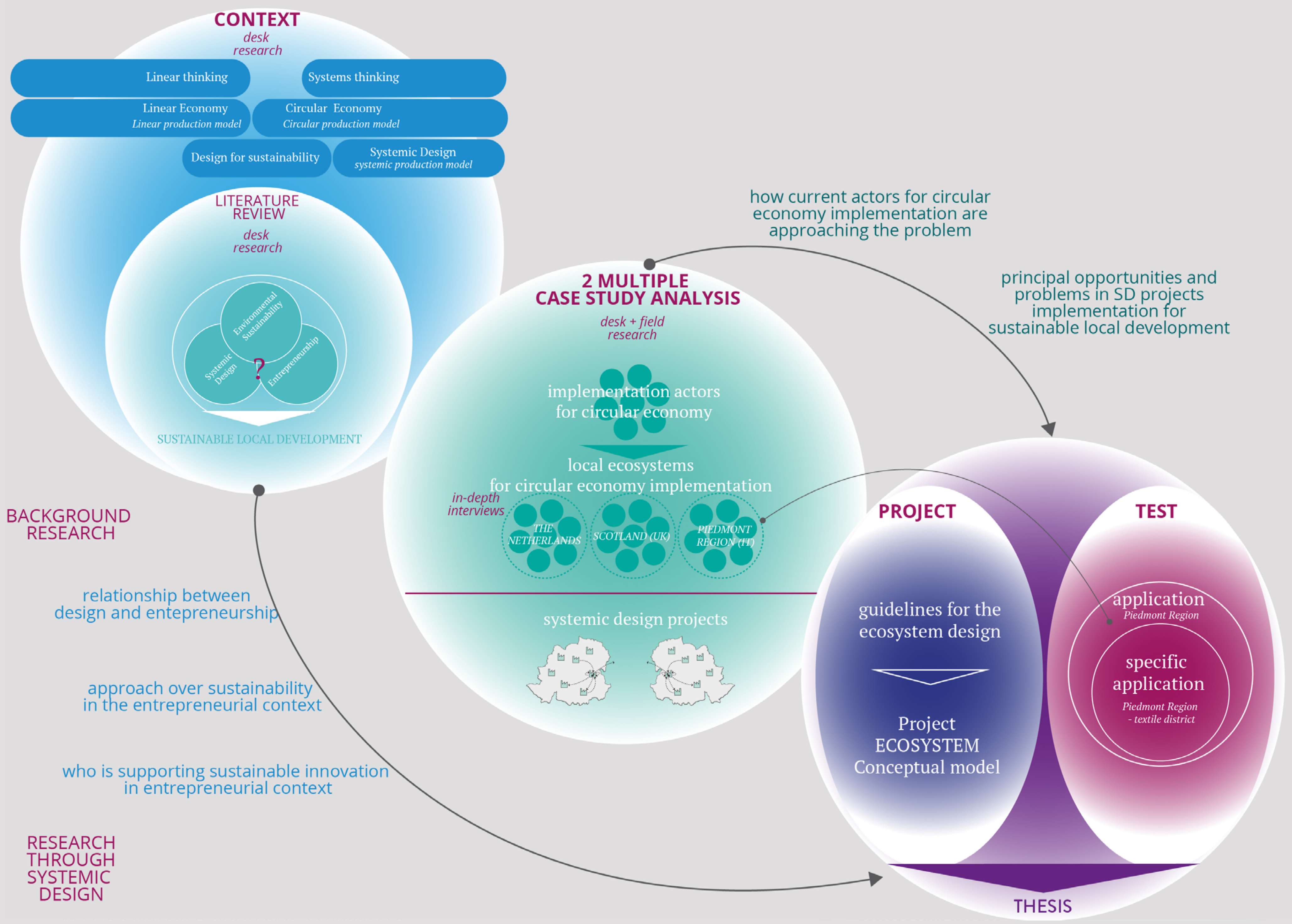
The overall research purpose is exploratory as it is focused on a research area that was poorly understood and explored (Robson & McCartan, 2016) – the implementation of SD projects. The research approach is inductive as the conceptual framework is built on the collection of data exploring a phenomenon (Saunders, Lewis and Thornhill , 2015). Following the exploratory purpose, qualitative research paradigm was applied for data collection and data analysis (Robson & McCartan, 2016) and a flexible research design was used to give answers to the different research questions that emerged during the evolution of the research process. In particular, the research strategy of the case-study was used being the research focus on 'how' and on contemporary phenomenon (Yin, 2014). The data collection was performed using multiple research methods, combining desk and field researches (Celaschi & Deserti, 2007), semi-structured interview and systems mapping with the HD method.
A first background research was followed by a project phase which was used in the research to design the conceptual model (RtSD), which were afterwards tested in a real context of application (fig. 4.4).
The complexity reached by the overall research was managed thanks data visualisation methods, in particular the creation of GIGA-maps which are the visualisations of complex relations defined by (Sevaldson, 2011; 2018).

This PhD research started with an extensive background research framing the context (chapter 2-3) with a literature review based on desk researches on scientific contributions found in scientific journals and conference proceedings, books, but also to more informal sources as national and international reports and websites. The concepts were also deepened with the participation to conferences, workshops, academic courses, summer and winter schools. Some simplified systematic literature reviews (Tranfield, Denyer, & Smart, 2003) were performed to identify scientific contributions over a specific topic. In particular the innovation dynamics in business and entrepreneurial context, through the concept of Business incubators and Business ecosystems, to find their approach to environmental sustainability and design field (chapter 2 and chapter 3). The goal of this first part was to explore the current relationships among the different disciplines and looking for gaps in the theoretical contributions. Based on the gaps found the overall research design evolved.

From the literature review, two main research focus was identified to overcome gaps:
- understand the current implementation barriers of SD projects, and the significant eco-entrepreneurial opportunities created by SD projects;
- understand how the current implementation actors for an alternative economy are acting.

Regarding the lack of contributions about the barriers encountered in the implementation of SD projects in the literature, the answer can be in the SD as an emerging discipline and that the approach focus on the manufacturing sector is only used in Politecnico di Torino. For this reason, an inductive research philosophy was adopted, which have started from my personal experience of involvement in some SD past projects. The research was focused on collection of qualitative data to distinguishing the barriers encountered during the implementation phase and, at the same time, the opportunities created. The strategy of research used was the one of the case study. The cases of analysis were two past SD projects for sustainable territorial development developed by the SD research group (chapter 7).

An inductive research philosophy was adopted also to understand how the implementation actors are


CONTEXT
desk research
Linear thinking
Systems thinking
Linear Economy
Linear production model
Circular Economy
Circular production model
Design for sustainability
Systemic Design
systemic production model
LITERATURE REVIEW
desk research
Environmental Sustainability
Systemic Design
Entrepreneurship
?
SUSTAINABLE LOCAL DEVELOPMENT
2 MULTIPLE CASE STUDY ANALYSIS
desk + field research
implementation actors for circular economy
local ecosystems for circular economy implementation
in-depth interviews
THE NETHERLANDS
SCOTLAND (UK)
PIEDMONT REGION (IT)
systemic design projects
how current actors for circular economy implementation are approaching the problem
principal opportunities and problems in SD projects implementation for sustainable local development
PROJECT
guidelines for the ecosystem design
Project ECOSYSTEM Conceptual model
TEST
application
Piedmont Region
specific application
Piedmont Region - textile district
THESIS
BACKGROUND RESEARCH
relationship between design and entepreneurship
approach over sustainability in the entrepreneurial context
who is supporting sustainable innovation in entrepreneurial context
RESEARCH THROUGH SYSTEMIC DESIGN

acting in the CE economic model, because the lack of information can be related to the fact that CE is a very recent phenomenon developing in a contemporary time period of this PhD research. This economic paradigm was chosen because it has many point of collisions with the SD: the goal to eliminate waste, the application of a systems thinking approach and the importance of the design process. The research strategy used to collect qualitative data was the one of the case study, being a research on a contemporary phenomenon and the research question based on 'how', according to definition of this strategy by (Yin, 2014). The cases were identified in the actors (organizations) that currently are working to ease the implementation of projects and new enterprises following CE economic model. The location in Europe was set out as a boundary, for its commitment to foster CE implementation. The discovery of actors was done through desk and mainly field researches as participation to academic conferences, European events, workshops, ... The collection of data was performed through desk researches on the official websites, and afterwards also with direct questions via online tools. The data were processed and data visualization method was used to produce diagrams that ease the comparison of the cases and the research synthesis. The comparison let understand in general the strategies that they are using and which services are providing. Moreover, thanks to visualization tools they were placed in the quadruple helix innovation model to understand which relationships they are activating (chapter 5)..

The case-study research subsequently moved from single organizations to local ecosystems, as identified in the literature. The focus was restricted to two European regions which are defined forerunners in the CE implementation - the Scotland and the Netherlands. The different regional innovation ecosystems were compared to the one present in Piedmont Region: this is the area where SD group is located and where, thanks to European RETRACE project[1] that the group is leading, the debate on the transition of the region to a CE economic model has begun. The cases found were analysed through the method of HD, mapping the principal components of the system and understanding the complex relationships among them (see chapter 4.3). It shares methods with other systems mapping as stakeholders mapping and ecosystems mapping. Data visualization tools were useful to understand the overall complexity of the ecosystems and comparing them. Following the quadruple helix model of innovation, the actors working in the local ecosystem for the transition to CE were identified. Qualitative data about them and their relationships were collected through mixed desk and field researches methods: official websites and report published, but also in-depth semi-structured direct or online interviews audio recorded (see annex). In the case of Scotland, the situation was deepened with a period of visiting researcher in Strathclyde University in Glasgow, Scotland, UK. The research over the Netherlands instead was enabled by the knowledge of a local actor and was conducted online. In the case of Piedmont Region, the actors were identified thanks to the direct participation to multiple events, and also thanks to the regional stakeholders of RETRACE project. (chapter 6).

At this point, after the background research, the project phase has started. The design of an ecosystem to foster SD projects implementation is used as a research tool (as identified in RtD) to construct the conceptual framework for the project.

The design process started from the identification of the main actors involved in the ecosystem and the services needed to foster systemic innovation and the creation of interactions between them, to define the guidelines useful for the ecosystem design. This last step laid the foundations for the design of the project concept of an ecosystem able to foster systemic innovation with impact al local level able to create circular and sustainable development (chapter 8).

The testing of the hypothesis was done through the application of the theoretical conceptual model to a concrete territorial context to understand how it changes shape and the consequent impact created. The concept of the ecosystem for systemic innovation was adapted to the area of Piedmont Region. The SD methodology was used in the development of the design project applied to a specific context: the

1 "A Systemic Approach for Regions Transitioning towards a Circular Economy". See https://www.interregeurope.eu/retrace/

Fig. 4.4 - Visualization of the specific methodology used (left page).

analysis of the territorial context with the HD, the definition of the problems and the leverages for change identified in the guidelines, the design of the relationships among the actors creating the new system. Starting from the current ecosystem previously identified, the relationships and the actors that should be born and be created to put in practice the implementation of SD complex projects have been defined defined. This phase was developed through a co-design process which included the feedbacks received from external stakeholders: in this case, there was the involvement of the key regional stakeholders individuated also thanks to the RETRACE project. To find out how the theoretical model can work in a concrete situation with its specific characteristics, the current situation in this Region was deeply mapped, with a special focus to the manufacturing sector. Due to the complexity and heterogeneity of this sector in this region, a further restriction to the industrial district in Biella was made in terms of productive sector, to give more results about the application phase. The textile sector was chosen for the critical economic situation. A specific SD project for a specific industry was taken as example to understand the expected impact of the project on the entrepreneurial ecosystem, and the opportunities and benefits that can contribute to overcome a situation of economic crisis (chapter 9).
Finally, the results of this application are discussed critically. The process to arrive at the situation framed in the hypothesis is defined based on the current actors and their configurations, and the findings are extracted at theoretical level (chapter 10).
As last step, the conclusions are drawn defining the limits of this research and how it could be implemented in future works (chapter 10.3)..

The overall research can be considered a research through SD, on SD and for SD, referring to the terminology of the study by Manzini, (2015) and Clemente, Tschimmel, & Pombo (2017). It because it was performed through the SD design methods, the research analyses SD projects as from an external point of view, and at the end it can be considered a research that contributes to evolve SD approach and specific methodology for the manufacturing sector.

box. 4.1 - Specification about the methodology

The methodological steps used are reflected also in the index of the thesis, and the specific methodology used for each step is present in the introduction of each chapter.

4.3 SYSTEM MAPPING

A prominent method used in this research is System Mapping. It is a consistent part of the execution of the HD part of the SD methodology. It is a process aimed at tackling the complexity of the socio-technical system under analysis, as the topic of research or the problem to study and afterwards design a better solution. It shares methods with other systems mapping tools as stakeholders mapping and ecosystems mapping. The first step consists of individuation and understanding of the principal components of the system, the so-called ‘node’ in systems theory. They can be actors, companies, organizations, … In the second step, the existing interactions and relationships among them are identified and represented as flows that ‘flow’ among the nodes. They can be exchange of goods, services, money, knowledge, people, information, energy, water... Data visualization tools are necessary to show all the information collected in the process and to pass to a further research synthesis stage, where give interpretation to the complexity. With the graphics tools, the designer creates the 'map' of the system which let him/her navigate through it. It is important to underline that the designer is an outsider of the system, he/she is observing and put information on a paper (real or digital), with a process of interpretation with all the implications of this delicate phase. It requires a phase of zooming out-in, from macro to micro to macro several times, as Donella Meadows underlined in system theory (Meadows, 2011). The result is the creation of giga-maps (Sevaldson, 2011; Forlizzi, 2013). This last visualization stage enable also the comparison phase among map with similar background or within maps with the same socio-technical system.

Chapter 5

Twenty eight case studies: implementation actors in the circular economy

Thanks to the strong push coming from the European Union to fight waste production, the CE has gained an important role in Europe. Following this trend, many organizations nowadays are working to support CE implementation or the transition to it. This chapter is about the multiple case-study analysis that was performed to discover and analyse these actors to understand who they are, how they are currently working and which services they are providing. 28 cases were identified, but, are these actors applying a systemic approach in the implementation of a new economic model for a sustainable local development?
In addition to the identification and analysis of the cases, a focus was made to understand if they are considering design among their services, and if they are including designers in their team (see chapter 5.4) Another focus was also conducted to understand the point of view of the companies that are implementing a CE in their activities (see chapter 5.5).

5.1 METHODOLOGY

The information on how the current actors are working to implement a different economic model for a sustainable local development were collected and extracted thanks to a multiple case-study analysis. It was focused on the actors that are working for a CE implementation, being the economic model that has more point of collisions with the SD approach and goal. This research strategy was chosen because it is focused on the investigation of a recent phenomenon and on understanding how the cases are acting. This process was conducted in three phases: first a careful identification of the cases, then a specific analysis and finally a comparison among them.

5.1.1 Actors identification

The research of cases started with a literature review on scientific databases with the crossing of keywords "business incubator*" and "CE" in 2018. Based on the few results, a further research was conducted considering other sources. Another review of the CE concept in the documents by the EU commission, revealed two main actors which just started before the year 2014 to support CE implementation in companies. They are: the Ellen MacArthur Foundation (supported by McKinsey) that was presenting some case studies and reports, and the cradle2cradle Products Innovation Institute, which was giving the certification on cradle2cradle products considering their entire life-cycle.
The research went on also based on more informal sources: desk research on Google and the social media Facebook. It was focused also on finding also the main events related to CE to distinguish more actors. Another source of information was given by the findings of the event 'Circular Economy Hotspot'(CEH) which took places from 2016 in

Tab 5.1 - the actors identified.

	NAME	LOCATION	FIND WHERE	WHAT
1.	Ville Durable Programme by Paris&Co	Paris, FR	Google	Business incubator
2.	Circular Economy Transition	Switzerland	Circular Economy Club Group (Facebook)	Business incubator
3.	EIT Climate-KIC Accelerator (from Green Garage)	Europe	EIT Climate Ki c+ (Bank & Kanda, 2016) and (Bank, Fichter, & Klofsten, 2017)	Accelerator programme
4.	Climate kic - Green House	Europe	EIT Climate Kic	Pre-incubation programme
5.	Zero Waste Scotland Limited	Scotland, UK	RETRACE (Pallaro & Pereno, 2018) + SCEH	Governmental lead agency
6.	Circular Glasgow	Glasgow, Scotland, UK	SCEH	Initiative by Chamber of commerce
7.	Clever	Torino, IT	Author's city	Innovation pole
8.	UNIVER	Vercelli, IT	From CLEVER	Management authority of the innovation pole
9.	Environment park	Torino, IT	From CLEVER	Management authority of the innovation pole
10.	Advance London	London, UK	contact in SCEH	Public programme
11.	Circular London - programme	London, UK	From Advance London	Public programme
12.	Circular London - accelerator	London, UK	From circular London	Accelerator programme

Tab. 5.1 (continue)

	NAME	LOCATION	FIND WHERE	WHAT
13.	Fit 4 Circularity	LX	LCEH	Programme from the innovation pole
14.	Circular Economy Lab	Milan, IT	Author country	Lab
15.	Blue City 010	Rotterdam, NL	author involvement in BE Network + RETRACE PROJECT (Pallaro & Pereno, 2018)	Business incubator
16.	Cradle To Cradle Innovation Institute	Amsterdam, NL	EU (2014); McDonough & Braungart (2009)	Innovation institute
17.	Metabolic	Amsterdam, NL	Climate Kic summit 2017 event	Consultant
18.	De Ceuvel	Amsterdam, NL	Metabolic project	Lab
19.	Copper 8	Amsterdam, NL	contacts in NL	Consultant
20.	Circle Economy	Amsterdam, NL	SCEH	Consultant
21.	Circle Lab	Online platform	mentioned by Circular Glasgow	Online platform
22.	C-Creators	Amsterdam, NL	contacts in NL	Foundation
23.	C-Beta	Amsterdam, NL	RETRACE project (Pallaro & Pereno, 2018)	Location
24.	Ellen Macarthur Foundation	UK	EU (2014)	Foundation
25.	Circular Change	Ljubljana, SL	SCEH	Organization
26.	Circul’r	FR	mentioned by Circle Lab	Start-up
27.	Symbiosis center denmark	Kalundborg, DK	Kalundborg Symbiosis	Public organisation
28.	Kalundborg symbiosis	Kalundborg, DK	literature on industrial symbiosis, (Chertow, 2000)	Industrial park

various places - the Netherlands in 2016[1] , Luxemburg in 2017[2] and Scotland in 2018[3] (SCEH) – that I attended in Glasgow. A further source of information was author’s work experience, as the involvement in Blue Economy networks, Systemic Design research network and in the RETRACE project.

A snowball approach in the process was applied and the research of cases was limited to the European context.

After the desk and field research, the following actors were identified in tab. 5.1.

5.1.2 Cases analysis

After the main actors’ identification, a deep analysis on all the cases was performed to understand how they are working, and at the end making a comparison. It was mainly focused on understanding which typology of actors they are, which services they are providing and with which other actors they have relationships, according to the quadruple helix model of innovation.

The collected data are organized according to the following topics:

- General information;
- Foundation year and motivation;
- Type of actor and main goal;
- Partners (for the quadruple helix);
- Main services;
- Specific services related to the CE;
- Specific services related to design.

1 https://hollandcircularhotspot.nl/en/

2 http://circularhotspot2017.lu/#ui-id-53-148093256354091

3 http://www.circulareconomyhotspot.scot/

Tab. 5.2 the questions for the multiple case-study

<table>
<tr><th></th><th>Questions</th><th>Unit / info</th><th>Reasons for question</th><th>References</th><th>Group topic</th></tr>
<tr><td>1.</td><td>NAME</td><td></td><td></td><td></td><td rowspan="6">GENERAL INFORMATION</td></tr>
<tr><td>2.</td><td>Website</td><td></td><td>To understand the source of information</td><td></td></tr>
<tr><td>3.</td><td>City, region, country</td><td></td><td>To understand the culture/context of reference and impact</td><td>the country is the most important factor which influence CE development (Zamfir et al., 2017)</td></tr>
<tr><td>4.</td><td>Status:
☐ Private
☐ Public body</td><td>(for incubators: Private, public, university)</td><td>To understand from where comes the economic support</td><td></td></tr>
<tr><td>5.</td><td>Typology of actor
☐ For start-ups
☐ For SMEs
☐ Other (specify)</td><td>(decided by the researcher)</td><td>To define the typology and compare with others</td><td></td></tr>
<tr><td>6.</td><td>Type of incubators:
☐ Mixed
☐ Economic development inc.
☐ Technology inc.
☐ Social inc.
☐ Basic research. (University)
☐ Other (specify)</td><td>(decided by the researcher) based on Bi typologies</td><td>Understanding which typology of BIs it is</td><td>(Aernoudt, 2004)</td></tr>
<tr><td>7.</td><td>Foundation year</td><td>year</td><td>To define their experience (long or young?)</td><td>"Most companies have undertaken some activity related to the Circular Economy in the last 3 years" (EU, 2016)</td><td rowspan="2">FOUNDATION</td></tr>
<tr><td>8.</td><td>Foundation motivation</td><td></td><td>To understand which was the need to satisfy</td><td></td></tr>
<tr><td>9.</td><td>Main goal</td><td>(statement from the website)</td><td>To understand which is their principal focus/goal</td><td></td><td rowspan="2">GOAL</td></tr>
<tr><td>10.</td><td>Principal focus:
☐ Create start-ups
☐ Regional development
☐ Create entrepreneurship
☐ Employment creation
☐ Business creation
☐ Stimulate innovation
☐ Create Spin-off
☐ Other (specify)</td><td>(decided by the researcher)</td><td>Understanding which is their principal focus/goal related to the literature on incubators</td><td>(Aernoudt, 2004)</td></tr>
</table>

Tab. 5.2 the questions for the multiple case-study (continue)

	Questions	Unit / info	Reasons for question	References	Group topic
11.	N° companies supported (in total)	n° enterprise/ last year available	Defining impact on enterprise creation		IMPACT
12.	Partners		Understanding if the triple helix is in action		QUADRUPLE HELIX MODEL OF INNOVATION
13.	Do they have relationships within the quadruple helix system? (industry, government, universities, civil society?	(decided by the researcher)			
	Relationships of which typologies? (partnerships, ..,		Understanding how the triple helix is in action		
14.	What are their principal services offered?		Understanding type of services provided (traditional services to business)		SERVICES
15.	What are their principal services offered? ☐ Access to capital ☐ Process support ☐ Access to physical resources ☐ Office support services ☐ Networking services Other services: ☐ Business model writing ☐ Legal advice, ... ☐ (specify)	(decided by the researcher)		(Aernoudt, 2004)	
16.	Do they have specific services related to implementation of CE projects/companies?		Understanding if they have specific type of services for business idea related to CE		
17.	Is “Design” mentioned as a service?		To understand the presence of design in the services provided		

A form, compiled on the basis of the already mentioned literature review, (tab. 5.2) with relevant questions has been used to collect data.

The identification and the analysis was made from November 2017 to January 2019.

The form with the questions was filled, for each actor, with information collected by desk research on their principal websites (see annex). Based on this information collected, they were also divided in categories: actor that support the creation of start-ups, actor that support the transition of existing enterprises, others.

For each case a synthesis lead to the production of complex infographic GIGA-MAPs: with a section dedicated to the information about the case and its principal services and another section in which the case is examined according to the quadruple helix model, with the aim of understanding its role with the services provided and the partnerships in action (see fig. 5.1). This has facilitated the comparison between all the cases. This process has facilitated the comparison between all the cases.

5.2 MULTIPLE CASE-STUDY ANALYSIS

Each case was studied singularly. See annex for the complete tables and more info.

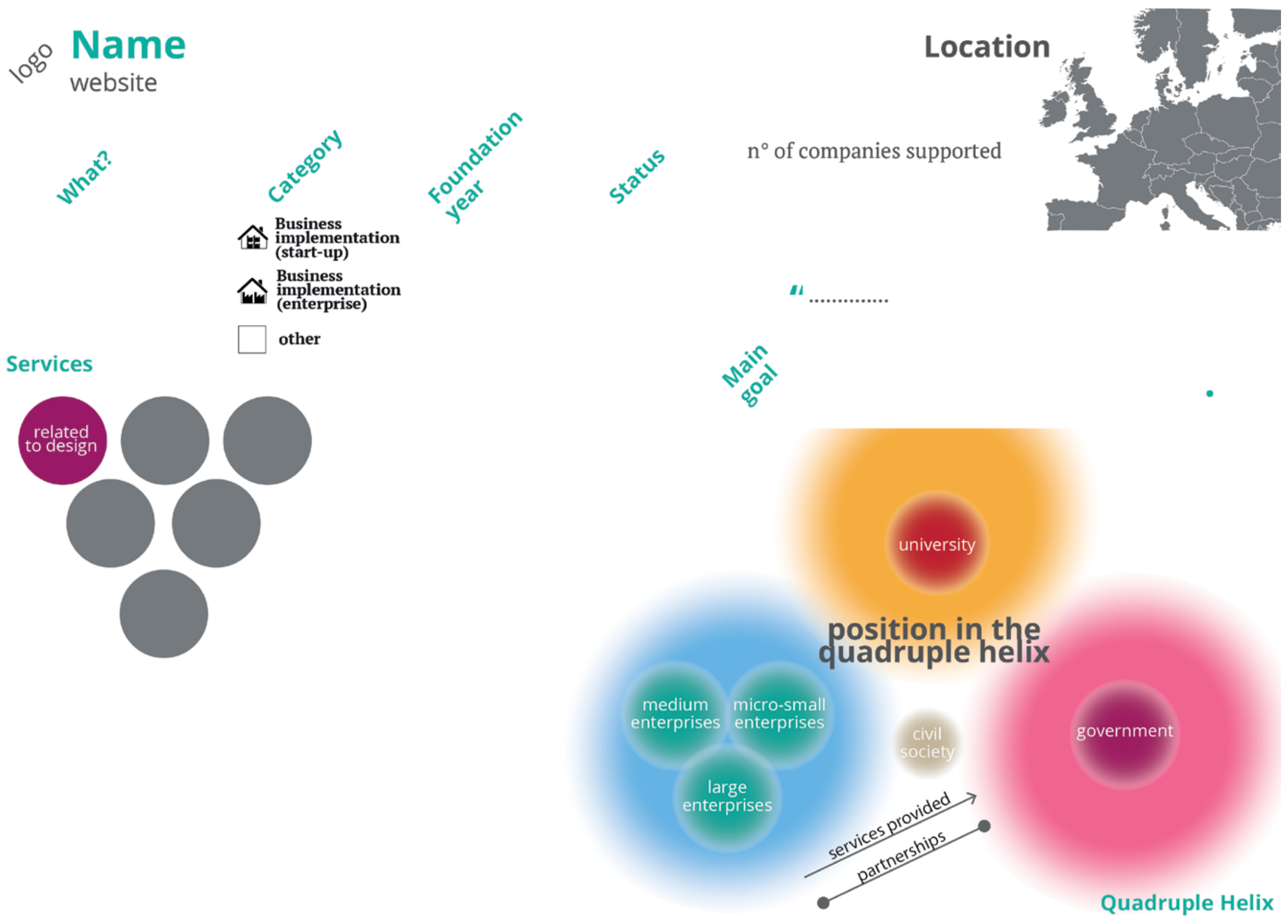


Fig. 5.1 - The structure of the complex GIGA map that was made for the analysis of each case

VILLE DURABLE PROGRAMME BY PARIS&CO[4]

Aims and objectives: this is a programme of a traditional BI dedicated to the circular economy. It aims to stimulate collaboration among start-ups and large companies to develop solution for a more sustainable city, Paris (FR) in this case.

Age and evolution: The section on the CE of this BI is a quite new experience, first start-ups were founded in 2017. Although, the number of start-ups incubated which are around 20 per year and are increasing during the years can reflect an increasing of attention on this topic and the potential of the numerous business cases to explore and exploit

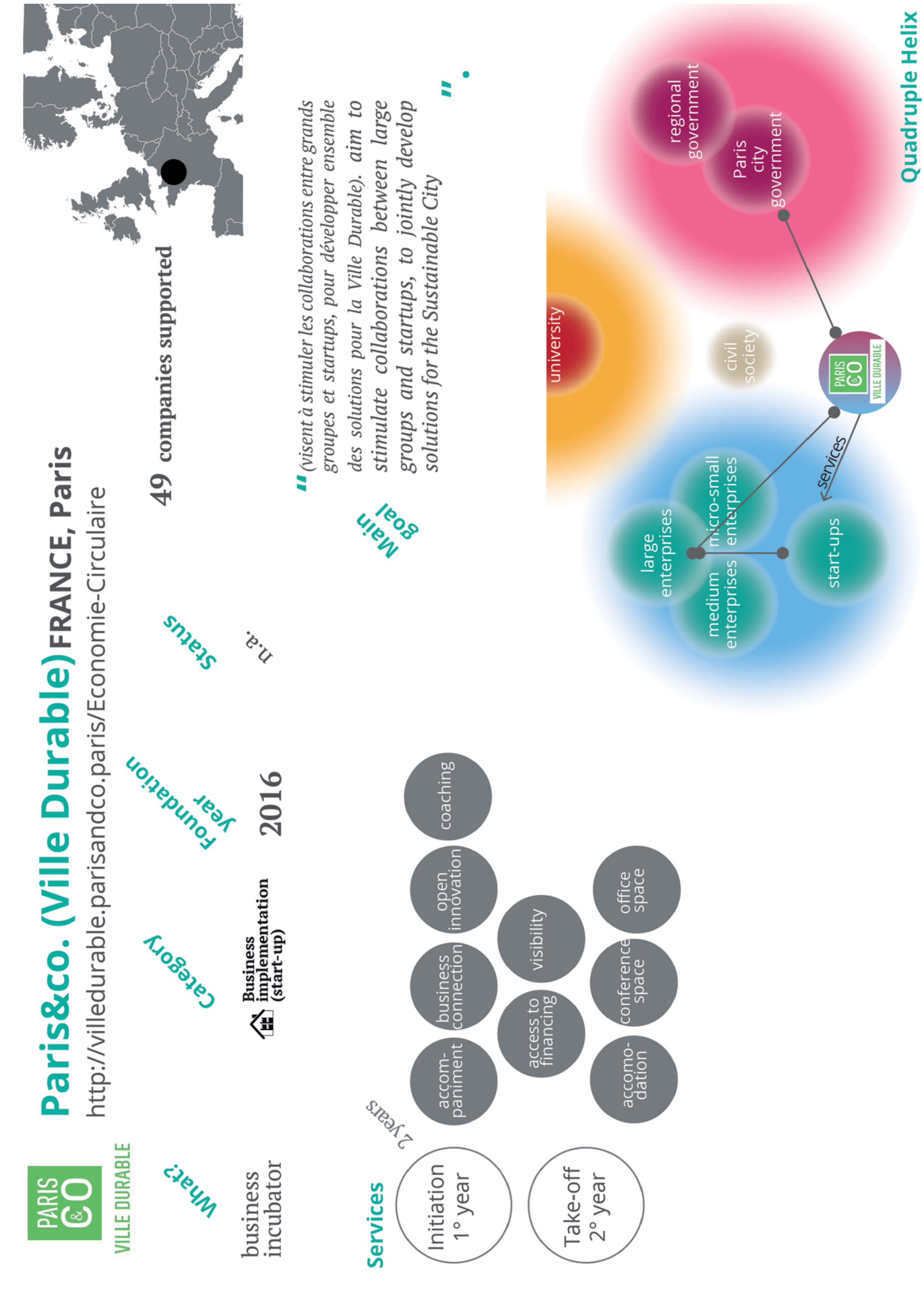
How it works: it consists of a 2 years' programme, one based on the business model validation and the second one on boosting the activity.

Points of interest for this research: the presence of a section in this BI entirely dedicated to CE topic and the interest and involvement of the city government. Moreover, they are concentrated on the creation of the local ecosystem for the city development.

Consideration: Considering their services, it seems that they are dealing with this topic and managing the new start-ups' creation with traditional BI services. Their focus is on creating collaboration among new start-ups and large companies (with no attention to SMEs).

4 https://villedurable.parisandco.paris/Economie-Circulaire/Offre-d-incubation

Fig . 5.2 - graphic visualisation of the principal elements of the case study Ville Durable



Circular Economy Transition[5]

Aims and objectives: a business incubator with the aim to foster the transition to CE of Switzerland

Age and evolution: in January 2019 they launch the first call for start-up

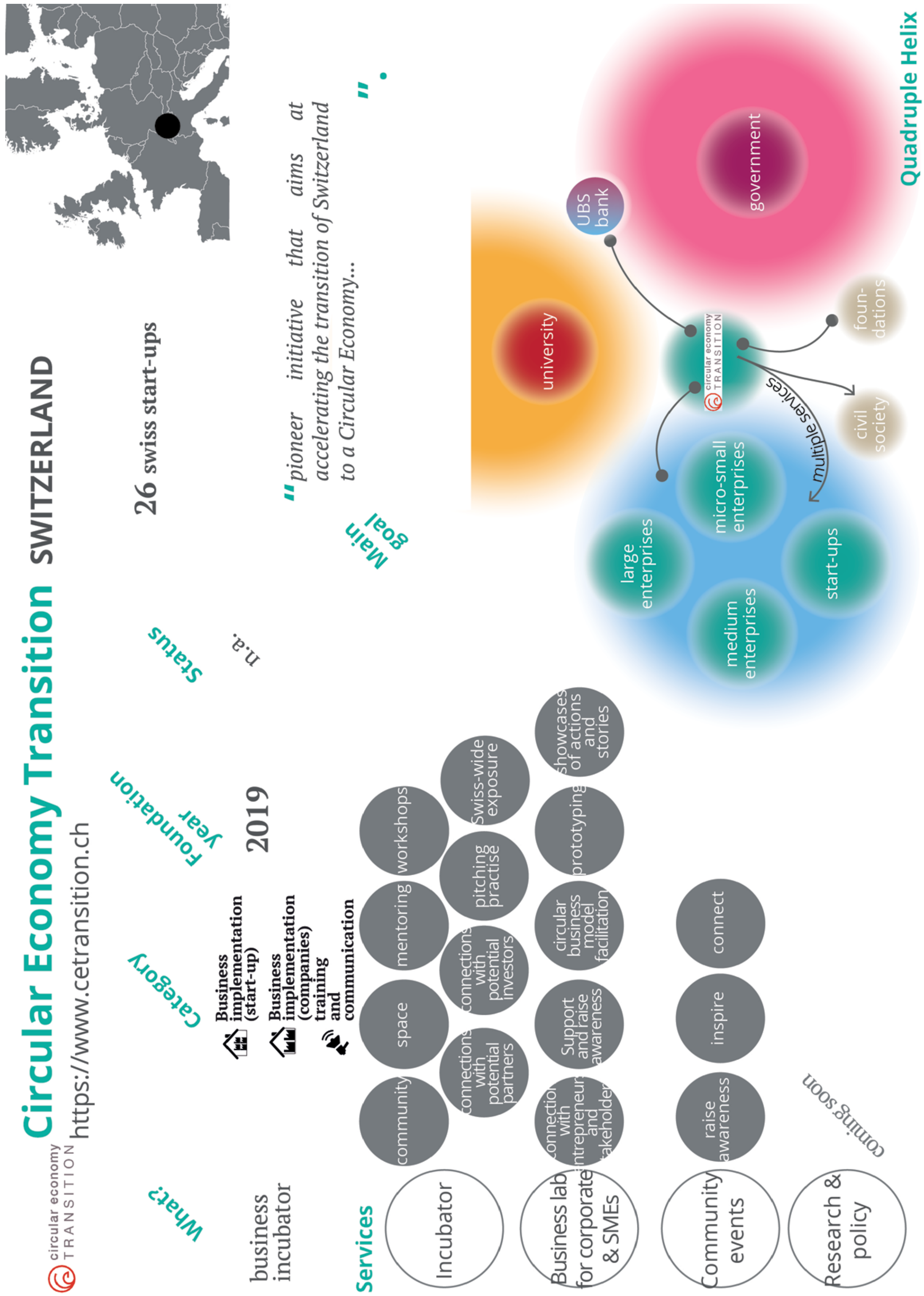
How it works: this case is both an incubator for new start-ups, and offer services to existing enterprises (business lab). Moreover, they are working on opening a lab for ' research & policy recommendation'.

Points of interest for this research: This case is very interesting for the multiple goals that they have and multiple actors that want to address: from business to policy making and society. Moreover, they are focused on the local territory where they are based (multiple locations in Switzerland).

Consideration: The fact that it is a very young reality (operating only since 2019) demonstrates that there was a need to create an incubator focus on CE aspects, which delivers different services. However, it is not explained how their support is different from a traditional incubator working in the linear economic model.

5 https://www.cetransition.ch/?fbclid=IwAR23kZVD42Iux2N_pAc8XHR8gvzi9B2uyOPyIyvoQQ_Qadso1tF_YUATG1M

Fig . 5.3 - graphic visualisation of the principal elements of the case study Circular Economy Transition



Climate-KIC Accelerator [6]

Aims and objectives: accelerator programme for start-ups focused on climate impact by cleantech commercialisation.

Age and evolution: started in 2010 (the climate kic programme).

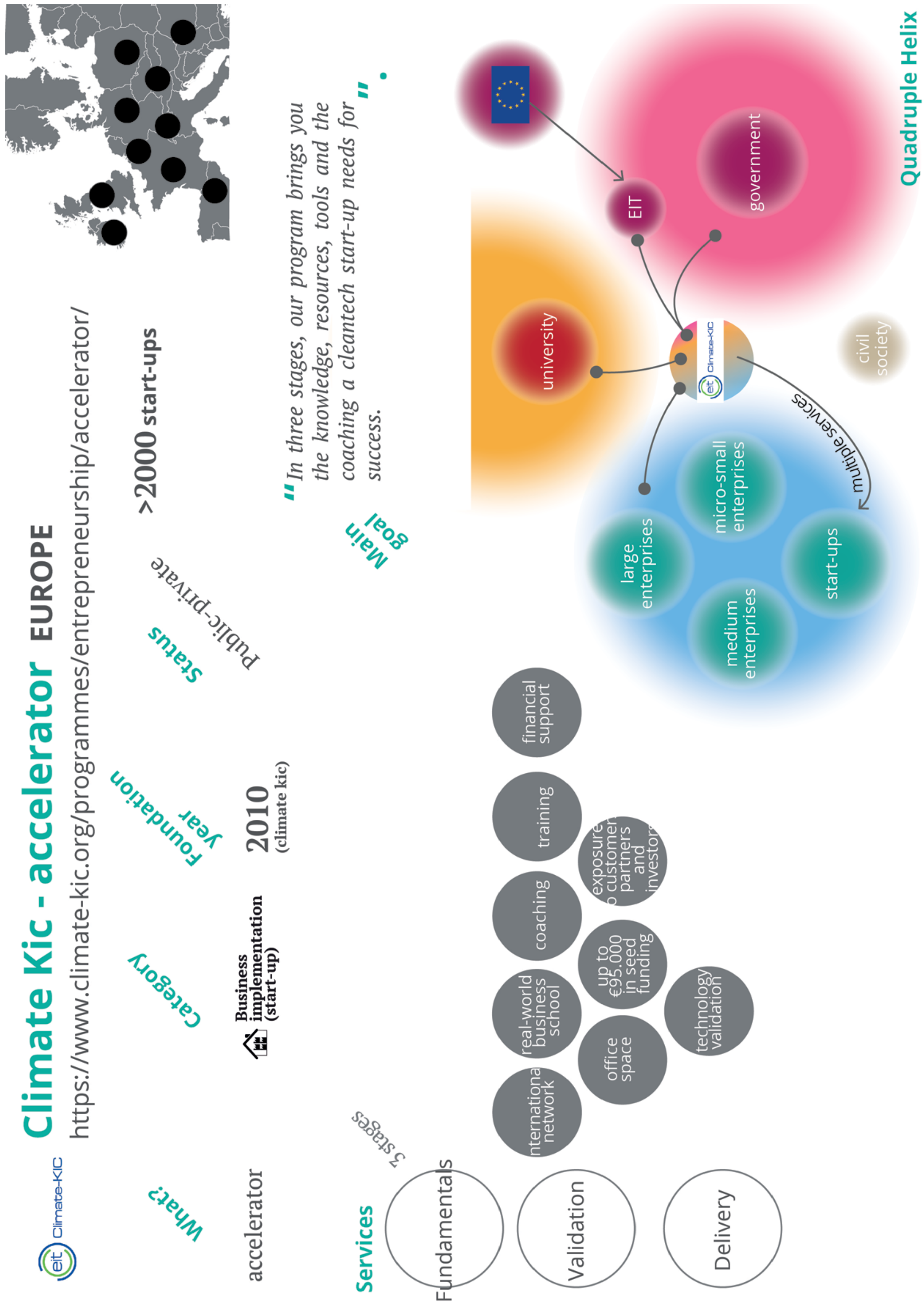
How it works: they offer the traditional services of BI (coaching, training, technology validation, office space, financial support)

Points of interest for this research: this case is interesting for their focus on selecting only start-ups that are creating a climate impact. Moreover, it is provided by Climate-kic which is a community involving actors from the triple helix model.

Consideration: They are boosting climate innovation at very large scale creating a big community (more than 2,000 start-ups). Providing the classic services of BIs it seems that they are not working to change the economic model behind and for a local development, however, they are focus on the climate impact.

6 https://www.climate-kic.org/programmes/entrepreneurship/accelerator/

Fig . 5.4 - graphic visualisation of the principal elements of the case study Climate-kic accelerator



Climate kic - Green House [7]

Aims and objectives: It consists of a ‘pre-incubator programme’ focus on climate innovation.

Age and evolution: started in 2010 (the climate kic programme).

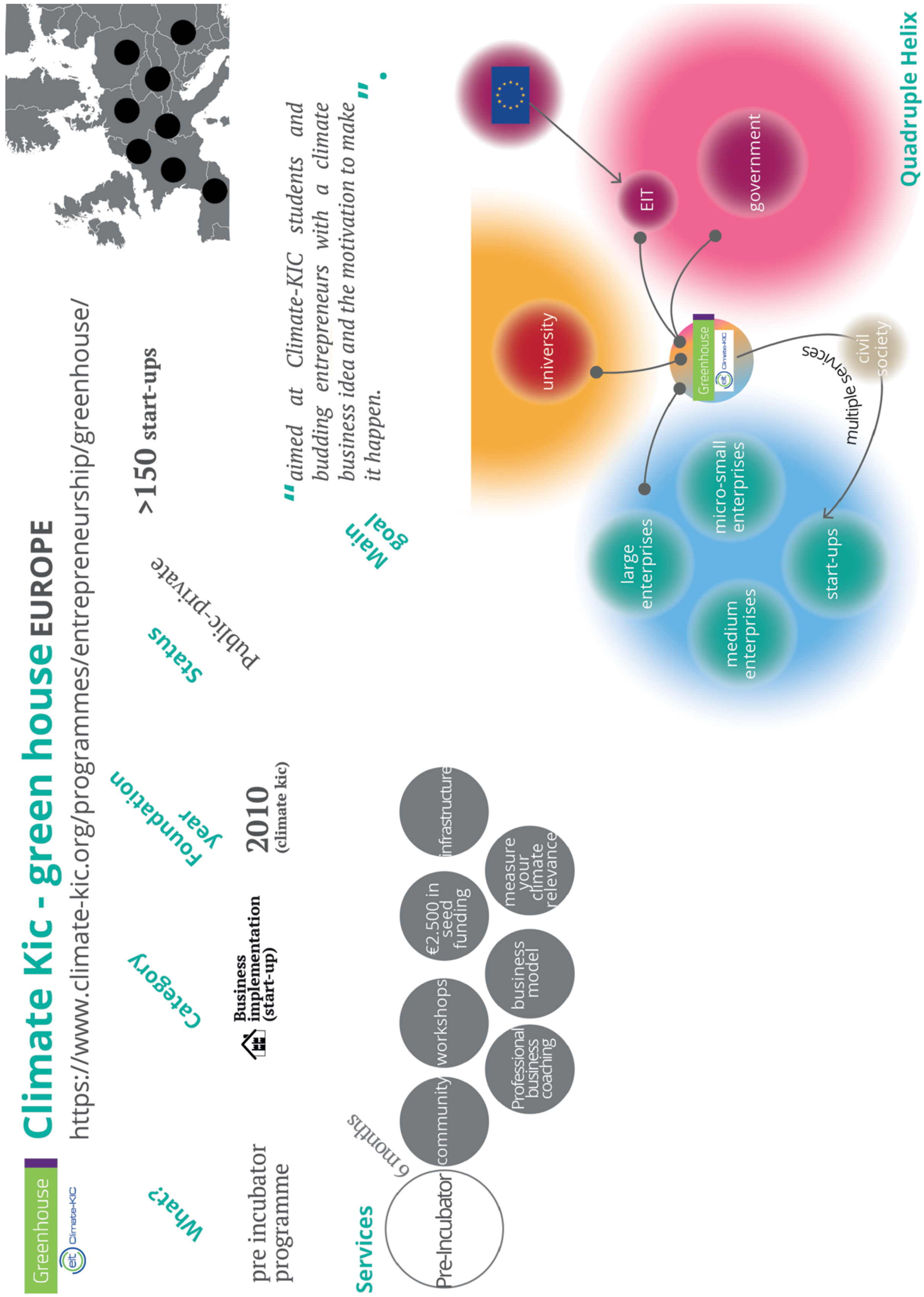
How it works: they are focusing on training entrepreneurial thinking for climate innovation providing multiple services as also the ‘climate impact measurement’.

Points of interest for this research: This case is very interesting for the focus on the phase before the business implementation and the focus on training entrepreneurs. Moreover, they are focus on climate innovation and the programme is delivered by Climate-kic which is a community involving actors from the triple helix model. It takes places in many cities.

Consideration: This pre-incubation programme can demonstrate the need, in this topic, to be focused on the first step of the idea creation supported by professionals. In addition, the service about the ‘climate impact measurement’ can reflect that they are working to the transition to a different economic model.

7 https://www.climate-kic.org/programmes/entrepreneurship/greenhouse/

Fig . 5.5 - graphic visualisation of the principal elements of the case study Climatekic-green house



Zero Waste Scotland Limited[8]

Aims and objectives: it supports regional business in the transition to a CE model

Age and evolution: the programme started in 2014 thanks to EDRF funds

How it works: Zero waste Scotland is a governmental lead agency which, along with to manage the waste management, has a specific programme for CE and works strictly in relationships with local SMEs providing many services, from the sending of funds, to the delivery of business support services to increase their projects strength. They also have a design support service for businesses in the CE framework. Moreover, it is active in many topics as the recent development of the deposit return scheme[9] , but also in actions against the waste production in general[10] .

Points of interest for this research: They are a very interesting case for the multiple services that are providing to the SME sector to support the transition to a CE model of the region , from the investment fund to the business support which also has attention on the design phase.

Consideration: It is supported by a consistent investment coming from the Europe Union (ERDF) which demonstrates the commitment of the region of Scotland to the topic of 'zero waste' before 2014, and wants to push the transition to a CE model in the region. All its services are concentrated in the SMEs sector. This action entirely has put Scotland in a forefront position in the European context.
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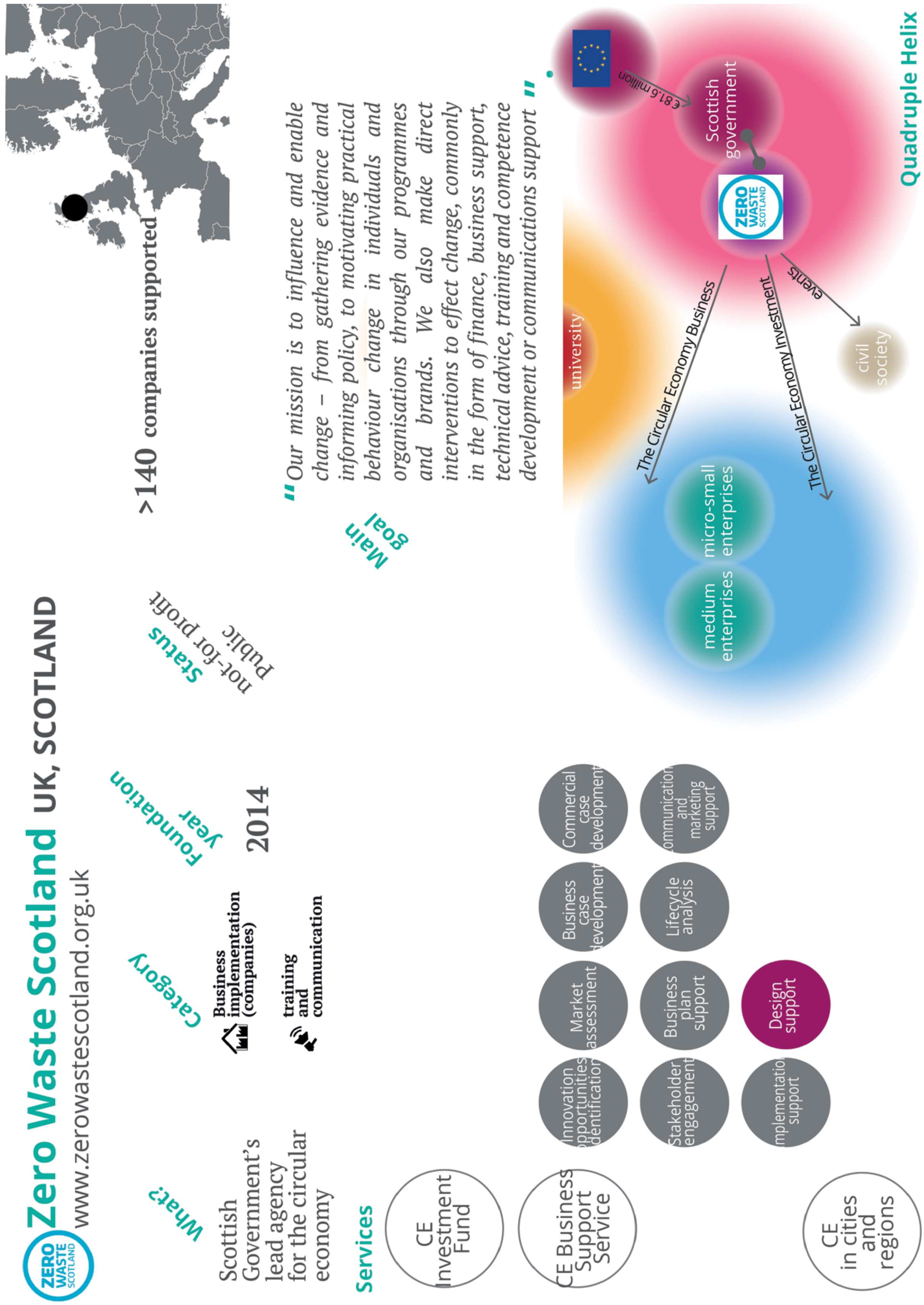
8 www.zerowastescotland.org.uk
9 https://www.zerowastescotland.org.uk/deposit-return-scheme
10 https://www.zerowastescotland.org.uk/litter-flytipping

Fig . 5.6 - graphic visualisation of the principal elements of the case study Zero Waste Scotland



Circular Glasgow[11]

Aims and objectives: this initiative of the chamber of commerce aims to inspire local businesses to reach a transition over a CE model

Age and evolution: it was funded by the EDRF fund received by Zero waste Scotland in 2014.

How it works: they are mainly working in the delivery of services as training and communication to the local companies to support local businesses. Thanks to the strict collaboration with Circle Economy in the Netherlands they have produced the city scan report and promoted and funded the use of the tools circle assessment and the circle workshops by Circle Economy that facilitate the transition of local businesses.

Points of interest for this research: it has a strong focus on the local business to facilitate their transition to a CE model. Moreover, they have promoted the use of many interesting tools by Circle Economy as the Circular city scan to assessing the material flows in the city and to find new opportunities to inspire the local businesses, a tool which have similar scope to the SD approach.

Consideration: they are an interesting and an important actor for the direct contact with local enterprises so they can be considered a central actor for the CE implementation in Scotland. Moreover, they are working in collaboration with Zero Waste Scotland and have connections with the city council.
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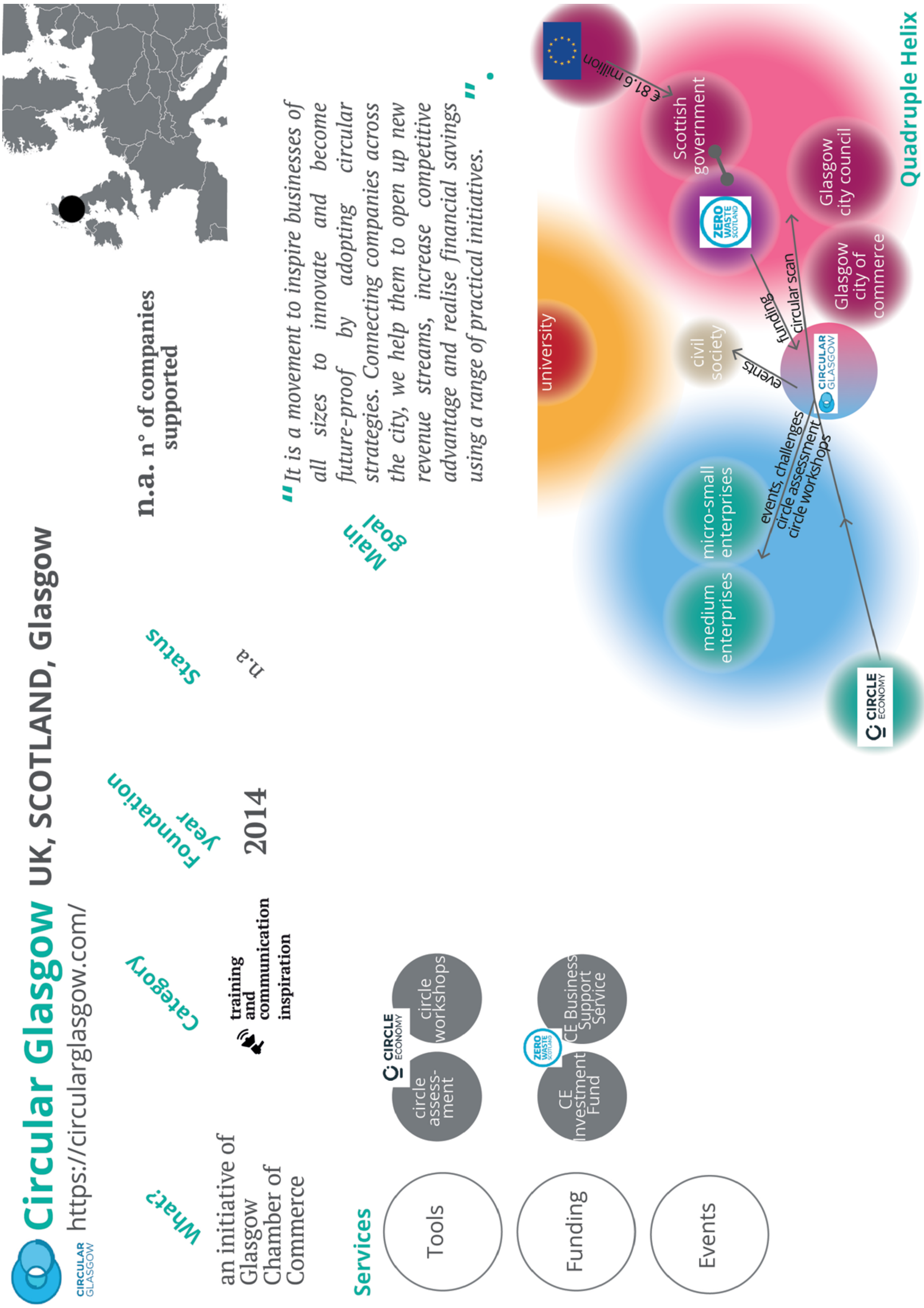
11 https://circularglasgow.com/

Fig . 5.7 - graphic visualisation of the principal elements of the case study Circular Glasgow



Clever[12]

Aims and objectives: this regional innovation cluster supports its partners (existing industries and research institute) in the implementation of innovative projects in the clean tech sector (also CE).

Age and evolution: they were found thanks to the EDRF in 2016 (in continuity with the previous cluster Polight and ENERMHY)

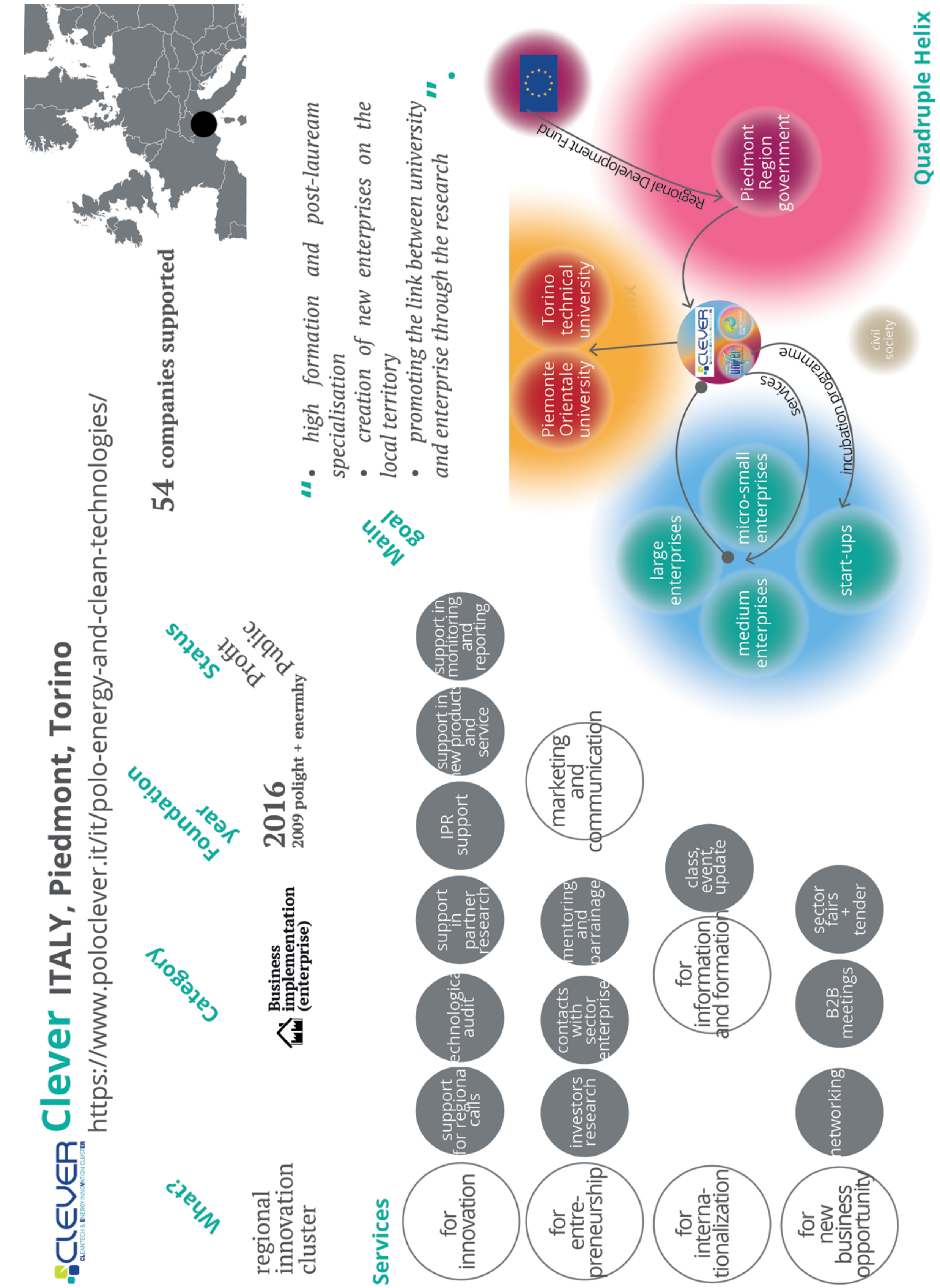
How it works: this regional innovation cluster is delivering many services to the companies associated with supporting the use of clean-technologies.

Points of interest for this research: it is the actor dedicated to supporting innovative projects in existing enterprises in Piedmont Region, also helping companies to answer to regional funding calls. They have a lot of experience in working with local industries.

Consideration: Their thematic areas are covering many aspects around the environmental sustainability and clean tech and the CE is only one of the focus. These thematic areas come from the regional strategy S3 and are inserted in the 'resource efficiency trajectory – energy saving and sustainable development' which is a transversal topic in the strategy (see chapter 6). The fact that it is managed by 2 different entities (Environment park and Univer), it enlarges its action range at regional level, from Torino to also Vercelli area, even if this innovation pole is dedicated to companies in the entire region.
Although if they have not specific services dedicated to the CE, they have others that can be useful as the support in partners' research, the audit and technology diagnosis, the support in regional and European calls and the marketing and communication activities.

12 https://www.poloclever.it/it/polo-energy-and-clean-technologies/

Fig . 5.8 - graphic visualisation of the principal elements of the case study Clever



UNIVER[13]

Aims and objectives: it is a consortium with public and private entities (link among local universities and local enterprises) which wants to create synergies to create a local economic development.

Age and evolution: 1994; from 2001 the BI of Vercelli.

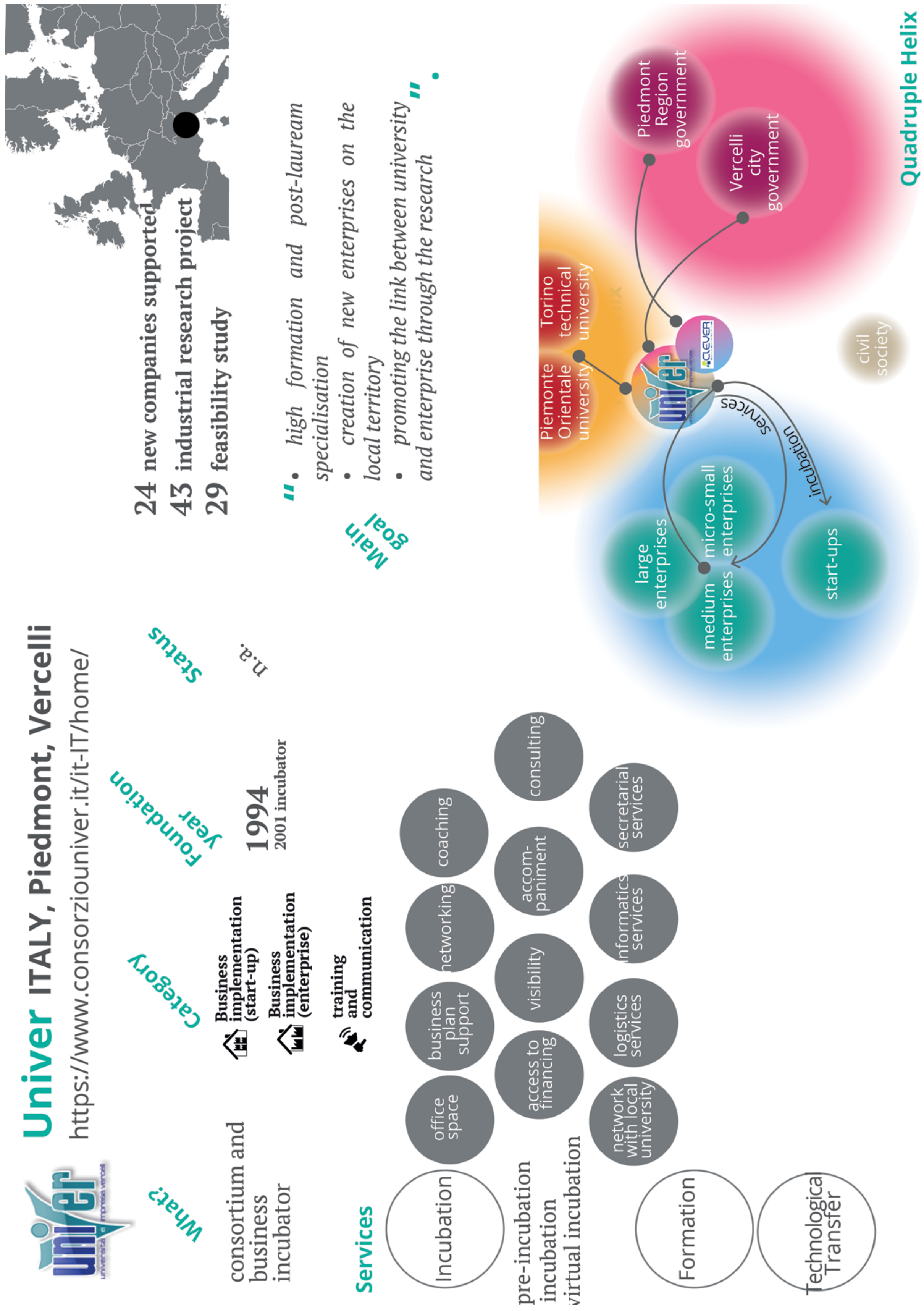
How it works: the focus of UNIVER is the boosting of the local economic development and facilitating the collaboration among universities and local enterprises. It offers support both to existing companies (being also the management body of the CLEVER innovation pole) mainly through training activities and facilitating the connection with the university, but they also manage a technological incubator.

Points of interest for this research: this consortium was created to put in connection the actors of the local triple helix model of innovation to support a local development, although their focus in not the CE model.

Consideration: Before their involvement in Clever, UNIVER was the management body of innovation cluster ENERMHY focus on the energy sector.

13 https://www.consorziouniver.it/it-IT/consorzio/mission/

Fig . 5.9 - graphic visualisation of the principal elements of the case study Univer



Environment park[14]

Aims and objectives: it is focused on providing technology transfer support services to promote innovation among businesses and public administrations, within the field of clean technology. It is a scientific and technological park for the environment.

Age and evolution: from 2000

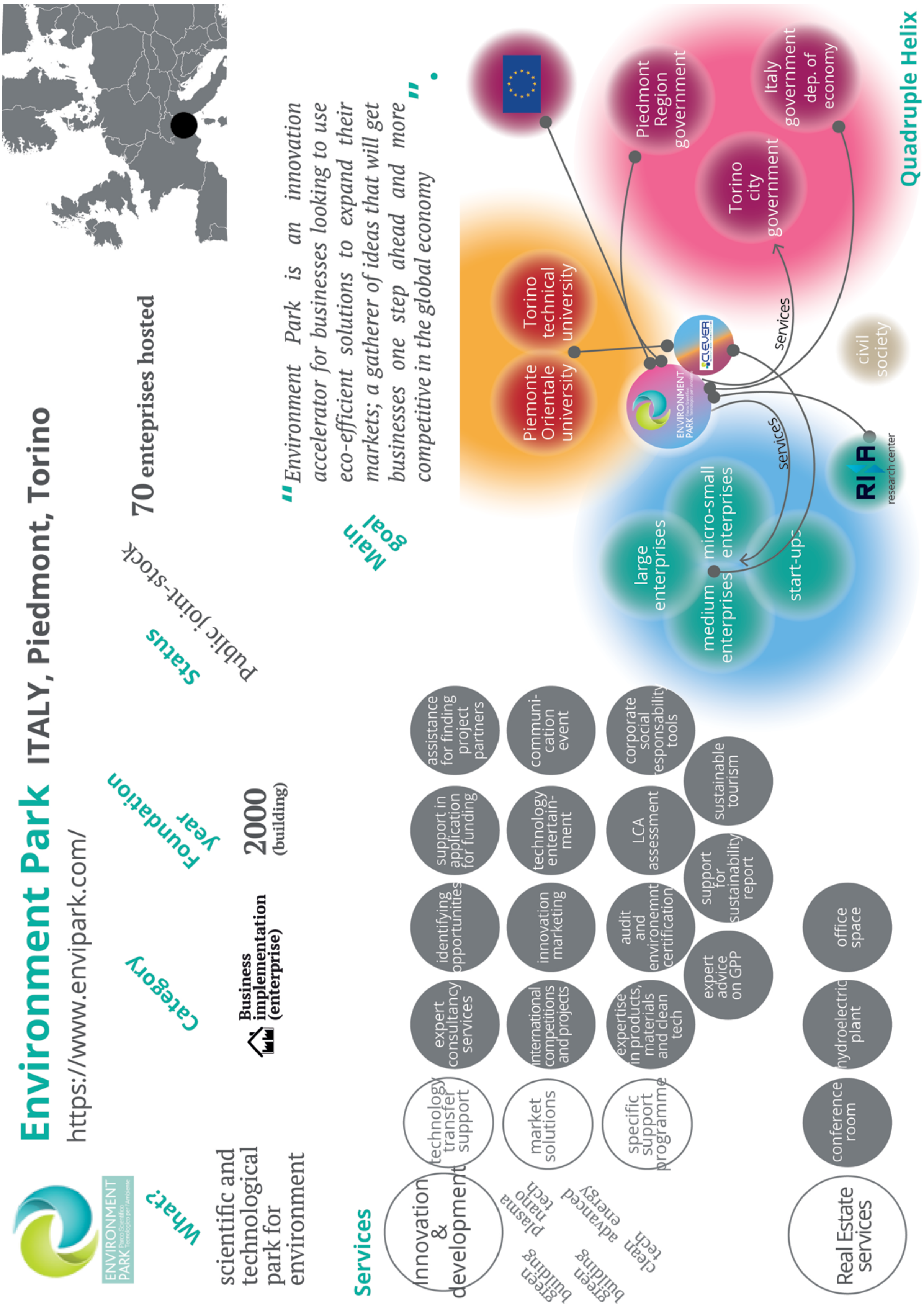
How it works: it is dedicated to the enterprises to support solutions in the clean-tech sector with many services, and they are also hosting around 70 enterprises. Its focus is on Green Building, Plasma Nano-Tech, Green Chemistry Advanced Energy and Clean Tech.

Points of interest for this research: they provide support to existing businesses in the clean tech sectors, and they are also the management body of Clever regional innovation cluster. It is very interesting also for its location, which is a new building that was constructed following specific requirements for being environmentally friendly and energy efficient.

Consideration: Although if they have not specific services dedicated to the CE, they have others that can be useful as the support in partners' research, identification of opportunities, the audit diagnosis, the support in environmental certification, the support for sustainability report, the delivery of LCA assessment, corporate social responsibility tool, ..

14 https://www.envipark.com/

Fig . 5.10 - graphic visualisation of the principal elements of the case study Environment Park



Advance London[15][16]

Aims and objectives: it give business support for SMEs to develop circular business models.

Age and evolution: it is a young programme, only from 2017

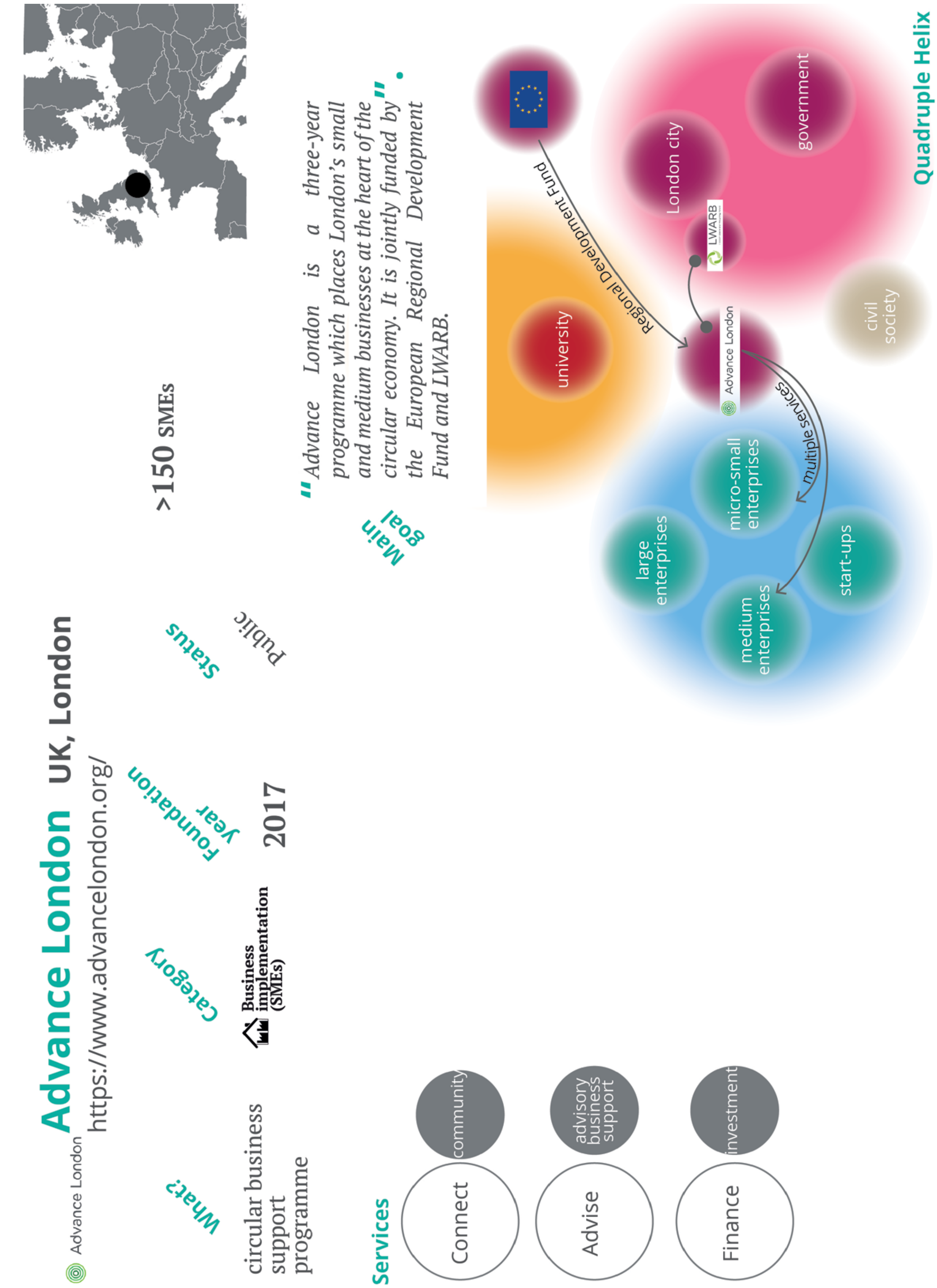
How it works: it is a public programme dedicated to SMEs and developed by the London waste and recycling board with EU regional funds.

Points of interest for this research: they provide free support to local SMEs to support circular business and also investment and networking opportunities.

Consideration: Due to the young age, on the website, there aren’t enough information to understand their services in-depth.

15 https://www.lwarb.gov.uk/what-we-do/advance-london/
16 https://www.advancelondon.org/

Fig . 5.11 - graphic visualisation of the principal elements of the case study Advance London



Circular London - programme[17]

Aims and objectives: This programme wants to accelerate the CE in London area and includes the business advisory programme of Advance London and the Circular London accelerator programme.

Age and evolution: from 2017

How it works: they are spreading good practices, programming events and challenges for new projects in the CE. They are also supporting the accelerator programme (see next case)

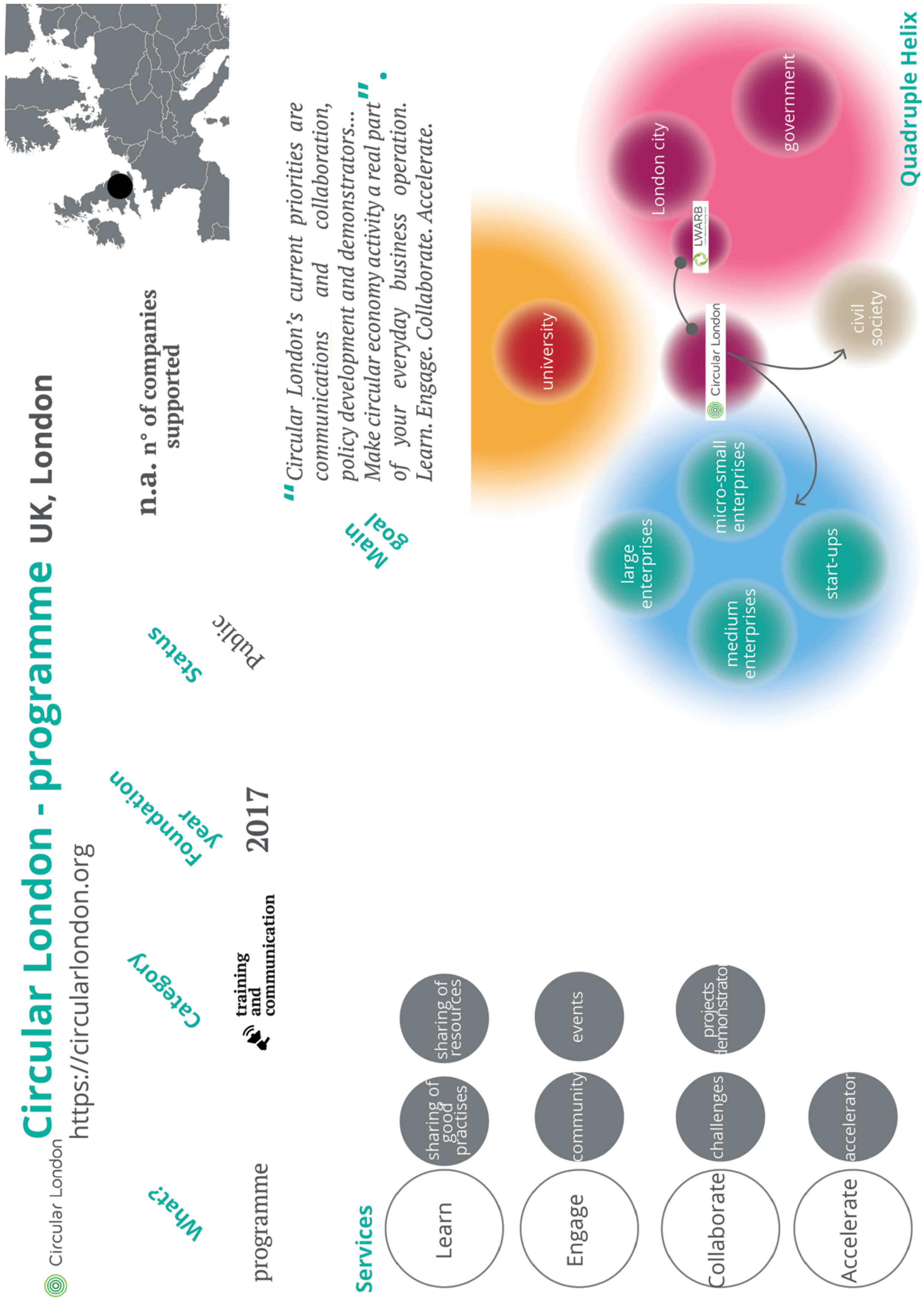
Points of interest for this research: it is a programme developed by the local government to foster CE transition. Very interesting is that they have developed and published the CE route map[18] for London in June 2017, with recommendations and actions for the circular future of the city.

Consideration: it is not a BI, but can be considered a CE implementation actor for their will to act and support the local business and community in the city area.

17 https://circularlondon.org/who-we-are/about-circular-london/

18 https://www.lwarb.gov.uk/wp-content/uploads/2015/04/LWARB-London%E2%80%99s-CE-route-map_16.6.17a_singlepages_sml.pdf

Fig . 5.12 - graphic visualisation of the principal elements of the case study Circular London



Circular London - accelerator[19]

Aims and objectives: accelerator programme of Circular London initiative for the CE

Age and evolution: from 2017

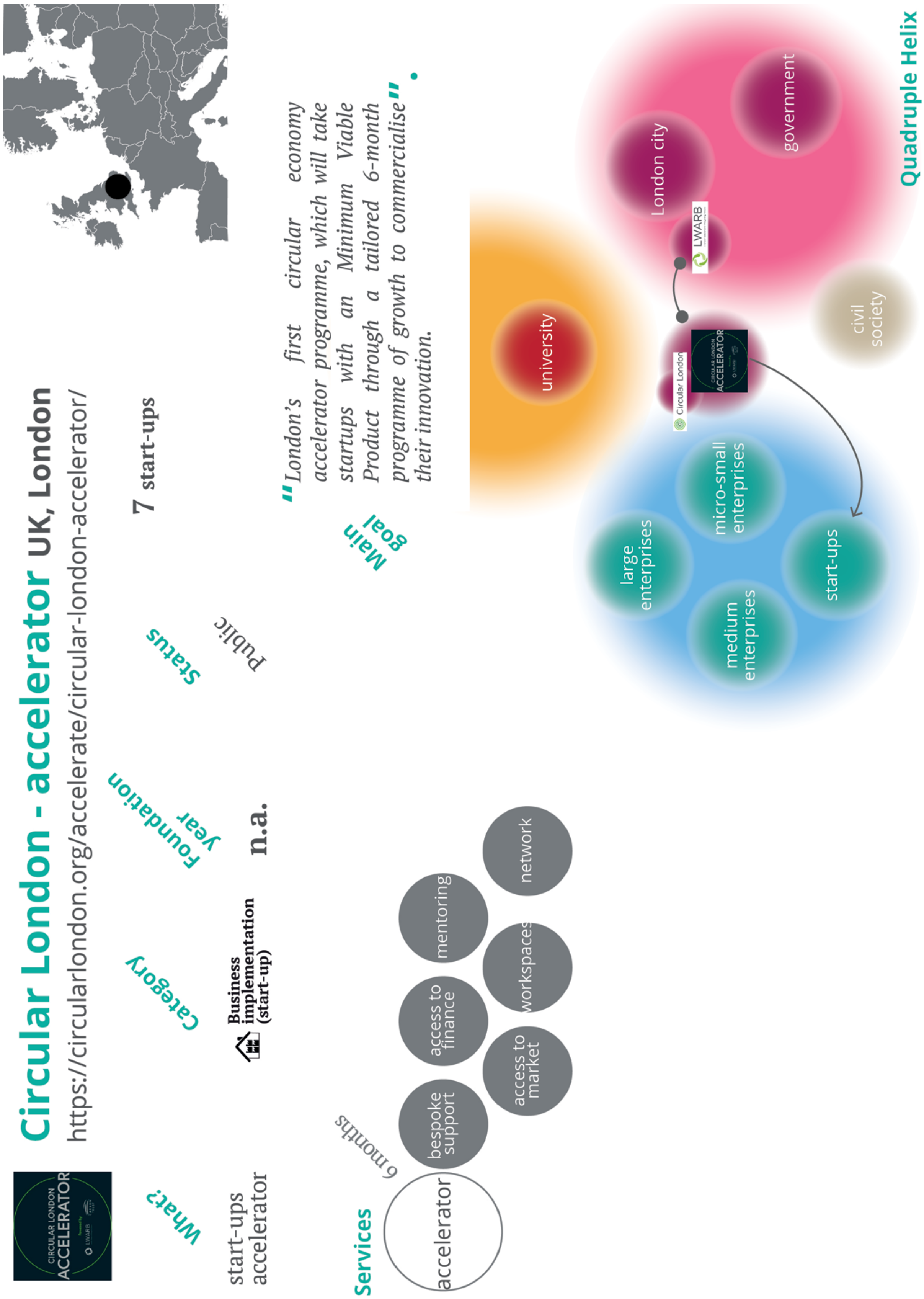
How it works: it is a 6 months' accelerator programme, a service by Circular London programme funded by LWARB, a local public authority. It is for selected start-ups to scale and commercialize their innovation products/service. The services provided are traditional ones (workspaces, mentoring, access to capital), but it is developed in collaboration with carbon trust, which is specialized in evaluating and assessing the environmental impact.

Points of interest for this research: this is a dedicated programme for start-ups operating in the CE

Consideration: interesting is the dedicated focus on the assessment of the environmental impact.

19 https://circularlondon.org/accelerate/circular-london-accelerator/

Fig . 5.13 - graphic visualisation of the principal elements of the case study Circular London - accelerator



Fit 4 Circularity[20]

Aims and objectives: a programme of the Lux innovation cluster dedicated to companies to facilitate their transition to a CE

Age and evolution: n.a.

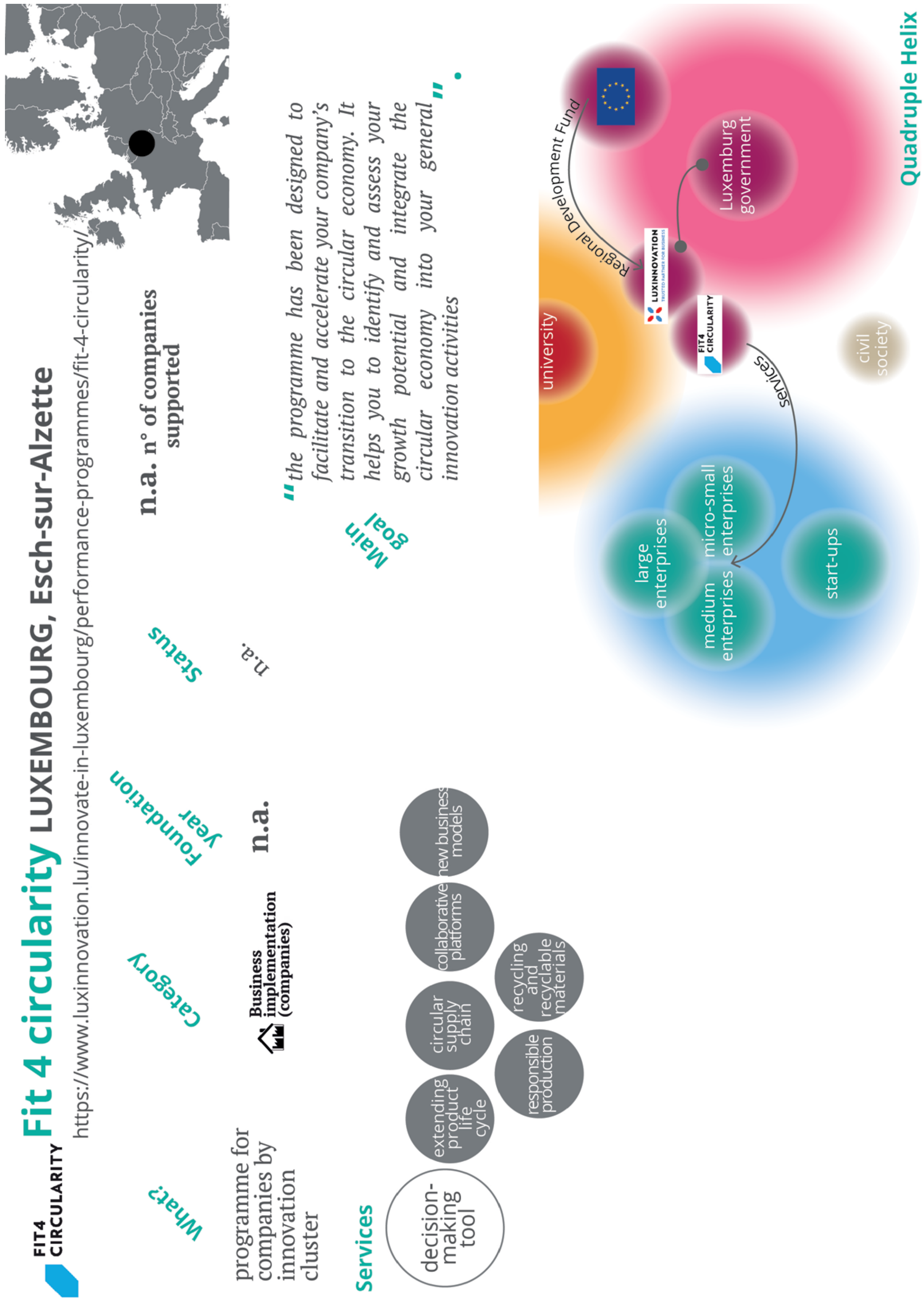
How it works: it is supported by EU regional funds, and mainly this programme is providing a decision making tool which guides through the adoption of the new economic and systematic approach of CE focus on: life-cycle extension, circular supply chain, collaborative platforms, responsible production and recyclability of materials.

Points of interest for this research: this programme is supported by the local government and is focus onlocal enterprises.

Consideration: their support is based on a decision-making tool can reflect the difficulties in making decisions in the CE framework.

20 https://www.luxinnovation.lu/innovate-in-luxembourg/performance-programmes/fit-4-circularity/

Fig . 5.14 - graphic visualisation of the principal elements of the case study Fit4Circularity



Circular Economy Lab[21]

Aims and objectives: the first lab on the CE in Italy by two main founders, Intesa San Paolo bank and Cariplo factory, with also the support of the Ellen MacArthur Foundation.

Age and evolution: from September 2018

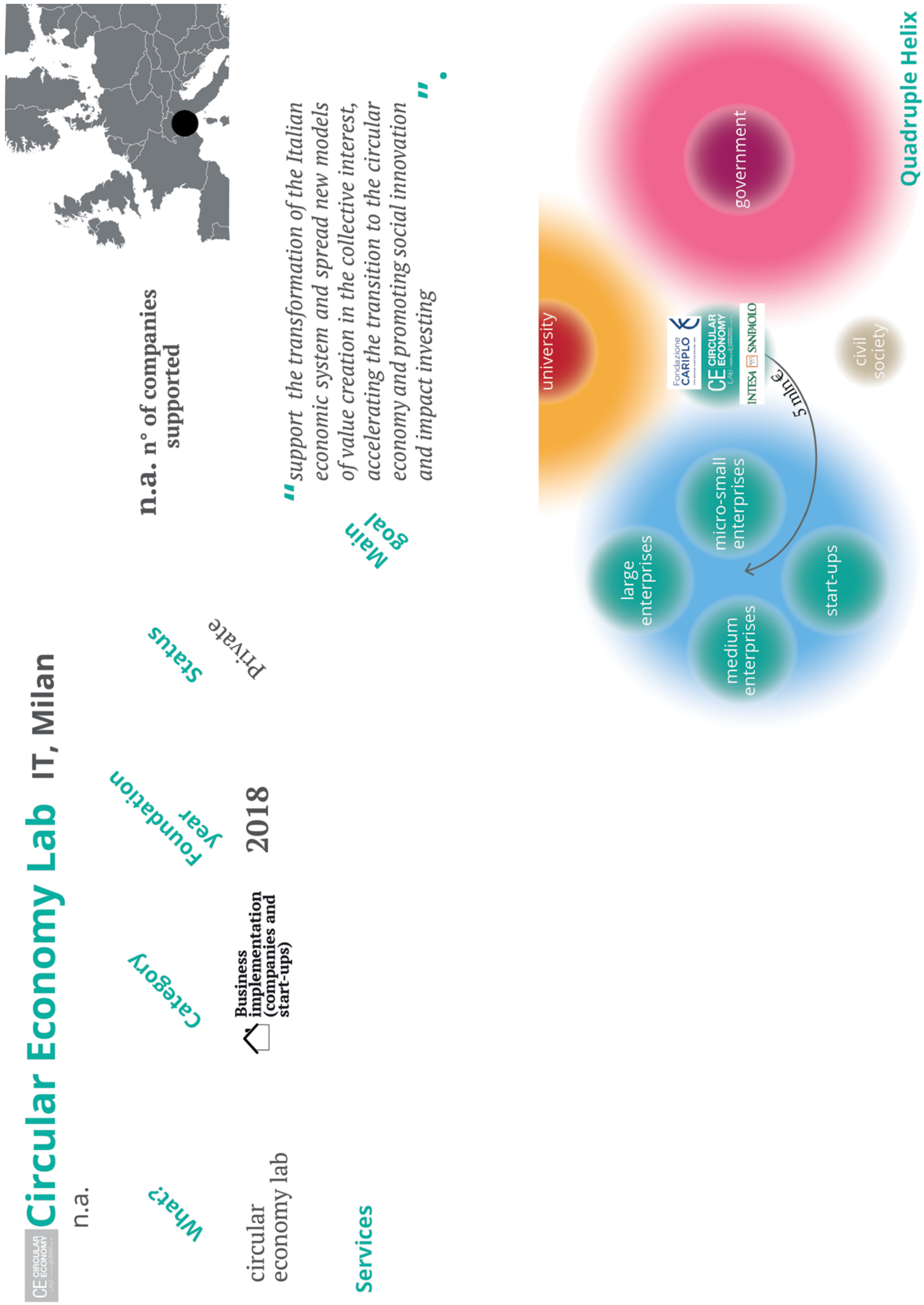
How it works: Following the announcement about the opening, Intesa San Paolo bank has placed 5 millions of euro in the period 2018-2021.

Points of interest for this research: This lab was unveiled as the first lab on the CE in Italy

Consideration: it is not possible to find an official website and other information.

21 https://www.cariplofactory.it/intesa-sanpaolo-e-fondazione-cariplo-lanciano-il-primo-laboratorio-per-la-circular-economy-in-italia/

Fig .5.15 - graphic visualisation of the principal elements of the case study Circular Economy Lab



Blue City 010[22]

Aims and objectives: an incubator for Blue and Circular economic development

Age and evolution: They are a little reality which has increased a lot its visibility and impact thanks to the spreading of the CE concept, from the former establishment in 2015.

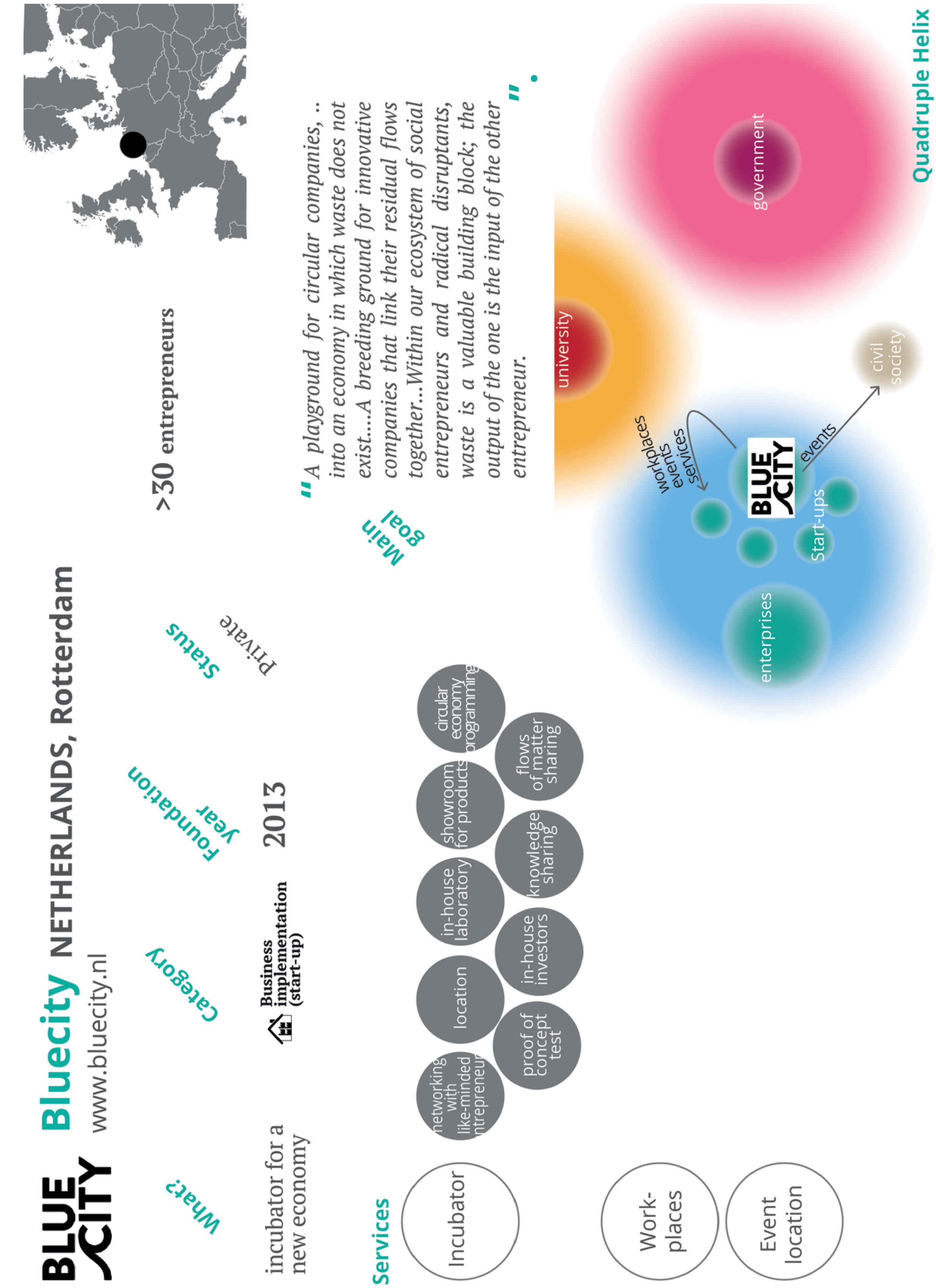
How it works: this incubator is placed in a renewed sustainable building which also contains a lab to conduct experiment and test. Moreover, they are focused on linking the residual flows between entrepreneurial activities in order to reduce waste.

Points of interest for this research: Blue city is a very interesting case because it is an atypical incubator working for a new economic model. Indeed, they follow the principles of the Blue Economy ,and they were the place of the first Blue Economy Living University that I attended in October 2017. They also offers a playground for experimentation in a sustainable building. Moreover, they are working to create relationships among the different start-ups, also in terms of residual flows.

Consideration: . They don't seem to have relationships with universities and local government.

22 www.bluecity.nl

Fig . 5.16 - graphic visualisation of the principal elements of the case study Blue City



Cradle To Cradle Innovation Institute[23]

Aims and objectives: foster the making of positive products and materials through the Cradle to Cradle® methodology.

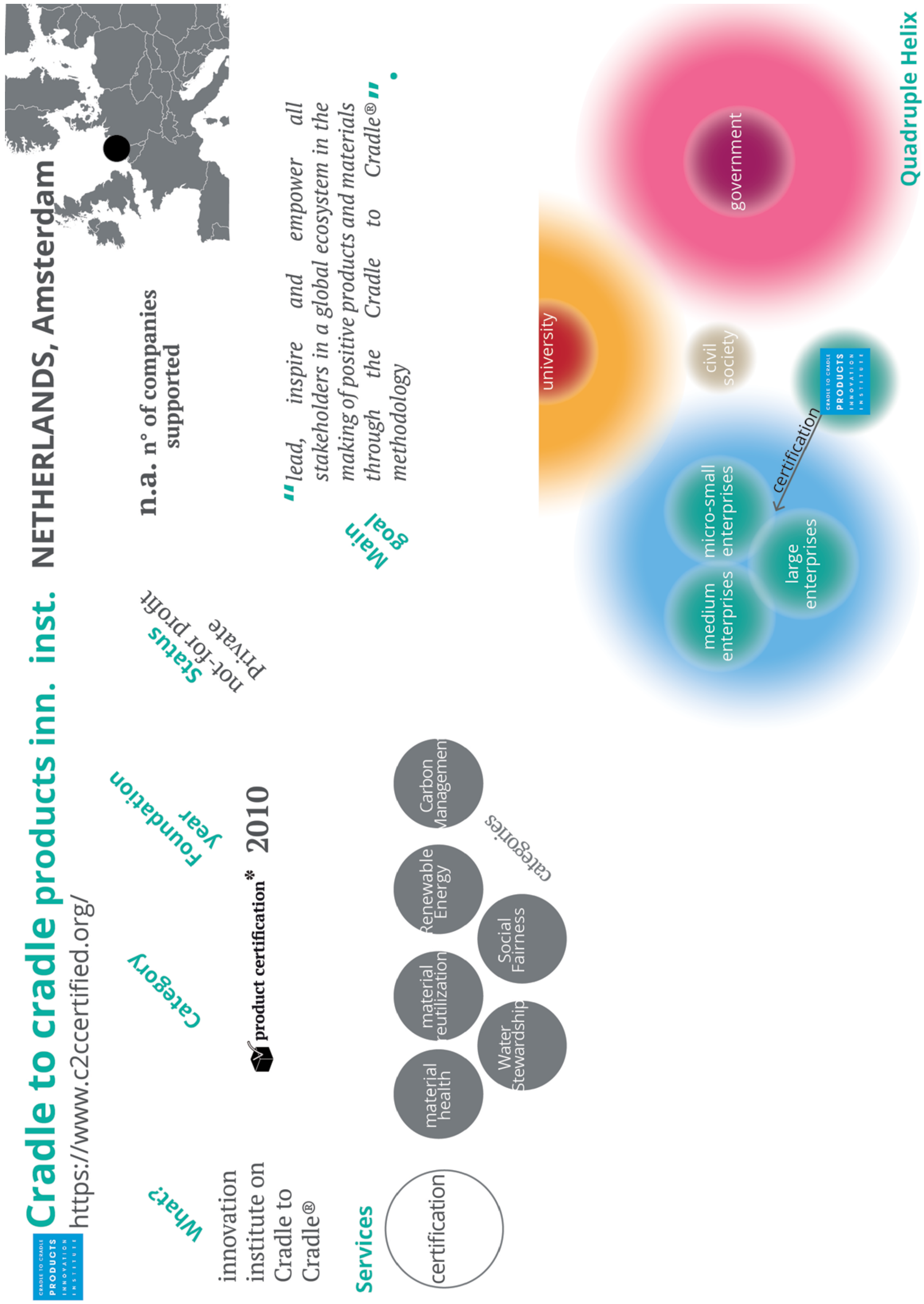
Age and evolution: from 2010

Points of interest for this research: This is a particular case because it is an innovation institute that was founded by William McDonough and Dr. Michael Braungart, who were the ones who introduced the Cradle to Cradle® as a circular design philosophy in the 1990s (see chapter 3).

Consideration: it is not a BI ,but it can be considered an important actor in the implementation of CE because they are able to produce certifications to Cradle to Cradle® products and materials that nowadays are more than 500.

23 https://www.c2ccertified.org/

Fig . 5.17 - graphic visualisation of the principal elements of the case study Cradletocradle innovation institute



Metabolic[24]

Aims and objectives: use systemic thinking to support a sustainable economy

Age and evolution: from 2012

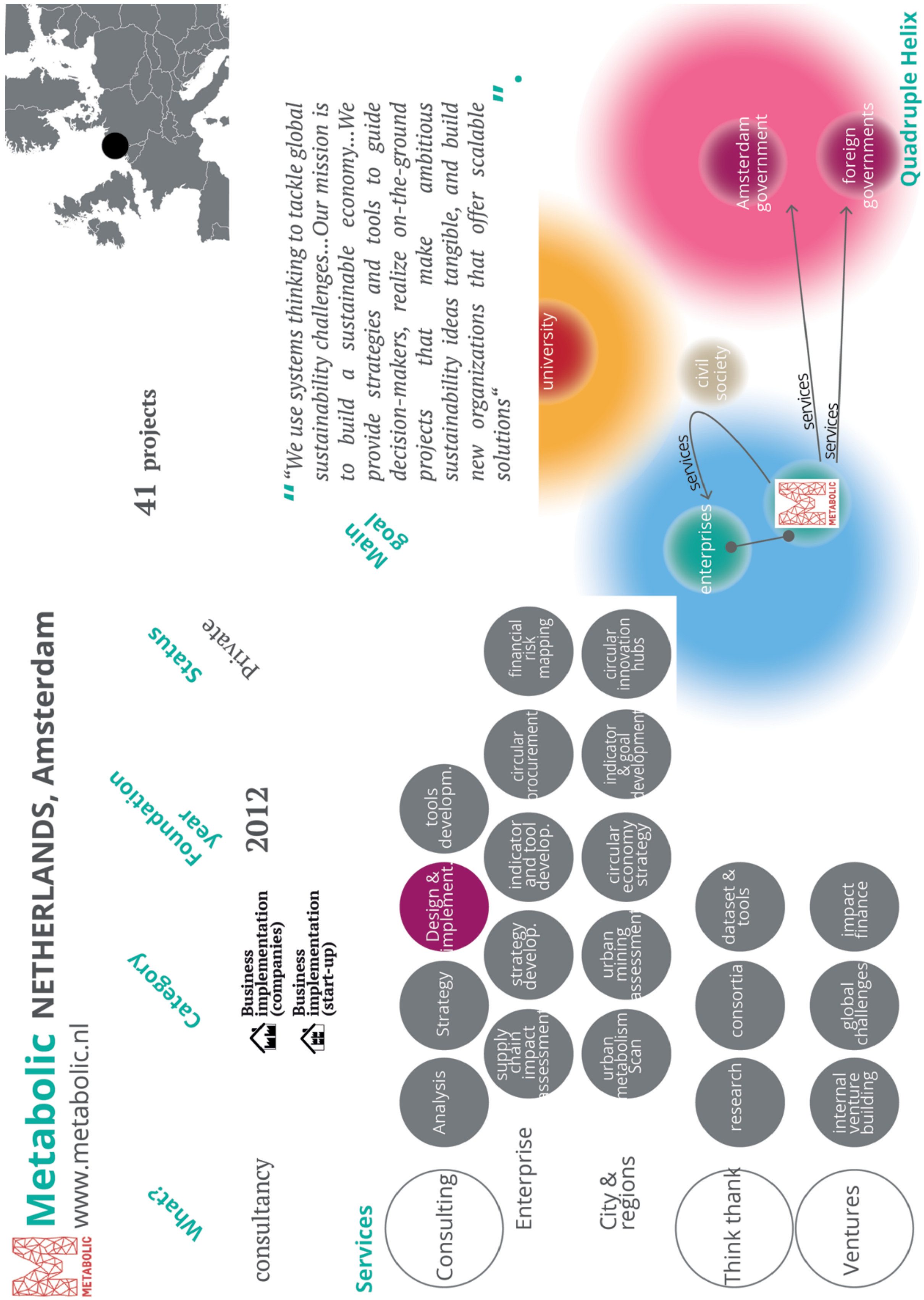
How it works: They are working as consultants both for existing enterprises and projects and in support of new sustainable ventures, both for cities and regions, providing multiple services

Points of interest for this research: Metabolic it is a very interesting case because their approach to sustainability is based on Systems Thinking and is visible in their actions and services, which are very similar to the SD Lab in Politecnico di Torino. For example, in its methodology and its services provided (see fig. 11.2 in the annex) they start from a scan of the existing system to find the points to intervene. Also, its strong believe in graphic design and data visualisation as one of the tools to drive sustainable change it's another thing that is in common. It is possible to see it for example in the representation of the project for 'Circular Friesland' (see fig. 11.3 in the annex). Very interesting are their projects on cities or particular territories where they started with the mapping of the most important energy, water, and materials flows (as in the HD of the SD methodology) which were performed in collaboration with Circle Economy. Moreover, they have also a focus on the design phase applying systems thinking approach.

Consideration: They seem not to have collaboration with the university, but actually the government, as the city of Amsterdam is very interested in what they are doing.

24

Fig .5.18 - graphic visualisation of the principal elements of the case study Metabolic



De Ceuvel[25]

Aims and objectives: a clean tech playground and the Amsterdam's first circular office park

Age and evolution: it opened in 2014 and it is in evolution

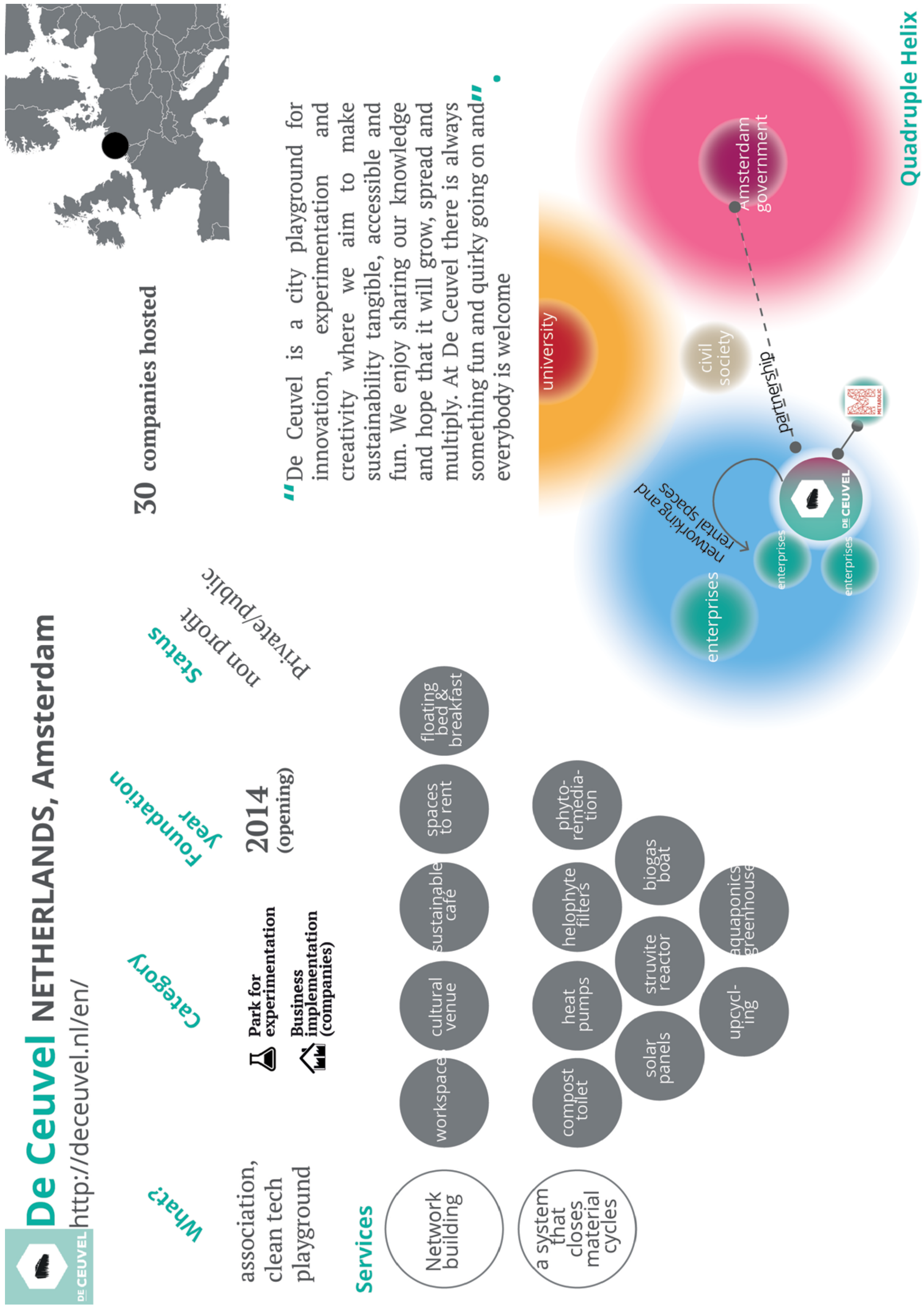
How it works: It is a project (where Metabolic is a partner) at its starting point of implementation, but it was created to test and implement circular projects.

Points of interest for this research: it is interesting for its potential to host and support the creation of new businesses, but also because it was designed and it is working as a system that closes material cycles.

Consideration: In the website, it seems that it is mainly a 'rental space' composed of seventeen houseboats for entrepreneurs, next to a cultural centre around sustainability, a café-restaurant, and a floating hotel. However it is very interesting for the area and how it was *"developed to show alternative ways of handling waste (flows) within a small-scale area"* as: compost toilets, solar panels, phytoremediation,...(see fig 11.4 in the annex).

25 http://deceuvel.nl/en/

Fig . 5.19 - graphic visualisation of the principal elements of the case study De Ceuvel



Copper 8[26]

Aims and objectives: provide sustainable breakthroughs, making new collaboration possible

Age and evolution: from 2013

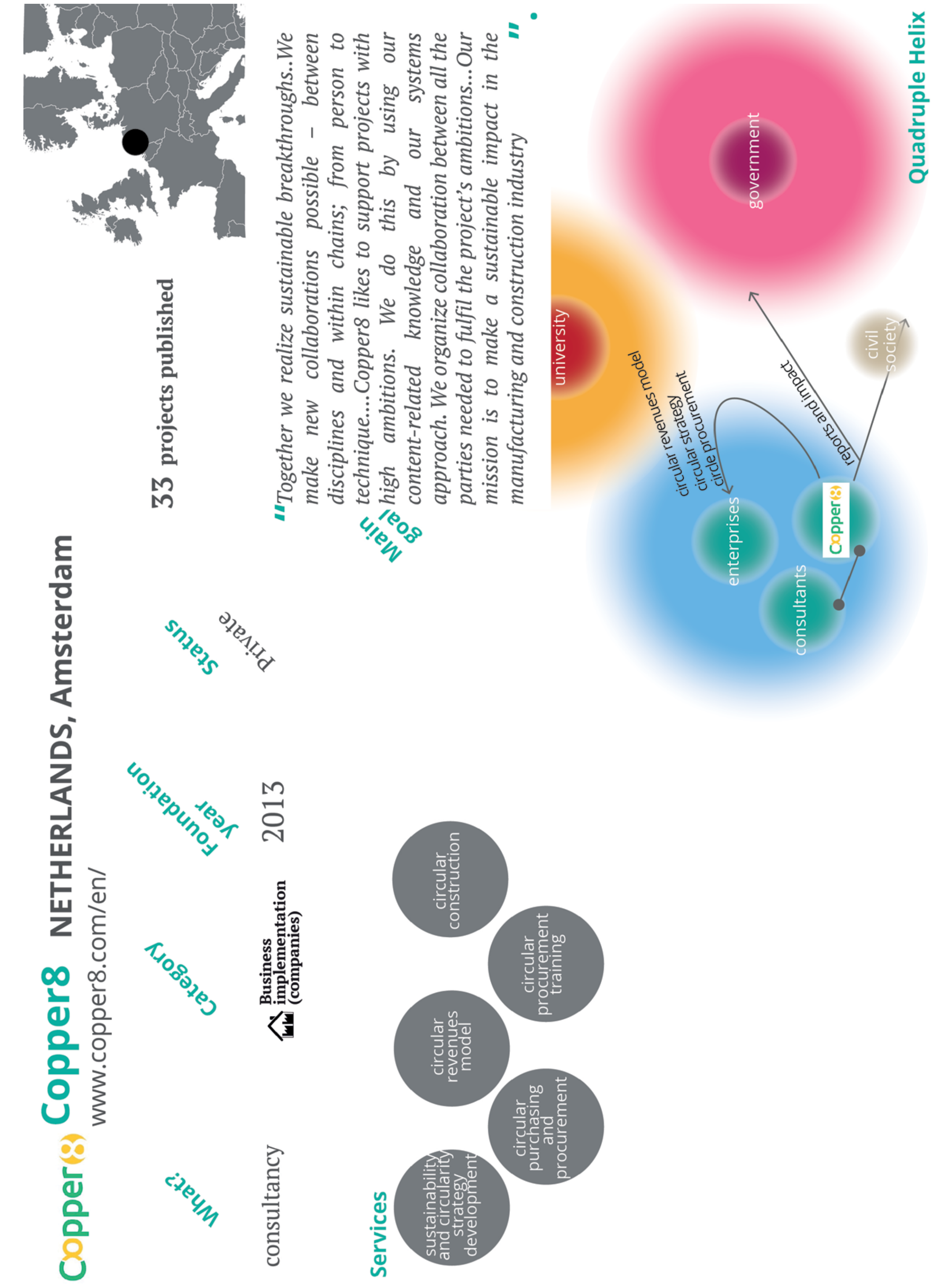
How it works: they are consultants providing multiple services mainly to build new collaborations among actors.

Points of interest for this research: although the CE is not in their statement, they are interesting for their focus on creating collaboration among different elements (disciplines, person, value chains,..) to create at the end a sustainable impact.

Consideration: all the services provided by them to existing companies are ‘circular’ ones and seems to be innovative (from strategy development to procurement and to revenue models)

26 www.copper8.com/en/

Fig . 5.20 - graphic visualisation of the principal elements of the case study Copper8



Circle Economy[27]

Aims and objectives: this non-for-profit organization wants to spread messages and solutions about CE to accelerate the transition

Age and evolution: n.a.

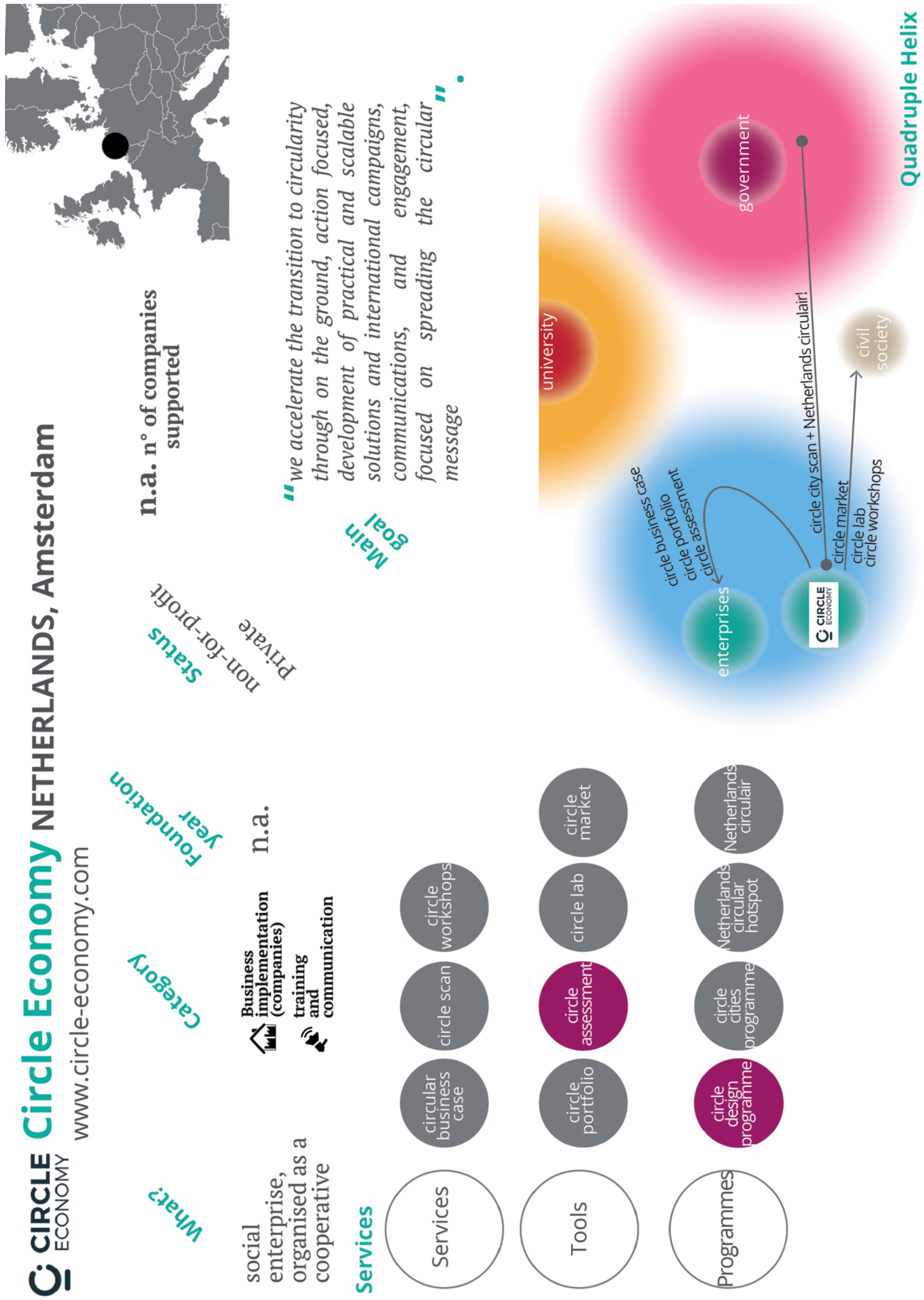
How it works: they are developing and providing multiple services to accelerate the transition to a CE

Points of interest for this research: They are a very interesting case for the multiple services, tools and programmes provided. They developed multiple tools both for businesses than for cities. For example, the 'circle city scan' is a tool which is very similar to the HD of the SD methodology, that defining the material flows in the city try to define a new strategy Also the 'circle assessment' which is an assessment tool for defining the current circularity of businesses and . They are also working to involve the civil society with, for example platforms as 'circle lab' and 'circle workshops'. Moreover, they are considering the role of design in the CE implementation, for example, with the Circle Design Programme, which wants to transform industries through circular design thinking.

Consideration: They were the founding partner of NCEH and they were present also at the SCEH because they are working with Circular Glasgow. Indeed, they developed the scan of the city of Glasgow to assess the current situations and the possibilities and opportunities in terms of CE. For this reason, they seem to be a crucial actor working for the CE implementation in Europe.

27 https://www.circle-economy.com/

Fig . 5.21 - graphic visualisation of the principal elements of the case study Circle Economy



Circle Lab[28]

Aims and objectives: digitalization of the knowledge around CE

Age and evolution: n.a.

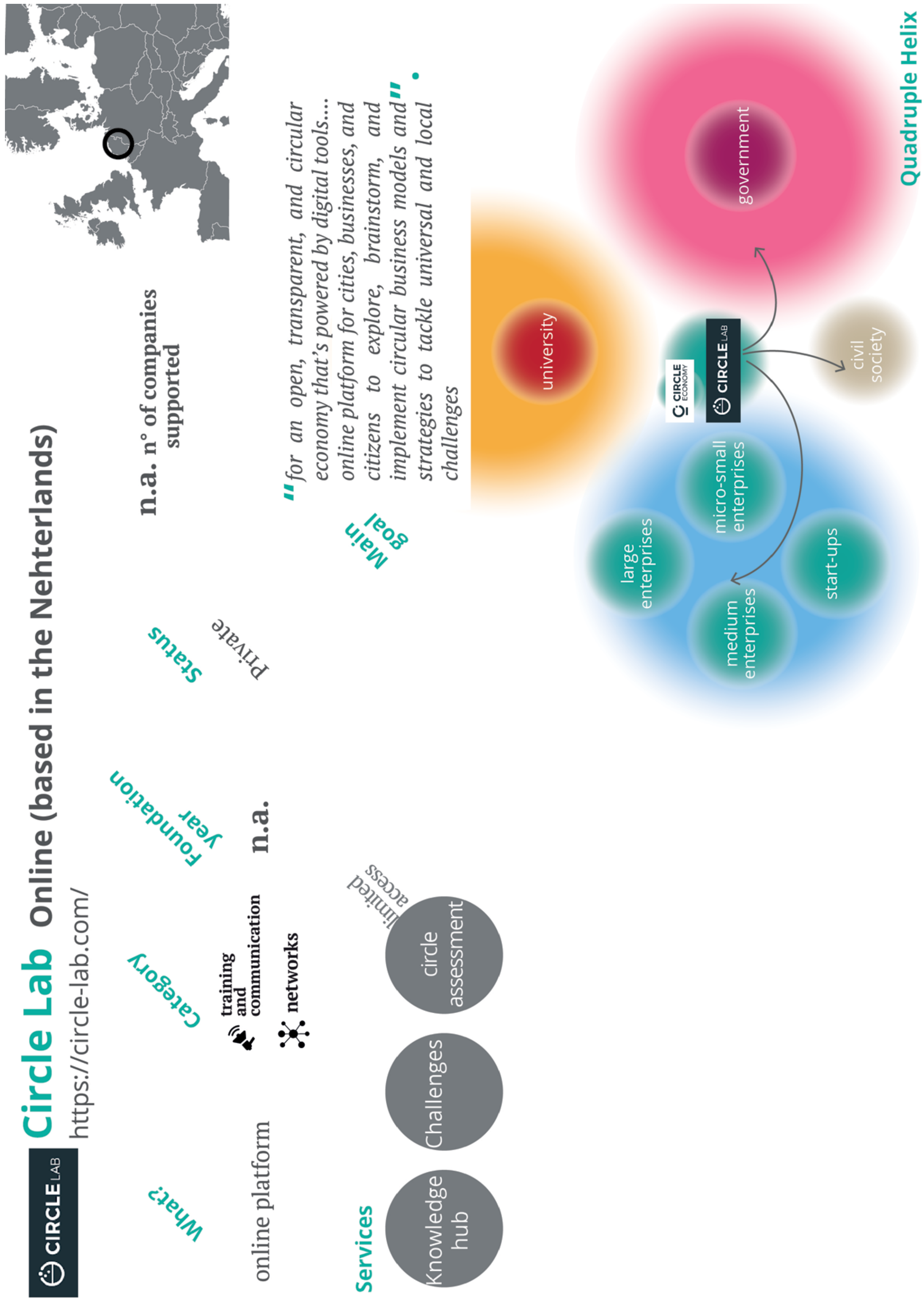
How it works: This online platform is powered by Circle Economy and is mainly a knowledge hub which collects case-studies, strategies, policy instruments about the CE. Moreover, they are publishing challenges which need the collaborations of many actors and circular solutions to be solved. Another service which is under a controlled access, is the circle assessment, the online tool by Circle Economy to support the decision makings about the CE and pointing out more opportunities for the business.

Points of interest for this research: they collected multiple cases that can be of inspiration of CE in practice

Consideration: they are not supporting business directly, but they are an important actor that is supporting the transition to a CE.

28 https://circle-lab.com

Fig . 5.22 - graphic visualisation of the principal elements of the case study Circle Lab



C-Creators[29]

Aims and objectives: accelerate and scale the transition to a CE in Amsterdam Metropolitan Area region.

Age and evolution: from Sept. 2018

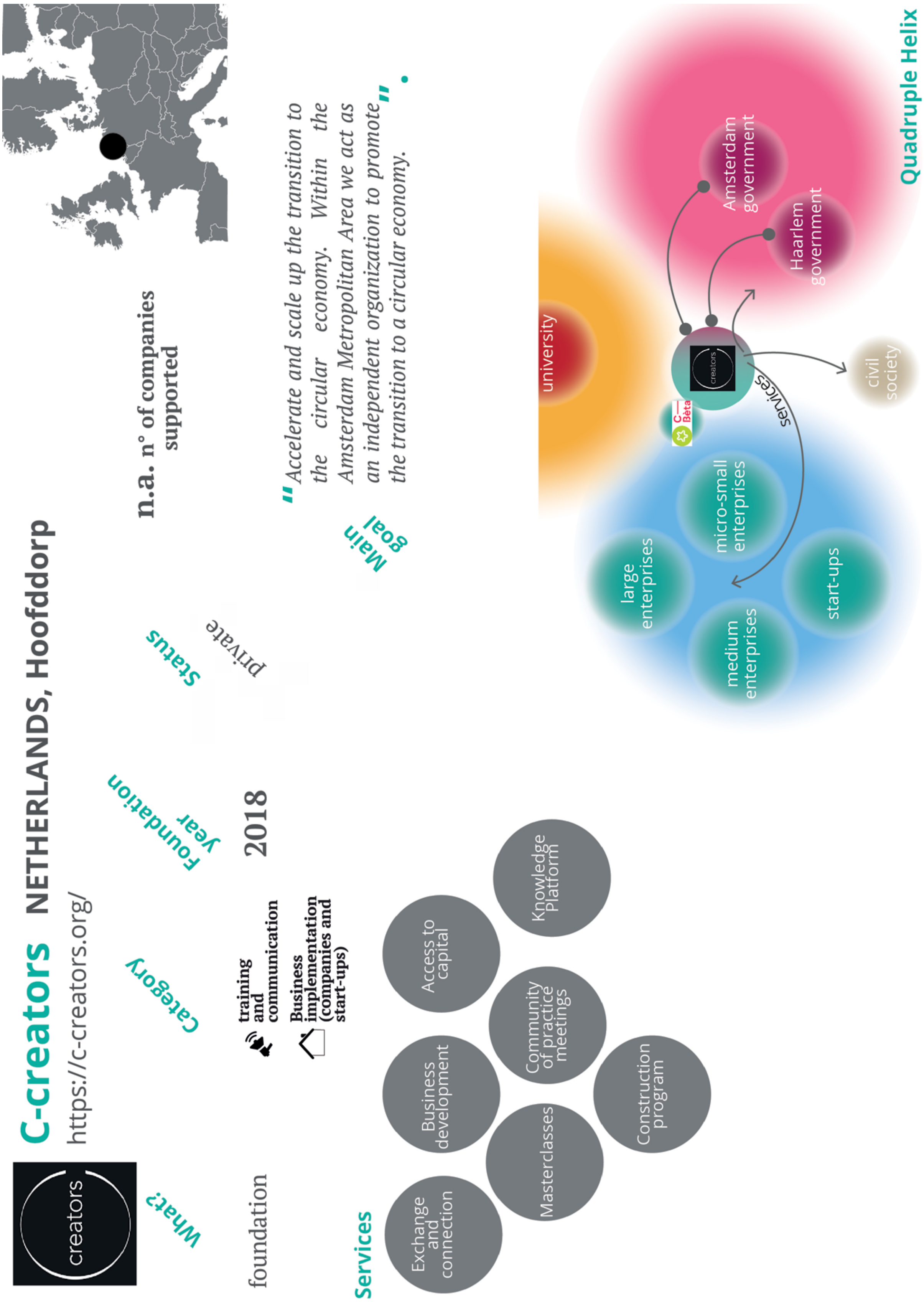
How it works: They are mainly playing a role of promoting knowledge sharing also with their digital platform to spread news on the CE, but they have both a business development innovation programme. They are located in c-beta (see next case)

Points of interest for this research: they are supported by the government (Amsterdam city) and private foundations and they are focused on the development of innovation in the CE in the Amsterdam Metropolitan Area.

Consideration: their business development programme is focused on the construction sector. Moreover, the website is not in English, so this has limited the research, but this can reflect the fact that this actor is concentrated only in the Netherlands local area.

29 https://c-creators.org/

Fig . 5.23 - graphic visualisation of the principal elements of the case study C-creators



C-Beta[30]

Aims and objectives: workspace for the circular economy

Age and evolution: n.a.

How it works: It is mainly a co-working space and an event location for CE business, moreover, it is an online platform to spread messages about the CE. It is also the location of c-creators.

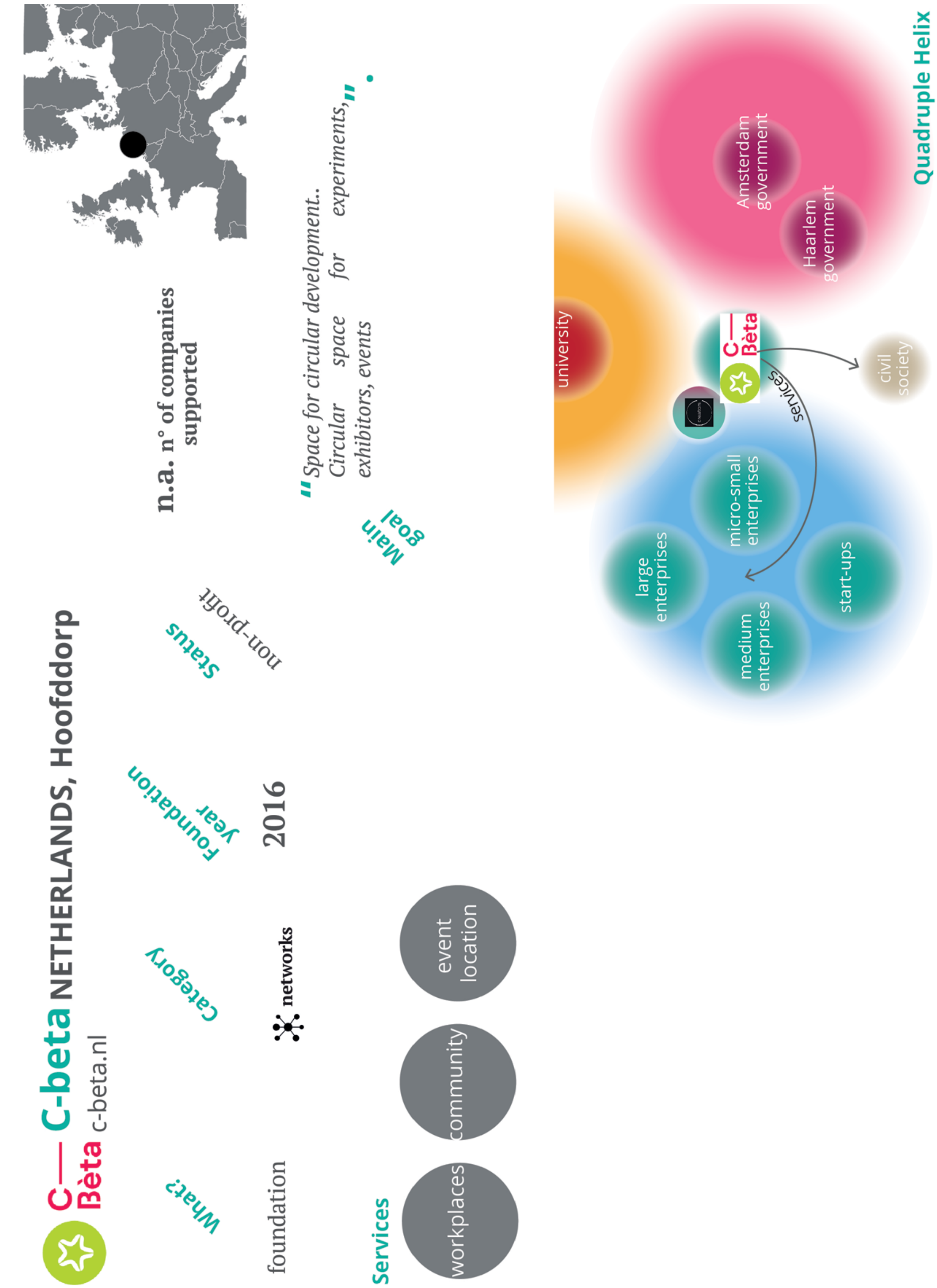
Points of interest for this research: This actor is the one that replaced the “Circular Valley”, a case which was found in 2017 as the first incubator for the CE, but it closed during the development of this research. For the moment, it is mainly a workspace and event location but it is in development.

Consideration: The website isn’t in English so this has limited the research, but this can reflect the fact that this actor is concentrated only in the Netherlands local area. They are located in the Schiphol Trade Park[31] which aims to become the most sustainable business park in Europe.

30 c-beta.nl

31 https://c-beta.nl/over-c-beta/schipholtradepark

Fig . 5.24 - graphic visualisation of the principal elements of the case study C-Beta



Ellen MacArthur Foundation[32]

Aims and objectives: the mission of this foundation is to accelerate the transition to a CE

Age and evolution: from 2010

How it works: They are focusing on learning activities, developing scalable circular business initiatives, working with governments and institutions to inform policymakers. Moreover, they are publishing many reports with insights and analysis, and case studies.

Points of interest for this research: Following its mission to spread the message everywhere, this foundation has become a point of relevance when talking about the CE in Europe and in the world.

Consideration: they are not supporting business directly, but they are a relevant actor for the implementation of CE.

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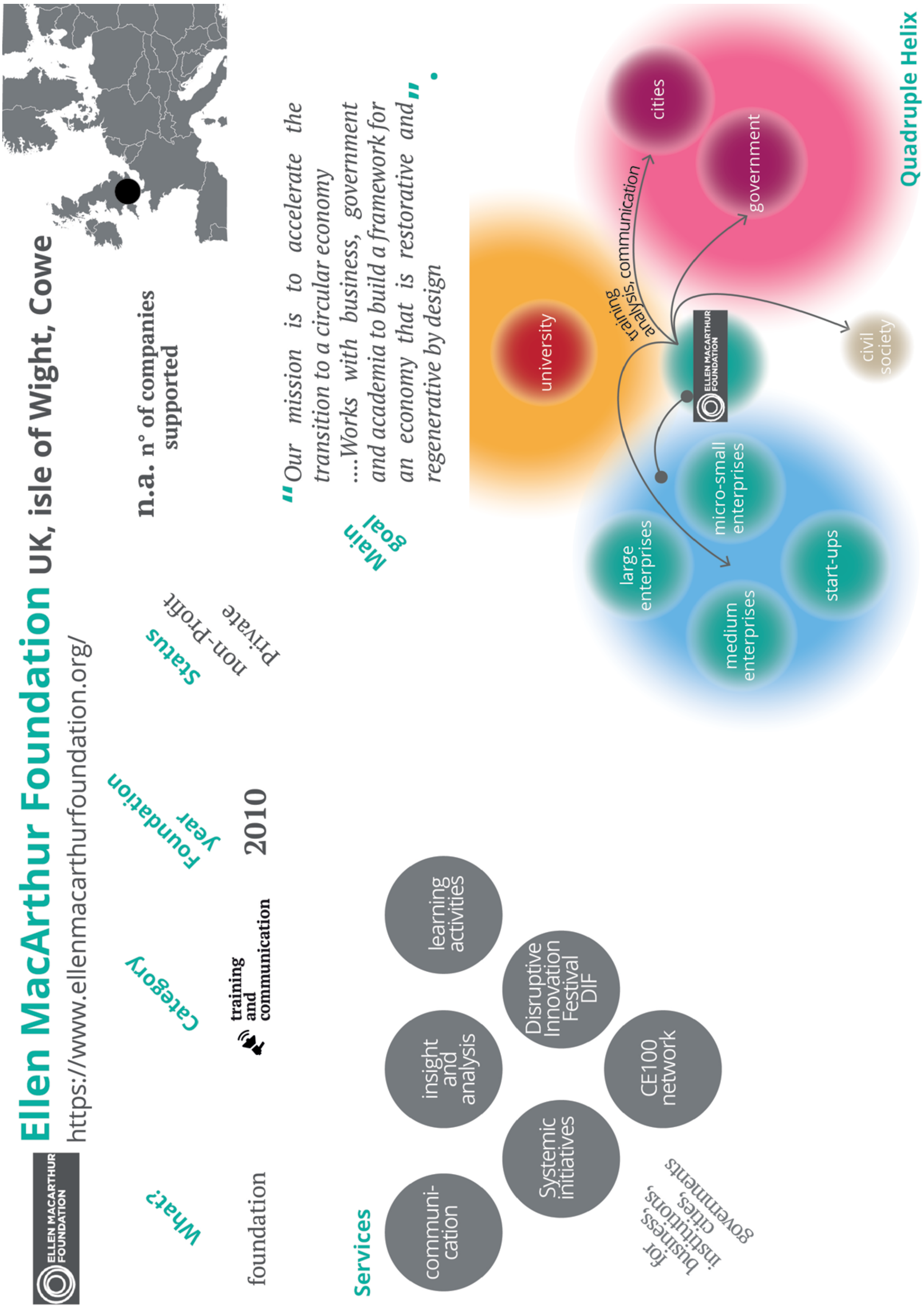
32 https://www.ellenmacarthurfoundation.org/

Fig .5.25 - graphic visualisation of the principal elements of the case study Ellen MacArthur Foundation



Circular Change[33]

Aims and objectives: connecting key players in the CE

Age and evolution: from 2015

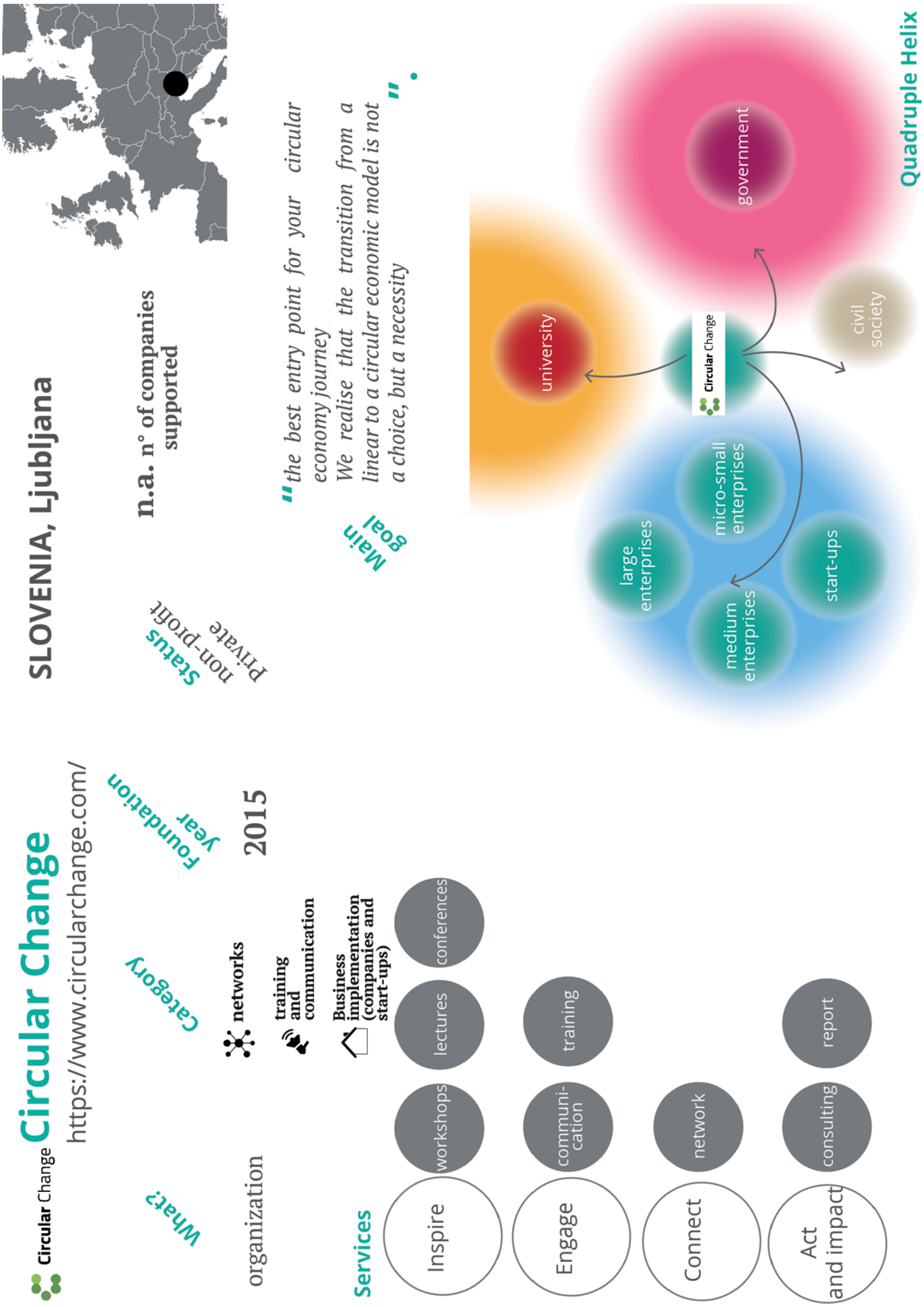
How it works: This private organization was born in Slovenia is working to inspire, engage, connect, and finally act with many services providing consultancy to existing businesses, but also engaging the civil society, government and researchers.

Points of interest for this research: They are providing multiple services to engage all the actors of the quadruple helix model. These are mainly focused on creating connections and involve the stakeholders, but also on the co-creation of CE solutions. They are also organizing the 'circular change conference' which in 2019 it is at the 4th edition . They have also received the support of main actors in Europe as Dr. Janez Potočnik, EC Commissioner for Environment 2010-2014.

Consideration: In the support of business implementation, they are not facilitating the access to capital and providing space.

33 https://www.circularchange.com

Fig .5.26 - graphic visualisation of the principal elements of the case study Circular Change



Circul'r[34]

Aims and objectives: connection among start-ups and companies in the CE

Age and evolution: from 2017

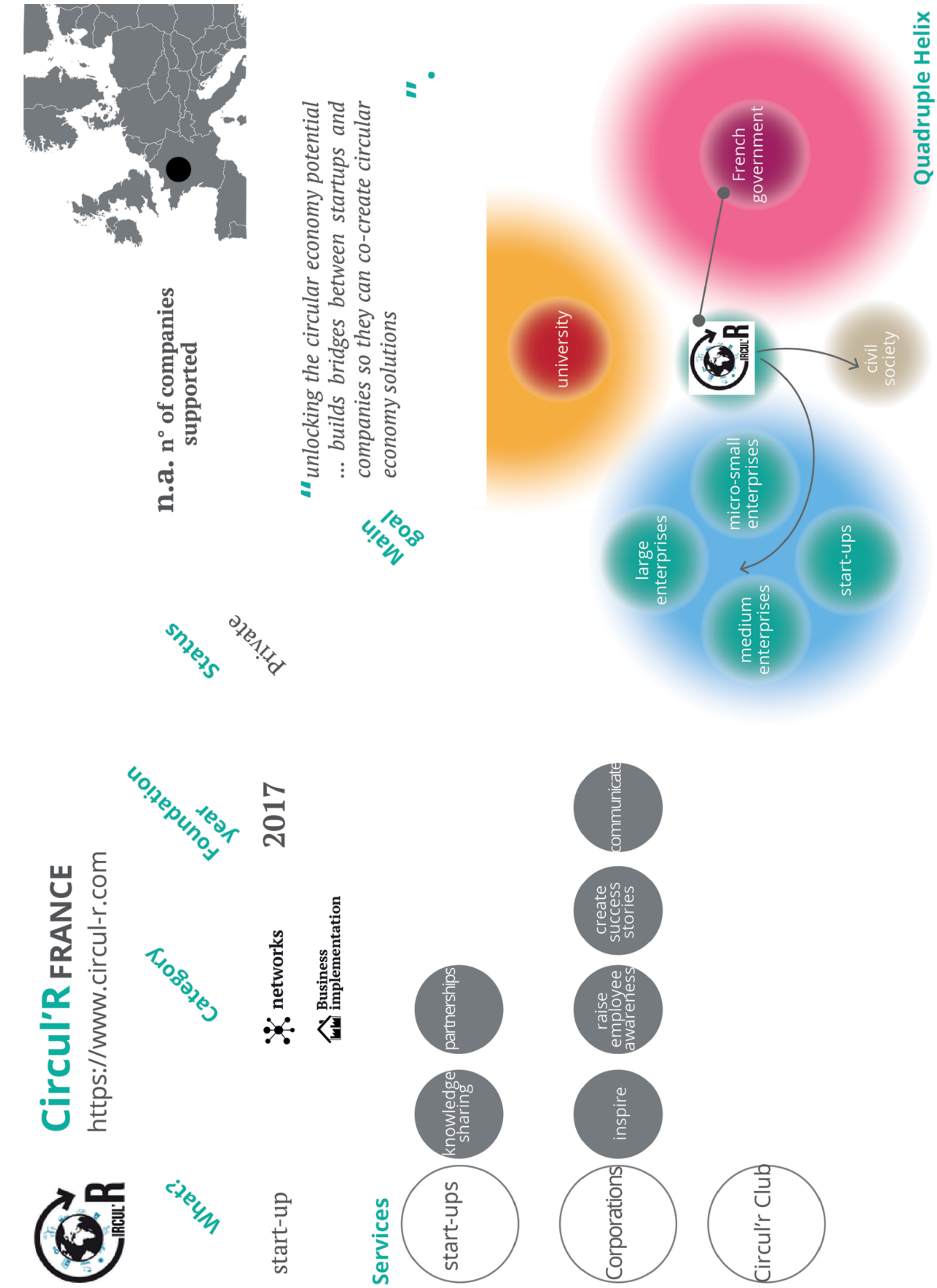
How it works: This young start-up made from a team of passionate young entrepreneurs, is providing services both for other start-ups than for corporations. Moreover, they have developed a club which organizes 4 events/year to increase networking.

Points of interest for this research: They are providing support both to companies and start-ups, and they are also focusing on creating connections and networking.

Consideration: They are not providing spaces and access to capital. The most interesting services are the one focus on creating connection and on raise employees awareness. Also the Circul'r club with a series of events to the members is very interesting.

34 https://www.circul-r.com/

Fig . 5.27 - graphic visualisation of the principal elements of the case study Circul'r



Symbiosis center denmark[35]

Aims and objectives: facilitate industrial symbiosis projects

Age and evolution: from 2015. It was created as a project in 2011 (by the partners of the industrial symbiosis park) and after it became a centre.

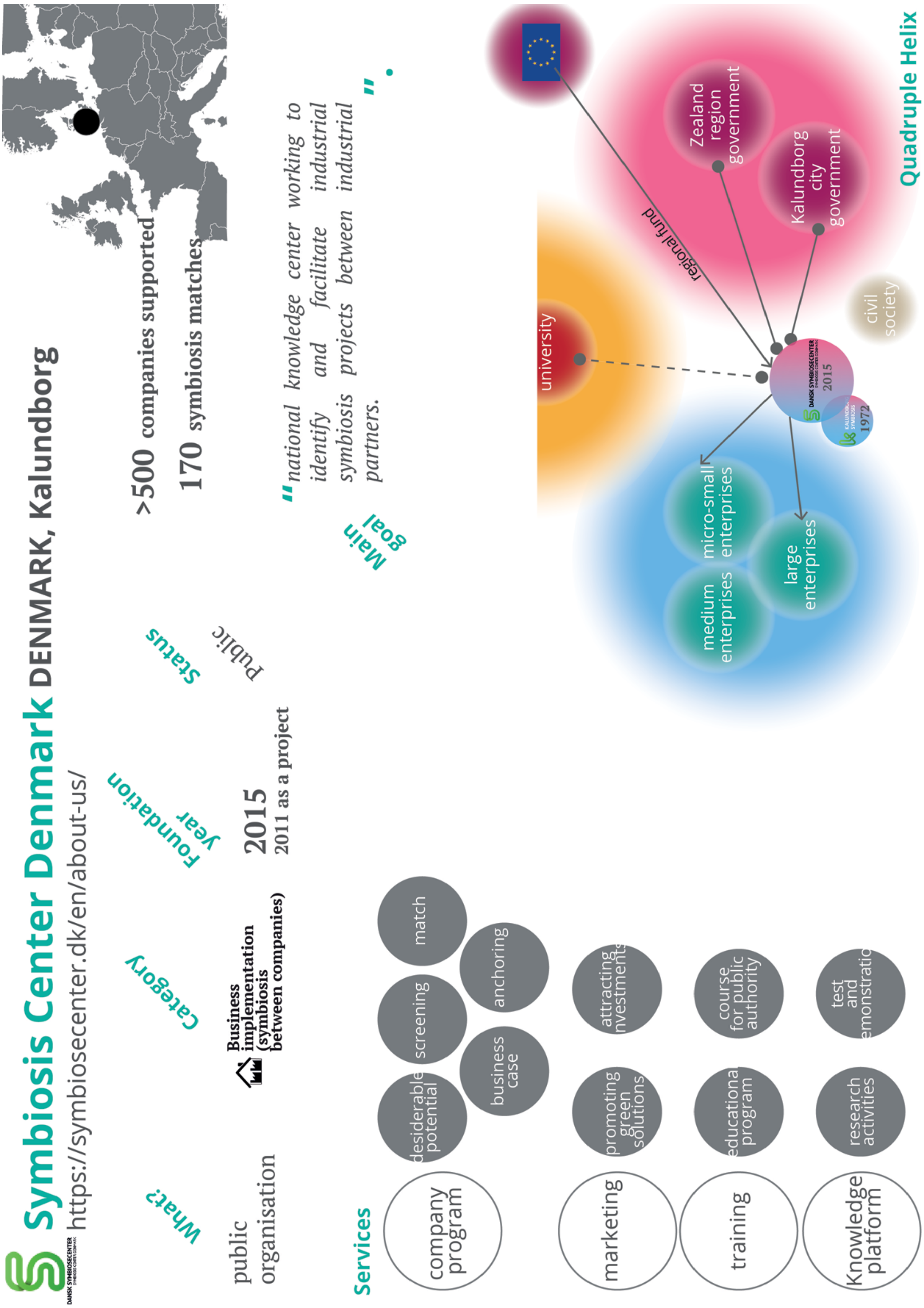
How it works: This centre is a public organization (no research center) but is working to identify and facilitate industrial symbiosis projects between industrial partners. They are able to assist through all the process of the industrial symbiosis project: after a screening process and the individuation of potentialities, they facilitate the connections and the creation of a business case and the establishment of the agreements.

Points of interest for this research: they are working on facilitating the implementation of processes of industrial symbiosis where there is an exchange of matter and energy flows among enterprises, following the entire process.

Consideration: It is run by the regional governmental bodies with also EU funds.

35 https://symbiosecenter.dk/en/about-us/

Fig .5.28 - graphic visualisation of the principal elements of the case study Symbiosis center denmark



Kalundborg symbiosis[36]

Aims and objectives: implementation of industrial symbiosis concept

Age and evolution: It started in 1972 as the 'surplus gas' project, and in 1989 was renamed 'industrial symbiosis'.

How it works: : This is the first world industrial symbiosis park, and it sees the cooperation of 9 industries, both public than private parties. The first stream was the surplus gas of a bioferinery that was transformed in heat. Afterwards, the steam supply from the excess of heat was assessed, and the infrastructure to transport this heat was built, which today is about 5 km. This was the starting point for the other collaborations built between companies which are not competitors.

Points of interest for this research: it is an example in practice of a difficult local cooperation with the goal to minimize waste and costs. It was built by a bottom up approach by the companies involved.

Consideration: from this project realized it was born the 'industrial symbiosis center' (see the precedent case). The analysis of this case was also done through field research, indeed in May 2019 I visited this site (see fig. 5.29) .
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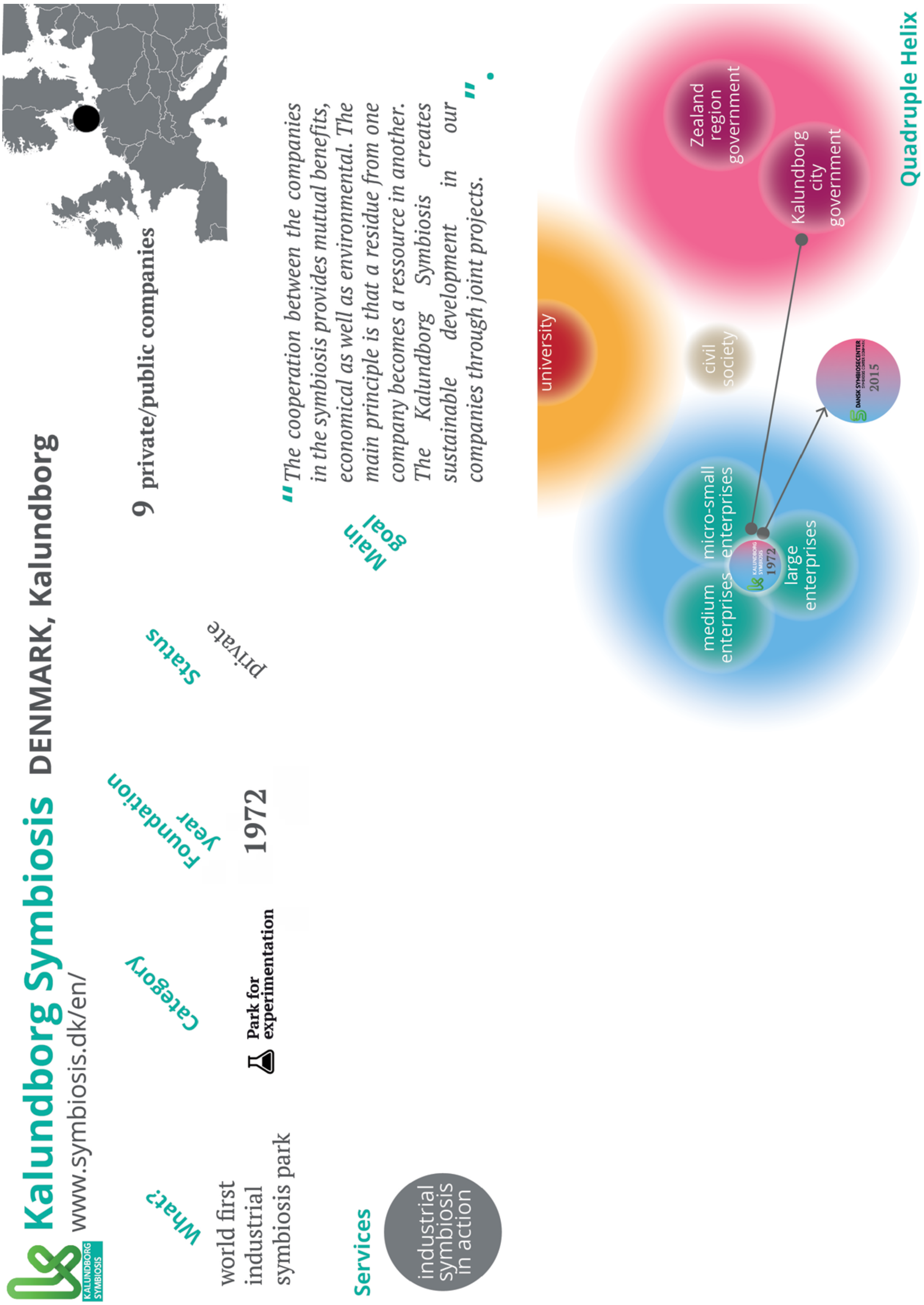
Fig . 5.29 - a picture about the field visit

36 http://www.symbiosis.dk/en/

Fig . 5.30 - graphic visualisation of the principal elements of the case study Kalundborg symbiosis



5.3 CASE-STUDIES COMPARISON

The overall analysis of cases studied, based on their principal goal, lead to identify the followings main types of actors for the 28 cases:

- Business Incubator for new start-ups
- Organization with services to support the transition of existing enterprises;
- Organization that mainly support communication and training;
- Organization that mainly support network creation;
- Park for experimentation;
- Particular Case.

Due to the multiple nature of some cases, some cases can fit in two categories as shown in tab. 5.3.

Tab. 5.3 main category for each case study

	NAME	MAIN CATEGORY	2° CATEGORY
1.	Ville Durable Programme by Paris&Co	For new start-ups	
2.	Circular Economy Transition	For new start-ups	For the transition of existing enterprises
3.	Climate kic - Accelerator	For new start-ups	
4.	Climate kic - Green House	For new start-ups	
5.	Zero Waste Scotland Limited	For the transition of existing enterprises	
6.	Circular Glasgow	support communication and training	For the transition of existing enterprises
7.	CLEVER	For the transition of existing enterprises	
8.	UNIVER	For the transition of existing enterprises	For new start-ups
9.	Environment park	For the transition of existing enterprises	(park for clean-technologies)
10.	Advance London	For the transition of existing enterprises	
11.	Circular London - programme	support communication and training	For the transition of existing enterprises
12.	Circular London - accelerator	for new start-ups	
13.	Fit 4 Circularity	For the transition of existing enterprises	
14.	Circular Economy Lab	For the transition of existing enterprises	For new start-ups
15.	Blue City 010	For new start-ups	Park for experimentation
16.	Cradle To Cradle Innovation Institute	(Particular case) on cradle2cradle product certification)	
17.	Metabolic	For the transition of existing enterprises	for new start-ups
18.	De Ceuvel	Park for experimentation	For the transition of existing enterprises

Tab. 5.3 main category for each case study (continue)

	NAME	MAIN CATEGORY	2° CATEGORY
19.	Copper 8	For the transition of existing enterprises	
20.	Circle Economy	support communication and training	For the transition of existing enterprises
21.	Circle Lab	support network creation	
22.	C-Creators	support communication and training	For the transition of existing enterprises // for new start-ups
23.	C-Beta	support network creation	for new start-ups// For the transition of existing enterprises
24.	Ellen Macarthur Foundation	support communication and training	
25.	Circular Change	support network creation	support communication and training // For the transition of existing enterprises
26.	Circul'r	support network creation	For the transition of existing enterprises
27.	Kalundborg symbiosis	Park for experimentation (on industrial symbiosis)	
28.	Symbiosis center denmark	For the transition of existing enterprises (on industrial symbiosis)	

In summary, the cases are:

- 6 Business Incubator/accelerator for new start-ups/firms;
- 10 organizations that mainly support innovation in existing enterprises for their transition;
- 5 Organizations that mainly deliver communication and training activities;
- 4 Organization that mainly support network creation;
- 2 Park for experimentation;
- 1 Particular Case.

Between these actors, it is important to include the event CEH which is a very important moment every year for each actor to meet, discuss, see the showcases and understand what is happening in each particular geographical context.

The identified actors, placed in the Europe map in fig. 5.31, reflect a very fragmented framework both in their locations, in their goals and in their typologies: from governmental agencies and cities board, to innovation clusters and traditional BIs, to consulting agencies and digital platforms. However, everyone can be defined a CE implementer for its goals, although someone provide support for the transition of existing enterprises or the SMEs, others support the creation new companies/start-ups and some have a broader goal. An exception is presented by the digital platforms which have the goal to increase the visibility and the relationships between the actors and the external ecosystem. Their role is also very important for raising awareness on CE concepts in citizens.

The phenomenon, in general, is very recent as the most were founded after 2014, reflecting the EU policy.

Although some actors have a larger focus than CE, they were included in this analysis because their goals are topic very related to the CE in a broader spectrum. For example Green House is on climate innovation; Metabolic on systems thinking; Copper8 in sustainability and in particular on circular procurements; CLEVER on energy and clean technologies, however it has a particular section on CE.

This analysis doesn't want and cannot be exhaustive. Many other realities can be present in Europe and every month many raise and grow outside their local area.

From the analysis of the services performed by the actors, many cases that state to work for a CE implementation seem that they are providing traditional services, following a linear economy framework and cultural paradigm. Only few actors are working and making a significant contribution in the transition to a different economic model, a cultural

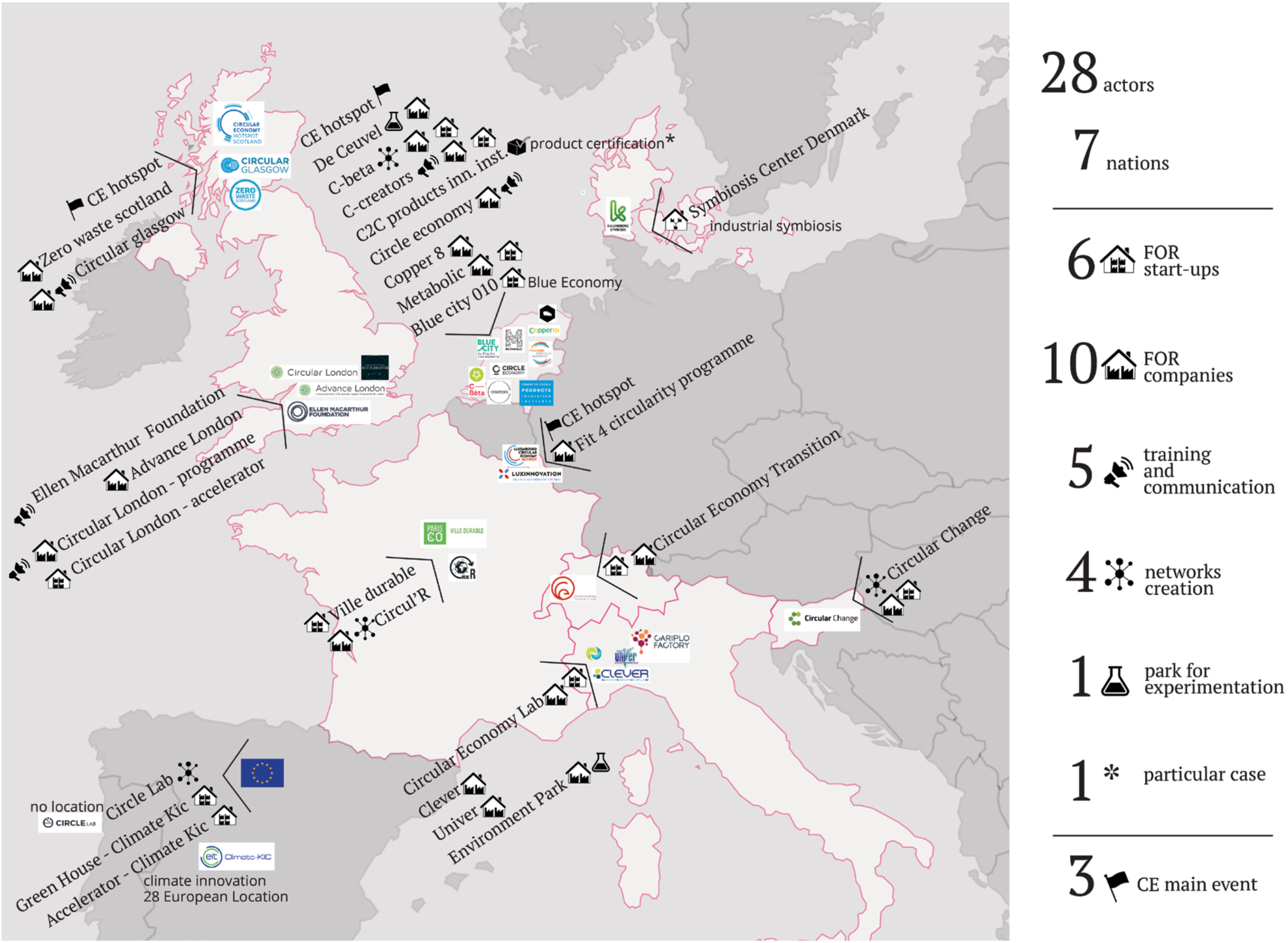


Fig.5.31 - actors on the map

paradigm and making consistent impact on their local area. Although, among the cases is possible to mention some cases which are providing something different: Metabolic working for the integration of systems thinking, the Blue City incubator working for a Blue Economy[37] and with a focus on connecting material flows, De Ceuvel a playground for connecting material flows, and Kalundborg Symbiosis where this exchange is in action.

However, the analysis found many services very interesting for the research scope:

- the ones provided by many actors who focus on facilitating relationships and connection among the players actually involved and the potential stakeholders;
- the ones more related to quantitative measurements as: the climate relevance by Climate kic; the circle assessment by Circle Economy and Lab; the tools by Metabolic; the certification on Cradle to Cradle® products; the decision-making tool by Fit 4 Circularity. These ones can underline the importance and difficulties on making decisions in this framework and also on calculating the impact;
- the ones related to the collection of case-studies and also to their showcases, aimed at inspiring business;
- the creation of events for the community;
- the combination of services for different actors: for example Circular Economy Transition is both an incubator, a business lab and a research and policy lab;
- the provision of capital for enterprises coming from the European Regional Fund and provided by agencies linked to the regional government: in the case of Zero Waste Scotland and Advanced London they are dedicated only to SMEs;
- the creation of a business support service next to the investment funds services (in the case of Zero Waste Scotland and Advanced London);
- the Circle Scan service by Circle Economy which is a very similar tool to the HD of the SD methodology, identifying opportunities and future strategy from the analysis of the local territory and of value chains;
- the presence of an in-house laboratory in Blue city;
- the pre-incubation programme of Climate-kic which can reflect the need to focus more on the idea creation and on the training of different entrepreneurs, for climate innovation.

Another interesting service found in some cases, was the attention to ‘opportunities’ identification. However, the attention and connection with the design phase seems to lack in many cases, except for few particular cases:

- Ellen MacArthur foundation, with the circular design guide;
- Metabolic, with the Design & Implementation services;
- Circle Economy with the Circle Design Programme;
- Cradle to cradle innovation institute, which is built on the circular design philosophy of the cradle to cradle,
- Zero Waste Scotland with the Design support.

To understand better this phenomenon, a deeper analysis was conducted on the category related to business implementation in start-ups and enterprises.

37 see chapter 2.2.2.6

FOCUS: THE ROLE OF DESIGN IN CIRCULAR ECONOMY IMPLEMENTATION ACTORS[38]

The design phase is starting to be considered the crucial point to obtain a CE as it required a profound radical change from the beginning of the process and at system level. After the multiple case study analysis to identify which are the players in the CE implementation, a research was performed to understand the presence and the role of design in the implementation process.

Methodology used: to investigate the role of Design and Designers in CE implementation actors, first the actors that are focusing mainly on the business implementation of CE were selected for further studies. 10 actors on business implementation were selected and contacted directly by author in January 2019:

- for new start-ups/firms: Ville Durable Programme by Paris&Co; Blue City 010; Circular Economy Transition; Climate Kic programme.
- for the transition of existing enterprises: Zero Waste Scotland Limited; Clever; Advance London; Fit 4 Circularity programme by Lux

38 Based on what published in Battistoni C., Barbero S. (2019

Tab 5.4 - questions for each case study

	QUESTIONS	ANSWERS	REASONS
1.	Do you have services for circular entrepreneurs performed by designers?	Yes/no/ can you specify?	Understanding what is the role of Designers in them
2.	Is there at least one designer between the staff?	Yes/no/I don't know	Understanding the presence of designers in the staff
3.	If there is a designer in the staff, which is his/her background (product design, communication, user experience, eco-design, ...)?	Please provide number and background	Understanding which kind of designer
4.	Is there at least one Designer between the mentor?	Yes/no/I don't know	Understanding the presence of designers between mentors
5.	If there is a designer between the mentors, how many are there and which is his/her background (product design, communication, user experience, eco-design, ...)?	Please provide number and background	Understanding which kind of designer
6.	Are there designers in the ventures accelerated' team?	Yes/no/I don't know	Understanding if designers are working in circular ventures
7.	if there are Designers in the ventures accelerated' team, how many are there and which is his/her background (product design, communication, user experience, eco-design, ...)?	Please provide number and background	Understanding which kind of designer
8.	Do you know if there are Designers in the founders of the ventures accelerated?	Yes/no/I don't know	Understanding if designers are the founders of the circular ventures
9.	if there are designers in the founders of the ventures accelerated, how many are there and which is his/her background (product design, communication, user experience, eco-design, ...)?	Please provide number and background	Understanding which kind of designer

Tab 5.5 - results of the investigation part on business implementation actor. Published in Battistoni and Barbero (2019)

Actor	**foundation year**	**n° Pr supported**	**Is D a service?**	**Are there any services provided by Der?**	**Is Der present in staff?**	**Is Der present between ment-ors?**	**Is Der present in PR founders?**	**Is Der present in PR team?**	**Reference**
Ville Durable	2016	>28 start-ups	No	n.a	No	n.a	n.a	n.a	website
Blue city 010	2013	8 start-ups	No	n.a.	Yes, from Superuse Studios	n.a	n.a	n.a	website
Climate Kic	*2010*	> 1500 start-ups	*No*	*No*	*No*	*No*	*No*	*No*	contact
Zero waste Scotland – business support service	2014	13 cases	Yes, improve current product D processes	n.a	Yes*	n.a	n.a	n.a	website
Clever	*2016 (2009 polight)*	*29 inn. PR*	*No (Yes from 2009-2015)*	*Support in new product development**	*No*	*No*	*Don't know*	*Don't know*	contact
Advance London	2018*	50 SMEs	No	n.a	No	n.a	n.a	n.a	website
Fit 4 c.	2014	4 inn. PR (1 in 2017, 3 in 2016)	No	n.a	No	n.a	n.a	n.a	Website and annual report
Copper 8	*2013*	25 Pr*	*No*	*No*	*No*	*No*	*No*	*No*	contact
Metabolic	2012	3 ventures	Yes*	Yes*	Yes*	n.a	n.a	n.a	website

Innovation cluster; Circular Economy Lab.
Two actors were excluded - Circular Economy Transition because is not operating in European Union and Circular Economy Lab because it was just born – and two actors were included – Metabolic and Copper 8 - because they are consultants but they are acting as business implementers.
Afterwards, the questions were decided to collect the data that are not present in the website of each actor, with the goal to understand better the role of design in their services and among staff/mentors. The following format (tab 5.4) were sent to them by emails in January 2019. .

Results and discussion:

Unfortunately, only Climate Kic, Clever and Copper8 answered, so the other information about the other ones were collected by the official websites.

The results shown in tab 55, prove that all the actors provide many services to support business, although design is considered just by few actors. However, projects, as the literature demonstrates, should be designed from the beginning to meets really the sustainability requirements of the world current environmental situation, before being implemented. If this is not checked or stimulated by implementation actors, the risk is to support businesses which are not providing a good impact at environmental level. Many designers have received the education for sustainability, as the Lens conference[39] wants to demonstrate, and have the skills both to contribute in eco-design for products both for services and systems. The Designers which are providing services are mainly working in traditional roles as user experience and prototyping, although many answers are missing. Moreover, their presence among the staff is only in 3/10 and almost between mentors. Unfortunately, this answer doesn't say anything about the role of designers because no one specified it as required by the question. Moreover, it wasn't found any evidence of the presence of designer in mentors. Another interesting result is the almost wholly unawareness about the presence of Designers in the project implemented. One reason can be found in the not interest shown by actors to map the skills involved in projects. However, this aspect is very interesting to be analysed in the CE phenomenon as it is a multi-disciplinary concept (Battistoni and Barbero, 2019).

Although many answers from this analysis are missing (for unavailability of the actors), the results show a very interesting picture of the design role. Designers in the last years were educated for an active role in meeting sustainability requirements. However this aspects seems not clear outside academia, and in the business world they remain known as the one that can only create beauty (both in product than in graphics) (Battistoni and Barbero, 2019).

This research has stimulated my curiosity in understanding the role of design and designers in circular ventures. For this reason, another research directed to the industries was conducted. For the moment it refers only to the Italian framework.

39 by the LeNSin, the International Learning Network of networks on Sustainability European project (2015-2019). Lens conference https://lensconference3.org/index.php#about

FOCUS: THE ROLE OF DESIGN IN ITALIAN VENTURES WORKING ON CE ASPECTS[40]

Along to the vision by the implementation actors, it was trying to understand the one by the enterprise world. For this reason, a particular research was conducted in January 2019 which wanted to frame the companies who are working on CE context to understand mainly which is their approach and awareness to CE. And if the design is playing a role in this transition. Previous studies have tried to frame the CE concept in European enterprises, as the Flash Eurobarometer 441 (EC, 2016) which in a questionnaire requested by the European Commission DG Environment on European SMEs and CE. It showed that almost three quarters of companies undertook some CE related activity (in Italy the 67%). To undertake this particular study was chosen the Italian context. This because Zamfir et al (2017) referring to Italian SMEs stated: *"SMEs from Italy display a very heterogeneous behavior in adopting Circular Economy practices….SMES that activate in the manufacturing sector are the most active in the field of Circular Economy…the openness of Italian SMEs from services and industry to Circular Economy is also influenced by their total turnover…"*. To collect the information the database of the app 'Mercato Circolare (MC) was chosen: it is made by the homonym i[41]nnovative start-up which since March 2017 is mapping the Italian context collecting more than 250 actors related to the CE selecting companies, products, events and experiences of circular citizenship.

Methodology

After a literature review about the relationships between CE concept and the design role, an online questionnaire was defined and sent, at the beginning of 2019, to each entity in MC database (MCd) which are 276 in total. Specific and mainly closed questions were asked to raise the response rate. The open (OQ) and close (CQ) questions (listed in tab. 5.6) first wanted to frame the identity of these actors, after focus on their awareness on working on CE concept and on the different scientific approaches related to CE, and at the end look for the presences of designers and their roles and main competencies. (see complete answers in the annex).

Results and discussion: The response rate to the questionnaire was of 14% (38 on 276) in 1 week of time availability. The data collected were processed and aggregate.

The results are:

- IDENTITY CARD: The answers came mainly by enterprises that are 87% (30 and 3 social cooperatives). The other 6% are represented by 3 sole practitioner designers or artisan, 2 association/non profit and 1 research centres. Between the enterprises, 19 are micro, 11 are small and 3 are medium. This means that 100% of the enterprises are SMEs which is perfect in line with the Italian average situation as demonstrated by Pedone (2016). This data confirm also as the micro and small enterprises are playing a role as the subject for the change (Barbero, 2016). Moreover, 21 entities state to be innovative (as the Italian law definition[42]) and precisely 8 are innovative start-ups and 13 are innovative enterprise (start-ups 5 years old). 55% works with clients (b2c), while 40% with other business (b2b) - no data about 5%. The foundation year frames the phenomenon in time. 22 were founded from 2012 and 2018, 10 between 2000 and 2012, and 6 from 1960 to 2000. The increase from 2012, with a pick in 2015, reflects the period in which Europe Union starts to talk about the CE. The ateco code provided in addition to the company description in MCd for the one who doesn't have a code, let define that the 42% are involved in manufacturing sectors. Precisely the main ones are: traditional manufacturing activities (8 cases); 'design and produce' (8 cases)

40 based on what published in Battistoni, Lambiase, Barbero and Barbera (2019)

41 https://www.mercatocircolare.it/ ; English translation: circular market.

42 Legge 17 dicembre 2012, n. 221 (DL Crescita 2.0- artt. 25-32). Retrieved online from http://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legge:2012-10-18;179!vig=

- will be referred as manufacturing activities along the paper -; informatics (4 case) and energy (3 cases). 4/8 ‘design and produce’ are sole practitioners.55% of the total entities are located in the north of Italy (21 cases, especially in Piemont, Lombardy and Trentino); 32% in the centre (12 cases especially in Emilia-Romagna, Lazio and Toscana); 5% in the south (2 cases). This reflects the situation about the total entities present in MCd.

- APPROACH TO CE: Surprisingly, 8/38 state that they have never always been aware to work in this context. Many of these answers provided came from companies that were born before 2001. Regarding the 8 entities that ‘design and produce’, 2 don’t know CE approach but 7/8 know the eco-design approach and 2 the C2C. Among all the 16 manufacturing activities only 3 know the SD approach and they are located in Piedmont region: this reflects the low diffusion of the approach in the manufacturing sectors outside the territory where it is a master degree (Torino, IT). Considering all the cases, after CE approach, the most known are: eco-design (16), BE (8), c2c (6) and SD (3). Only one reality know all the 4 approaches proposed. Approaches as Design Thinking, Sustainability, Green Economy, LCA and sustainable development were proposed voluntarily by 8%. In the questionnaire 45% declare to have internal competencies about CE, while 30% have not yet invested in a training course on CE. To frame which aspects of the CE they are implementing, we decided four main principles, which come from our interpretation of the Ellen MacArthur principles: ‘generate value from waste’; ‘use natural input or from second raw material’; ‘design for the long-lasting duration’; ‘prefer use to property.’ In this specific research, many answers included more than one principles. The most cited was the ‘generate value from waste’ (33/38) and in 18 cases it was mentioned with the ‘use natural input or from second raw material’ which was cited in total 23 times. 9 state to work on ‘design for the long-lasting duration’ and 3 on ‘prefer use to property’. Only 3/8 of ‘design and produce’ category are working for long-lasting duration of objects and 8/8 are generating value

Tab . 5.6 Questionnaire questions. Published in Battistoni, Lambiase, Barbero and Barbera (2019)

n°	Motivation: understanding ..	Typology of data	Collection method	References
ENTERPRISE IDENTITY CARD				
1	..the principal sectors in which the enterprises are working	Productive Sectors	OQ	statistical classification of economic activities NACE https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32006R1893. In Italian: ATECO code
2	..the principal area in Italy	location	MCd	
3	..the age of the phenomenon	Foundation year	OQ	
4	..which are their clients	B2B or B2C	MCd	
5	.. the typology of enterprises working on CE	Enterprise size	CQ	European statistics https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Enterprise_size + Pedone (2016)
		n° Innovative Enterprise and start-up	CQ	Italian law on ‘innovative enterprise and start-up’
		n° start-up		

Tab . 5.6 Questionnaire questions. Published in Battistoni, Lambiase, Barbero and Barbera (2019) (continue)

n°	Motivation: understanding ..	Typology of data	Collection method	References
APPROACH TO CE				
6	..which approaches are known	Awareness on scientif approaches related to CE	CQ	Approaches defined by authors
7	..their awareness on being into the CE concept	Ce awareness	OQ	
8	...the most common CE principles	Ce principles	CQ	Principles are base on an elaboration of Ellen MacArthur foundation principles
9	...the level of education about CE	Investment in training on ce	CQ	closed answers mainly based by authors experience and EU (2016)
10	...the solutions and strategies adopted	Solutions to transition to ce	CQ	closed answers mainly based on EU (2016)
11	..the most common problems faced to work on CE	2 main problems in ce implementation	CQ	closed answers mainly based on EU (2016)
IDEA CREATION, COMPETENCIES AND ROLE OF DESIGN				
12	...how the idea behind the enterprise was born	Idea creation	CQ	closed answers based by authors experience
13	..presence of Designers (by formation) in the company	Design presence in founders and company team	CQ+CQ	
14	...if designers (by formation) are entrepreneurs	Design presence in founders	CQ	
15	understanding principal competencies involved in CE	Competencies by team and founders	CQ+CQ	
		External consultants	CQ	
16	..if they are cooperating with other realities and are they public or private?	Partnership	CQ	

from waste. About the actions taken as solutions or strategies in the last three years, 50% have done anything (9 are ‘manufacturing activities’). Among them, 11 are micro enterprises. While about the other 50%, 10 have done an analysis of their fluxes and 6 a LCA, 4 have obtained environmental certification, 3 have re-design the product and 3 have environmentally improved their plant. To understand the difficulties that they encounter frequently to work on CE, we have asked the main 2 problems. More than 52% identified difficulties in making the value added appreciated by the market, and about the 40% difficulties in accessing fundings. However, as the Flash Eurobarometer 441 state, one of the problems can be that in Europe “just over a third of companies are aware of government financial incentives for activities related to the Circular Economy” (EU, 2016).

- IDEA CREATION, COMPETENCIES AND ROLE OF DESIGN: One of the most interesting aspect emerged is that 11/38 (30%) answered that CE is their philosophy of life. This reflects that the CE is not only a business opportunities, but a high percentage of people consider it as a cultural paradigm. About the creation of the idea, almost the 50% choose the reason ‘to solve a society problem’, 37% ‘from a personal need’, 30% ‘from a previous working experience’. 7 were born between colleagues in another enterprise, 5 from scientific research, 2 to answer a call and 2 from a family enterprise. 11 of the total had an experience in Business Incubators. In 47% of cases they have external partnerships and in 47% of cases they haven’t. 4 declare to have partnerships with research centres.With the goal to investigate the role of design in the CE, was asked to define the competences of the founders and the employees. 21/38 has stated to have internal competences in design. To frame better this concept, it was asked if there are designers by formation in the team. In this case, only 1/3 of these 21 have answer positively. The reason behind this double question can be find in the lots of meanings of the term ‘design’. Infact, lacking an official register, design is intended has a capacity possessed by many people and not a specific profession which correspondence to a particular bachelor degree. The designer by formation are working in 12 of the 38 identities analyzed and in 11 cases they are founders (in enterprise founded after 2001). This reflect the abilities of designer as entrepreneurs (Margolin, 2002). Designers are working in 7/8 in the ‘design and produce’ category which reflects the skills of ‘designer as producer’ as demonstrated by Margolin (2002). Along the competencies in design (45% between founders and present in 25 entities), the main one are: business and marketing (33), communication (27), financial (19), social science (16), engineer (15), Ict and development (14), natural science (10) and legal (9). It’s important to underline that communication and legal services are mainly also delegated to external consultants, in addition to management one.”(Battistoni, Lambiase, Barbero and Barbera, 2019).

The results better define the Italian context on the CE, previously framed by other studies. Despite the response rate was of 13%, the main results are interesting: 79% are micro and small enterprises; 21% are not aware to work on CE; more than 52% identified difficulties in making the value-added appreciated by the market; 21% are ‘design and produce’ realities; design competencies are present in 66% of realities and in 29% the designers by formation are founders. Although, the results do not highlight the designer with a role in the design at the system level, as one of its emerging skills (see SD). This can let start a reflection on the need to spread this message out of the academia and research sectors, to change really the business practice over the sustainability aspect. (Battistoni, Lambiase, Barbero and Barbera, 2019).

Chapter 6

Three case studies: local ecosystems for circular economy implementation

After the research and analysis of case studies about the implementation actors in the CE, from single cases (see chapter 5) the analysis moved to the comprehension of complex local business and entrepreneurial ecosystems. Indeed, it is reductive to consider the implementation actors as the only one who acts for the innovation and entrepreneurship creation in a specific territory for its circular and sustainable development, but it is a combination of actors in the quadruple helix. This chapter is about the multiple case-study analysis that was performed over three territorial areas: the Netherlands, the Scotland (UK) and Piedmont Region (IT). The goal was to deepen the knowledge about the different actors identified to finally understand how the quadruple helix innovation is in action in the different areas, and which are the differences. This step was useful to extract the elements that can be applied for the design of an ecosystem model. This ease the implementation of opportunities found out thanks to SD projects and its further application in Piedmont Region.

6.1 METHODOLOGY

The research strategy of the multiple case-study analysis was chosen to understand how the innovation ecosystem is composed in a specific local area for the implementation of a local CE for a sustainable local development. In specific, this analysis started from two European areas that are considered forerunners in the CE and that have hosted the Circular Economy Hotspot: the Netherlands in 2016 (the first) and Scotland in 2018 (the third). These two ecosystems were lastly compared with the one currently present in the Piedmont Region (Italy) to understand the differences and extract elements for further development of the situation there.
Each selected territory was analysed through the method of HD: first understanding the context of the systems, then mapping its principal components and understanding the complex relationships among them (see chapter 1.2.4). This process shares methods with other systems mapping as stakeholders mapping and ecosystems mapping. Data visualisation tools through the creation of giga-maps were useful to understand the overall complexity of the ecosystems and to make a comparison. The analysis starts a short overview of the territory: geography, demography, governance and the approach to the CE framework. After a reviewof the literature with a desk research, an investigation was conducted of the main actors that are working there for the CE implementation, based on the actors identified in the previous analysis (see chapter 5) and applying a snowball approach to identify the others that compose the system. This phase was performed mixing desk and field researches. In the case of Scotland, the author has spent a period of three months there as a visiting researcher in Strathclyde University (Glasgow) and has attended the CEH in 2018 (see fig.6.1 and fig. 6.2). In the case of Piedmont Region, she lives here and she has attended many local events. For the Netherlands, the analysis was made online and thanks to the collaboration of local actors.
Moreover, a further analysis was conducted on the cases identified before to understand in-depth how they are working. Finally, for each territory, the local ecosystem that supports local CE implementation is drafted based on the relationships that were understood among the actors also examined inside the quadruple helix model.
The goal of this in-depth analysis was to understand:

- how they are acting in the support of projects/ businesses;
- what are the services provided, their evolution, and which are the most important;
- how they are providing these services;
- who is providing the services (competencies) and if they are including also the designers in this process important in the idea creation;
- which are the typologies of projects/business supported;
- if they are considering and evaluating the impact on the local territory at environmental, economic and social level of these new businesses
- if they are acting as an open system (open to exterior);
- the relationships with the other components of the quadruple helix model

In the planning and design phase of the multiple case studies analysis, these research goals were translated in form of questions to ask to the different organizations. In the following table 8 the questions are reported, with their motivations, the unit of the answers (if applicable) or more info, and the references to the specific question or the closed answers chosen.

Subsequently the questions were grouped for ‘group topic’ which mainly are:

- General info;
- Specification on the services about their support to business;
- Who are delivering these services and disciplines involved;
- Specification about the businesses supported;
- Impact, monitoring and reporting;
- Lesson learnt from their experience and improvement for the future
- Communication to the external system (different table)

Tab .6.1 - the questions for the cases and ecosystems analysis

	Questions	Unit / info	Reasons for question	References	Group topic
			GENERAL		
1.	Website			From the precedent analysis	
2.	Main goal			From the precedent analysis	
			FOR BUSINESS SUPPORT DEPARTMENT		
3.	Which kind of support do you give to business related to CE?	Specify specific services	Understanding the main services provided by the entity analysed		
4.	Do you give support in: □ Opportunity identification □ Idea/ project ideation □ Feasibility study □ Economic support □ Business plan development □ Technical support □ Legal support for normative problems, □ Eco-design, □ Design of the entire production system □ Life cycle assessment, □ Monitoring and reporting environmental performance data? Eg.: Waste, CO2 eliminated? □ Other	(decided by the researcher) Multiple choice answer	Understanding type of services provided (traditional services to business)	(Aernoudt, 2004)	
5.	Who are delivering it? Internal expertise or external consultants?		Understanding fields involved in supporting CE implementation To understand if they have all the competencies inside		**COMPETENCIES FOR SUPPORT**
6.	Who are they? Specify principal role or competencies.		Understanding the competencies involved in this support		
7.	How does it has started?		To understand the motivation to start this service		
8.	Do service cost? How much do service cost? (average)	€/service	To understand if its affordable		
9.	Who are the Eligible organisations? What is the PROJECT ELIGIBILITY?		To understand their target		

	Questions	Unit / info	Reasons for question	References	Group topic
10	How to apply?		Understanding which kind of document the project makers have to deliver?		
11	About the financial support... From where the money is coming?		To understand if they received economic support from outside	*Financial support is a barrier for ce implementation (Rizos et al., 2016)* *lack of capital(Rizos et al., 2016)* *limited sustainable public incentives (Bicket et al., 2014)*	**SUPPORT SERVICES**
12	How much is your maximum financial support per project?	MAX €/project	To understand maximum Money invested for project		
13	Which is the average amount of financial support?	AVERAGE €/project	To understand average Money invested for project		
14	Do you give technical support ?		Understanding if their support in technical aspects	*lack of technical support and training* (De Jesus & Mendonça, 2018) *lack of technical and technological know-how(Rizos et al., 2016)*	
15	Do you have a legal service?		To Understand if they give support for regulatory system		
16	Do you have specific services related to assess environmental sustainability of idea?		To Understand if they give support in the assessing of the environmental sustainability of the project	*"monitoring and reporting environmental performance data is barely affordable" (Rizos et al., 2016)*	
17	Do you have specific services related to design?		Understand the role of design in business support		
18	About your experience in supporting business, which is the most important service, or part useful?		Understanding the most important services		
19	How do you select projects/business to fund?		Understanding the selection process		**BUSINESS SELECTION**
20	Specific evaluation criteria Example... □ Value proposition	(decided by the researcher)	Understanding which are the selection criteria		**BUSINESS EVALUATION**

	Questions	Unit / info	Reasons for question	References	Group topic
	☐ Profitability ☐ Economic sustainability ☐ Environmental sustainability ☐ Level of trl				
21	Which is the most important thing that you evaluate?		Understanding if some criteria are more important than others		
22	Who is the evaluation committee? Specify principal role or competencies.		Understanding how it is composed the evaluation committee (only technician, or others?		
23	How many projects do you support per year?	n° project/year	Defining impact on enterprise creation		**QUANTIFICATION OF BUSINESS SUPPORTED**
24	How many idea/proposals/projects did you received per year?	n° project/year	Defining quantity of project received to manage		
25	Has it changes during the years?	quantitative and qualitative results			
26	About the business that you have supported.... Who are they? Which type of projects have you financed?		To understand in which sectors there is more concentration of project/enterprise		**BUSINESS CARACTHERISTICS**
27	In what sector would most of the business that you've facilitated classified? Specific numbers ☐ Agriculture ☐ Food transformation ☐ Construction ☐ Manufacturing ☐ Shops ☐ Digital services ☐ Bioeconomy ☐ Social/community	(decided by the researcher)	Understanding the sectors where there is more concentration		
28	Which Circular Economy principles are more frequent between business supported / start-up? 5R: ☐ Share ☐ Maintain ☐ Reuse ☐ Refurbish/Remanufacturing ☐ Recycle	(decided by the researcher)	Understanding trends in Circular Economy	Trends in CE	
29	Which are the main frequent problems to reject projects/business?	Indicate 3	Understanding the rejection process, the main problems in projects		**FAILURE**

	Questions	Unit / info	Reasons for question	References	Group topic
30	Do you know, after the funding, if there is some case of failure?		Measuring the failure idea/projects		
31	Do you know how much have failed? If yes, quantify	n°	Measuring the rate of success and failure		
32	Is frequent that you have to reject project due to reasons related to the policy on waste?		Understanding if this problem is real		
33	Do you monitor your environmental impact?		Understanding if they monitor e		**MONITORING ACTION**
34	Do you monitor the impact on the region about the single business supported?		Understanding if they are monitoring the results of each project		
35	Do you monitor results of your impact on the region thanks to your support (in total)? At environmental, economic and social level		Understanding if they are monitoring the results of their actions in total		
	Do you produce report?		Understanding if they are Reporting their performances to exterior		
36	How do you measure this impact?		Understanding the parameters to measure the impact		**IMPACT ON THE TERRITORY**
37	How you measure in particular the environmental impact on the region? ☐ Energy save, ☐ Waste save, ☐ Co2 save, ☐ Builded land save ☐ Planted trees ☐ Other	(decided by the researcher)	Understanding the parameters to measure the impact		
38	Do you measure the evolution of the impact over the years? How is it?		Understanding if they are taking under control their impact over the years, and if it is positive or negative		
39	Do you help enterprise to measure it?		Understanding if they are supporting projects in measuring their impact		
40	Which are you major achievements? Do you receive some Awards?		Understanding which is the most important results		**ACHIEVEMENTS /AWARDS**
41	Which is the most important thing that you have learnt from this experience?		Understanding what they have learn from the experience, if it was good or bad experience		**LESSON LEARNT**
42	Have you experienced the resistance of change by some actors involved in the process?		Understanding if they have experiences resistances in the process?	resistance to change *(Rizos et al., 2016)*	

	Questions	Unit / info	Reasons for question	References	Group topic
43.	How you can improve the process?		Understanding what they want to change in the process		
44.	Did you transfer the lesson learnt to the policy makers? In a successfully way?		Understanding if there are relationships with the policy sphere in the triple helix		
45.	What you will like to do but you cannot do? (which problems met)		Understanding if there were some limitations in their actions for reasons as economic or others		
46.	Which are the future projects?		Understanding the evolution of the project		

Tab . 6.2 - the questions for the cases and ecosystems analysis about the communication part

	Questions	Unit / info	Reasons for question	References	Group topic
		About the COMMUNICATION			
1.	Do they involve common citizens, future consumers? (do you have Specific programmes?)	To be evaluated by researchers	Understanding if they to something to involve customers and increase awareness Impact on the territory		**PUBLIC PARTICIPATION , CITIZEN'S INVOLVEMENT TO INCREASE CUSTOMERS AWARENESS**
	Which one?	To be evaluated by researchers			
2.	Do they perform awareness-raising activities?	To be evaluated by researchers			
	Which one?	To be evaluated by researchers			
3.	Do they organize event to involve citizens?	To be evaluated by researchers	Understanding if they involve citizens		
	Which one?	To be evaluated by researchers			
4.	Do they have a website?	y/n To be evaluated by researchers	Understanding their national/international visibility		**VISIBILITY/COMMUNICATION**
5.	Website perception from outside	To be evaluated by researchers	Understanding Website perception from outside (image coordination)		
6.	Do they use public press?	y/n To be evaluated by researchers	Understanding if it's possible for interested citizens to be updated		
7.	Do they have a newsletter?	To be evaluated by researchers			
8.	Do they use social network?	To be evaluated by researchers			
	Which social network do they use?	To be evaluated by researchers			
9.	Are social and website regularly updated?	To be evaluated by researchers	updates		
10.	Are report uploaded on web/social?	To be evaluated by researchers	Reporting on their performances		
11.	Do they a special section for project implemented? ☐ Yes with link ☐ Yes with small description ☐ Yes with pictures ☐ No	To be evaluated by researchers	Understanding If Project are advertised		**VISIBILITY FOR PROJECT**

After the identification of the study criteria for the cases, the data to collect, and the creation of the framework where to collect them, the data collection phase started. Due to the high quantity of information needed, precisely 46 questions, a desk research was firstly conducted on the official websites, which usually, in this historical period, includes official and updated information and reports. Subsequently, in-depth direct interviews were conducted to collect missing data and get information and feedback about their experience. For this reason, the method of the semi-structured interview was chosen. This first collection phase on data from desk research has reduced the number of questions of the interviews and their length in terms of time.
The large data collected has been organised for each case, in three main categories to explain the case and the importance of them for the research and the ecosystem analysis:

- How it works;
- Feedbacks from their experience;
- Points of interest for this research and ecosystem analysis.

The analysis started with the case of Zero Waste Scotland (ZWS) which, through the previous analysis, appears to be the “best” one: they are focusing on the CE and providing a positive impact at local level (regional), with support both at financial and at technical and environmental level.
For this reason, the methodology to follow for the multiple case studies analysis defined by (Yin, 2014) was changed in:

1. case identification and identification of criteria for evaluation;
   - a. selection of the best one (ZWS);
   - b. evaluate with them why they are the best and how they are acting, with semi-structured interviews with a qualitative approach;
   - c. reformulation of questions for other cases;
2. preparation of the interviews for the other cases;
3. collection of results;
4. analysis and comparison;
5. share

The entire process was at the beginning set and validated by the professor Eleonora Buiatti, Adjunt professor at Politecnico di Torino, expert in cognitive ergonomics.

The answers collected from each case are present in the annexes, and also the transcription of the complete interview.

After data collection for each singles cases, it was trying to draft the ‘local ecosystem’ for each geographical context taken in consideration: Scotland, the Netherlands and after the Piedmont Region in Italy. It was made based on the actors of the quadruple helix and based on the feedbacks collected from the in-depth interviews.

The in-depth analysis of each cases and the local selected ecosystems were made in the years 2018 and 2019. This analysis doesn’t want and cannot be exhaustive. Many other realities can be present in the geographical context selected which were not identified from the author, also because the CE is a very recent phenomenon and in constant evolution, so every month many realities raise and grow. Also, the creation of the ‘local ecosystems’ doesn’t want and cannot be exhaustive because it is based on the data collected, but mainly on the perception of the author about it. It also depends on the availability of people that have accepted to talk with the author, the information that many people have shared with the author and how the author have understood them. The data collected were cut on the research goal of this thesis, so many information can be not taken into consideration. The author thanks all the people that have shared important data and feedbacks with her.

Fig 6.1 . a picture about the visiting period in Strathclyde University in Glasgow, Scotland

Fig 6.2 . pictures taken at the Circular Economy Hotspot in Glasgow, Scotland in 2018.

6.2 LOCAL ECOSYSTEMS ANALYSIS

6.2.1 Ecosystem in Scotland

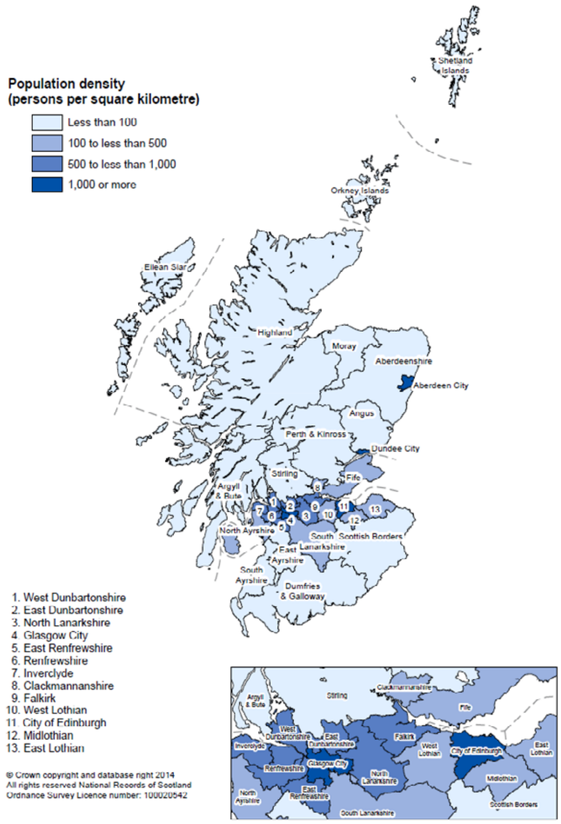
6.2.1.1 Context

Scotland is a constituent country of the United Kingdom, located in the northern part. UK is a monarchy but Scotland has a certain autonomy, with a prime minister, a Government and a Parliament.
It has a total area of 78.772 km2 with a population of 5.295.400 citizens in 2011 and a population density of 67,5/km2[1] . The low population density can be related to its geomorphological characteristics such as the high presence of lakes and woods (see image 6.3). The capital is Edinburgh, but the most populated city is Glasgow[2] (see fig.6.4).
Due to the vote of the UK for the withdrawal from the European Union (Brexit) it has passed time of political tension in 2018-2019 for its will of independency as witnessed also by the referendum of 2016.
Regarding its approach to CE, Scotland has a specific economic strategy published in March 2015: the report 'Making Things Last: a Circular Economy Strategy for Scotland'[3] which set out the opportunities for

1 https://en.wikipedia.org/wiki/Scotland#Politics_and_government
2 https://en.wikipedia.org/wiki/Scotland#Politics_and_government
3 retrieved from https://www.gov.scot/publications/making-things-last-circular-economy-strategy-scotland/

Fig . 6.3 - physical map of Scotland. Author: Eric Gaba, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=3217118)

Fig . 6.4 - map of the population density in Scotland. Retrieved from https://www.nrscotland.gov.uk/files/statistics/population-estimates/mid-2013/html/mid-2013-population-estimates-administrative-areas.html



the Scottish manufacturing in the CE framework and the "potential for the reuse of goods and materials to help protect the environment, and deliver social and economic benefits to our communities." according to the politician Richard Lochhead[4] . For the Scottish government this is "*Our Circular Economy strategy to build a strong economy, protect our resources and support the environmen*t"[5] and could bring to a reduction in the carbon emission of 11 million tonnes by year (Scotland, Scottish Government, & APS Group Scotland, 2016, p.g. 1).
This specific strategy by their government have contributed to put Scotland at the forefront of the CE – they were the first country in the world with a government strategy on CE- and it worked thanks to the collaboration among policy-makers and business (glasgow chamber of commerce, Zero Waste Scotland, Glasgow city council, & Circle economy, 2016).
This strategy is focused on the followings topics:

- Waste Prevention;
- Design;
- Reuse;
- Repair;
- Remanufacture;
- Recycling;
- Producer Responsibility for reuse and recycling;
- Recovering value from biological resources;
- Energy recovery;
- Landfill.

A particular attention in this strategy was put on 'design', of products, processes, services, business models, considering the full life cycle. A particular research was specific on mapping the design for CE ecosystem in Scotland by Whicher, Harris, Beverley, & Swiatek (2018) which is at the intersection of the innovation ecosystem, design ecosystem and CE ecosystem and was analysed based on the identification of the principal components (Whicher & Walters 2017). Following them, they are:

- Users (private, public citizens);
- Support (programmes);
- Promotion (trade fair, festivals and exhibitions);
- Actors (innovation centres, science parks, networks and clusters);
- Policy;
- Funding (grants and subsidies);
- Research (research, innovation and design centers);
- Education;
- Suppliers (R&D personnel and designers).

Their stakeholders mapping identified 114 actors and initiatives related to design and CE in Scotland divided for 'skills and education', 'policy and regulation', 'promotion and awareness' and 'business support and funding' (Whicher et al., 2018). Moreover, they identified the role of ZWS as "facilitator for change thinking across the economy, rather than prescribing action in focused sectors" (Whicher et al., 2018, p. 3242) and finally defined a 'design CE action plan for Scotland'. It passes from support to industries, to the promotion of skills in education and also among business advisors, to the promotion of design and the increase of awareness on its potential, to the need of policy and regulations that encourage its inclusion in the strategies.

4 https://www.gov.scot/publications/making-things-last-circular-economy-strategy-scotland/
5 idem

6.2.1.2 Actors for the Circular Economy development.

Along with Zero waste Scotland and Circular Glasgow, previously analysed in chapter 5, other actors are present for their contribution in transition to a CE and which have relationships with these actors.:

- SCOTTISH INSTITUE FOR REMANUFACTURE[6]: This institute, funded by the Scottish Funding Council and Zero Waste Scotland, and hosted at the University of Strathclyde, work with companies on the topics of reuse, repair and remanufacture, to include these innovation in their activities;

- SCOTTISH ENVIRONMENT PROTECTION AGENCY (SEPA)[7]: Strategic partner of ZWS, a non-departmental public body, focused on controlling activities about the Scottish environment, but also on supporting business in environmental regulations and legislations;

- INDUSTRIAL BIOTECHNOLOGY INNOVATION CENTRE (IBioIC)[8] : it was established in 2014 thanks to the National Plan for Industrial biotechnology 2015-2025[9] . It accelerates the commercialization of biotechnologies thanks to the creation of connections among academy, government and industry;

- Master in environmental entrepreneurship (University of Strathclyde)[10]: A master which exists since 2008 and was the first of its kind in Europe. The duration is of 1 year and all the academic backgrounds are eligible to enrol. It is performed by the collaboration mainly between the Department of Civil & Environmental Engineering and the Hunter Centre for Entrepreneurship of the Business School . It also includes contributions by the departments with multiple disciplines;

OTHER ACTORS WORKING IN THE INNOVATION ECOSYSTEM:

- INSTITUTE FOR FUTURE CITIES[11]: This multidisciplinary group of experts based in University of Strathclyde (Glasgow), are working with global commercial, civic and academic partners to tackling future challenges for sustainable cities, leading research and innovation based on inequalities, reduction, sustainable urban systems, citizen's health improvement and citizens participation. They are conducting researches also about the city of Glasgow producing for example the "Glasgow atlas" with multiple layers of data placed on the map ;

- Universities:
  - university of Strathclyde[12] (engineering, business, humanities & social sciences, and science), the Caledonian University[13] and the University of Glasgow[14] ;

- Glasgow city innovation district[15] : although it is not focused on the CE it is the hub for innovation and entrepreneurship. It has a partnership with Glasgow City Council, the University of Strathclyde, Scottish Enterprise, Glasgow Chamber of Commerce and Entrepreneurial Scotland.

6 http://www.scot-reman.ac.uk/
7 https://www.sepa.org.uk/; (Pallaro & Pereno, 2018)pg. 46
8 http://www.ibioic.com/; (Pallaro & Pereno, 2018)pg. 58-59
9 http://www.ibioic.com/file/Scottish%20IB%20Progress%20Report%202015.pdf
10 https://www.strath.ac.uk/courses/postgraduatetaught/environmentalentrepreneurship/
11 http://ifuturecities.com/
12 https://www.strath.ac.uk/
13 https://www.gcu.ac.uk/
14 https://www.gla.ac.uk/
15 https://www.strath.ac.uk/workwithus/glasgowcityinnovationdistrict/

6.2.1.3 In-depth analysis with direct interviews.

ZERO WASTE SCOTLAND (ZWS)

The information collected for ZWS case study comes from their official website and the direct interview that was performed in March 2019 with the CE sector manager.

For each of the questions previously defined in the methodology chapter, the answers are presented in the annexes as the transcription of the complete interview. The principal concepts resulting in the interview are present in fig. 6.5

How it works (see fig. 6.6): Zero Waste Scotland is a very active player in the region with many services for local business, as stated before also in chapter 5. Being a government's lead agency, this facilitates its role in the territory and the possibility to send direct feedbacks from their experience to the policy makers. They are managing the waste management in Scotland, but they are also leading the "Resource Efficient Circular Economy Accelerator Programme" funded by £73 million European Structural Fund received from the EU for the Scottish SMEs. This fund let them providing two types of support to local SMEs: the CE investment fund and the CE business support service. With the CE investment grant fund, they are able to manage £18 million grant, with a maximum of 1 million for projects. It is dedicated to funding projects in an advanced development stage (no early-stage research but for conducting the trial stage), with a significant impact for carbon saving, or adding value to a waste, in certain sectors (food-drink, construction and demolition, energy infrastructure, remanufacturing, reuse & repair). In this case, only 10% of business success to receive the grant. On the other side, the business support service is dedicated to companies which want to develop a project in the CE framework. They give

Fig. 6.5 - gigamap about the information collected in the in-depth analysis of ZWS

about business support)..they look to build capacity with the businesses as well, it's not just like here's a business plan, here's a life cycle assessment on you go. We want to build capacity with them so that they are in a much stronger position to take the project forward so I would argue that that is a really useful part of the fund. The businesses need funding so the fund is really important as well, but hopefully through the business support service we leave businesses in a place where they can have a really strong funding application and they can go out a seek private investment as well

need to support before the call for funding

Sometimes they're at a too early stage, but what we've done now is try to put in some workshops to try and answer some of those early questions and develop a bit of a roadmap so they see where they need to go and then we would offer them business support, so we don't tend to reject anyone.

interest increased

It wasn't really because businesses were demanding it when we started, we get much more businesses coming to us now, now people understand the principals of circular economy a bit more, but at first it was more us going to businesses and saying that we can help you explore this through our support

evolving the business support

(problems in business support)We've tried to do some work in what support the businesses actually need and what stage they are at, there is maybe gaps in their skills, basic sort of business skills (how you write a business plan, how you approach investors for funding and things like that). We try to evolve the business support accordingly.

need of business skills

(business support) is really valuable because they need that nudge and handholding, to help give them the confidence to go forward that they might not otherwise have on their own.

create confidence

(about investment fund).. there may be business that don't take things forward, so we might do some work with them, but then the business... doesn't stack up so then we might try to take things in a different direction and we might just have to say this isn't going to work this time. Or with the business itself, something might happen where they don't take things forward immediately so we try to follow up with some of the businesses and capture that. But yes there is no guarantee. We try to pick businesses that have got a reasonable chance of success and that we can take forward

no guarantee of success

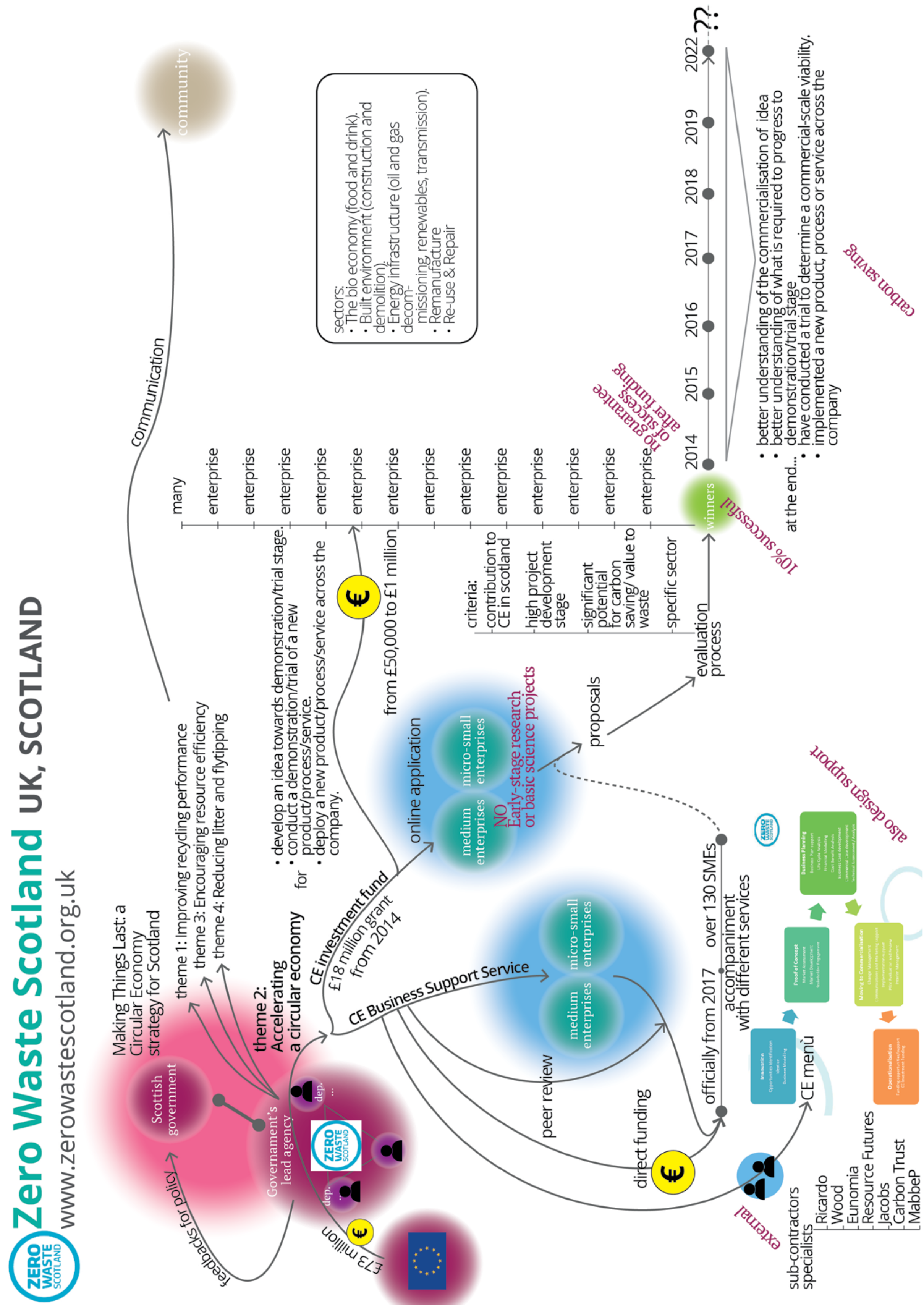


Fig.6.6 - the principal and relevant highlights of the interview to ZWS

support from 2 years following the CE menu thanks to one-to-one consultancy time with external experts: from opportunity identification, business modelling and project ideation, but also to market assessment, technical support, environmental impact evaluation, communication and marketing, management support for implementation, … At the end of the support service, the company can also apply for the CE investment grant or looking for other investments.
It is also important their mission in the process of raising awareness over the CE among the local community. Indeed, they are also supporting and create many campaigns for the diffusion of the CE concept, in particular focusing on the recycling and reuse, as the project 'love food hate waste'[16] . In addition, their website is very well structured and full of information, which reflects the importance for them to communicate, spread the message, with also case-studies with description and images to take as example for new entrepreneurs. They are also evaluating their impact on Scottish territory.

Feedbacks from their experience: The business support service exists from more than 2 years (it has started before without this current configuration), and it has evolved following the needs of the companies. It has needed time to get interest from businesses, reflecting the increase of awareness on the CE concept. Indeed, they had perceived a different context in the years: before they had to go to the enterprise to show these services, while nowadays they are coming to them. The programme is focused on built capacity within the business "We want to build capacity with them so that they are in a much stronger position to take the project forward" and there is no guarantee of success, although it's important for the creation of the confidence to go further. They have noticed a gap in the business skills and they also provide a design support service to also *"explain how to design out waste"*.

Points of interest for this research and local ecosystem mapping: The fact that they are developing this business support service for free with direct funding (consulting time) it is a crucial element for the local enterprises and an essential element to facilitate the transition to a zero waste economy of the entire territory.
One thing that seems reductive is that they evaluate in the impact of the projects only with the carbon savings.

16 https://scotland.lovefoodhatewaste.com/

CIRCULAR GLASGOW

The information collected for ZWS case study comes from their official website and the direct interview that was performed in March 2019 with the project manager.

For each of the questions previously defined in the methodology chapter, the answers are presented in the annexes as the transcription of the complete interview. The principal concepts resulting in the interview are present in fig. 6.8

How it works (see fig. 6.7): it is an initiative of the chamber of commerce supported by the founding of ZWS from the European Regional Development Found.

They are collaborating a lot with Circle Economy in the Netherlands which help them to developing services as workshops, challenges, and the city scan[17] and the circle assessment tool. In particular:

- with the city scan they have mapped the current situation of material flows and distinguished the strategic sectors with more potential on the CE: started from the analysis of health, manufacturing and education, they selected the manufacturing one especially the food & beverage part for the importance in Scotland. From this first selection, they arrived on focusing on three sub-sectors: bakery, meat and fish, beer and spirits. From each of them, they provided also worldwide case-studies on circular innovations. With this published report, they were able to engage local companies, showing them case-studies and trying to start pilot projects. Also, the university of Strathclyde and the institute for future cities have participated inthe creation of the scan;
- with the circle assessment, they can provide for free the mapping of the current situation to the enterprises interested, and this can let them understand their current level in the CE, but also how to develop a more sustainable business.

Feedbacks from their experience (see fig. 6.8): thanks to the circular city scan, published in 2016, in particular they were able to identify strategic sectors for the local business. They revealed that it was a pushing process over the companies involved on the sectors identified (food and beverage), because they needed to go to them, trying to involve them in taking pilot actions. The scan has facilitated the comprehension being very visual, although they are aware that the process of change is very long and that it takes time, but they are seeing a growing interest over the years. Another problem that they find is the lack of time for R&D activities especially for SMEs, so it required a proper interest and enthusiasm. Another aspect that they noticed is that there is the need to provide inspirations and that communication is the key: they are also working a lot in the spreading of the message and case-studies, thanks to many reports and also a website easy to understand. To the single cases they are also able to provide the circle assessment tool for free thanks to the EDRF funds and further support with the services of ZWS (business support and grant fund).

About the city of Glasgow in general, they added that the collaboration among the different actors of the triple helix innovation model is happening and working collaboratively.

Moreover, this programme is a case of success and ZWS has started it in many other cities in Scotland, and not only in Glasgow.

Points of interest for this research and local ecosystem mapping: Circular Glasgow is very interesting for its proactivity, although the team is composed of few people. The programme is developed by the chamber of commerce (that in UK it is a voluntary action) which were conducting a very pushing process over the local companies to spread existing cases of circular innovations and start pilot projects, thanks mainly to the first scanning phase of the 'city scan'. The financial support by ZWS permits their connection with the governmental sphere and have started the process of learning from what is happening in the real context by policy makers. They are also working on the involvement of the local community creating for example a circular hub exhibition in the city for the next future.

17 (glasgow chamber of commerce, Zero Waste Scotland, Glasgow city council, & Circle economy, 2016)retrieved from https://circularglasgow.com/wp-content/uploads/2019/01/Glasgow-City-Scan.pdf

Fig. 6.7 - the principal and relevant highlights of the interview to CIRCULAR GLASGOW

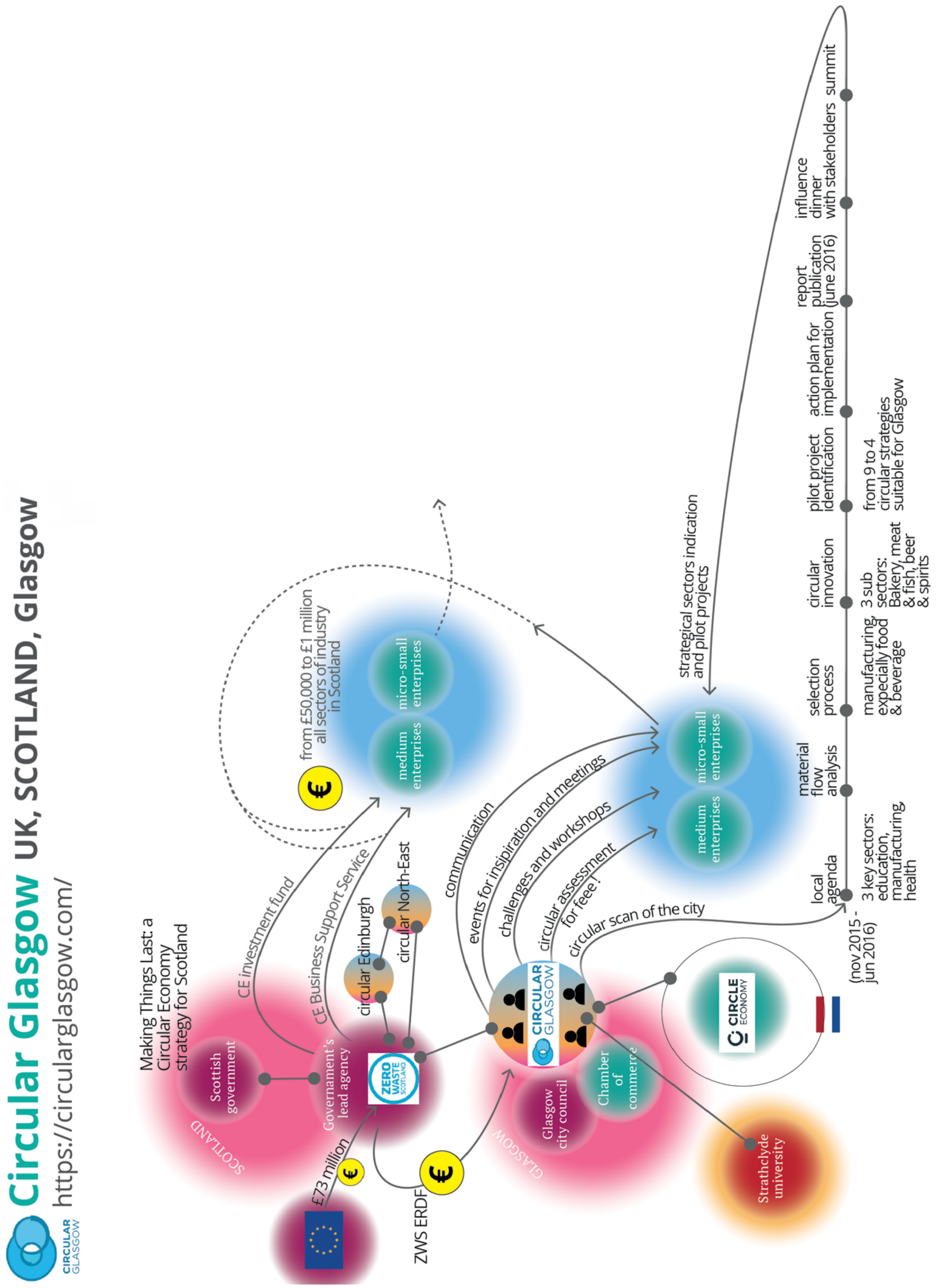


Fig. 6.8 - gigamap about the information collected in the in-depth analysis of circular Glasgow

we publish the report (circular scan)... for a lot of businesses that it's the first time that they've heard of the concept and hard of what it actually can mean...by having the report we could be saying here is a huge opportunity for Glasgow, so it was a positive response from businesses and it was an education piece for them, it was something that was tangible for them to go and read and look at (it is quite a visual report so it stood out and was easy to understand) ...choosing the food and drink sector was so that it was easy to understand and project was easy to understand as well

CIRCULAR GLASGOW

visual report easy to understand - city circular scan - important as education piece

after the report came out which identified businesses we thought would be interested in implementing and we were having conversations around very much trying to do that, to meet with some businesses which had seen the report and were interested themselves. So it was very much the case of us trying to go out and meet different businesses to see if they could pilot it or if they couldn't to see what were the barriers for them.

push process, meeting business to look for pilot

Glasgow the city works well in a collaborative manner. The chamber has a really good relationship with Glasgow city council and the university also, academic institutes and industrial sectors across the city. I think that at city level the collaboration is strong. In a wider sense Glasgow has leadership organisations or partnerships that are formed by some of the key influencers/leaders in the city.

collaboration in the city, the triple helix is in action

Our hope/intention was that these businesses would see the opportunity. We wanted to make connections and facilitate introductions and be on hand to offer support..... we as a chamber of commerce are wanting to make connections, spot opportunities and to bring that together and see where that could go and offer some additional support.

propositive role of chamber of commerce to make connections and facilitate and be supportive

some interest in coming to us and some interest in us going out to them

Bringing the best practice from a country that's a bit further ahead so we can learn from them and do the same, but it's still a work in progress.

learning from best practice

how to communicate, communication is key (...) communicating the message well, we've tried to do a lot of work around that,

communication is important

CIRCULAR GLASGOW

There's still much work to be done, people are more aware and interested in it.

still work to do, but growing interest

probably just everything takes time, actually speaking with the right people at the right time, what may not be right for them now, might be right for them later.

it takes time
right person at the right time

is actually time for business to do it, they (business) can see the opportunities and they can see the benefits, particularly for a small organization to be able to absorb the time to do any R&D, to try and get funding if they need funding, to get it up and started, it's a project for them.

it's time to do it

But that takes time, and it's being able to have that time to devote to it is probably the main thing, we can see what to do but it takes time to commit to that.

it's require time

in Scotland it is still about doing a bit of education, inspiring businesses, especially for small and medium sized business

It does require hand holding, support, talking to them, keeping them on the agenda/radar.

need education and inspiration

enterprises require support

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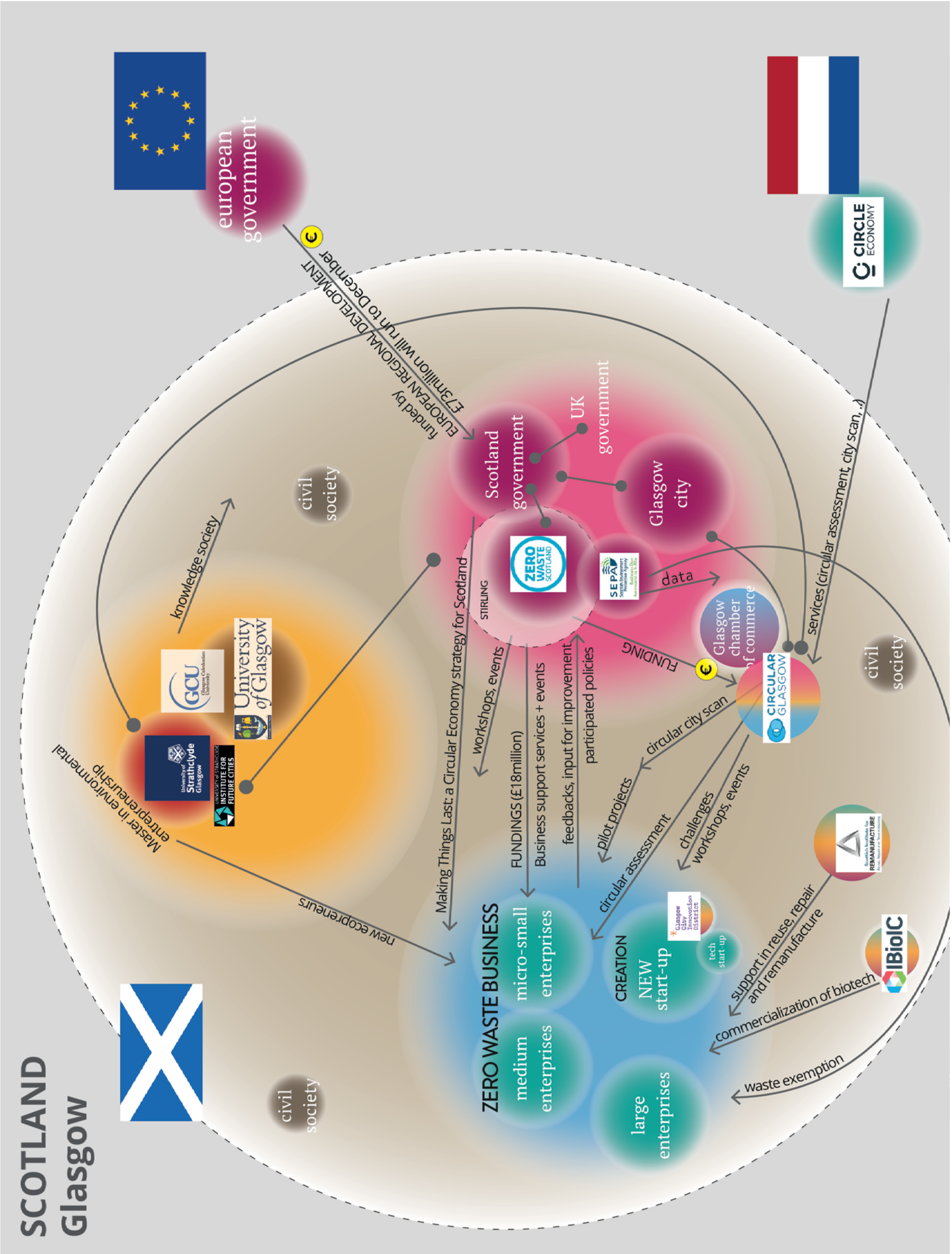
6.2.1.4 The Scottish ecosystem for the Circular Economy .

ECOSYSTEM COMPOSITION:
Applying the quadruple helix innovation model to define the role of the actors in the Scottish ecosystem for the transition to a CE framework, referring mainly to Glasgow city, the actors are placed in the different spheres as represented in fig 6.9.
ZWS is in the government sphere and Circular Glasgow is closer to the industrial sphere for being a programme of the chamber of commerce, but also supported by the city council and having relationships with ZWS. In the university sphere, there is the Strathclyde University, along with to other 2 universities with a long history which are building the knowledge society: the Glasgow Caledonian University and the University of Glasgow. Next to Strathclyde University is placed the Institute for future cities that has conducting studies also about Glasgow city and collected many data in the Glasgow atlas. IBioIC and the Scottish Institute for remanufacture are placed among the three spheres for its connection to the research field.

AIMS AND OBJECTIVES:
In Scotland, the transition to a CE has started thanks to £73million received from the EU EDRF which through the governmental agency ZWS £18 million are invested in the Scottish SMEs to accelerate the transition to a circular and resource efficient economy, with a maximum of 1 million for grant. Thanks to these funds, they are both providing the CE business grant fund and the CE business support for the SMEs delivered for free. ZWS have also funded the Circular Glasgow initiative in the city of Glasgow, which are supporting the local enterprises to the transition to a CE thanks to many communication and training activities. Moreover, they involved also Circle Economy in the Netherlands to help them to develop the city scan which highlighted the opportunities to working in the food & beverage sector, providing concrete examples and strategies for the local entrepreneurs. They are also providing the circle assessment tool to the enterprises that want to understand criticalities and opportunities in the CE framework.
Along with these actors who are working in synchronization, the universities are building the new knowledge society with also attention to new ecopreneurs thanks to the master in environmental entrepreneurship in Strathclyde university.
The transition to a CE model is also built by other support organizations which works also for the connections of the actors in the triple helix: IBioIC, focus on biotechnologies, and the Institute for remanufacture.

IMPORTANT INSIGHTS:
The situation seems for the moment only focus on the SMEs sectors and highly dependent on the EU funds, but the shadows of the Brexit can create confusion and problems in the near future.
Whicher et al. (2018) arguing about the design CE ecosystem in Scotland stated some other important elements about the Scottish ecosystem. For example, there is a lack of expertise in design and CE among business advisors and there is also a low ‘sustainability literacy’ among designers. Moreover, there are “still barriers to companies designing products with the whole life cycle in mind”, but they identified that more opportunities would come from the next generation of designers, but also industrialist and academics. Also (Whicher et al., 2018) identify ZWS as a principal actor, fundamental for this ecosystem and which is acting as a facilitator. However, they argue the need for a larger vision “Circular Economy thinking across the economy”, than on a focus on specific sectors.

Fig.6.9 - the local ecosystem in Scotland for the CE implementation



6.2.2 Ecosystem in the Netherlands

6.2.2.1 Context

The Netherlands is a European country located in the north-west part. It borders to Germany, Belgium and the North Sea. It is a constitutional monarchy with 12 provinces which have its own government and provincial assemblies[18] , and Holland is one of them (see fig. 6.10).

It is the most densely populated country in Europe with about 17.093.000 inhabitants (in January 2017) in an area 41.543 km^2: the medium density is 417,7/ km^2 (see fig. 6.11)[19].

The country capital is Amsterdam with the highest population. Follows Rotterdam, the Hague, Utrecht and Eindhoven. One of the main characteristics of this country is that most of the land is under sea level (see fig. 6.12).

Thanks to its actions this country can be considered a forerunner in the CE. The roots of the CE attention in this country can be traced in the Cradle2cradle movement (see chapter 3) one of the school of thought behind this concept that has the European office in Amsterdam (Cradle to Cradle Products Innovation Institute - see chapter 5). Moreover, they hosted the first Circular Economy Hotspot CEH, an annual event which took places from 2016 in various places: in the Netherlands *"the circular expo provides a stage for scalable circular projects and trade and press campaigns highlight these forward thinking, circular initiatives within the campaign."*[20] .

The Netherlands government demonstrated its fully commitment to the CE implementation in the country with the programme *"Nederland Circulair 2050"* (fig. 6.13) and its report[21] published in September 2016 by the Ministry of Infrastructure and the Environment and the Ministry of Economic Affairs, and also on behalf of the Ministry of Foreign Affairs and the Ministry of the Interior and Kingdom Relations. Although the goal is 2050, they set a half way milestone: *"50% reduction in the use of primary raw materials (minerals, fossil and metals) by 2030."* (pg. 5 of the summary).

They identified five major chains and sectors that need to have the priority: biomass and food, plastics, manufacturing, construction, and consumer goods. They focused on the use of raw materials which are *"sustainably produced, renewable or generally available raw materials"* (pg. 6 of the summary) and on the reduction of waste as much as possible. Moreover, they put the attention on the end of life of products facilitating the smart return and the collection systems to do not lose their high quality. These strong statements have highly contributed to the creation and development of actors working on CE and its implementation.

Especially the city of Amsterdam seems to be fully committed to the realization of the ambitious goal of its country. In 2018 a report commissioned by the City of Amsterdam was published. It sees the collaboration of Copper8 and Circle Economy *"The Amsterdam Circular: evaluation and action perspectives"*[22] .

Fig . 6.10 - political map by Alphathon - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=11322507

18 http://www.netherlands-tourism.com/

19 https://en.wikipedia.org/wiki/Netherlands#Demographics

20 https://www.circle-economy.com/tool/netherlands-circular-hotspot/#.XX9lSZMzbGI

21 available at https://www.government.nl/documents/policy-notes/2016/09/14/a-circular-economy-in-the-netherlands-by-2050

22 available at https://www.circle-economy.com/case/amsterdam-circular-evaluation-and-action-perspectives/#.XR3NhtMzZR1

Fig . 6.11 - map of the population density. By nerdy.maps - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=89055755

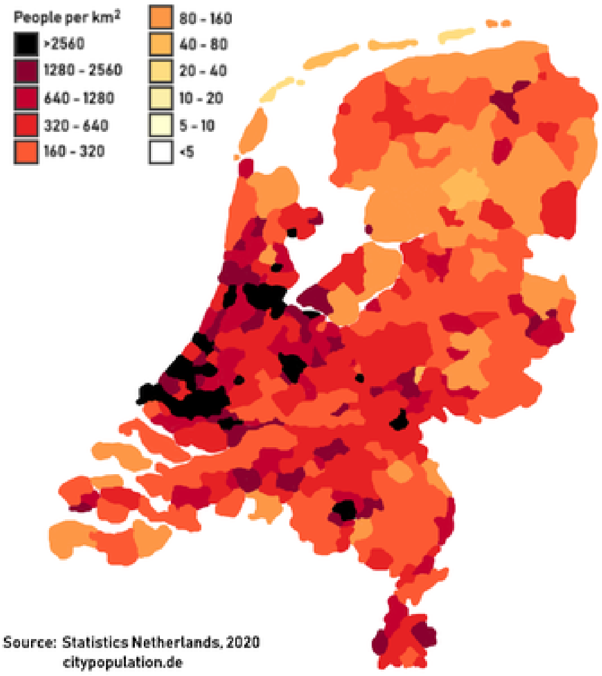


Fig . 6.12 - map about areas of the Netherlands below sea level By User:Jan Arkesteijn - Originally from nl.wikipedia; description page is/was here. Reference: http://ahn.geodan.nl/ahn/viewer3/index.html, Public Domain, https://commons.wikimedia.org/w/index.php?curid=1922415

Indeed, from the evaluation of the number of projects present for each sector (see fig. 6.13-14), 73 circular projects in total, they distinguished 3 value chains promising to scale up (construction, biomass and food, and consumer goods) and the expanding of the use of 2 municipal instruments: the procurement and the knowledge function (‘research, information provision and networks).

The report locates Amsterdam at the end of the first phase and ready for the next one, where projects are scaled up and become a standard. However, they concluded stating that there is still much more work to be done to change the current economic model because business as usual is still used and *“both the private sector and governments are still in the ‘innovator’ phase’”* (pg. 6.14). They highlighted the role of government for the scaling up and the transition to the second phase, and moreover the needs of cooperation among the triple helix elements. (pg.43). The government from the words of the Deputy Mayor Sustainability of Amsterdam, Marieke van Doorninck, in 2018 demonstrated the will to learn from mistakes and continue the work because the projects can be of inspiration for others[23]

The CE of Delta Development Group, identified in an interview [24] , that key elements of the Netherlands for the development of the CE are:

- an egalitarian society, with few differences between rich and poor people, which permits to their inhabitants to think about the future, and don’t be worried to much about present;
- a country with zero resources, with the necessity to reconsider the economic model;
- a small country that can make the differences and show how things can be done in a qualitative scale.

He also highlighted that it’s important to create the infrastructures to create innovation in order to share the risks and the benefits and don’t let all the risks to the entrepreneurs.

23 idem

24 see the interview recorded for the field visit conducted t for the RETRACE project and published in 2017, available at https://www.youtube.com/watch?v=mEC9nCE35bU

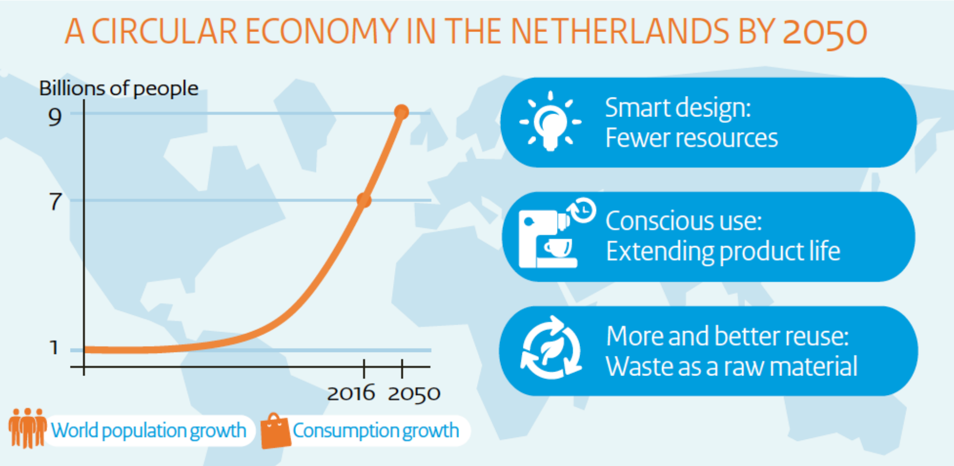


Fig. 6.13 - the main points of their strategy. Retrieved from "A Circular Economy in the Netherlands by 2050 (summary) available at https://www.government.nl/documents/leaflets/2016/09/22/a-circular-economy-in-the-netherlands-by-2050

Instruments \ Value Chain	Construction	Biomasss & Food	Manufacturing	Plastics	Consumer goods
Land issue	5	-	-	-	-
Spatial planning	4	-	-	1	-
Procurement	3	1	-	2	1
Education & Information provision	3	2	2	-	-
Research	11	6	2	3	3
Networking & Information exchange	9	6	3	4	3
Legislation & Regulations	1	2	-	1	-
Business & Financial support	5	6	4	3	-

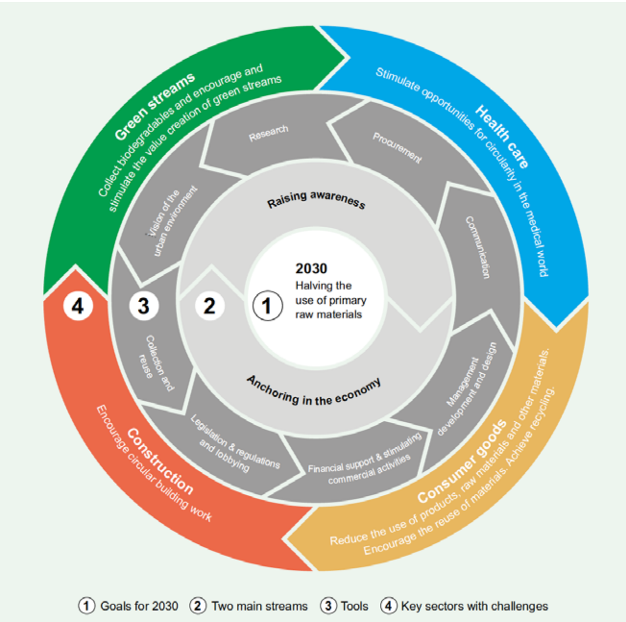
Fig. 6.14 - projects evaluated in the report. retrieved from the report, pg. 14

The interview collected also the thinking of a Circular Valley initiator which stated the importance to understand the system boundaries and the interface between the other systems, and of the director at Circular Valley who reminded that the challenge is not the economic growth, but the growth in quality and insisted on the need to have the politics not only close but that takes the leadership.

In addition, the city of Rotterdam seems very active and another central point for the Circular Economy transition in the Netherlands. the website "Rotterdam Circular"[25] dedicated entirely to the programme of the city reports: *"By 2030, circular will be standard. Rotterdam will be a 'living laboratory' in which we experiment, pioneer and embed successes. In which we profile the city and the port as a circular hotspot"* . The municipality settled this objective as a priority and developed a plan for 2019-2023 entitled "from trash to treasure"[26] published during the week of the Circular Economy in 2019 where the city stated its will and commitment to be a circular city with a waste-free society. They also underlined the different position of this city for the presence of many initiatives and they have also expressed their support to circular entrepreneurs to facilitate their activity.
Also in Rotterdam, Circle Economy, in collaboration with Metabolic and Blue city, developed the report 'Circular Rotterdam-opportunities for new jobs in

25 https://rotterdamcirculair.nl/en/about-rotterdam-circular/#rcp
26 http://rotterdamcirculair.nl/Programma_Rotterdam_Circulair_2019-2023/UK/index.html

Fig. 6.15 - representation of the Rotterdam action plan. Retrieved from the report "from trash to treasure" pg. 4 published in http://rotterdamcirculair.nl/



a zero waste economy'[27] which identified the key sectors for this city: construction, green streams, consumer goods, and healthcare. Especially regarding to the consumer goods they have an innovative way to manage them and extract their value: *"we are facilitating the recycling of consumer goods by turning the waste separation collection points into 'upcycle malls'. Not only can you bring your goods here when they are broken or you don't want them anymore but you can repair them or pick up items for reuse ."* [28](pg. 3). Based on the report, they have developed an action plan (see fig. 6.15)

6.2.2.2 Actors for the Circular Economy development

The main actors working in the Netherlands, identified also as case-studies in chapter 5 are:

- BLUE CITY 010
- CIRCLE ECONOMY
- METABOLIC
- C-BETA
- C-CREATORS
- COPPER 8
- CRADLE2CRADLE PRODUCTS INNOVATION INSTITUTE

To understand more how they are acting and the ecosystem relationships, in-depth interviews were scheduled. This action was very long and unsuccessful at the beginning. A direct contact, known thanks to the RETRACE project, was fundamental to reach some positive answers, and direct interviews were conducted with Metabolic, Copper8 and Blue city. The information collected was very useful and insightful both for the study of the single actor and to understand the entire situation there.

This in-depth analysis let also identify other actors:

- TU-DELFT[29]: the Delft University of technology active in the CE fields[30] and with relevant research figures as Conny Bakker in Design for the CE and Nancy Bocken working on sustainable business models;
- DRIFT FOR TRANSITION[31]: The Dutch Research Institute For Transitions (social enterprise) in Rotterdam, conducting multidisciplinary research in sustainability transitions established in 2004 at the Erasmus University of Rotterdam;
- EXCESS MATERIAL EXCHANGE[32]: *"a digital facilitated marketplace where your company can exchange any excess materials and products. We function like a dating site: We actively match supply and demand and materials with their highest-value reuse opportunity."* [33] ;
- CIRCULAR IQ[34]:*"our key product is an online software application which uses simple data to*

27 https://rotterdamcirculair.nl/wp-content/uploads/2018/11/GemeenteRotterdam_Report_English_15-11-18.pdf
28 http://rotterdamcirculair.nl/Programma_Rotterdam_Circulair_2019-2023/UK/index.html
29 https://www.tudelft.nl/en/
30 the fist university looking of 'circular economy' on Scopus database with 96 contributions. Research updated 16/09/2019
31 https://drift.eur.nl/
32 http://excessmaterialsexchange.com/
33 video "ECO17 Amsterdam: Maayke Damen Excess Materials Exchange" https://www.youtube.com/watch?time_continue=51&v=IVGViBxPBfY
34 https://www.circular-iq.com/

support intelligent decision making on circularity."[35] ;

- DELTA DEVELOPMENT GROUP[36]: *"an innovator in sustainable C2C real estate"* ;
- ECOR[37] *"a technology, a community and a Circular Economy enabler" which invented also the ECOR* material, an 'advanced environmental composite panel';
- HOLLAND CIRCULAR HOTSPOT[38]: *"is a private public platform in which companies, knowledge institutes and (local) authorities collaborate internationally with the aim of exchanging knowledge and stimulating entrepreneurship in the field of Circular Economy. Activities:*
  - *to stimulate cooperation between the private sector, knowledge institutions, governments and other relevant parties;*
  - *to provide international visibility of Dutch CE innovations/best practices;*
  - *to assist foreign parties in linking with relevant Dutch CE parties;*
  - *to establish a online community where both Dutch and foreign companies can post CE challenges and solutions, and generate business matches;*
  - *to facilitate access to Dutch and international (financing) instruments and programmes"* .

The information shared by the direct contact added also more data and actors for the analysis of the current situation. In the system bank, they are moving for CE investments, and also there is a charity foundation making philanthropic actions (The Goldschmeding Foundation [39]).

OTHER ACTORS WORKING IN THE INNOVATION ECOSYSTEM:
Another interesting actor, not focus on CE, is Amsterdam smart city[40] , which see the partnership between companies, governments, knowledge institutions and citizens to create a platform to add value to the city (Pallaro & Pereno, 2018,p.54).

6.2.2.3 In-depth analysis with direct interviews

METABOLIC

The information collected for Metabolic case study comes from their official website and the direct interview that was performed with a skype call in July 2019 with the Green Building consultant.

The answers collected for each question previously defined in the methodology chapter, are present in the annexes, and also the transcription of the complete interview. The principal concepts from the interview are present in fig. 6.16

How it works (see fig. 6.17): As written in chapter 5, Metabolic it is a very interesting case, working as consultant both for existing enterprises both for cities and regions. Its approach to sustainability based on systems thinking is visible in their actions and services and they are advising companies but also government and other actors about it. They are also developing tools to advice on sustainability issues and providing classes on systems thinking and circularity. The multiple services are provided by a very multidisciplinary team.

Feedbacks from their experience: they recognized very important the way in which they talk with the actors that they are supporting, and also the need to consider the whole picture before giving a solution, because it can have consequences on other things. Moreover, the need to have balance between what is useful for the environment and what makes sense to implement, including the requirement to involve many stakeholders and the right actors. They recognized also an increasing in demands for support which can be related to the pressure that companies can received from their clients. However, working with companies is difficult mainly for the need to have data and understanding the current system, with are problems on data sharing and data security. In addition, companies want an immediate

35 https://www.youtube.com/watch?time_continue=6&v=GNjkCZYV1x8
36 http://www.deltadevelopment.eu/en/
37 http://ecorbenelux.com/ecor-europe/
38 https://hollandcircularhotspot.nl/en/about-us/
39 https://goldschmedingfoundation.org/
40 https://amsterdamsmartcity.com/

profit, as in the current economy, but in this different non linear process change in ownerships and value creation is needed.
About the involvement into the local ecosystem, they are working with other actors as Circle economy and Copper 8 depending on the projects that have to follow. They have partnership with universities but not with the government, however for example the city of Amsterdam is very interested in what they are doing, especially thanks to the De Ceuvel project (see chapter 5).

Points of interest for this research and local ecosystem mapping: They are private consultants, but their attention to the systems thinking is important for the research . This is applied in their projects and consulting. Moreover, very interesting are also the barriers that they have found in working in this different cultural paradigm, as the difficulties in sharing data from the companies and the change in ownership and value creation. Noteworthy is also the process of collaboration that they are putting into practice with other actors of the local ecosystems, depending on the projects they have to implement.

Fig. 6.16 - the principal and relevant highlights of the interview to Metabolic

“we use systems thinking throughout all our projects and work...advising for example companies, governments and NGO's on how they can use systems thinking to improve sustainability of their operations and their projects”

application of systems thinking

“teaching systems thinking and circularity, so they are working on creating master classes and we are providing a lot of master classes and presentation, and actually is a big part of everyone at the company does beside consulting, also speaking, teaching lectures or presenting, a big part is dissemination of the thinking”

dissemination activities

“mainy people have very different background”

multidisciplinary group

METABOLIC

consultants

“Yeah, but I think that is a part that is really particular to the Netherlands, indeed the government is really looking at how they can implement these thinking in the policy and in the laws... we want to work on bottom up initiatives as top down ”

lesson learnt to the government

“tackle some of the most urgent and critical sustainability challenges facing society”

committment to the problem

“you need to have the balance between what is most environmentally useful to do and what has the most sense to actually be implemented”

balance in implementation

“the way we talk to..it really add value when we are doing this”

most important service? talking in the right way

“data gaps are a huge one... also data security, and willingness to share and cooperate... the problem is really that our economy is based on immediate profit”..

current problems

“people come to us wanting to shift to most sustainable state because they also get pressure by their clients or people who give them assignment to have a really sustainability position”

pressure to sustainability by clients

“maybe the people doing the effort is not the person that would get back the benefits at the end”

problems in value

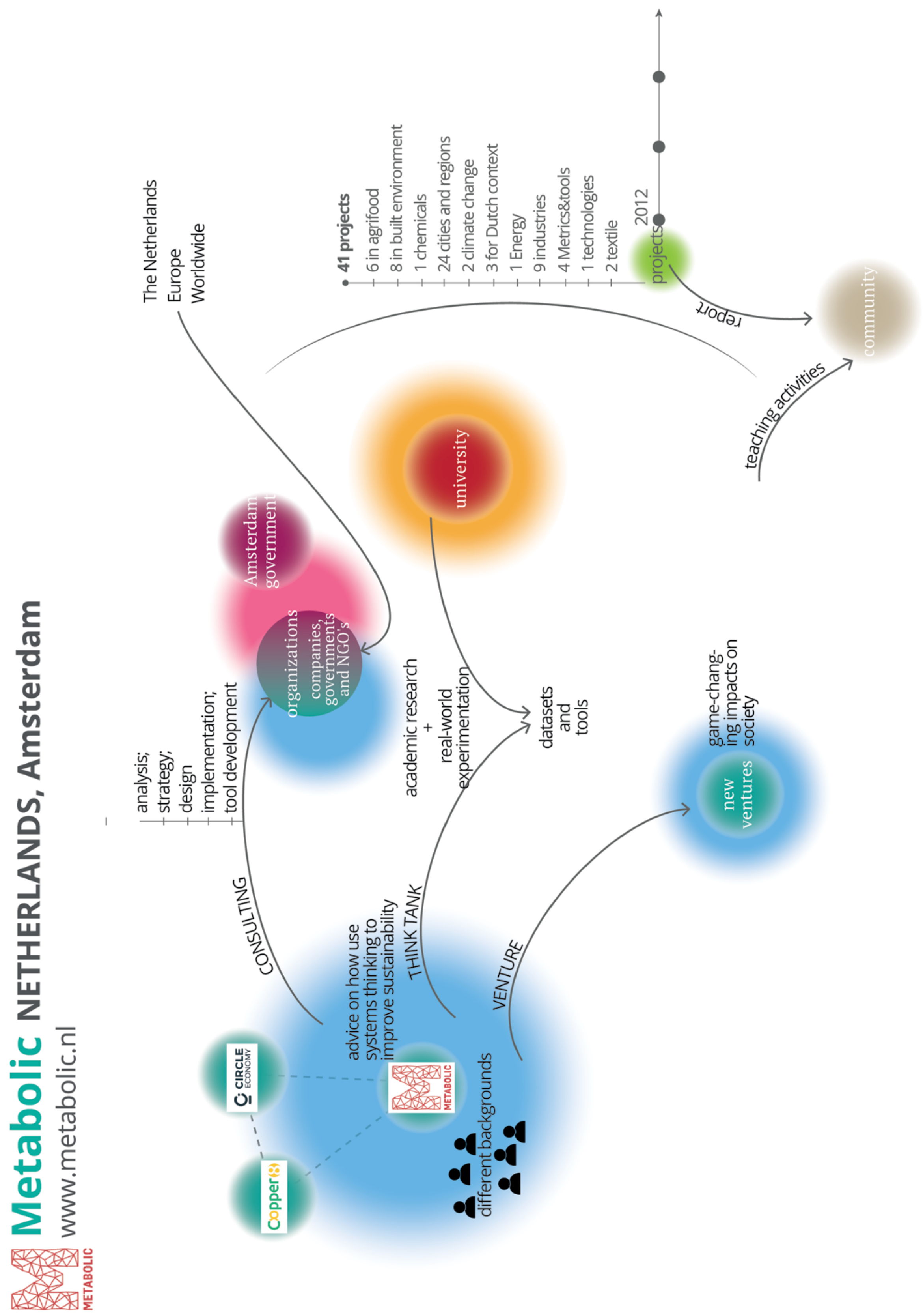


Fig. 6.17 - gigamap about the information collected in the in-depht analysis of Metabolic

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COPPER8

The information collected for Copper8 case study comes from their official website and the direct interview that was performed with a skype call in July 2019 with one of the founders.

The answers collected for each question previously defined in the methodology chapter, are present in the annexes, and also the transcription of the complete interview. The principal concepts from the interview are present in fig. 6.19

How it works: see chapter 5 (see fig.6.18): although they are really focused on public procurement which is not the focus of this research, they are consultants providing multiple services mainly to build new collaborations and cooperation among actors.

Feedbacks from their experience: Circular procurement in Hollands is supported by the political statement: 50% by 2030. With this objective, many organizations are looking for support. They believe that circular procurement is a strong method to change the market.
Moreover, another important point highlighted by them is the problem of the need to shift the cultural paradigm, also if it needs time. Indeed, it's important to cooperate, sharing the same goal, dividing profit and loss, and having trust. Working in a CE brings new different values and standard in comparison to the linear model.
they added, in the interview, that they are working with local actors as partners depending on the complexity of the project: a good example of collaboration between the principal actors. The same was reminded by the other actor Metabolic. Differently with the government, they are not partner but they are making reports to share the lesson learnt.

Points of interest for this research and local ecosystem mapping: Although they are focused on public procurement which is not really the scope of this research, from the analysis of Copper8 especially with the interview was possible to extract some useful information about the barriers faced by the CE implementation as the problems in working with a different cultural paradigm. From the interview, useful information was discovered about the Netherlands ecosystem, which confirmed what also Metabolic has shared: the collaboration among the actors depending on the projects goal.

Fig. 6.18 - gigamap about the information collected in the in-depth analysis of Copper8

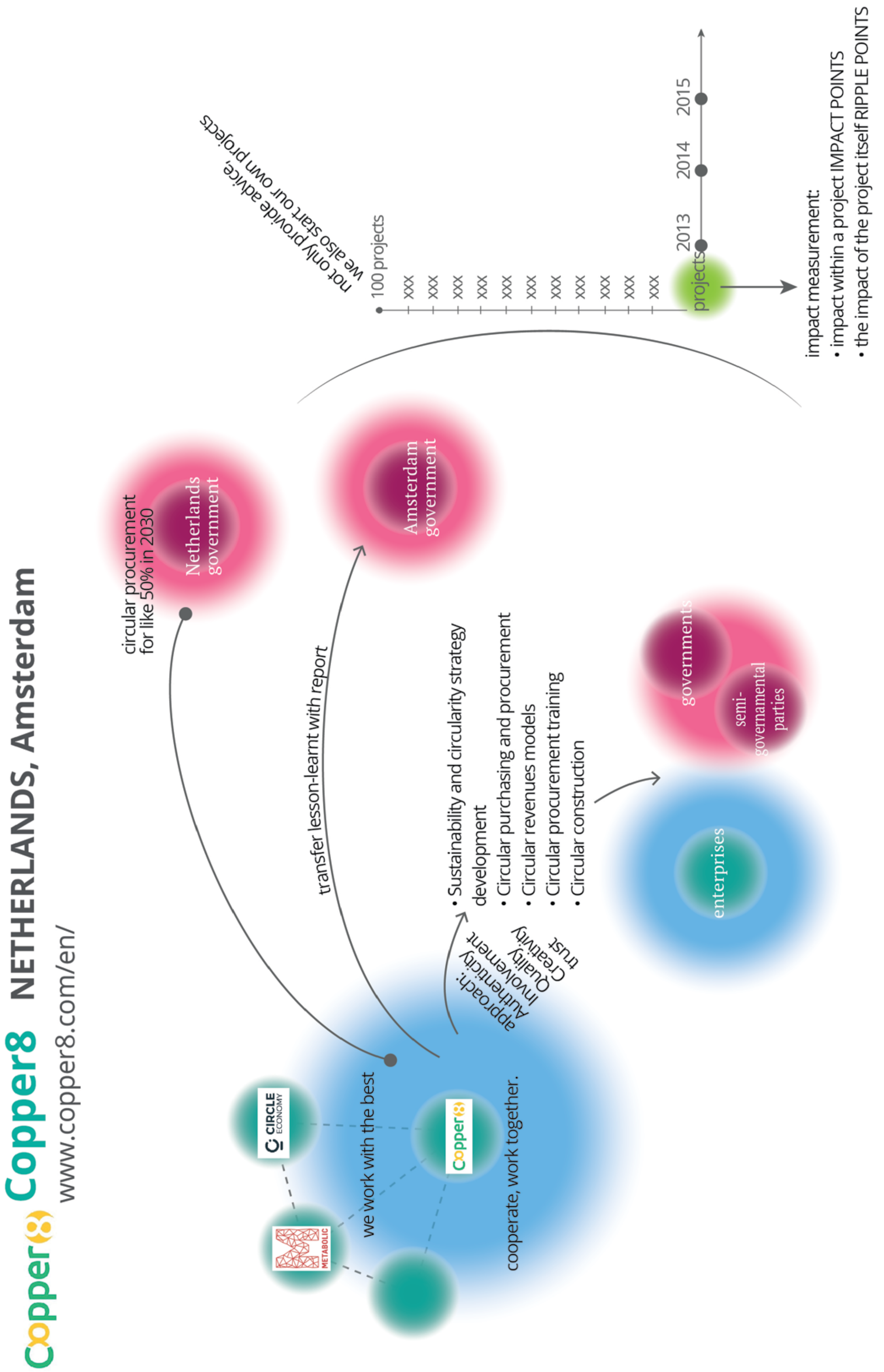

Fig. 6.19 - the principal and relevant highlights of the interview to Copper8

"we founded Copper8, we though we need to be a good example on how we can organize on one hand a commercial firm and on the other hand a social business as well"

commerical firm + social business

"Copper8 it's like cooperate, work together. One of the most important things to going from linear to circular is that you really need to find partner to cooperate with, you make profit and loss and you all share, you want to reach the same goal and you are really transparent on what will bring and how much it will cost. Cooperation is one of the main focus in circular economy"

importance of cooperation in the Circular Economy

"we believe if you do one part very good you can work together with other parties that are really good in a part that you are less good at....we want to work with the best in their fields"

relationships with other parties

"you can have a very big role if you organize procurements in a right way..I really believe that procurements it's a strong method to change the market...We need to make this change."

strong power of procurement in a right way

We measure our success in terms of the impact we have achieved rather than in terms of sales and people. We measure the impact in two ways: our impact within a project and the impact of the project itself. (impact points and Ripple points)

different impact measurement

""the municipality and the region are not partner but clients ...we do speak with the municipality of Amsterdam as well and we made reports.. it's our way to disseminate our lesson learnt"."

relationships with government: transfer the lesson learnt

"we see a growing, ..Things are moving from sustainable department to the procurement department in company, so it is a really good"

growing interest

"when the money and time are involved, everybody shift to the old methods again"

problems in the cultural paradigm

"everybody wants to have proven technologies, measurable results, all the clear things about money and time, all the hard things that the linear economy is driving on, but the working in the circular economy is different"

"short term investments and revenue models, that is the one thing. One the other things if you look in companies people they get their salaries or even their bonus on the all standards: "

" the mindset of people... I think we need to shift it, think about what is the value, what's your environment having traumas with or not, it's not about having but using it, it's not about status but joying and this kind of stuff, it's really about shifting mankind" "

need a shift

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BLUE CITY

The information collected for Blue City case study comes from their official website and the direct interview that was performed with a skype call in October 2019 with one of the programmers.

For each of the questions previously defined in the methodology chapter, the answers are presented in the annexes, and also the transcription of the complete interview. The principal concepts from the interview are present in fig. 6.21

How it works: (see fig. 6.20) it was born from the experience gained by Rotterzwam[41] (producing mushroom from coffee waste) and afterwards they renovated an iconic building that became a lab, an event location, but also workplaces. During the years, they grew thanks to the interest generated by their work. Nowadays, they can be considered as an incubator, even if their offer is not yet well structured and in progress. In addition, Blue city itself is a start-up that is growing and defining its business model. They became also a central point for the CE in the city of Rotterdam. They collaborated with Metabolic and Circle Economy to the report 'Circular Rotterdam' to help the policy makers understand the current state-of-art and what is needed to do. One of their main characteristic is the goal to have the connection of residual flows among the entrepreneurial activities based there.

Feedbacks from their experience: Very interesting was to find their interest in having connected residual flows. About it, in the interview they revealed that it is a voluntary action and is happening only for some of them (ex: the production of mushrooms from coffee waste of the cafeteria, and the mushrooms afterwards are used as food in the bar). Indeed, it is a complex goal that requires also infrastructure and investments for it. It challenges companies to cooperate and can influence also the ecosystem outside Blue City.
Moreover, the city government with the years has grown its interest towards Blue City also because the city has built a vision about CE and now they are learning also from this experience. Thanks to this now they are collaborating. Blue City has also established relationships with universities as Erasmus, Delft and Drift.
Blue City has also seen a growing interest in their activity by entrepreneurs, especially on the creation of circular business cases and propositions. Moreover, also the attention to the 'blue city' case has grown from the exterior (as media) and this is also facilitating the market for the start-ups incubated. In addition, they are also formalizing the support that they can give to entrepreneurs in the right moment, as on circular models and on legal advice. They are also a start-up that is finding its business model, so they are in evolution.
They are also working on making all the aspects circular: a circular location, setting also circular events and circular workplaces. An ambition is also to try to set up the model to make it replicable for the creation of more 'blue cities'.

Points of interest for this research and local ecosystem mapping: The case of Blue City is interesting because they are working following a new economic model and the cultural paradigm proposed by the Blue Economy and the CE. They are in evolution and working to find the best support for CE start-ups, a new phenomenon looking for an answer, as explored in this PhD research. Since 2016, from the first exploration, the interest to their activities from the exterior has increased, and it is in line with the worldwide trend opinion on CE aspects. This fact has allowed them to create more connections with the local ecosystems. Although they are located in a different city in the Netherlands, they are increasing exponentially.

41 https://www.rotterzwam.nl

Fig. 6.20 - gigamap about the information collected in the in-depth analysis of Blue city

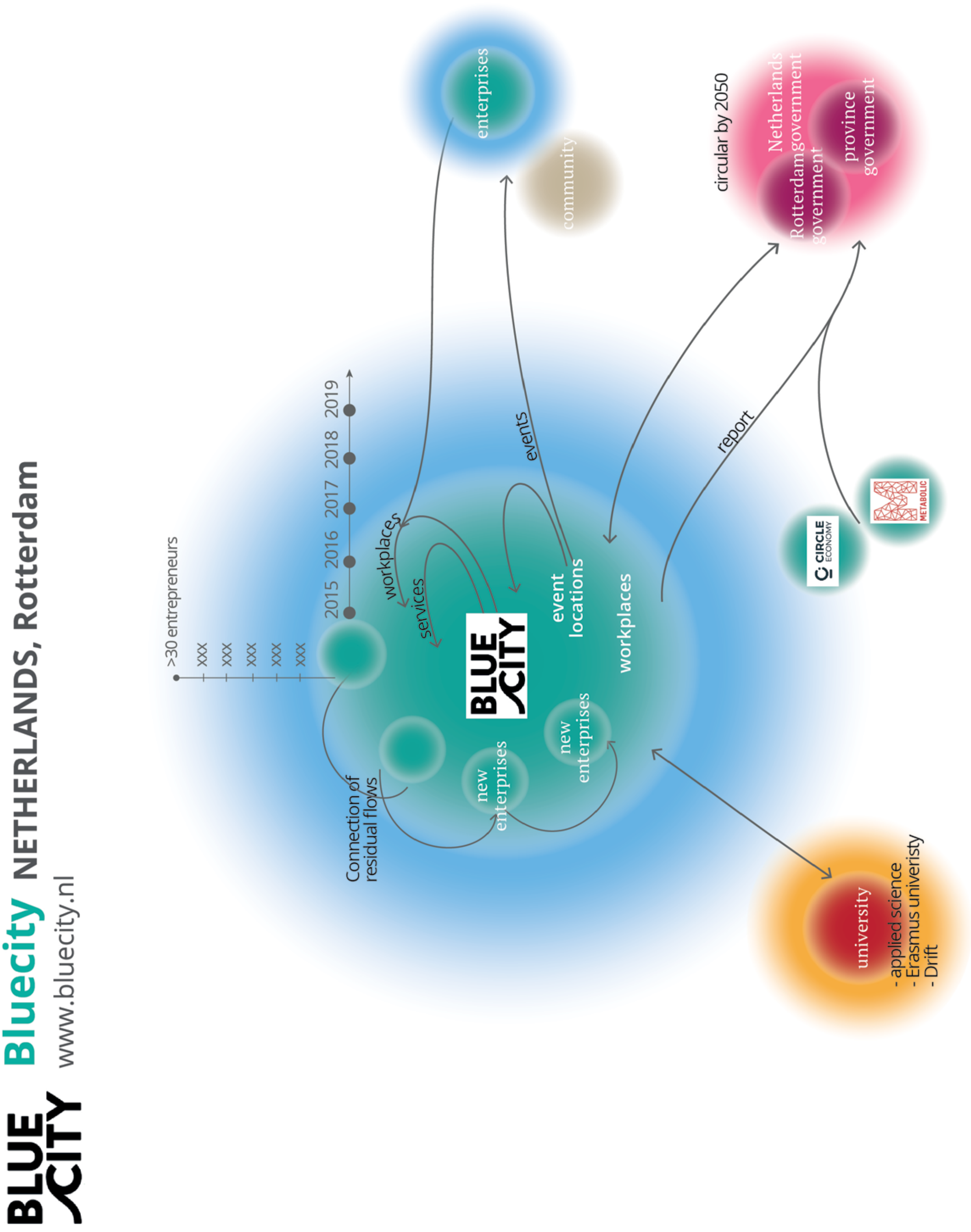

Fig. 6.21 - the principal and relevant highlights of the interview to Blue City

"Connection of residual flows...it is a goal, and has been partly working..depend on the phase that the start-ups are in, the quantity that can offer and leave, it is quite challenging to do at a scale as Blue city. "

connection of input and output: complex

"We do see an increasing in getting inspiration, looking to do stuff..."

growing interest

"blue city the organization itself it is also a start-up, there is a lot of lessons, it's finding the business model for the organization itself" B.V.

still growing as a start-up

"there is an ambitious to create more blue city, set the lesson that are replicable, we are also looking at them...

"we are one of the key partner for the city. If you look at the city but also at the province, when they begin there was such a big lack of knowing what they actually need to do or what to do, they can really use us and entrepreneurs because we are linked with many other actor on the topic, and they started shaping their own vision. The relationship now is very good."

involvement of the city, more and more
used by the city to understand what needed

"it is also a mix of a lot of functions, we don't feel like we are so special, not anymore.. I think a lot of isolated silos we look at different organizations, but they are separate. We are looking at existing models and understand how we can use it in a circular context".

not unique anymore as experience,
but a mix of different ones.

"dutch government... they have bigger budget and still looking for answers on how to invest them"

government is learning

"we are trying ways maybe to formalizing the supporting of the entrepreneurs, could be peer to peer support...but..in many cases you need when you needed, and not when we organize the meeting"

need to deliver services at right time
for the entrepreneurs

"with every aspect that you do has to be circular (building, workplaces, event, .."

need to be circular in everything

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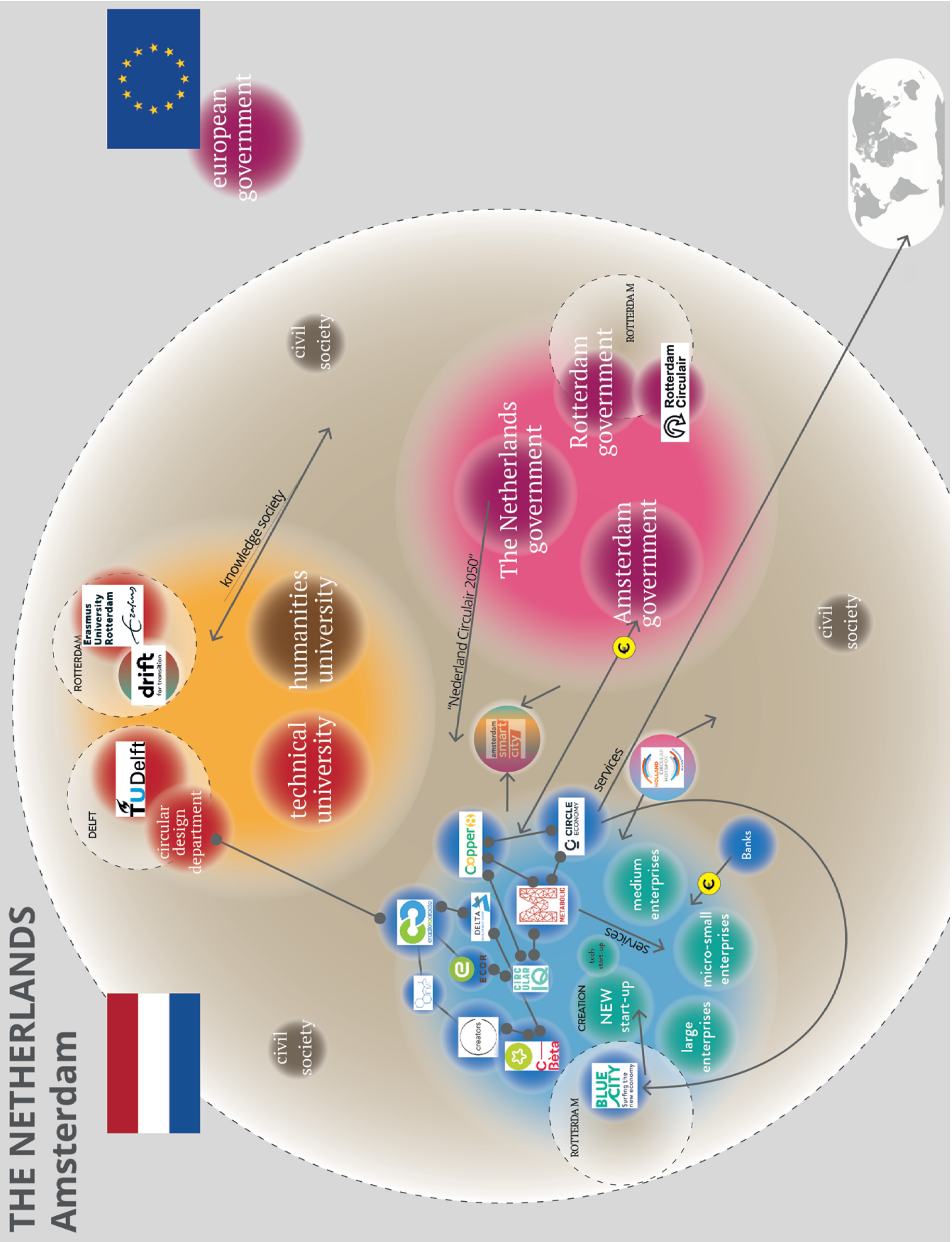
6.2.2.4 The Dutch ecosystem for the Circular Economy

ECOSYSTEM COMPOSITION:
Using the quadruple helix innovation model to define the role of the actors in the Netherlands ecosystem for the CE, the actors are placed in the different spheres as represented in fig 6.22. Together with the focus on the city of Amsterdam for the presence of majority of actors, it is important to consider also the city of Rotterdam. The majority of the actors are consultants working for organizations supporting the industry sector, so they are placed in this sphere. Two actors are placed in a middle position – Amsterdam smart city and the Holland circular hotspot – as they are two platforms created by mix partnerships among all the helices.

AIMS AND OBJECTIVES
The local ecosystem working for a CE transition in the Netherlands seems composed by many actors: private groups consultants working together. For example, usually Copper8 works with Metabolic and Circle Economy; Copper8 and Metabolic are partners of Circular IQ. Very interesting are the cases of: Metabolic, which are applying the systems thinking in their work; the Circle Economy which provides many services and are developing many tools for the enterprises and the cities, working around the world. Many of the actors are working both at local level than globally.
Moreover, the CE in the Netherlands is really linked to the cradle to cradle philosophy (a school of thought of the CE) today represented by the cradletocradle innovation institute. Many actors are applying it, as Delta Development, the master in the university on circular design at TU Delft, and also the activities around new products as Ecor. This last one, in this analysis represents one of the many of these typologies.

IMPORTANT INSIGHTS
What seems the motor and booster of the ecosystem is the Netherlands government with the ambitious strategy of 2050 that has built the ground for many actors and initiatives to support the pursue of this goal.
Many actors are established in or near Amsterdam, a city which has also demonstrated its commitment to the CE topic and that is learning from the activities carried out. Moreover, the nearby city of Rotterdam has put the CE as a priority strategy and started many activities, as the city scan with Circle Economy to identify the focus sectors. It is increasing its role in the CE thanks also to the presence of Blue City that is working as a BI but for a different economic model.

Fig. 6.22 - the current relationships among the actors in the eco innovation ecosystem



6.2.3 Ecosystem in Piedmont Region (Italy)

6.2.3.1 Context

The Piedmont Region is a region located in the north of Italy, in the western part. This area is a strategical point of growth for Italy that has been influenced by its neighbouring countries France and Switzerland. Italy is composed by 20 regions with limited autonomy and are the constituent entities of the Republic, divided into provinces.

The Piedmont territory is more than 2.500.000 ha. Almost 50% of the territory is used for agriculture purposes (fig. 6.23). The other 50% is a mountain area. The population, more than 4.400.000 inhabitants, is distributed according to the development of economic activities and urban centres locations. After the main city Turin (around 890.000 inhabitants), where most of the infrastructures and services are located, other 7 cities well distributed on the entire territory are important: Biella, Cuneo, Vercelli, Novara, Verbania, Alessandria and Asti (fig 6.24). (Battistoni & Giraldo nohra, 2017, annex).

The Piedmont regional government has defined the Regional Innovation Smart Specialization Strategy (S3)[42], where the CE is not mentioned, but they identified the 'resource efficiency' as a transversal sector together with the smart production, among two main pillars (fig. 6.25):

- the industrial sector, with some priority productive sectors (Aerospace, Automotive, Mechatronics, Green Chemistry/Clean Tech, and Made in Piedmont - Textile and Agrifood -);
- the health sector.

Moreover, for the EDRF programme 2014-2020[43], they allocated 350 million of euro for the R&D measures (37%), the 22% to the competitiveness of the industrial sector, the 20% for the sustainable energy and life quality, and 5% to the urban sustainable development and 3% for the protection of the environment and valorisation of the cultural heritage (fig. 6.26). The context in Piedmont Region is strongly conditioned by the Italian situation. The document published by the Italian Minister of the environment *"Towards a Model of Circular Economy for Italy. Overview and Strategic Framework"*[44] in November 2017 claims for a shift in the cultural paradigm to see the CE as an opportunity rather than a necessity, with the following:

- Investing in research and development for stimulating the entrepreneurial system (the SMEs especially of the manufacturing sector) to rethink production models;
- Spreading the CE concept throughout the country (ex: more information on production processes for greater transparency and reducing illegal practices, and allowing consumers to reward virtuous enterprises);
- the use (and reuse) of recycled materials (in a country poor in raw materials), to be less dependent on foreign countries;
- development and consolidation of the secondaryraw materials market;
- invest in the training of new skills.

This document, which wanted to define the Italian strategic position over the CE, however doesn't represent the National action plan for CE implementation which needs to be defined, as the report about the CE in Italy in 2019 also underlined[45] . this last report has compared the Italian situation regarding the CE in comparison with the other European countries especially UK, France, Germany and Spain. The evaluation of the performance over the macro sectors indicated by the EU action plan [46], has defined Italy as the better one in 2019

Italian strategic position over the CE, however doesn't represent the National action plan for CE implementation which needs to be defined, as the report about the CE in Italy in 2019 also underlined[47] . However, this last report, comparing the Italian

42 https://www.regione.piemonte.it/web/temi/sviluppo/sistema-ricerca-innovazione/s3-strategia-specializzazione-intelligente

43 European Regional Development Fund https://ec.europa.eu/regional_policy/en/funding/erdf/

44 available at https://circulareconomy.europa.eu/platform/sites/default/files/strategy_-_towards_a_model_eng_completo.pdf

45 by the Circular Economy Network and Enea, available at https://circulareconomynetwork.it/wp-content/uploads/2019/02/Rapporto-sulleconomia-circolare-in-Italia-2019.pdf

46 (Comunicazione COM(2015) 614 final) available at https://eur-lex.europa.eu/resource.html?uri=cellar:8a8ef5e8-99a0-11e5-b3b7-01aa75ed71a1.0012.02/DOC_1&format=PDF: production, consumption, waste management, the market for secondary raw materials and water reuse, innovation and jobs.

47 by the Circular Economy Network and Enea, available at https://circulareconomynetwork.it/wp-content/uploads/2019/02/Rapporto-sulleconomia-circolare-in-Italia-2019.pdf

situation regarding the CE in comparison to the other European countries especially UK, France, Germany and Spain, evaluating the performance over the macro sectors indicated by the EU action plan [48], has defined Italy as the better one in 2019 (as in 2018) for the following aspects:

- 1° in production;
- 3° in consumption;
- 1° in waste management with the Germany;
- 3° in the market of secondary raw materials;
- 2° for innovation and job.

This can reflect a situation where there is a lack of top-down initiatives but plenty of bottom up ones.

48 (Comunicazione COM(2015) 614 final) available at https://eur-lex.europa.eu/resource.html?uri=cellar:8a8ef5e8-99a0-11e5-b3b7-01aa75ed71a1.0012.02/DOC_1&format=PDF: production, consumption, waste management, the market for secondary raw materials and water reuse, innovation and jobs.

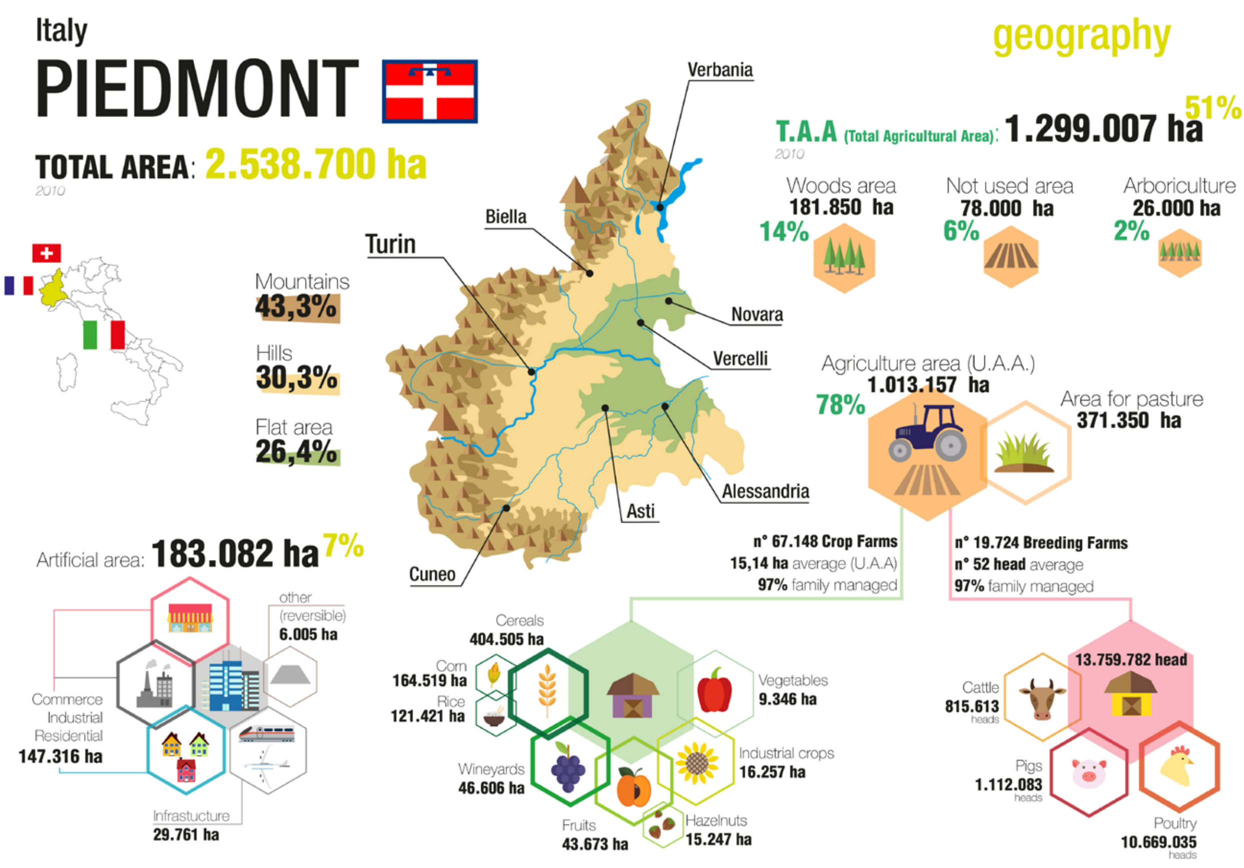


Fig. 6.23 -an overview of geographical context in Piedmont Region. Retrieved from (Battistoni & Giraldo Nohra, 2017, annexes p.145)

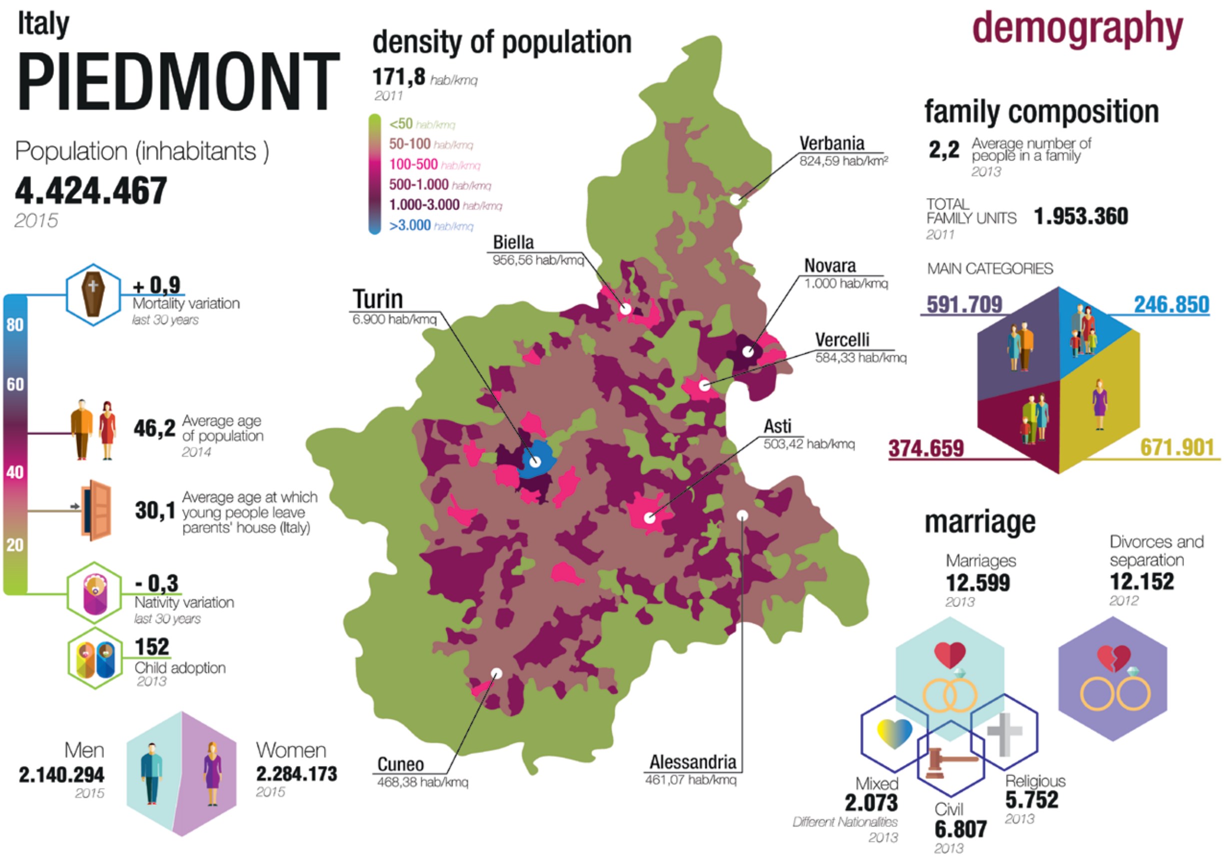


Fig. 6.24 - an overview of demographical context in Piedmont Region. Retrieved from (Battistoni & Giraldo Nohra, 2017, annexes p.145)

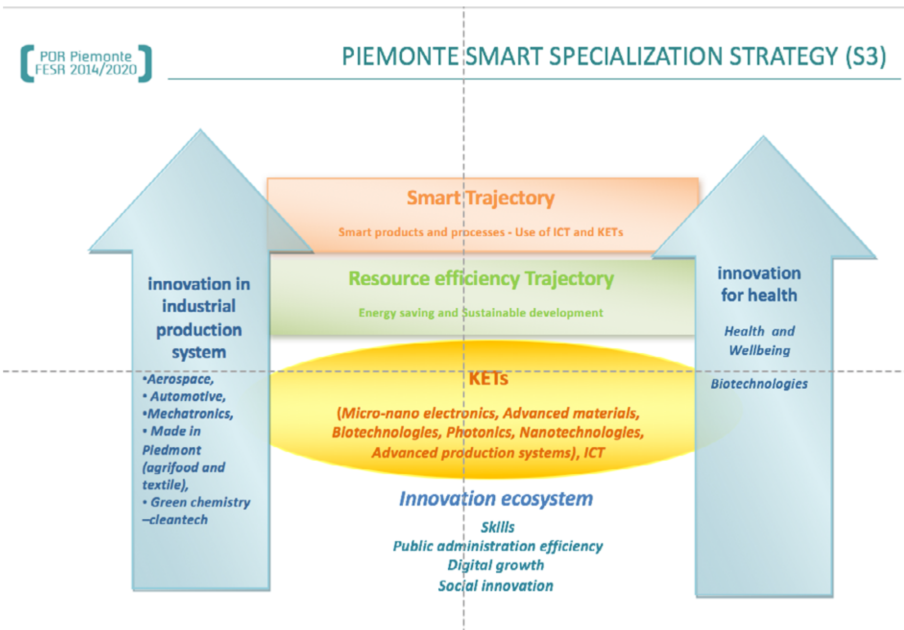


Fig. 6.25 - a graph about the smart specialization strategy in Piedmont. Retrieved from a presentation by Piedmont Region in the Systemic master course

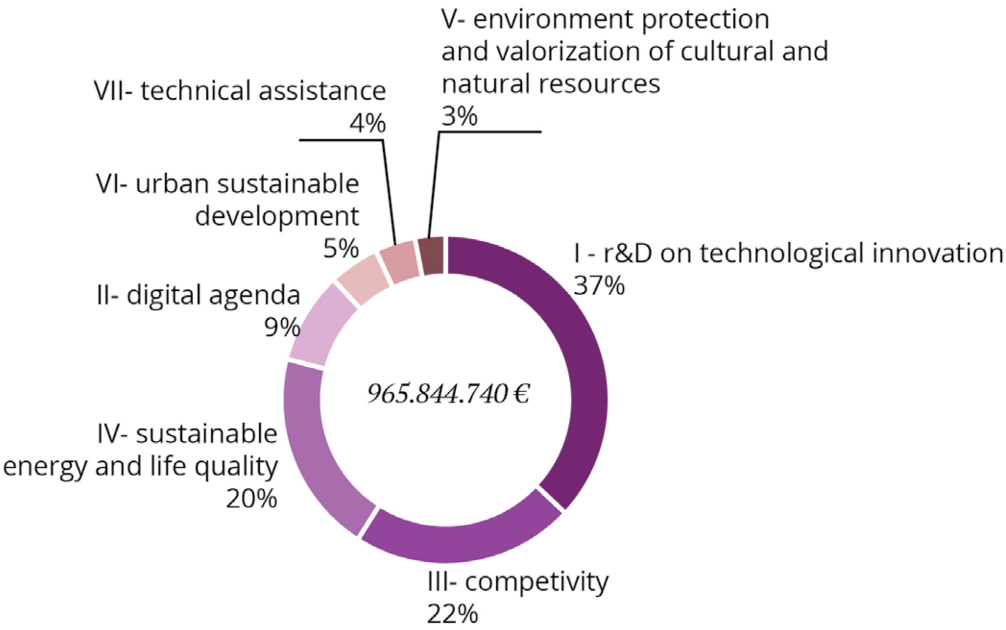


Fig .6.26 - a graph about EDRF funds distribution in the different measures. Based on a presentation by Piedmont Region in the Systemic master course

6.2.3.2. Actors for the Circular Economy development

The main actors working in Piedmont Region, identified also as case-studies in chapter 5 are:

- CLEVER, regional pole of innovation on clean-tech and energy innovation.

Moreover, thanks to the fact that this Region is my home town, the identification of the actors was facilitated. Thanks to this, other actors, programmes and projects were identified that have a specific focus on the CE:

- Turin Living Lab on Sharing and Circular Economy: Action 3.02 Axto deeply analysed with a in-depth interview in the next paragraph;

- IN THE UNIVERSITY:
  - BIOCIRCE master[49]: the first master in Europe about Bioeconomy in the CE (4 weeks of full-time lessons and 6 moths of stages), started in 2017 by national partners, from universities (with also the involvement of University of Torino) to some industrial players in the bioeconomy and the funding of Intesa San Paolo bank;
  - SD master course[50]: The Systemic design MSc is one of the 4 course of the master in 'Systemic Design-Aurelio Peccei' in Politecnico di Torino. It is active from the academic year 2003/2004 and is attended by around 80 Italian and international students each year. It is based on the methodology of SD (see chapter 3) and consists of 4 courses by different disciplines (Battistoni & Barbero, 2017): design, history, economy, environmental engineer (fig. 6.27) .
  - Ph.D. programme 'innovation for the Circular Economy'[51] : Active since 2017, it is a three years industrial doctoral programme in the University of Torino with around 9 students;
  - research groups as the ones in Politecnico di Torino: professor Fino and her course in 'Re-use and energy recovery processes'; the research group of professor Comino and her course in 'Environmental management engineering';

49 http://masterbiocirce.com/
50 https://didattica.polito.it/laurea_magistrale/design_sistemico/en/presentation
51 http://inno-ce.campusnet.unito.it/

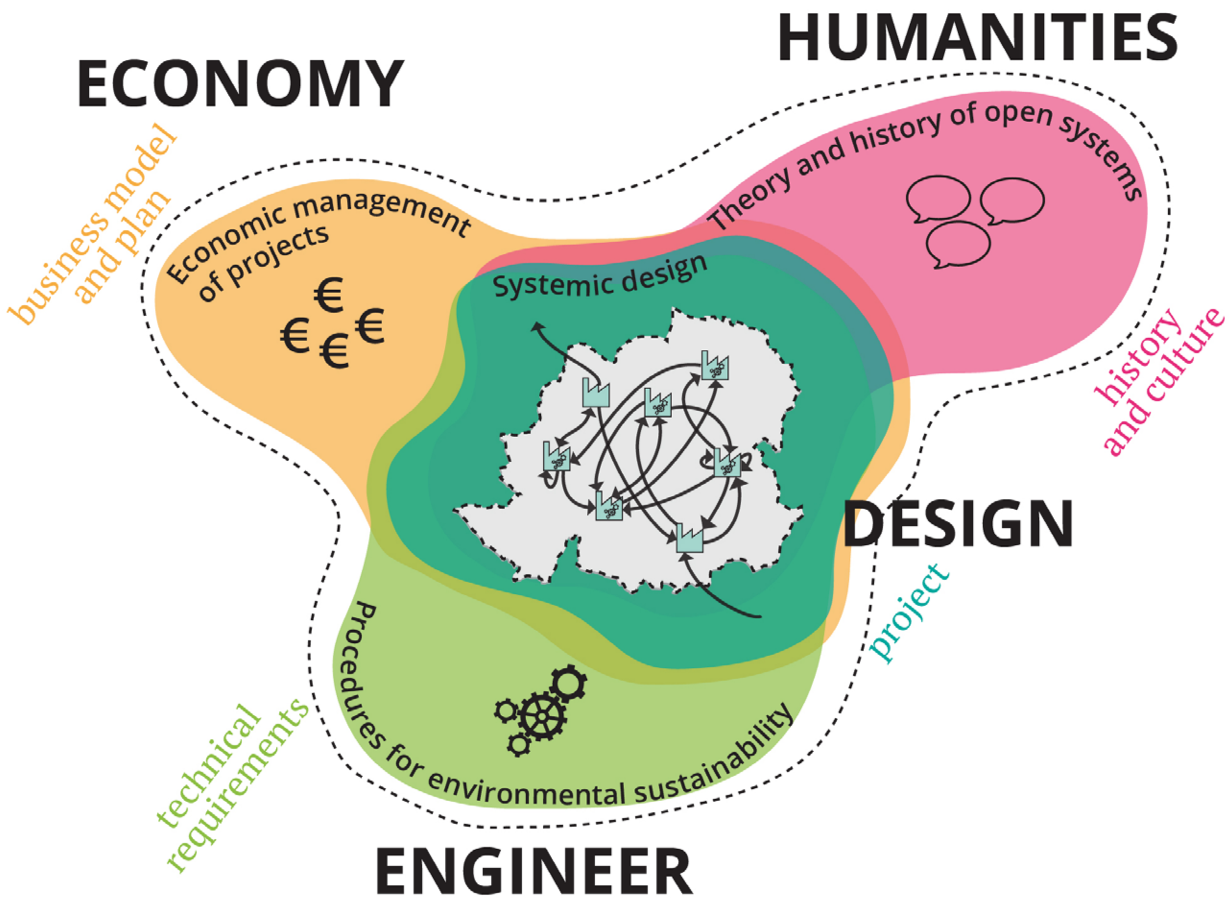


Fig. 6.27 - visual representation of the 4 courses in Systemic Design lab. Published in Battistoni and Barbero (2017).

- PROJECTs
  - RETRACE project[52]: This Interreg European Project RETRACE - A Systemic Approach for Regions Transitioning towards a Circular Economy - is led by the SD research group in Politecnico di Torino and see the involvement of 5 European Regions: Piedmont Region, Nouvelle Aquitaine, Basque Country, North East Romania and Slovenia . The project was able to act directly in 5 actions of the Regional Action Plan of the Piedmont Region in 2019 (Barbero & Giraldo Nohra, 2018): from training activities to a new call for projects which will establish the Bioeconomy platform, expecially dedicated to agri-food, green chemistry and the connection between these areas;
    1) training activities at Politecnico di Torino;
    2) review of regional strategies in view of the new programming, to explicit include the promotion of the CE;
    3) definition of improved evaluation systems for Regional Calls.
  - URBAN WINS project[53]: The municipality of Torino was the pilot city of the H2020 European Project 'Urban Wins' with other 7 cities in Europe to test co-design methods to implement strategies for waste reduction and management . This project which wanted to develop *"innovative strategic plans for urban waste reduction and management"*, funded 3 actions in 2019 in the Torino municipality which were developed in public and co-designed urban agoras with participation of policy makers and citizens[54]:

52 https://www.interregeurope.eu/retrace/

53 https://www.urbanwins.eu/

54 I was involved in all the three projects

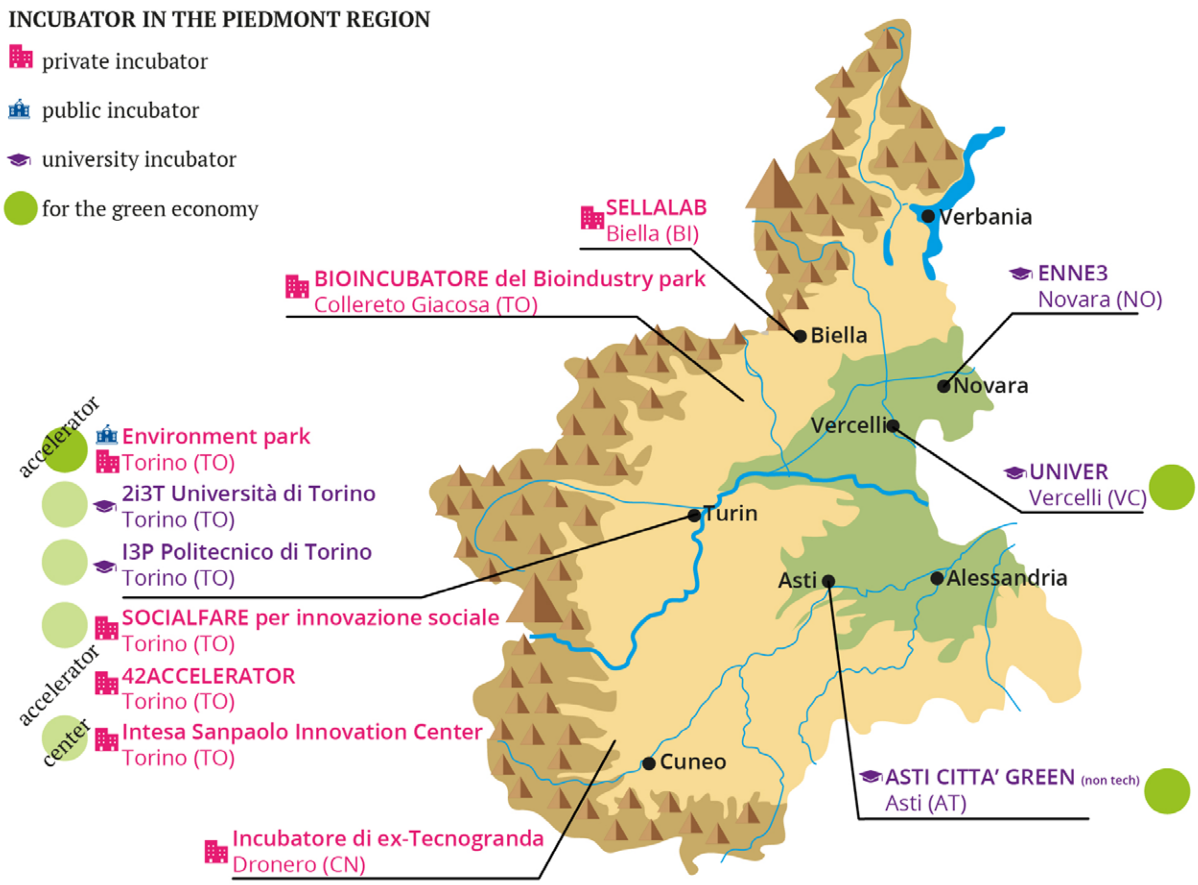


Fig. 6.28 - visual representation of the location of the incubators in Piedmont Region. A green dot is placed next to the one that has a

- CE Hub, an initiative which starts with 4 events with a part of discussion (among citizens, policy makers, academia and companies) and a part of workshops;
- the installation of water stand posts and distribution of reusable cups in public offices to reduce plastic waste;
- definition of sustainability guidelines for the management of public event in open spaces.

• INCUBATORS: In Piedmont Region, are present several incubators, mainly private (in pink in fig. 6.28) and university incubators (in purple in fig. 6.28). Among them, is possible to extract some realities that are working on CE topic or similar:

- Univer in Vercelli (see next paragraph)[55];
- 2i3t in Torino[56]: the university incubator of University of Torino, which have some start-ups working on the topic 'energy and environment';
- Asti città green in Asti:[57] it is a school/laboratory for start-ups addressed to young people (18-35 years old) that is focused on creating added value for the Asti province in activities with zero or low level technologies: from agri-food, to typical products, tourism, culture, wellness, green economy, management of goods and local traditions. Funded by FinPiemonte [58];

55 https://www.consorziouniver.it/it-IT/home/

56 www.2i3t.it

57 https://www.uni-astiss.eu/incubatore.html

58 Piano Giovani 2011/2013 Misura 5 attraverso il Bando per il sostegno finanziario a favore di "Incubatori non Tecnologici".

- I3p in Torino[59]: University incubator of Politecnico di Torino, which is active mainly in the sector of ICT/Digital, Cleantech, Medtech e Industrial;
- Environment park in Torino[60] (see chapter 5 on case-studies);
- Intesa San Paolo innovation Center in Torino[61] : dedicated to the acceleration of enterprises which are focused on current megatrend as Industry 4.0 and CE;
- SOCIAL FARE, in Torino[62]: the first centre for the social innovation in Italy. They offer mainly an accelerator programme for national national and international social impact startups. They are also providing support on 'impact design: We co-design solutions with the beneficiaries, generating awareness and knowledge so to foster and share capacity for systemic change. Our core methodologies – Systemic Design, Design Thinking, Theory of Change – are applied to design sustainable eco-systems.

• Centre for Sustainable Future Technologies of Italian Institute of technology based in Environment Park in Torino[63];

• Tavolo del riuso[64]: it was established in 2016 thanks to the support of Compagnia di San Paolo. It is an open round table for the actors active in the metropolitan city of Torino, coordinated by Triciclo. In there, take part cultural associations, social cooperatives, journals, and all the non-profit subjects that deal with environmental topic and CE. Among the 3R - reduce, reuse, and recycle – they decided to be concentrated on the 'reuse' as suggested by the name;

• Museo A come ambiente[65]: environmental museum with many educational activities and thematic exhibition. Among the partners there are the city of Torino, the province of Torino, the water manager (SMAT), the waste manager (AMIAT), the energy manager (IREN), the transport manager, environmental park and others ;

• Arpa Piemonte[66]: regional agency for the protection of the environment;

• IMPACT HUB, in Torino[67]: Coworking space and a laboratory for the social innovation and social entrepreneurship. It takes part to the international community of 'impact hub';

• Compagnia san paolo:[68] this foundation of a bank is supporting many projects active on the topic of sustainability as 'tavolo del riuso'.

OTHER ACTORS WORKING IN THE INNOVATION ECOSYSTEM

The focus on these actors let also identified other actors which are understood as working for the innovation ecosystem.

• Regional Innovation pole/clusters: They are 7 diffused in the regional territory and are promoted by the Piedmont Region [69]:

59 https://www.i3p.it/
60 https://www.envipark.com
61 https://www.intesasanpaolo.com/it/progetti-futuro/progetti-innovativi/acceleratori-di-imprese-e-startup-intesa-san-paolo-innovation-center-a-prova-di-futuro.html
62 https://www.iit.it/centers/csft-polito;
63 https://www.quotidianopiemontese.it/2018/10/04/istituto-italiano-di-tecnologia-environment-park-e-politecnico-nasce-a-torino-il-nuovo-centro-per-le-tecnologie-future-sostenibili/
64 http://tavolodelriuso.it/il-tavolo-del-riuso/ , https://www.facebook.com/tavolodelriuso/
65 https://www.acomeambiente.org/
66 http://www.arpa.piemonte.it/
67 https://torino.impacthub.net/
68 https://www.compagniadisanpaolo.it/
69 https://www.regione.piemonte.it/web/temi/fondi-progetti-europei/fondo-europeo-sviluppo-regionale-fesr/ricerca-sviluppo-tecnologico-innovazione/poli-innovazione

- Polo AGRIFOOD – Agri-food[70] Manager: M.I.A.C. Scpa;
- Biopmed[71] - life science and health ; Manager: Bioindustry Park Silvano Fumero Spa;
- CGreen[72] - green chemistry and advanced materials; Manager: Ats tra Consorzio Proplast, Consorzio Ibis e Pst Spa;
- CLEVER[73] – cleantech and energy innovation; Manager: Ats tra Environment Park Spa e Consorzio UN.I.VER;
- MESAP [74]- Smart Products and Manufacturing ; Manager: Centro Servizi Industrie Srl;
- Pointex [75]– innovation in textile ; Manager: Città Studi Spa;
- Polo ICT[76] - information technology and multimedia ; Manager: Fondazione Torino Wireless

• Torino city lab[77]: the city of Torino as an open lab to test new technologies. The action tools are living labs, each one with a specific goal, are *"providing the urban territory to create a public – private - people partnership, achieving the innovation model of the quadruple helix"* (Cuomo, Lambiase, Castagna, 2019) (see the action 3.02 axto in the next paragraph);

• Chamber of Commerce of Turin[78]: it has a service dedicated to the support the citizens which have an innovative entrepreneurial idea, with specific traditional services (desk start-up). Moreover, it collaborates in the programme MIP (mettersi in proprio[79]) with the support of Turin metropolitan city and the Piedmont Region, and organize specific meetings and workshops. This program is financed by European Social Fund 2014-2020[80] and is addressed to who wants to start a new enterprise (small, medium or large) or a new start-up or a new enterprise in the primary agricultural production;

• Union Camere Piemonte[81]: the association of the different chambers of commerce in Piedmont Region;

• Confindustria Piemonte[82]:"supports the Territorial Associations and, through these, the associated companies and represents them in relations with the Region, local, national and community institutions.";

• Finpiemonte spa[83]: finance company of the Piedmont Region.

70 https://www.poloagrifood.it/site/index.php?id=1
71 https://www.biopmed.eu/
72 https://www.cgreen.it/
73 https://www.poloclever.it/it/polo-energy-and-clean-technologies/
74 https://www.mesap.it/
75 https://www.pointex.eu/
76 https://www.poloinnovazioneict.org/
77 https://www.torinocitylab.it/it/
78 https://www.to.camcom.it/deskstartup
79 https://www.mettersinproprio.it/2019/03/04/vogliadimpresa/
80 https://ec.europa.eu/esf/home.jsp
81 http://www.pie.camcom.it/
82 https://www.confindustria.piemonte.it/chi-siamo
83 https://www.finpiemonte.it/

6.2.3.3 In-depth analysis with direct intervews and stakeholder group meetings

Turin Living Lab on Sharing and Circular Economy: Action 3.02 Axto

After the identification of the case study Action 3.02 Axto-torino living lab, a previous analysis in the website was made in order to collect the information needed for the analysis and understand if an in-depth interview was necessary. Afterwards, direct contact led to direct interview in June 2019 and emails for follow-up notes.

For each of the questions previously defined in the methodology chapter, the answers are presented in the annexes and also the transcription of the complete interview. The principal concepts from the interview are present in fig. 6.29

How it works (see fig. 6.30): This action was promoted by the city of Torino thanks to the funds received for outskirts enhancement by the Italian Government. It is a call addressed to entrepreneurs with a project related to a circular and collaborative economy, and aimed at experimentations of maximum 9 months with a fund of max 15.000 euro, in specific areas of the city outskirt, which ended in September 2019. Moreover, the call required an active involvement of the citizenships and the build of partnerships with the civil society. The call expected the presence of a facilitator actor with the goal to support the experimentation in all the phases. For this reason, the call was opened for the management body which was won by an actor which included many actors and consultants: a communication actor (European research institute), a budget controller (Envipark), a workshop manager (Socialfare) and 2 consultant experts on circular and collaborative economy.

Feedbacks from their experience: The interview with two actors of the management body, experts in the CE, has permitted to understand the main limitations of these action (fig. 6.31), as: the few communication between the different city government divisions; limitation of the experimentation in time and budget; difficulties in relationships among the government, the management body and the entrepreneurs. Although the action seems that it will not be re open, one of the main goal of the city with this action was to understand how to facilitate the creation of a local hub for the circular and collaborative economy for the sustainable local development. The management body indeed should produce in November 2019 (after the finish of this thesis) a report on the impact of this project and the useful indications for the city government. In the meantime, in the interview came out some useful indications for the hub (fig. 6.32) which are similar to the one published in Cuomo, Lambiase, Castagna (2019), a paper that was published after the interview.

Points of interest for this research and local ecosystem mapping: This first experience of the city of Turin for the development of local CE is interesting to receive feedback about how the CE is perceived at the local level, in the biggest city of Piedmont Region, although the focus was both on circular and on social economy. The action highlights the need of support on the design phase of the business creation for the novelty of this approach and the necessity to check all its innovative aspects. An important aspect was the direct involvement of the civil society from the beginning: both as an organization partner in the project, and the importance given to the communication phase directed to the local community. A restrictive aspect was the eligibility of projects dedicated only to certain districts of the city.

From this city action, the CE experts have extracted feedbacks for the creation of a potential future hub for the CE in the city. They insisted on the fact that the circular hub is a question of governance, and the government should learn from the action and shift from a regulatory subject to a negotiator actor, that negotiate solutions and regulations with the other subjects. Moreover, it has to be set as the strategy for the city government, a political intention, which is not there today.

Fig. 6.29 - the principal and relevant highlights of the interview to AXTO case study

build competencies and know-how for the city observing its limits
the intention to work on circular and collaborative economy came from the city
the topic has been defined by the city, which has to learn

the 'city' actor it's not clear who is it, it is fragmented with different intentions and results

Limited funds and internal organization of the city government

...it's a fact of transition to a different way to make economy
facilitate the transition to a new economic model

foster a different entrepreneurship
generate a different entrepreneurship, which care about this topic

weak design ... unclear objectives ... sometimes they didn't have to do with circular economy
help in creating partnerships and involving the territory
problems in the design phase

the involvement of the local community is a relevant aspect, create a common language and create consensum
involvement of the citizenship

the partnership with someone of the civil society was a necessity but also an opportunity
the quadruple helix in action

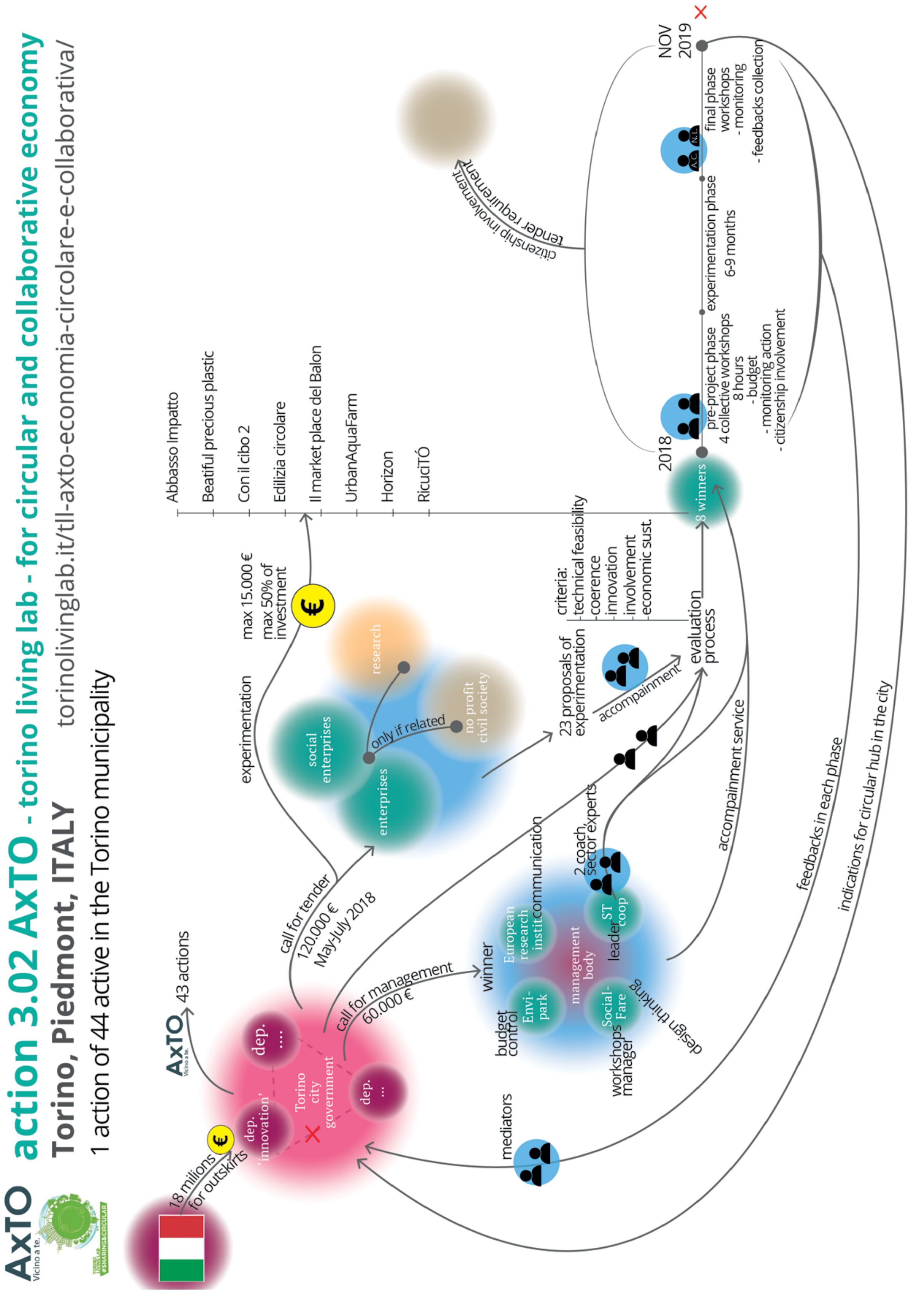


Fig.6.30 - gigamap about the information collected in the in-depth analysis of Axto

Fig.6.31 - gigamap about the information collected in the in-depth analysis of Axto with problems identification

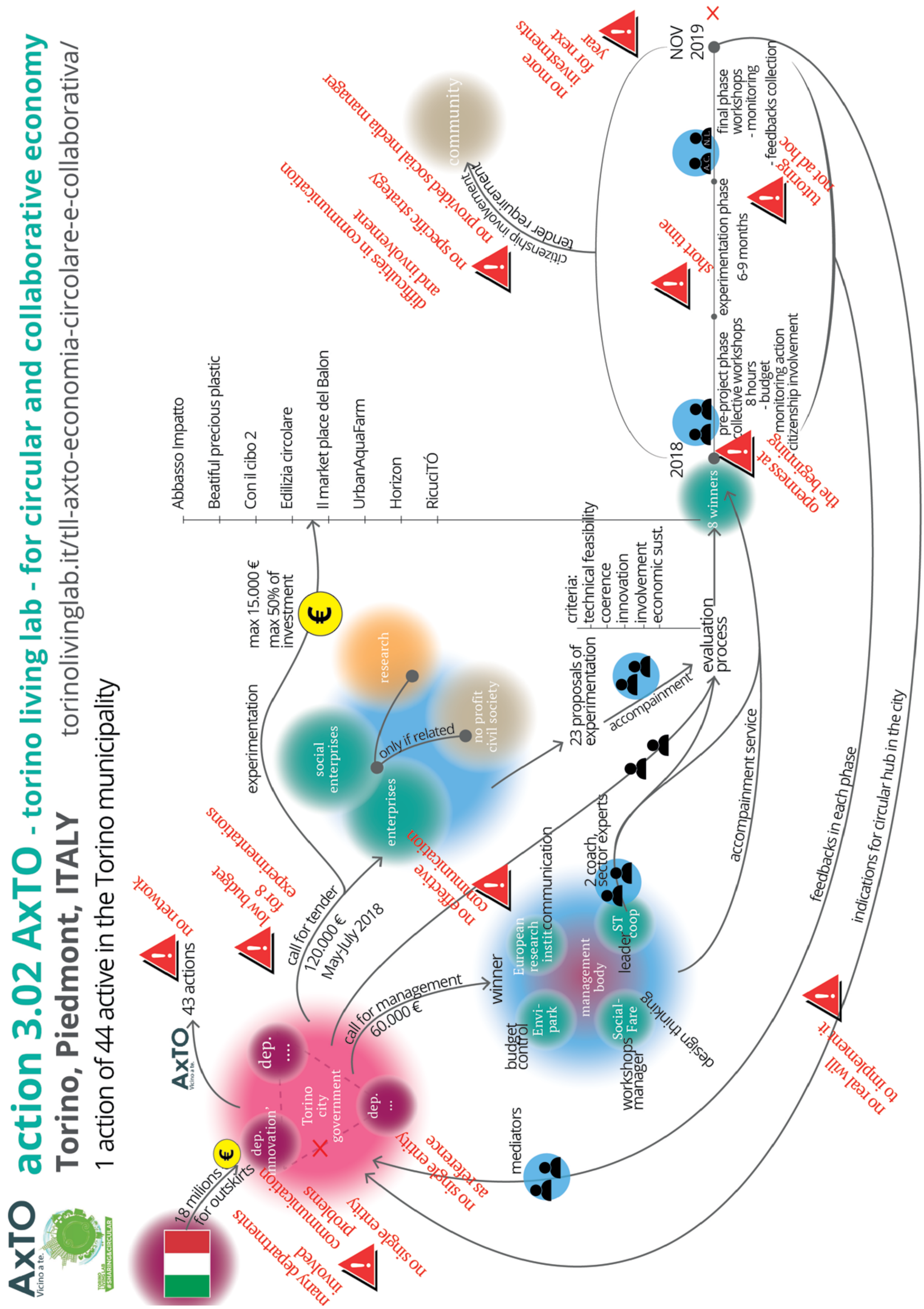


Fig. 6.32 - the principal and relevant highlights about the indications for a circular hub which came out from the interview to AXTO

the call has in origin the goal to design an hub for the circular economy

it is a strategy of the city government

few political intention

it starts a reflection on the action of the overall context as enabling

it is not a question of place where physical action happen, but of governance

it has the goal to give the city government the ability to build a further step

government as enabler

it is a question of governance

the hub is a facilitator

there is the need to build horizontal and vertical relationships .

the government can enable the other elements of the entrepreneurial and research context.

indications for a circular hub

the government makes happen normative actions, incentives and penalty, it is the direction

the laws and regulations are not rigid, but element of support to the evolution of the system

regulations are accompanying regulations

government: from regulatory subject to negotiator

government: from regulatory subject with absolute power
to a subject that negotiate the solutions with other subjects

paradigm shift

it is a big cultural paradigm shift, from linear to circular

UNIVER

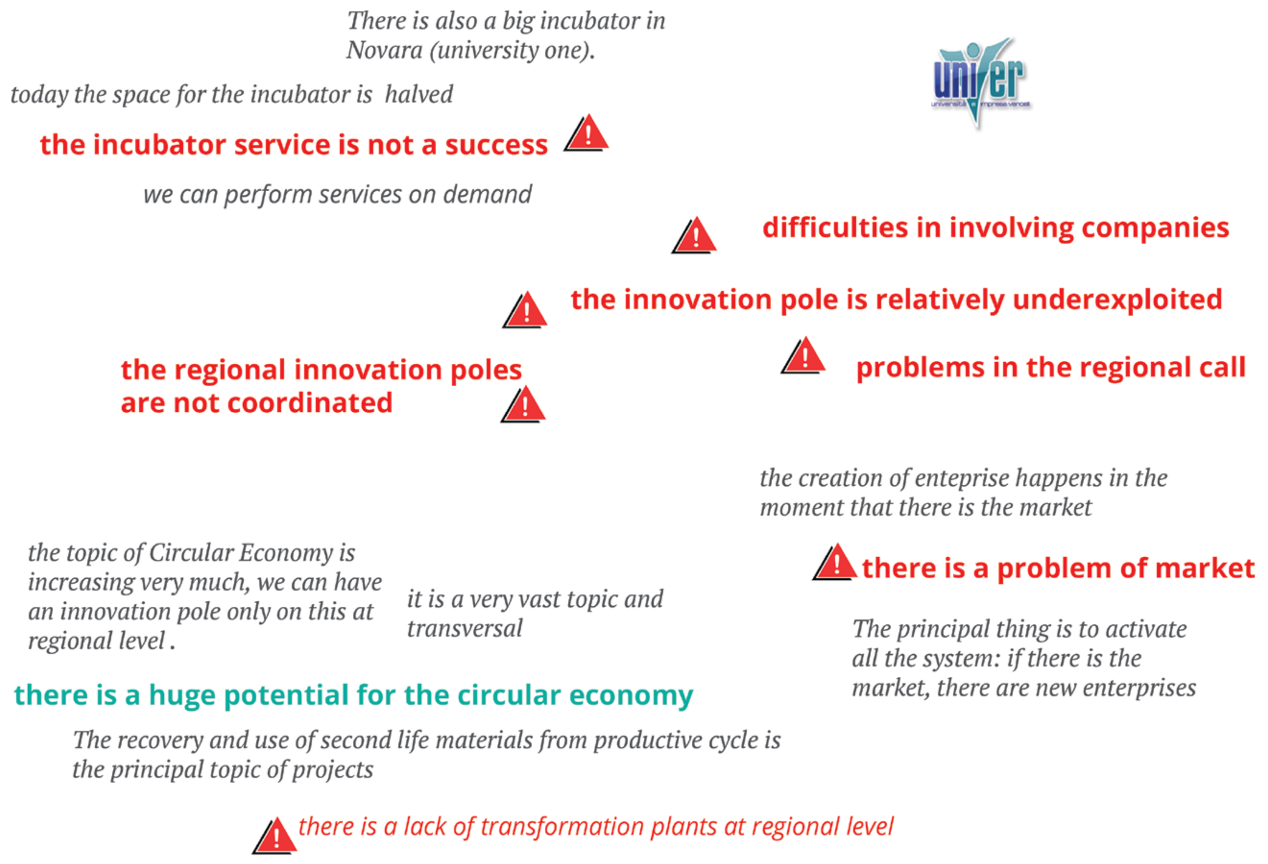
Another case identified to deepen the analysis was the innovation pole Clever, just analysed briefly in chapter 5. The analysis was especially focused on understanding more about the incubator experience, which is managed by Univer, one of the two management bodies of the Clever cluster. For this reason, was interviewed a person working in Univer in July 2019.

In this case, due to the fact that the incubator activity is in a momentum of low exploitation, the collection of information mainly focused about understanding the reason behind, and the role of the innovation pole. In the annexes, are present more info and the transcription of the complete interview. The principal concepts from the interview are present in fig. 6.33

How it works (see fig. 6.34) : The interview with Univer demonstrated that the activity of the incubator was in the clue part in 2014 and nowadays is relatively underexploited: although it can provide its services, it isn't receiving applications. Maybe also due to the fact that before they were located next to the chamber of commerce of Vercelli and now they changed location with also less co-working space.

Feedbacks from their experience: The interview revealed that actually this management body of the Clever pole is composed only by few people, although it constitutes the part of the innovation pole which is able to reach also the companies that are located outside of the Torino city and near the production and agricultural area of Vercelli and Novara. The reason behind it can be the underexploited capacity of these regional innovation poles: although they can provide many services, the enterprises are interested in them only in the occasion that there is a call for funding. Moreover, there are also reasons related to the regional calls, which have specific requirements. In addition, there is a less attention by the region to

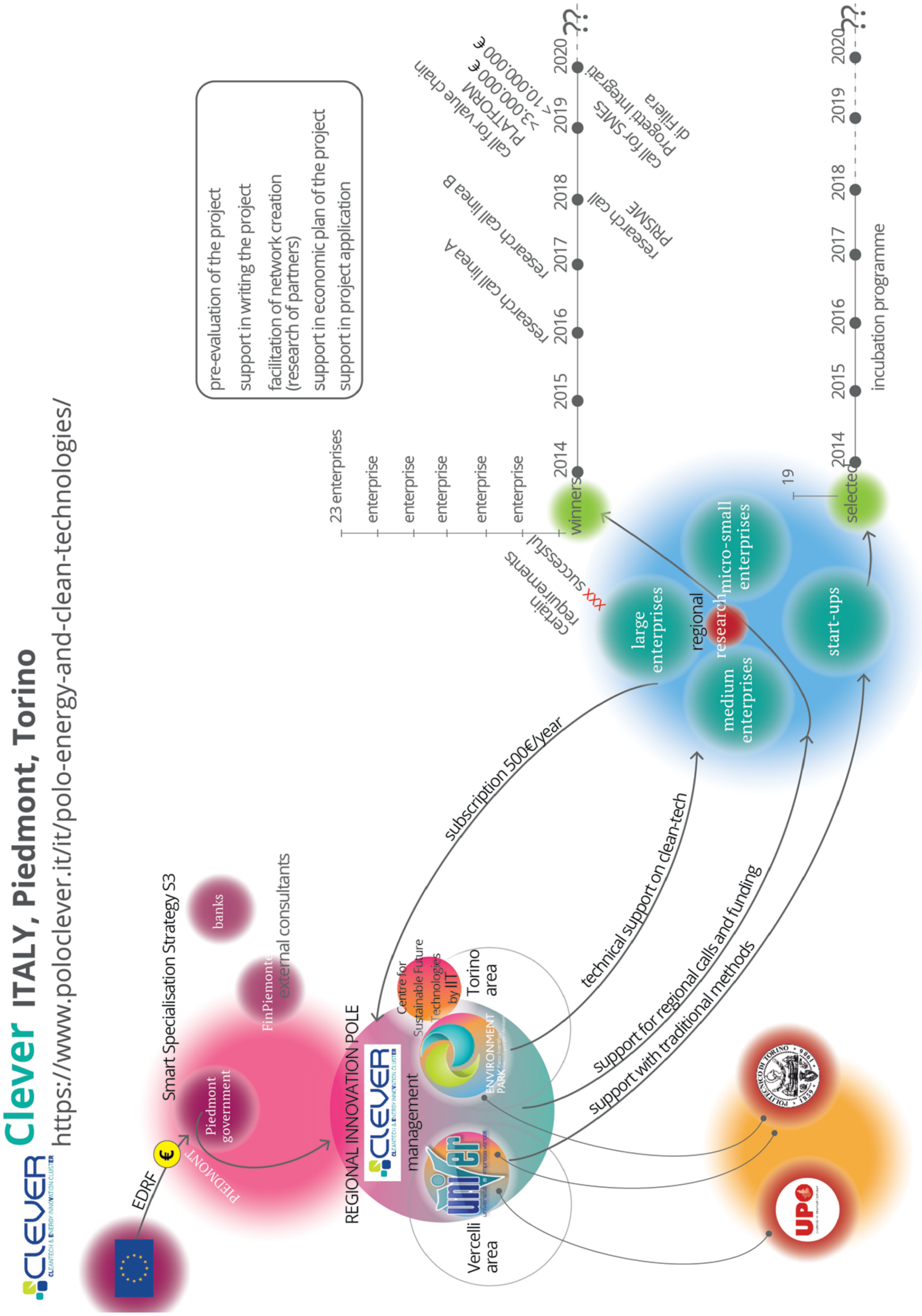
Fig. 6.33 - the principal and relevant highlights of the interview to Univer



them which can cause the presence of uncertainties about the future of the poles in the next years.

Points of interest for this research and local ecosystem mapping: However, during the discussion emerged many potentialities related to their service ‘audit’, the assessment of the current situation with respect to the CE and the change of production models in the existing companies, although today this is not a specific focus. However, they perceived that today the market is not completely ready. In addition, another problem can be the lack of specific plants to help the manufacturing sectors doing some processes.

Fig 6.34 - gigamap about the information collected in the in-depth analysis of Clever (Univer is comprehended)



RETRACE'S LOCAL STAKEHOLDERS GROUP MEETINGS

Another case identified to deepen the analysis was the innovation pole Clever, just analysed briefly in chapter 5. The analysis was especially focused on understanding more about the incubator experience, which is managed by Univer, one of the two management bodies of the Clever cluster. For this reason, was interviewed a person working in Univer in July 2019

In this case, it wasn't conducted a single interview, but the feedbacks coming from the RETRACE project's local stakeholders group meeting were collected.

How it works: During the RETRACE project duration 2014-2020, the local stakeholders group meetings in Piedmont Region were 6:

- 7th July 2016
- 6th December 2016
- 11th July 2017
- 13th February 2018
- 4th December 2018
- 17th September 2019

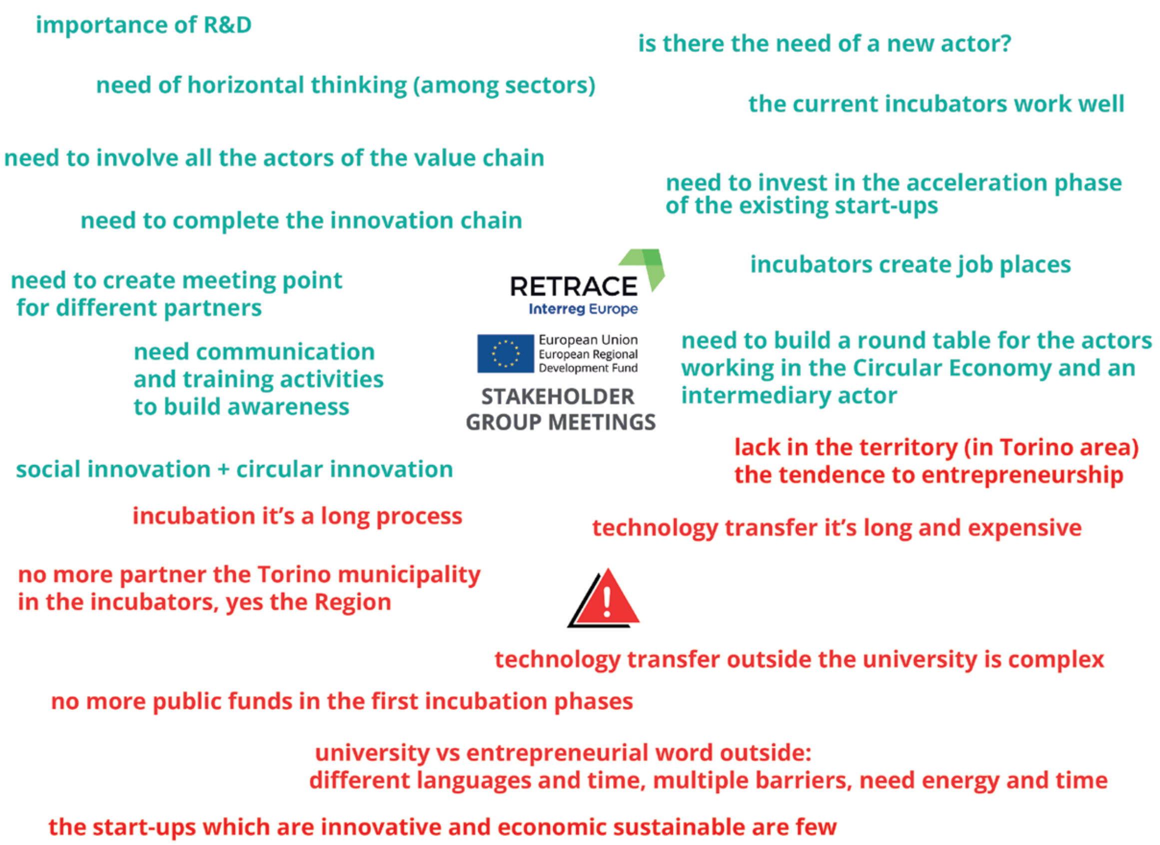
The local stakeholders identified and that participated were 16:

- Regional innovation pole CGREEN - Green Chemistry
- Regional innovation pole CLEVER – Clean Energy
- Regional innovation pole PO.in.tex - Textile
- Regional innovation pole MESAP - Smart Products and Manufacturing
- Regional innovation pole Agrifood
- SAF - Systemic Approach Foundation
- 2i3T Incubator
- Enne3 Incubator
- I3P Incubator
- Museum 'A come Ambiente'
- AMIAT s.p.s., Iren group
- ANFIA - Associazione Nazionale Filiera Industria Automobilistica
- Torino Chamber of Commerce
- Triciclo Soc.Coop.
- Città dell'arte - Fondazione Pistoletto
- European Regional Council

During the several meetings, all the feedbacks from their experience were collected. The principal one are present in fig. 6.35

Feedbacks from their experience and points of interest for this research and local ecosystem mapping: During the meetings, the stakeholders shared the feedbacks about their role in the local ecosystem and in the circular economy development and proposed suggestions on how to improve it.
For example from the incubators, which are mainly linked with the universities, emerged the importance of transferring the technology outside the university which is a complex process, for problems linked to: different languages, different time, needs of funds in the first incubation phase but also in the acceleration one. However, they recognized that the current incubators are working well, but that is missing both the financing support from the public sphere. Moreover, is missing an entrepreneurial culture, especially in the city of Torino which has a flourished industrial past that today is missing and need a transformation. Along to the incubators, other actors emerged as the regional innovation poles, which insisted on the need to complete the innovation value chain, and to involve all the actors, from start-ups to SMEs and large companies, to research centres. With respect to the CE development, emerged the need to think horizontally, in order to involve all the industrial sectors, without making actions only for specific sectors. Another point that has emerged is the importance to link circular innovation with social innovation. The last one has emerged a lot in Piedmont area with actors as 'tavolo del riuso' and 'socialfare'. For these multiple reasons, all the stakeholders discussed a lot on the need or not to create a new actor, for the multiple one already existing. They finally recognized at least the need of an intermediate actor between the private subjects and the policy makers to report all the problems and opportunities which always emerged more rapidly. Furthermore at last, they underlined the need to create training activities to increase the awareness of the companies but also of the local communities on CE and sustainability in general. For the last reason, it was also requested the need to financially support the communication activities of the companies and projects to the local community, which is the future market.

Fig. 6.35 - the principal and relevant highlights of the RETRACE stakeholders group meetingsr



6.2.3.4. The Piedmontese ecosystem for the Circular Economy

ECOSYSTEM COMPOSITION:
If the quadruple helix innovation model is applied to define the role of the actors in the business and entrepreneurial ecosystem of Piedmont region, the actors are placed in the different spheres as represented in fig 131.

AIMS AND OBJECTIVES
The horizontal trajectory based on smart products and processes and resource efficiency of the smart specialization strategy in Piedmont Region (s3), dealing with energy saving and sustainable development, cannot be really understood as a strong statement by the political sphere as an action toward a different economy. This hasn't produced a real local ecosystem for CE implementation, but seems that in the Region many actors are present, although they are working individually (fig. 6.37). Moreover, nowadays there is no one that is dedicated to CE, but occasionally becomes one of their topics of actions. In addition, considering the Piedmont Region, is possible to notice a concentration of the actors in the city of Torino, while the production sectors in very diffused in all the region, with the presence of some industrial districts as textile, food & beverage, gold, metals, housewares, automotive (see chapter 9).

IMPORTANT INSIGHTS
Although in the region seems that is not present a strong and linear direction towards a different type of economy, and lacks of a top-down approach from the government sphere, considering the quadruple helix many actors and many competencies are present: for example the university is moving to provide new skills (e.g. the UNITO master on CE, the SD research group the master degree in Politecnico di Torino and other research groups , the national master biocirce with also the involvement of University of Turin and many research groups), the A come

Ambiente environmental museum is providing many educational activities and exhibition. Moreover, the city of Turin is moving the first steps to create a hub for the CE, as represented by the action Axto 3.02. In addition, the Clever innovation pole has the competencies and instruments to support the transition of the present companies in clean-tech sectors. Active seems the non-profit sector, as the network of 'tavolo del riuso' (the table of re-use) which gathers the actors that believe and deal everyday with the topic of environment, sustainable development and CE, with the goal to produce knowledge and create networks.

Another example is the entrepreneurial ecosystem that, according to Colombelli, Paolucci, & Ughetto(2019) is "widespread and prosperous". They identified indeed 59 institutions (fig. 6.36) among the categories that characterize an ecosystem: "associations, community, and coworking; education and research; incubators, business and innovation centres, accelerators, and science parks; investors; public institutions; and trade associations". Moreover, *"These institutions provide a broad range of services (i.e., education and research, incubation and acceleration, financing, provision of technological infrastructure, professional, technical, administrative, and facility management services)"* [...] *"Turin's entrepreneurial ecosystem is now in the B transition phase and shows a governance design that is somewhere in the middle between the hierarchical and relational mode". They in addition stated that especially the category of Business incubators, business and innovation centres, accelerators and science parks "is particularly lively"*. (Colombelli, Paolucci, & Ughetto, 2019).

In addition, the recent published study about the action 3.02 axto, especially regarding the situation in Turin, also identified that *"there is an emerging network of local businesses, associations and committees of citizens increasingly active in the field of sustainable entrepreneurship"* and that moreover agreed that the challenge of the local ecosystem is to *"bring together different actors on both a local and global scale to promote real changes in environmental regeneration and citizen services policies"* (Cuomo, Lambiase, Castagna, 2019) .

Fig. 6.36 - the incubator ecosystem in Torino. Retrieved from Colombelli, Paolucci, & Ughetto (2019)

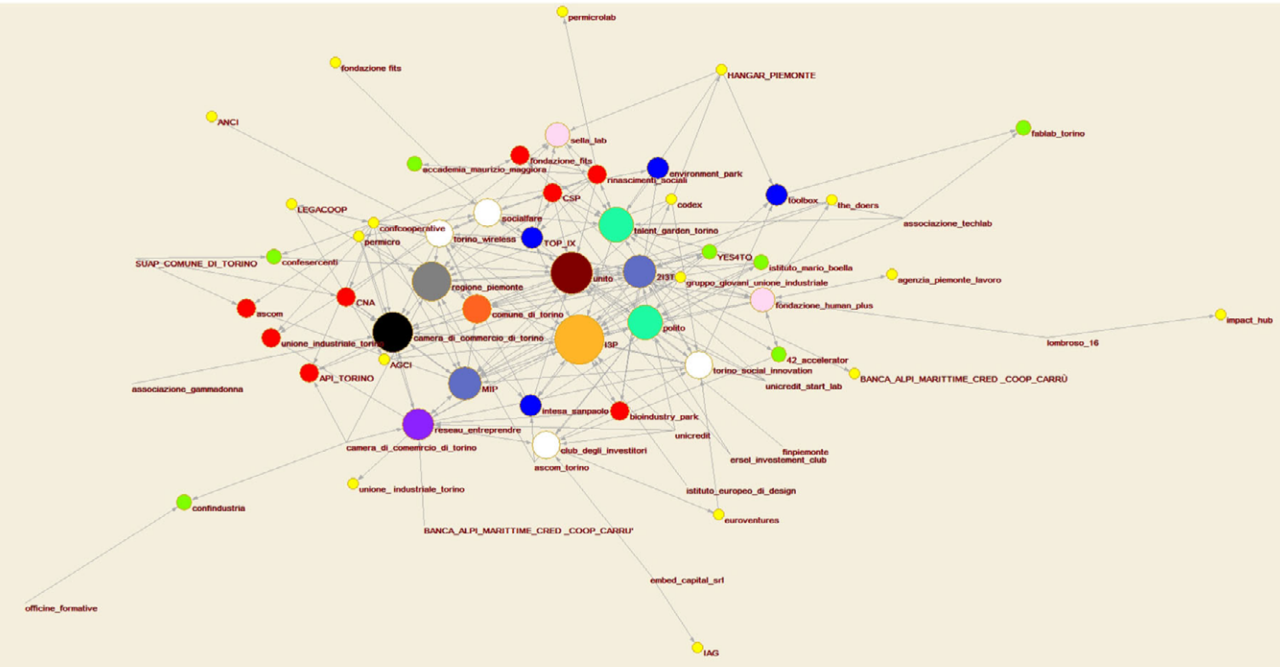
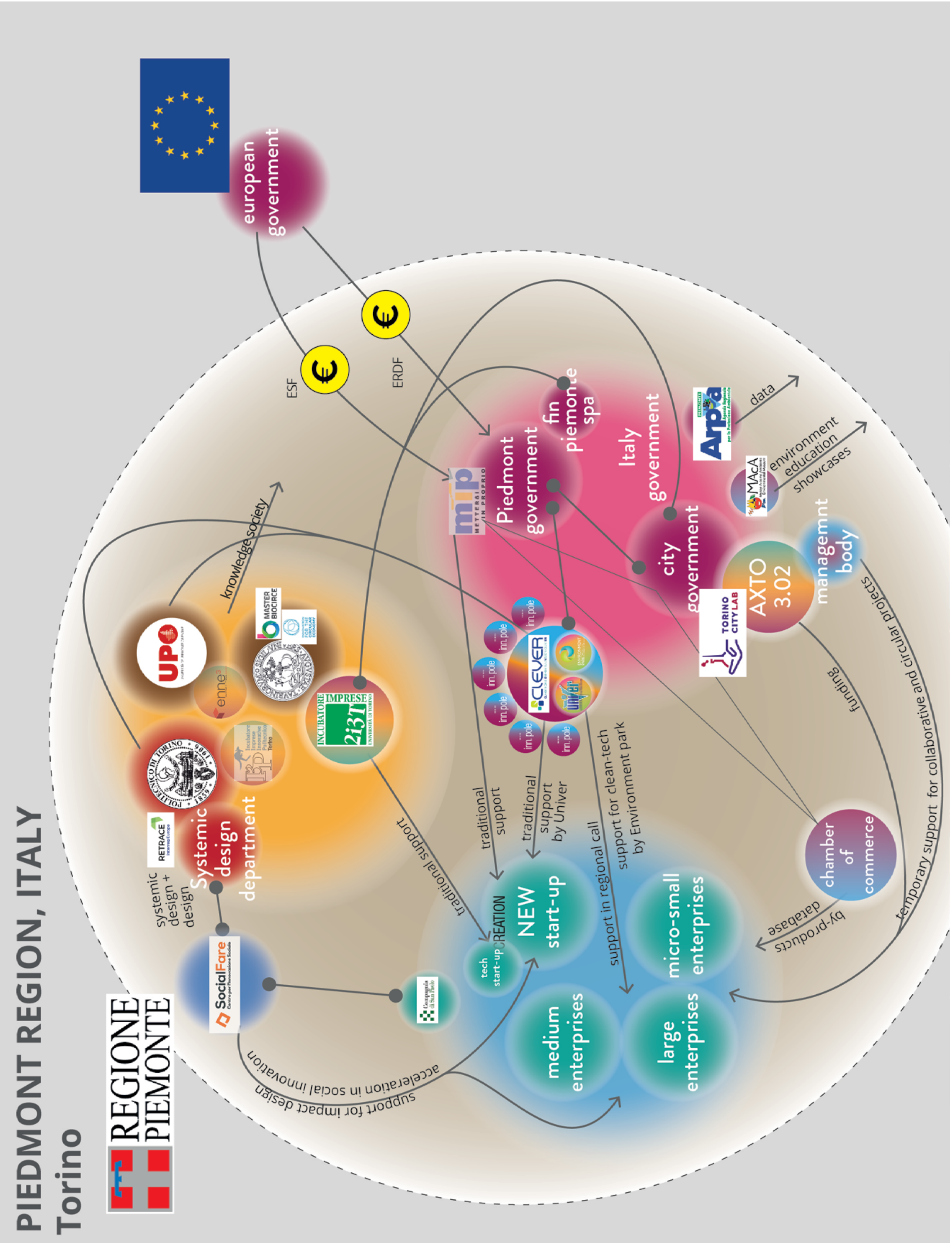


Fig. 6.37- the current relationships among the actors in the eco innovation ecosystem



6.3 LOCAL ECOSYSTEMS COMPARISON

The analysis of the three local ecosystems let the comparison between them, although they are three different realities in terms of size, population and government (see tab. 6.3). Indeed the Netherlands is a country, Scotland a constituent country and Piedmont is a Region. Moreover, the first two are governed by a constitutional monarchy while Piedmont is part of the Italian Republic.
Discussing about their approach to innovation, according to the European innovation scoreboard (fig. 6.38)[84] in the Netherlands there are some areas that are leaders, Scotland is in a strong position while Piedmont is moderate.
Both in Scotland and in the Netherlands strong statements by the political sector have driven a very active ecosystem with respect to the creation of a local eco-innovation ecosystem for CE:

- in the Netherlands, with the programme *"Nederland Circulair 2050"* they published in 2016 the statement to become fully circular by 2050, working mainly on the following sectors: biomass and food, plastics, manufacturing, construction, and consumer goods;
- in Scotland, in 2015 the government published

84 According to the 2019 Regional Innovation Scoreboard. Report Available at https://ec.europa.eu/growth/sites/growth/files/ris2019.pdf

Tab. 6.3 - Data comparison among the three European Region analysed. The data about Europe are from https://en.wikipedia.org/wiki/European_Union

	SCOTLAND	THE NETHERLANDS	PIEDMONT REGION	EU
AREA	78.772 km^2	41.543 km^2	25.386 km^2	4.475.757 km^2
POPULATION	5.295.400 in 2011	17.093.000 in 2017	4.424.467 in 2015	513.481.691
POPULATION DENSITY	67,5/km^2	417,7/km^2	171,8/km^2	117.2/km^2
GOVERNMENT TYPOLOGY	Devolved parliamentary legislature within a constitutional monarchy	Unitary parliamentary, constitutional monarchy	Region in an unitary parliamentary republic	Supranational and intergovernmental
INNOVATION SCOREBOARD (2019)	Strong +	From moderate + to leader	Moderate +	(see fig.)
DESIGN INCLUDED IN NATIONAL INNOVATION POLICY	No (Yes in Uk in 2014, following Whicher, A. (2014)	No in 2014, following Whicher, A. (2014)	Yes in Italy in 2014, following Whicher, A. (2014)	Action Plan for Design-driven Innovation in 2013
STRATEGY FOR CE	Yes, "*Making Things Last: a Circular Economy strategy for Scotland*"	Yes, "*Nederland Circulair 2050*"	No (Yes in Italy "*Towards a Model of Circular Economy for Italy. Overview and Strategic Framework*")	Yes, "*Towards a Circular Economy: A zero waste programme for Europe*" and "*Closing the loop - An EU action plan for the Circular Economy*"
DESIGN INCLUDED IN INNOVATION POLICY FOR CE	Yes, with a dedicated chapter	Yes, circular product design	No (Yes in the national one, in underlined the fundamental role in CE)	Yes, product design

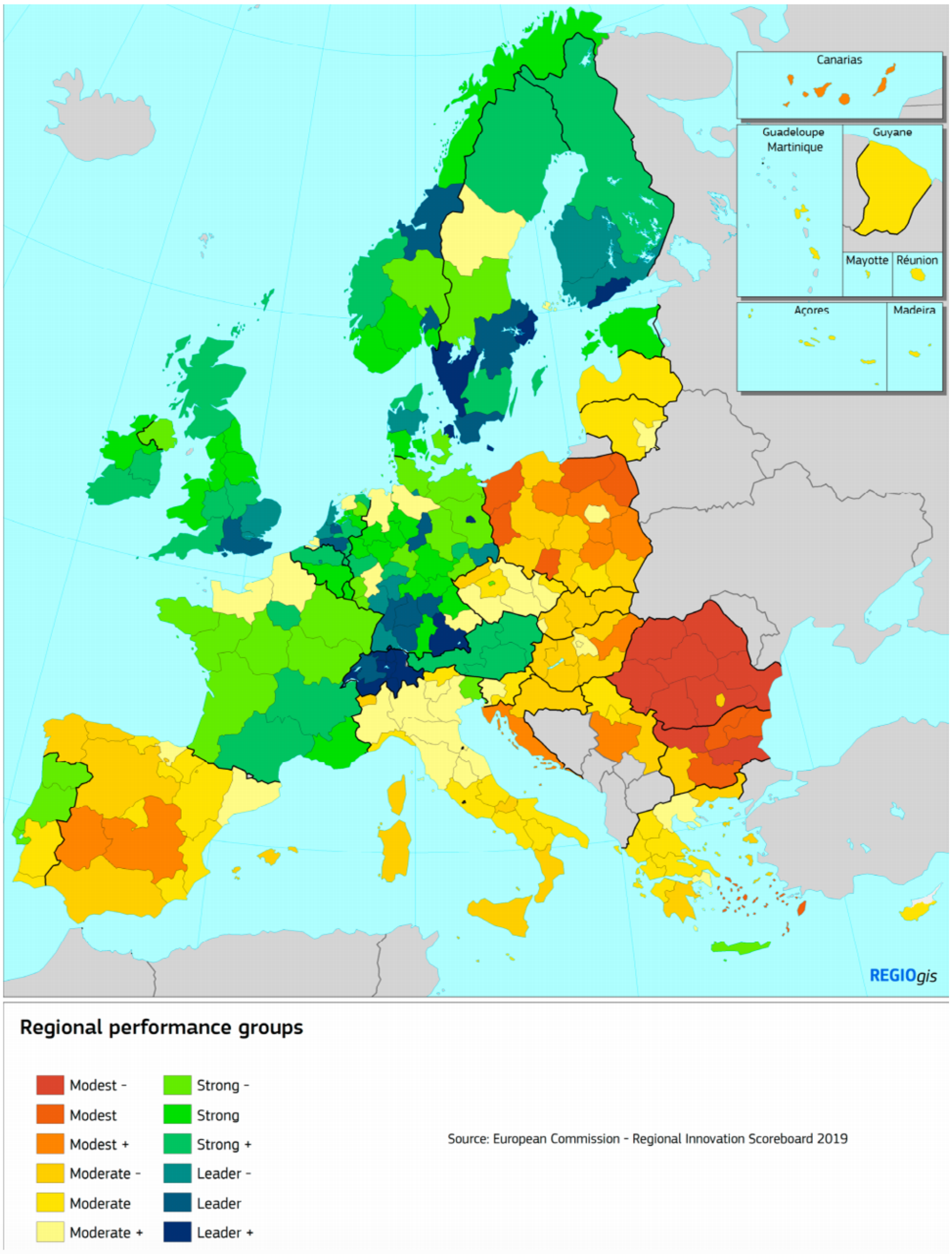


Fig. 6.38 - The European Regional Innovation Scoreboard. Retrieved in 2019 from the official report. Report is available at https://ec.europa.eu/growth/sites/growth/files/ris2019.pdf

the report *"Making Things Last: a Circular Economy Strategy for Scotland"*, working on: waste prevention, design, reuse, repair, remanufacture, recycling, producer responsibility for reuse and recycling, recovering value from biological resources, energy recovery, landfill.

In Scotland, the transition to a CE has started thanks to £73million received from the European Structural funds which through the governmental agency ZWS is able to manage and devolve £18million, with a maximum of 1 million for activity, to the Scottish SMEs to accelerate the transition to a circular and resource efficient economy. ZWS has also funded the Circular Glasgow initiative in the city of Glasgow, which are supporting the local enterprises to the transition to a CE. They have also involved Circle Economy in the Netherlands to support them to develop the city scan which highlighted the opportunities, providing concrete examples and strategies for the local entrepreneurs. They are also providing the circle assessment tool to the enterprises that want to understand criticalities and opportunities in the CE.

In the Netherlands, the city of Amsterdam is very active and is working with many consultants, thanks also to the strong statement by the government, they are dealing with CE and topic of sustainability in general. There are some very interesting cases as Metabolic, which are applying the systems thinking in their work, and the Circle Economy which provides many services and are developing many tools for the enterprises and the cities and working worldwide. In addition, the city of Rotterdam seems have started many activities, doing a city scan with Circle Economy, thanks also to the presence of Blue City that is working as a business incubators but for an different economic model.

In Piedmont, the horizontal trajectory based on smart products and processes and resource efficiency of the smart specialization strategy (s3) cannot be really understood as a strong statement by the political sphere as an action toward a different economy, as in Scotland and in the Netherlands with the CE. This hasn't produced a real ecosystem for CE implementation, but many actors are present that are working individually. In addition, it is possible to notice a concentration of the actors in the city of Torino, while the production sectors in very diffused in all the area of the region, with the presence of some industrial districts as textile, food & beverage, gold, metals, housewares, automotive. There, the actions of the innovation poles working with the enterprises seem to have a great potential which today is underexploited. Moreover, there is a vivid entrepreneurial ecosystem mainly based on the business incubators (in Torino) which however are focus only on technological innovation, without really considering the environmental impact and implications. The Italian government is lacking in giving specific directions over the CE: they published a small document on strategy framework without giving really an action plan. However, the performance over the CE in Italy seems in line with the other leader countries. This can reflect the possibility that in Italy, although the government is in late with top down initiatives due to high political instability, there are a lot of good examples of bottom-up initiatives.

IMPORTANT INSIGHTS

The comparison among the three different ecosystems let emerge many important insights about the CE implementation:

- a strong statement by the political sector, with a public strategy, can drive the creation of the ecosystem;
- however, the public strategy doesn't represent the quantity of bottom-up actions that enterprises are making alone;
- the relationships among the actors of the quadruple helix which can drive innovation is important also in the case for circular innovations;
- the instrument of the 'city scan' seems useful to map the current situation and find future opportunities for the entrepreneurial sectors;
- as underlined by the literature, the design plays a part in the creation of a CE and it should be considered in the policy strategy;
- CE implementation requires vast funds for the experimentation phase and is important to let freedom also to make mistakes and fail;
- the EU funding can represent an important support for the countries;
- the communication of successful cases studies can boost the entrepreneurial sector to take the first step;
- along to communication actions for the enterprises, important is also the communication to the local community which represents the future market.

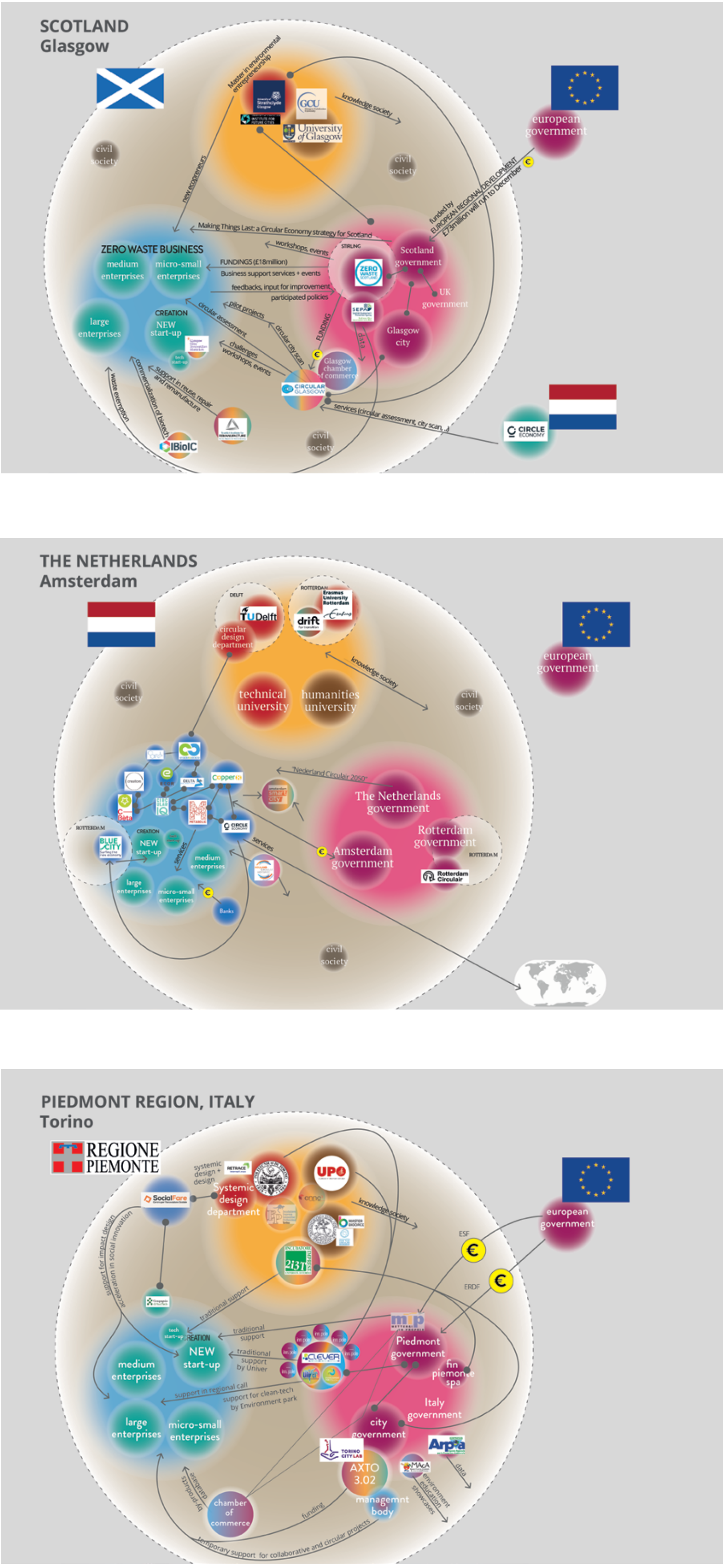


Fig. 6.39 - The comparison among the CE innovation ecosystem

Chapter 7

Opportunities and barriers and of Systemic Design projects

The application of SD specific methodology in different projects over the years has demonstrated its ability to create eco-innovation for sustainable local development (Bistagnino, 2011; Bistagnino, 2017) and rural development (Barbero, 2018). The application of this approach to production models, acting mainly on a different cultural paradigm, from linear to systemic and circular, is able to create new opportunities to produce the economic, environmental and social sustainability and that can stimulate the entrepreneurial system for their implementation. The literature has highlighted important characteristics of SD projects to reach a sustainable local development, although the opportunities at the entrepreneurial level have never been defined. Moreover, the problems related to projects implementation, that sometimes cause their failure has never been studied. Indeed, the particular characteristics of these projects are strong points, but at the same time, they can represent the barriers for their success and implementation.

For this reason, the implementation barriers from one side, and the opportunities created from the other side, were studied more in depth. This chapter shows this analysis, process of discovering, enabled by my experience and involvement in many SD projects (fig. 7.1) and my experience as assistant teacher in the SD course in the master 'Systemic Design' at Politecnico di Torino (fig. 7.2).

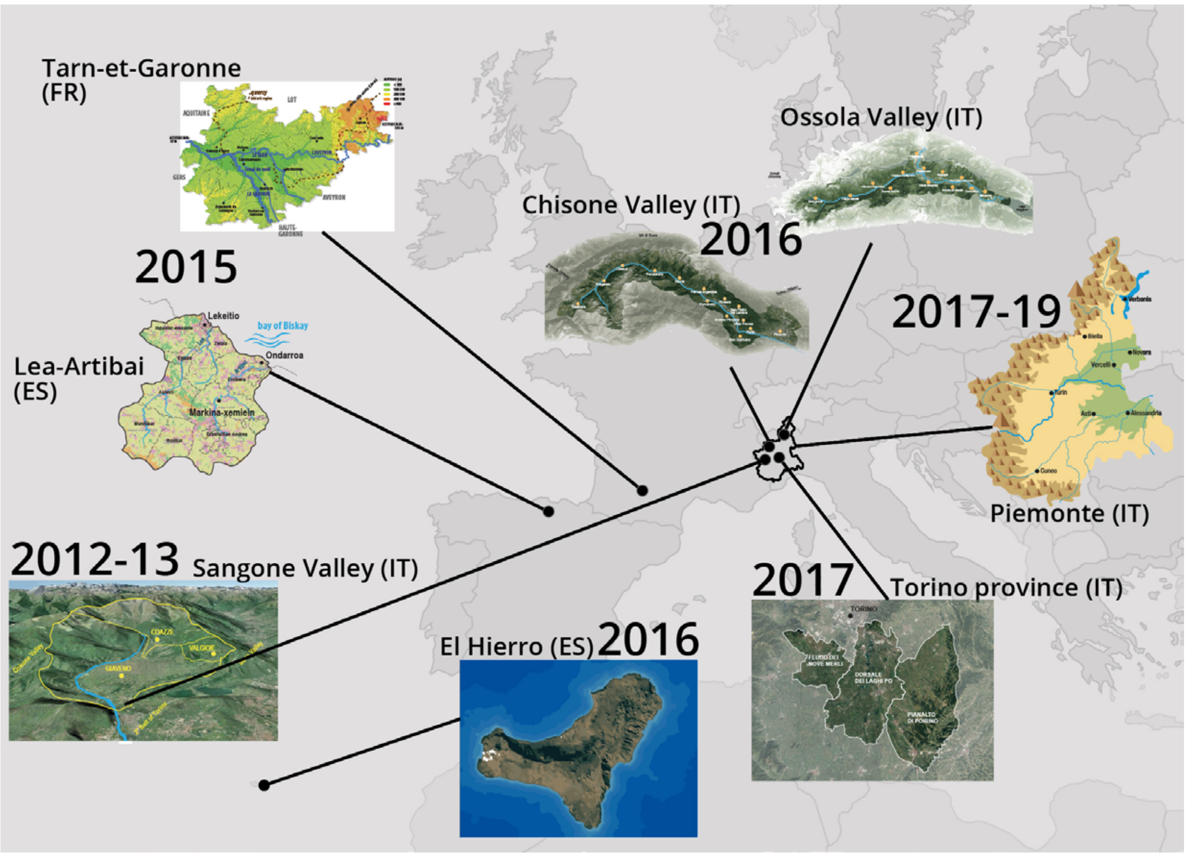


Fig. 7.1 - The location of the different projects on SD that I've personally followed

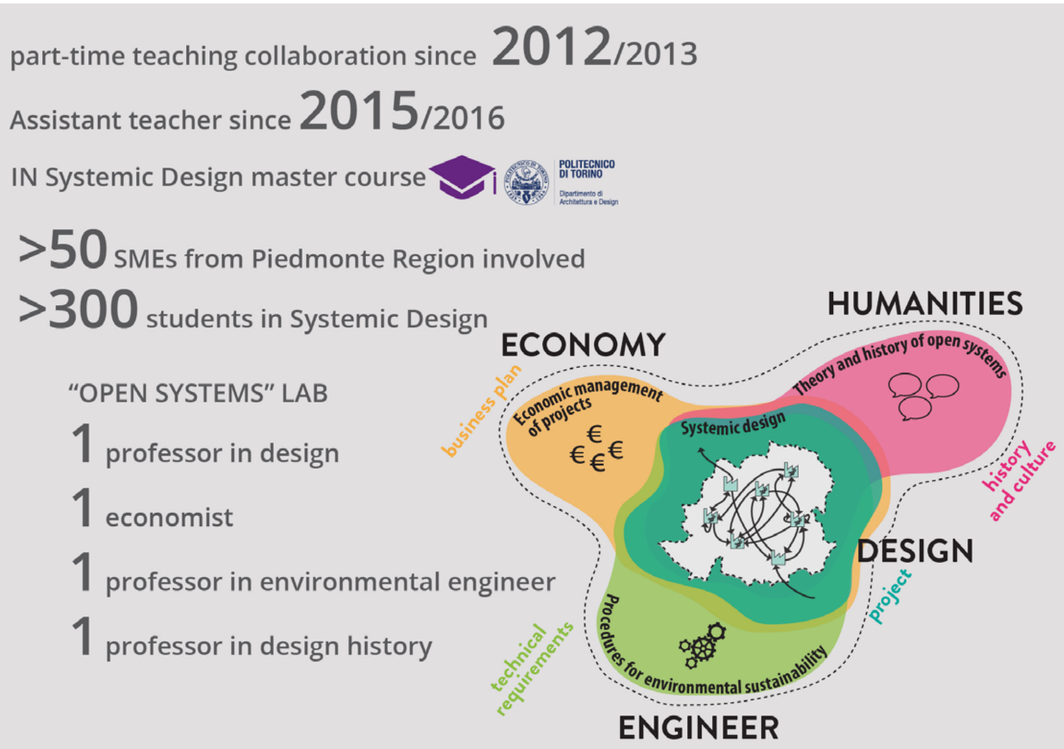


Fig. 7.2 - The summary of the characteristics of my experience in the'open systems lab'

7.1 SPECIFIC METHODOLOGY FOR SYSTEMIC DESIGN PROJECTS DEVELOPMENT

The specific SD methodology (see fig. 7.3) was developed during the years through the application in many projects by the research group in SD and in the 'Open Systems lab' in the Master of Science on 'Systemic Design-Aurelio Peccei' at Politecnico di Torino. It was recently published in Battistoni, Dominici, Comino and Barbero (2020). It consists of mainly 8 steps.

After the selection of a single production model to study, the HD is performed (step 1-2), through field and desk researches, discovering the context where it is inserted and then zooming into the flows of energy and matters (but also money, people, information, ..) that flow among the principal steps of the production process, coming into as raw materials and going out as waste. After the assessment of the state-of-the-art through the collection of multiple data and the visualisation of them on several giga-maps, the

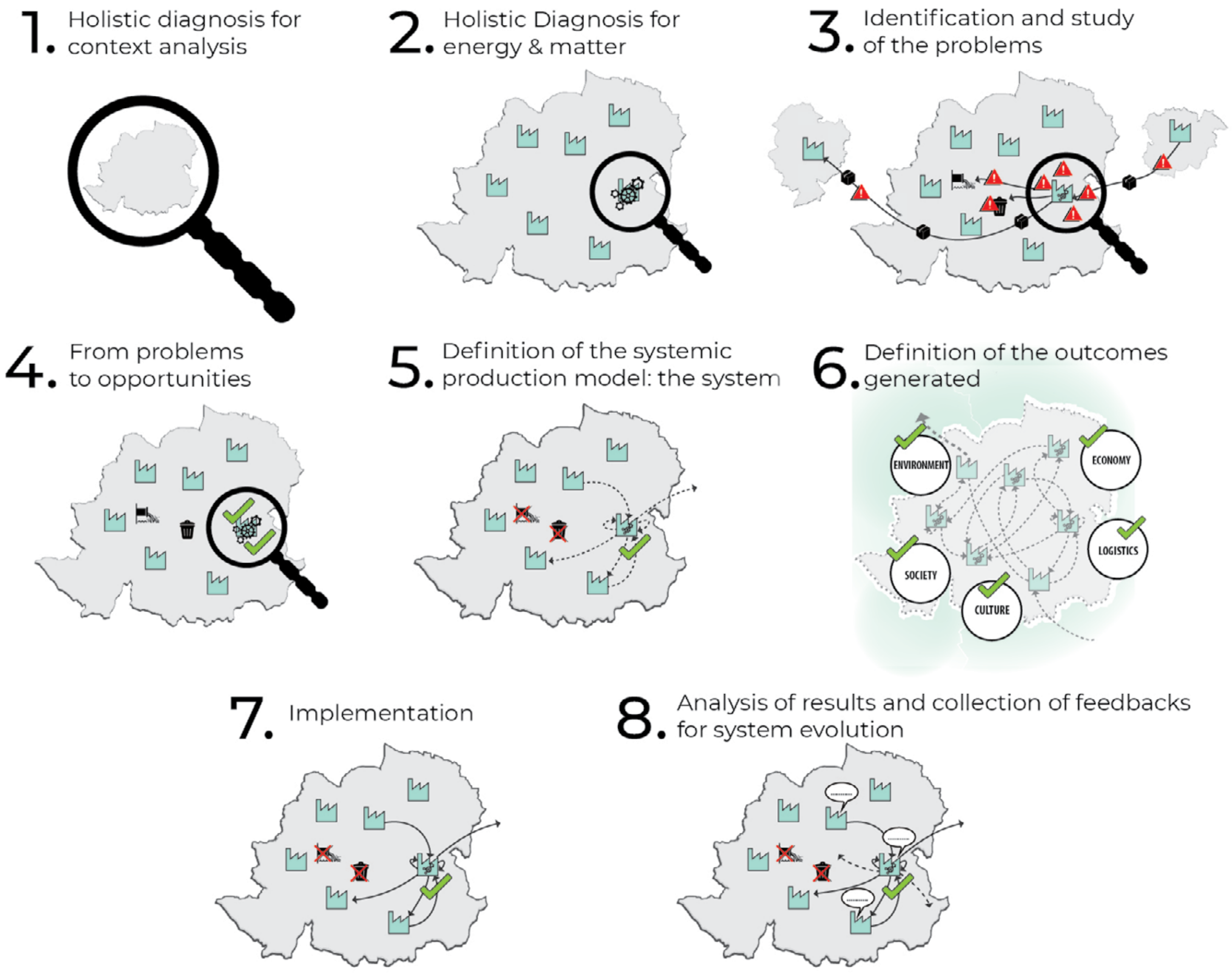


Fig. 7.3 - visual representation of the methodological steps of Systemic Design. Published in Battistoni, Dominici, Comino and Barbero (2020).

Identification of the problems (step 3) starts with the goal of discovering the critical issues of the linear production models at the environmental, economic and social level. These problems are ‘leverages for the change’ and turned into potentialities: this principal concept starts the design a new system – (step 4) From problems to opportunities - following the principal guide-lines of the SD approach (see chapter 1). Based on the research of existing sustainable case-studies, the outputs are enhanced as input for the same or other or new production processes, taking into account their intrinsic quality and their properties, and thanks to the creativity of designers, to at the end obtaining a different open system. The selection of new opportunities based on data found in HD process brings to the next step 5 - Definition of the system. The design process ends with the Definition of the outcomes generated (step 6) whit a preliminary evaluation of the impacts and benefits created regarding the economic, socio-cultural and environmental level is performed. At this point, the project phase ends and starts the Implementation phase (step 7) involving all actors and stakeholders recognised locally, realizing a feasibility study, implementing the project and, in the end, analysing the results and collecting feedbacks to allow the discovering of always new opportunities, making the system and the process autopoietic - (step 8) Analysis of the results and collection of feedbacks for system evolution.

7.2 IMPLEMENTATION OPPORTUNITIES[1]

7.2.1 Methodology

A multiple case-study research (Yin, 2014) was used to identify the opportunities created by the SD projects at entrepreneurial level. The cases studies are projects carried out in the first semester of 2018 by the SD research group with the collaboration of the master students in SD. The cases were extracted from the analysis that was done under the framework of the RETRACE project, led by my department in Politecnico di Torino, which at the beginning have carried out the HD of the Piedmont Region (Battistoni & Giraldo nohra, 2017). After selecting the main productive sectors important at regional level, for each one, a specific company was selected to deepen the analysis and have concrete data.

The selected sectors were 19 in total and 19 manufacturing companies located in the Piedmont Region agreed to collaborate:

- milk (breeding and transformation),
- meat (pig breeding and meat transformation),
- rice (production and transformation),
- fruit and nuts (production and processing);
- wine (production and processing);
- distillation;
- chocolate processing;
- production of building materials;
- demolition of buildings and management of building wastes;
- textiles (wool);
- organic waste management.

After the selection of the companies, the specific SD methodology was applied these production models thanks to their collaboration: after the HD process about the regional territory and about the single production processes selected, the students, guided by the course teachers and assistants, designed a specific complex project for each enterprise.

To extract the main opportunities created by the potential implementation of these projects, an in-depth analysis of each project was carried out. Afterwards, the principal opportunities were grouped depending on their levels of impact: environmental, economic, social and cultural.

7.2.2 Opportunities identification from case study analysis

The analysis of each project carried out in the SD master course ended with the extraction of the principal opportunities from their potential future implementation. The opportunities identified are the ones shown in tab 7.1.

Each opportunity was also explained with the outcomes that it can produce. The outcomes were in the end grouped by level impact: environment, economical or social.

1 based on what published in Battistoni and Barbero (2019)

Tab . 7.1. Opportunities identification from case study analysis

SECTOR	OPPORTUNITY	OUTCOME	OUTCOME LEVEL
Wine production	Use of water from grapes washing and wine making to the fertilization phase;	Reduction in the use of drinkable water and well water for industrial uses	Environment
Fruit production	Useful insects and reflecting films to defence the plant	Less use of chemical products in the processes that can contaminate the soil	
All	Phytodepuration, membrane filters, ….	Natural purification water treatments which reduce the use of energy	
Textile, wine production, …	shift to natural colourants in textile; use of agridetergents; dry ice blasting and ultrasounds washing for wine barrel; ozone cleaning; ..	Less use of chemical products in the processes that can contaminate the water to simplify the natural water treatment	
Pigs breeding	production of energy from manure covered	Improvement of the quality of air for all the area with the reduction of emissions of methane	
Building materials	Air recycling	Reduction of thermal dispersions during the processes	
Breeding, agriculture	shift to organic agriculture, permaculture and free pasture	Increasing in the quality of products sold and in the soil	
e.g. milk and yoghurt producers, fruits producers,	the creation of a local shop for the producers of edible products	Reduction of food waste	
Building materials	Solar energy	Increasing in energy self-sufficiency	
Rice production	integration of duck breeding into paddy field	Increasing in biodiversity and ecosystem restoration	
All	New products and new production processes	Increasing in the revenues	Economy
All	New products and new production processes	Increasing of job places	
All	Waste as resource	Reduction of costs for waste disposals	
Rice transformation, fruit transformation, …	ash husk, husk as element for biocement, amasake sugar from bran, flour and oil from broken rice; liquors from fruits dehydrated seeds and peduncles; flours from wine marc, oil from grape seeds, new fabrics from local wool, ….	Birth of new products	
Wine making, rice transformation	Wine marcs, seeds and sticks used for cosmetics products thanks to polyphenols;	Birth of new value chains	
Textile	Regeneration plant	Birth of new market sectors	
Rice transformation + building materials	Rice transformation + cement production = rice hull cement	Increasing of partnerships	

SECTOR	OPPORTUNITY	OUTCOME	OUTCOME LEVEL
Rice producers, grapes producers	sharing of machinery between industries	Sharing economy	
Distillation	Possible use of Wine seeds for dental use	Opportunities for research on bio-materials	
Wine production	Internal Packaging line	Increased control of the entire production line	
Textile	Support to local wool farmers	Support of local traditions	
All (food)	Workshop on food cooking with local and seasonable ingredients	Support of local know-how	
All	Communication and local shop	Awareness increasing by the final buyers about the entire production chain, closer relationship between producers and final buyers	
All	Increasing in products, air, environment, soil quality	Increasing in well-being	
All	Less noise, high temperature, dust, …	Increasing in the working conditions	Society and culture
Nuts production and transformation	Workshop on saponification from nuts shells ashes	creation of new job skills	
Textile	Fab lab for textile prototyping; school for tailoring its	Improving local competence / support to local know-how / enhancement of jobs opportunities for specialized workers and researchers	
Water depuration, breeding,	Phytodepuration park; educational farm	Re-establishment of the relationship between people and environment.	
House and road demolition	Exhibit & moulds material from gypsum waste	Increase awareness on waste	

7.2.3 Systemic Design project implementation opportunities

The result of this analysis was that SD projects have great potential because they decrease the environmental impact of production processes and increasing the social and economic ones. The multiple opportunities that emerged from the application of SD approach to the manufacturing sector on multiple aspects are reported in fig. 7.5.
Indeed, acting on a specific production model, SD can produce a shift from a linear to a systemic and circular one, transforming a profit and waste producer into a profit and value creator.
One of the principal opportunity created seem the potential in increasing partnership and the creation of cross-collaborations between different sectors thanks to the creation of new products and productive chains (fig. 7.5).
Moreover, in the case of opportunities for new businesses, they can be developed internally creating a spin-off: for example, for the transformation of a single output well-known by the research community, competencies can be foundinside the geographical area where the production is based (e.g. the regeneration of broken yarns in new yarns to weave). Depending on the quantity of the output, the collaboration can be generated among similar industries or just by one. Otherwise, the opportunities can be developed in a new enterprise/ start-up which can solve a specific problem of one industry or of a specific industrial district or of a geographical area (e.g. the management of hazelnut shells in an area particularly dense of hazelnuts cultivation and processors). Start-ups can also be

developed by systemic designers who become eco-entrepreneurs with an idea that comes from different past experiences.
Industries can also create clusters to manage the outputs, , if there are the conditions of proximity, with the same goal of the concept of the eco-industrial park (Chertow, 2000), sharing output-input but also, for example for the sharing of technical instruments or machines.
Projects with the focus to model production processes can also lead to the creation of research projects which can insist on a specific output not well-known by the scientific community and producing advance in the scientific knowledge and future possibilities for new businesses. Moreover, the research projects can be focused on the redesign

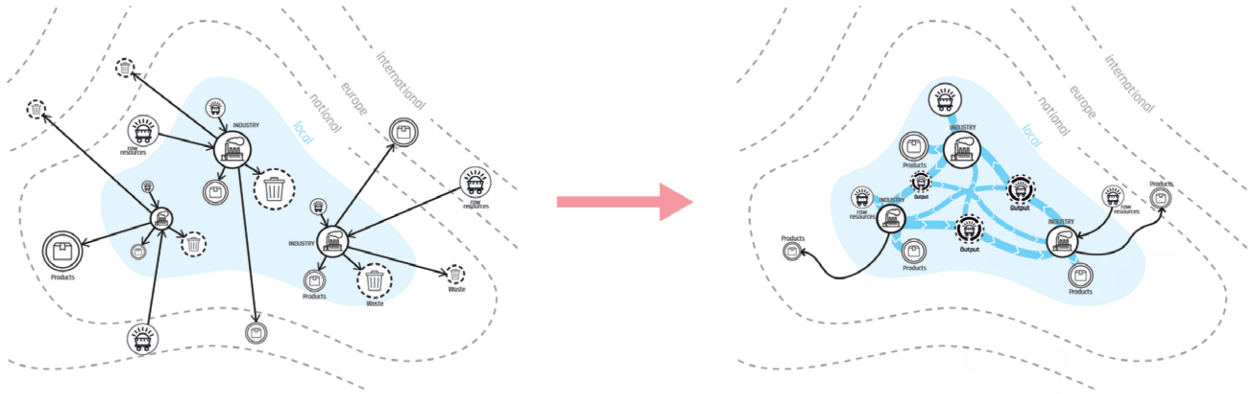


Fig. 7.4 - The shift from competition to cross-collaboration. Visual representation by students.

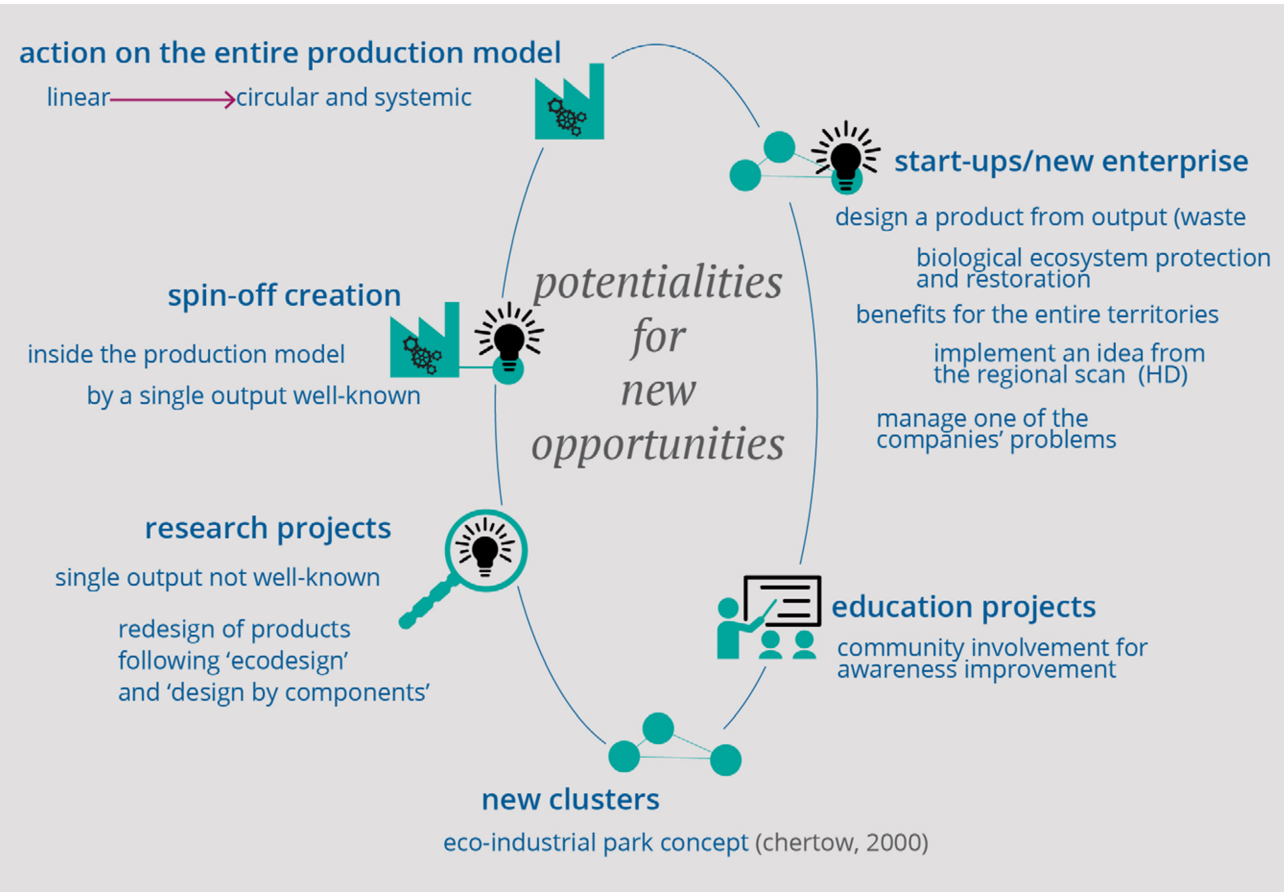


Fig. 7.5 - visual representation of the opportunities created by SD projects at entrepreneurial level

of products, packaging or services following several approaches provided by design for sustainability as 'ecodesign' (Lanzavecchia, 2012) and 'design by components' (Bistagnino, 2008). In addition, education projects can be implemented for improving the awareness within the disclosure on systems thinking and ecological concepts to the community, which is potentially composed of future designers, researchers, entrepreneurs, customers…
The HD of the territory, if performed at the territorial level, can represent a guide to find problems and gaps to overcome. Moreover, seen the problems as the leverage for the change, it creates the basis for new projects and enterprises, both profit (e.g. creation of a fab-lab for the recovery of local know-how) than non-profit ones (e.g. biodiversity and biological ecosystem protection and restoration). Activities (workshops, laboratories, lessons,..) can be created with the goal of community involvement, increasing awareness on waste, re-design of the entire production chains, re-establishment of the relationship between people and environment. Also to produce a new kind of product from something that now is considered waste, and alternatively, for the policy makers to direct future policies and solve real problems.

7.3 IMPLEMENTATION BARRIERS[1]

7.2.1 Methodology

A multiple case-study research (Yin, 2014) was used to identify the barriers for the implementation of SD projects. In this case, on two SD projects which the author followed from the beginning and at the end were not implemented. They are two projects that are aiming at fostering sustainable development of the context of reference, starting from two different points:

- the first one started from from a specific geographical area and then was analysed all the production processes located there;
- the other one the design process started from a specific production process but subsequently has enlarged its focus to the geographical context of reference.

After the description of the project and the application of SD methodology, the main enablers and barriers around the projects' implementation are identified and analysed to understand the main problems for their implementation. The enablers are identified related to geographical and socio-economic factors as defined in the HD and related to the project itself. The barriers are both related to the context, and to internal factors related to the project itself, and to the implementation phase.

1 based on what published in Battistoni and Barbero (2020)

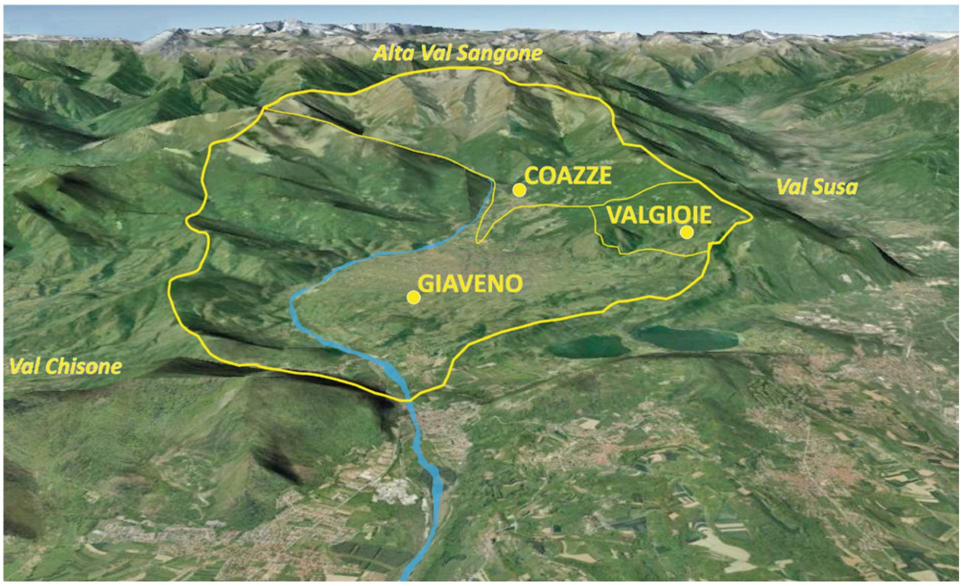


Fig. 7.6 - A visual representation of Sangone Valley using the view from google earth. Retrieved from (Battistoni & Daghero, 2016)

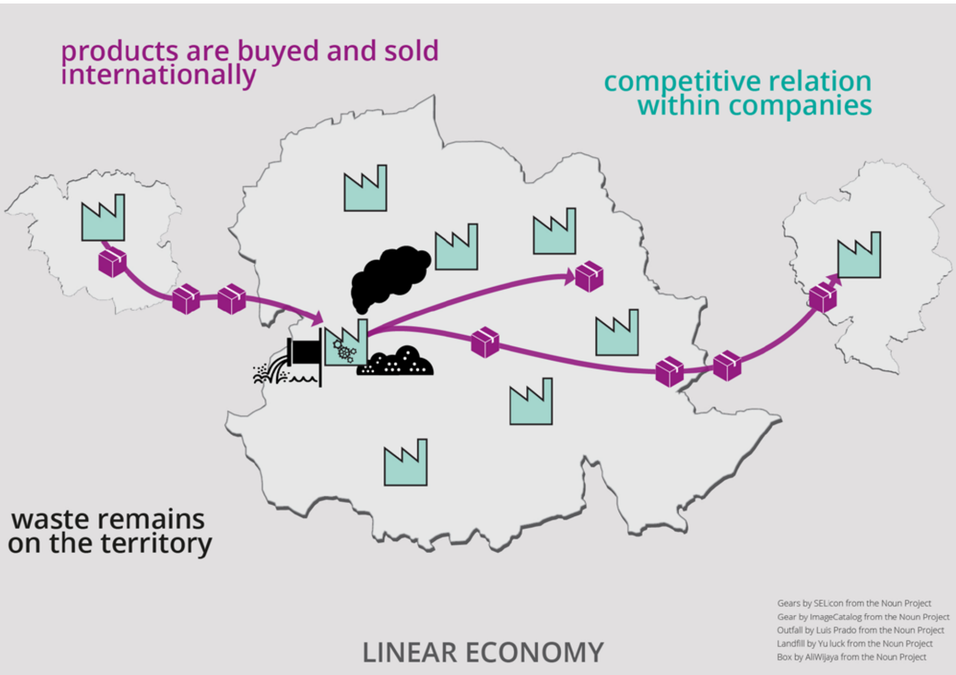


Fig. 7.7 - A visual representation of the current situation

7.2.2 Case study analysis

7.2.2.1 Systemic Design project for a specific territory

In this project, the SD approach has been applied in a valley of the Italian Alps in Piedmont Region in Italy, 20 km far from Torino (Battistoni & Daghero, 2013; 2017) (fig. 7.6). The project was developed by the designers of the research group on SD in Politecnico di Torino in 2012/2013 and started thanks to the will of the city major to have a sustainable future vision for the area.

The project started with the HD of the area at the geographical, economic and social level, which included the data from the national census about the list the typology of productive enterprises present in this specific area and the analysis of the Useful Agricultural Area (UAA). Afterwards, the production models of 24 typologies of enterprises located in the area, from primary productions as breeding for milk to transformation actors as the pastry shop, were

analysed with field researches, visiting the activities and interviewing the employees to collect specific data.
The analysis of the current situation framed a Valley where every activity is independently working for itself, and producing waste and using a lot of natural resources as water without considering its specific quality (fig. 7.7).
For this reason, started the design of a new sustainable production model for each production activities involved, applying the SD guide-lines, and connecting output and input, which created the base for the design of a complex system at territorial level (fig. 7.8), able to generate territorial development at the economic, environmental and social level as the waste reductions, the involvement of the community and the creation of new job places
The analysis of the project impact reveals the potential creation of a new entrepreneurial opportunities: 26 typologies of new activities created from the analysis of the relationships of energy and matter between the 24 activities considered (fig. 7.8)

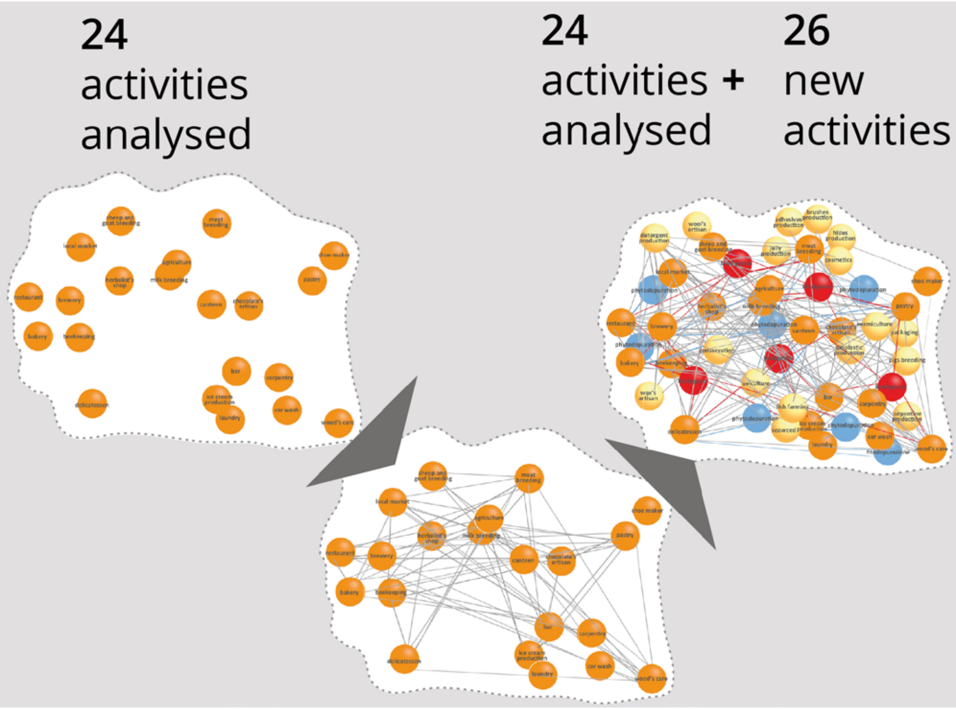


Fig. 7.8 - Graphic representation of the major outcomes produced by the project. Based on what published in Battistoni & Daghero (2017) and Barbero (2020)

Fig. 7.9 - A picture of the exhibition made in Giaveno city. Retrieved from min 00:12 of the video https://www.youtube.com/

as:

- fruit conservation to preserve during the years all the products of the agriculture and the woods as fruits, chestnut and mushrooms;
- fish farming in the Sangone river;
- turpentine and wax production from the management of the forest (wood's care) in the alpine mountain

Moreover, also the environmental benefits were studied, as the reduction of the use of the drinkable water of 80% thanks to a decrease in the use and the phytodepuration process. The economic assessment of each project, from the current situation to the systemic one, has revealed an estimate large increase in the economic profit: the earnings before taxes increase of more than 700%.

This project demonstrated that it is possible to create a Zero Waste Valley which can also limit its strong dependence on the import of goods from far away territories.

The project was presented to the community and the producers with an exhibition in the principal square of the city and with videos[2] for the promotion of the project (fig. 7.9). Although the support of the municipality and positive feedbacks from the entrepreneurs, the project failed at an early stage of the implementation phase.

The motivations behind the project failure are

2 Youtube channel https://www.youtube.com/playlist?list=PL8b_eg-7EJTq1EgXHaWK-pMEC0V590mzo

Tab . 7.2.Enablers and barriers of the project implementation phase (published in Battistoni and Barbero,, 2020)

ENABLERS	An alpine Valley plenty of natural resources	Geographical factors
	Close valley (at geographical level)	
	High sense of community between citizens	Socio-economic factors
	Presence of only micro-small enterprises	
	Rich Valley	
	Strong relationships between nature and inhabitants	
	Support from city major	Political factors
	Long research phase related to the context resources and dynamics	Factors Related to the project
	Developing of forecast for the environmental and economic impact	
BARRIERS	Close valley (at social level) and reduce openness to innovation	Factors related to the context
	Sleeping Valley: most of the people who live there, work outside the Valley	
	Most of the activities involved are from the 1° sector (agriculture and breeding), owned by old people and with no inclination to investments	
	Lack of a feasibility study of the project, only economic forecast	Factors related to the project in itself
	Lack of commitment by the activities' owner along all the project	
	Top-down approach (not coming from the citizens or enterprises but from the political party and academy)	
	Lack of co-design process	
	The city major changed few months after the project	Factors related to the implementation phase
	Difficulties in understanding the complexity of project by who have to take action	
	Difficulties in understanding the importance of the project	
	Lack of awareness on the importance to change (no Valley in crisis)	
	Lack of strong commitment by the entrepreneurs	
	Lack of funding, despite the city major commitment	

7.2.2.2 Systemic Design project for a specific production process based in a particular territory

In this other case study, the SD approach was applied to a specific production process: a French biscuit factory with a family tradition considered large for its turnover and number of employees (Barbero & Battistoni, 2016). The project, done by the SD research group in Politecnico di Torino in collaboration with the industry, was commissioned by the industry CEO.

It started with the HD of the territory where they are located (fig. 7.10), considering many aspects, from the geography to the open markets and the special dishes.

At the same time was analysed the current production model (fig. 7.11, top part). This study was performed thanks to many field visits in the territory and in the factory, and thanks to the collaboration of the employees with many meetings in person and workshops. This process permitted to increase the employees' awareness of the current situation and afterwards to guide the enterprise towards a different and systemic production model.

The HD of the current production model identifies that it is based on a linear economic model, producing tons of standard biscuits every day (more than 300 million of packets/year), using worldwide raw materials and shipping the final product everywhere, selling in the national and international market. The environmental impact was not considered especially in the area where they are located, as the social one, for example, on the public health of the inhabitants and the customers. This production model is exploiting and not valorising the local territory. Instead, the area where the central plant is settled was recognised as one of the most important places for agriculture in the country.

The project mainly acted on the recipe of the biscuits, recreating the connection between actors involved in the local food production, local natural resources and know-how of the region. The re-design of a typical traditional biscuit, the "sables", was done with a nutritionist and with the goal to become a symbol of the region and to show the industry's care about the consumers' good health.

In addition, a study was done on the opportunities to solve internal environmental problems as broken biscuits or heat production by hoven. Moreover, the suggestion of using local ingredients as milk, eggs, fruits and spices, creating relationships with local producers, let the factory starts acting as a re-activator of the local agriculture and manufacturing sector (fig. 7.11, bottom part). This could have reduced their environmental impact, created a cascading impact as the creation of new businesses also for other local entrepreneurs (as the production of butter) and starting at the end a more sustainable territorial economic development for all the region. The factory produced the first prototype of the new biscuit (fig. 7.11) but didn't decide to go on in the project implementation.

The reasons for this choice can be a lot. It was tried to understand the main enablers and barriers that the project has faced to define the implementation barriers. (table 7.3).

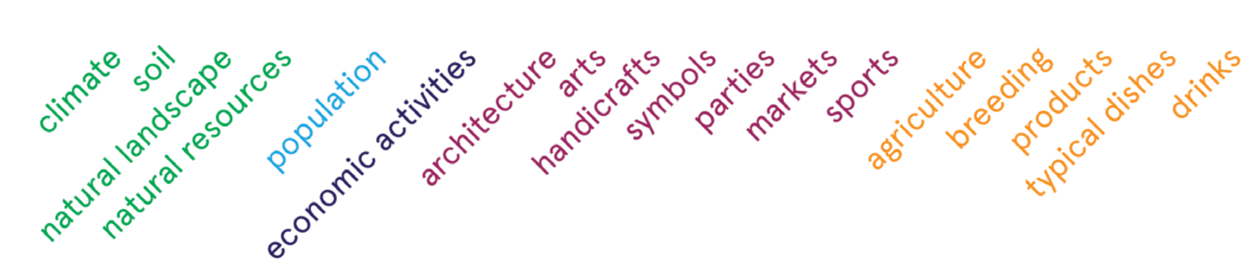


Fig. 7.10 - the categories analysed in the Holistic Diagnosis of the context of the project

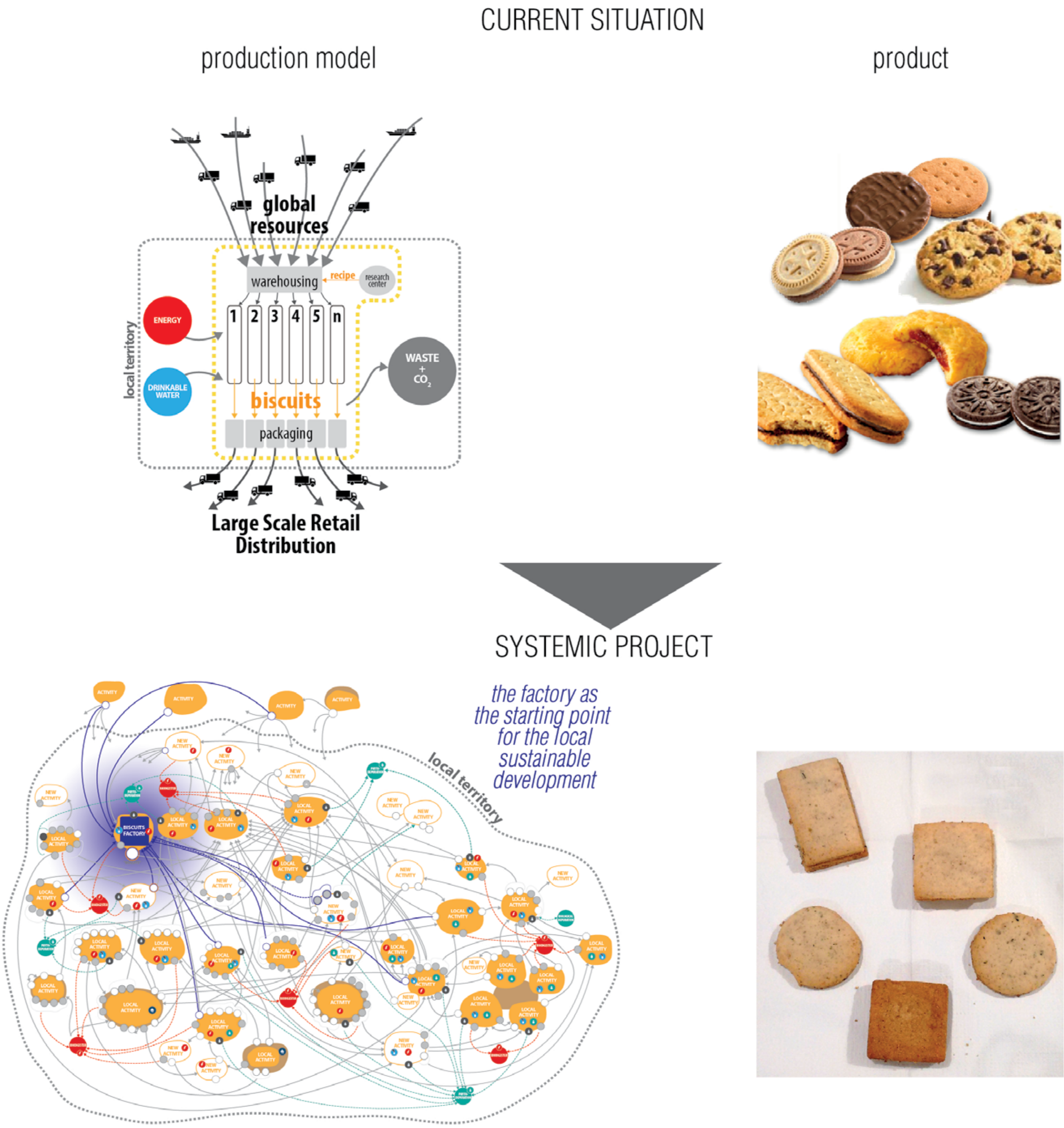


Fig. 7.11 - visual representation of the shift proposed by the SD project. Published in Barbero and Battistoni (2020)

Tab . 7.3.- Enablers and barriers of the project implementation phase (published in Battistoni and Barbero, 2020)

ENABLERS	No problem in economic investments	Factors related to the industry
	Interest for innovation projects	
	Internal nutritional research centre	
	Industry which in the past started as a little biscuit maker in the same location (it has a recognisable role in the area)	
	Thanks to innovation in management, the employees are listened by the CEO and their ideas are taken into consideration	
	Agricultural region with many production activities	Factors related to the context
	Co-design process with employees and CEO thanks to frequent meetings	Factors related to the project itself
BARRIERS	Lack of commitment by the employees along with all the project duration	Factors related to the industry
	Change of CEO during the implementation phase of the project	
	Difficulties in sharing internal data to external people (even researchers involved in the project)	
	Lack of data on the specific quantity of the different inputs and outputs	
	Difficulties to understand the importance of the project over the economic benefit	
	Large industry which must preserve many job places, it acts with caution	
	Reduced openness to collaboration with other industries	
	Lack of awareness by the CEO on the area where they are located (better situation among employees)	
	Focus on its own production and lack of awareness on what is happening outside (especially on agriculture topic)	
	Lack of awareness on the implications of their actions on the environment and consumer's health	
	Lack of future visions on the environmental situation	
	Difficulties in managing the complexity of the projects	
	Resistant to change demonstrated by the employees	
	Very ambitious	Factors related to the project itself
	Didn't take in consideration the transition to the different production models	
	Lack of in depth feasibility studies	

The main barrier, in this case, seems the difficulties in understanding the real goal of the project outside the economic impact, which enlarged the focus from the biscuits to the entire production model and the impact on the local area. In addition, because they were immersed in the linear production model and demonstrated high resistance to change. Although the CEO commissioned the project and was committed, it had to discuss it with the shareholders. Moreover, this was only one of their multiple investments as a large industry, which at the end, they decided not to carry on, and the CEO quits few months after.

7.2.3 Systemic Design projects implementation barriers

The previous case studies analysis let understand the significant barriers faced by SD projects in their implementation process.

The principal one seems that SD projects require a cultural paradigm shift from the linear to the systems thinking, from competition to collaboration (Barbero, Bistagnino, Peruccio, 2017), as identified by Capra (1988), but usually is possible to experience a resistant to change which is expected in the human being behaviour. Moreover, the system designed is complex as one of its fundamental characteristics, based on many relationships that are created between the components, requiring the involvement of many actors and stakeholders also in the design phase with co-design practices. The necessity of the project to act over the triple aspects of the sustainability, environmental economic and social, make SD projects multidisciplinary and interdisciplinary ones. This requires the involvement of other competencies next to the design one, creating difficulties in the realization in practical terms. Moreover, the complexity reached in these projects requires a co-design process involving multiple actors and multi stakeholders for their multilevel scale of impact, from entrepreneurs to academics and policy makers. All these factors complicate the implementation process, which cannot follow a linear process but includes in every stage multiple contributions, evolving through multiple feedbacks loops as it is happening in the evolution of the natural ecosystems.

Also, the projects need a general overview of the territorial context, considering the impact not only on the production model but also on the territory where they are located, which makes them difficult to understand for the enterprises which usually lack a long-term vision for themselves and the environment around.

Furthermore, focusing on the manufacturing sectors, the problems increase. First, the change in the production model to give an answer to the requirements of sustainability, required radical choices and strong decisions which the consequently need significant investments or external funds which are not easy to take. Moreover, talking about inputs/outputs and not waste, which have to flow among the components of the system, the current legislation on waste sometimes is limiting these types of relationships. These results over the implementation barriers are in line with the ones identified by Rizos et al. (2016) discussing the barriers found by SMEs in the implementation of CE business models: company environmental culture; lack of capital; lack of governmental support/effective legislation; lack of information; administrative burden; lack of technical and technological know-how; lack of support from the supply and demand network.

Luckily, the current emphasis from the European Union on the CE is helping to bridge the cultural gap since 2014 and formulating new policies to ease the CE implementation (see chapter 3).

Is possible to summarize the barriers in the ones present in fig 7.12 that can be categorized in:

- related to the project itself (internal);
- related to the industry sector (internal);
- related to citizens, entrepreneurs and policy makers (external).

SYSTEMIC DESIGN PROJECTS IMPLEMENTANTION BARRIERS

related to the industrial sector

understand the importance of the project over the economic benefit

reduced openness to collaboration

focus on its own production

lack of future vision

lack of commitment by the industry along all the project duration

resistant to change

economic problems for required investments

lack of human resources to invest in a new project

lack of data on specific quantity

related to the project itself

Complex

shift from competition to cooperation

collaboration of different partners and stakeholders

lacks the complete feasibility study

involvement of other experts

do not give the exact indication on ‘where to start’ and ‘how to start’

needs a balance between top-down and bottom-up approaches

needs a co-design phase

related to external factors

few public economic support by public sector

no mechanism that rewards the most virtuous

legislation barriers

lack of enough research studies

lack of a long-term vision by policy makers, and consequent lack of funds

lack of of awareness on the environmental situation

Fig. 7.12 - the main implementation barriers identified by the analysis

Chapter 8

Ecosystem design

The previous methodological steps performed and defined in the previous chapters (the two multiple case studies; the identification of the implementation barriers faced by SD projects; the discoveries of the potentialities for new entrepreneurial opportunities), started the path to the design of the entity that can support the implementation of SD projects, missing contributions today by the scientific literature on its definition.
The first step was the definition of the guidelines for the project definition with the outline of the requirements, and afterwards of the services and actors needed. After this process, the conceptual model was designed.
It was a long process which passed from many reasoning published in Battistoni and Barbero (2018; 2019; 2020).
This entity was identified in an ‘ecosystem’ composed of multiple actors from the quadruple helix models, as identified in the literature review.

8.1 GUIDELINES DEFINITION

8.1.1 Requirements

Stated that the goal of the entity is to stimulate and foster the birth and the implementation of eco-innovative systemic projects to obtain a sustainable regional development, is identified the need to (see fig. 8.1):

- work in strict relation with the existing enterprises to:
  - support the transition of production models;
  - training on eco-entrepreneurship;
  - examine their current state-of-the-art in terms of waste production, energy and matter used, and define the specific quantity and quality;
  - the definition of possible new spin-offs;
  - communication of their activities to the market/client;
  - create connections with the other actors of the quadruple helix model;
- be able to receive problems faced by the manufacturing sectors to delete the implementation barriers related to external factors;
- work in strict relation with the existing business incubators and the creators of new start-ups to:
  - act in the design phase and help create new business models which take in consideration not only the economic sustainability but also the social and the environmental one;
  - insert training on eco-entrepreneurship (both for the incubators managers than for the startuppers);
- perform studies as the HD on the entire local territory to understand the current state-of-the-art of the natural resources, the waste management, the impact of the manufacturing sectors, which can give direction to new research projects;
- spread the knowledge on sustainability topic and systemic thinking to increase awareness in the civil society and engage future entrepreneurs;
- support the local know-how and creativity;
- facilitate the creation of relationships and collaborative projects among industries for the creation of clusters;
- support the inclusion of design competencies both in the industries than in the policy making processes and decision processes.

8.1.2 Actors & Services[1]

From the requirements definition is possible to identify the services needed to perform them and the actors involved, shown in fig. 8.2.

All the multiple services identified are referred to particular actors: from who is working in the industries, both the entrepreneurs, the managers and the workers, to the startuppers, the researchers in the academy, the decision makers in the government and the citizens of the local communities. All the actors should enter in relationships and converge to the principal beneficiary, which is the area where they live, act and are involved in the local community. The territory indeed becomes an actor with specific needs to be respected.
The delivery of different services needs that the experts arrive from different disciplines but share the same goal: regional sustainable development. Especially, next to the designers who have a vision from above and act as mediators and directors managing the complexity, there should be mentors and consultants which are people that:

- recognise both the economic value and the environmental and social one of the projects (as it is happening for the social entrepreneurship phenomenon (Deloitte, 2018);
- facilitate the creation of an "open system": advise on the possible networks that are possible to create between the business realities and the local stakeholders, local natural resources, local know-how;
- support the local know-how and creativity.

The implementation of the entrepreneurial opportunities can be facilitated by the relationships between the systemic designers and the current actors involved in innovation: entrepreneurs and managers of industries, entrepreneurs creator of clusters / spin-offs / start-ups, and researchers

1 Based on what published in Battistoni and Barbero (2019)

and policymakers. To reach the development of eco entrepreneurial opportunities, training in ecopreneurship and systems thinking can let the evolution of current entrepreneurs in ecopreneurs. Moreover, if also the designers are included in the entrepreneurial activities, the systemic designers can become systemic designers-ecopreneurs.

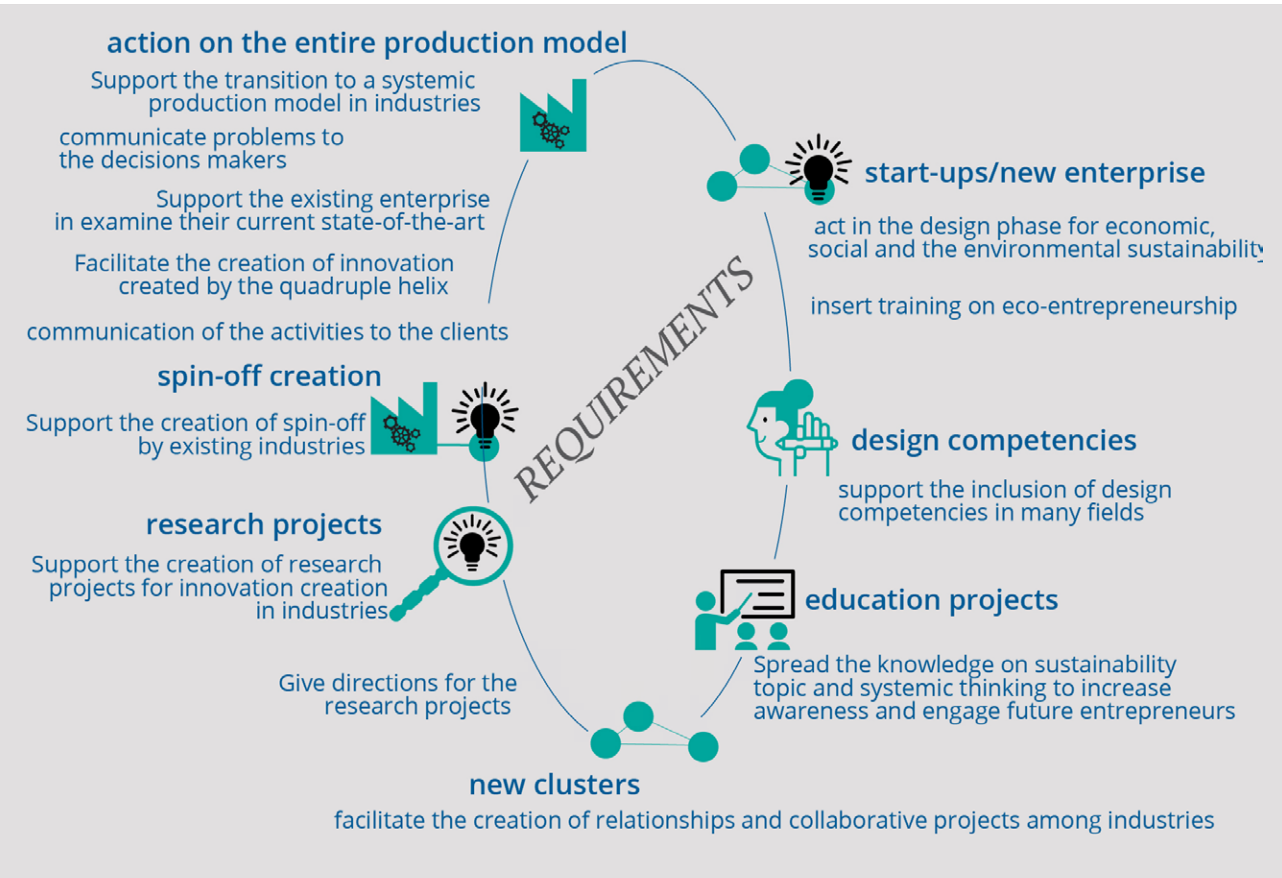


Fig. 8.1 - visual representation of requirements definition from the opportunities identified in chapter 7

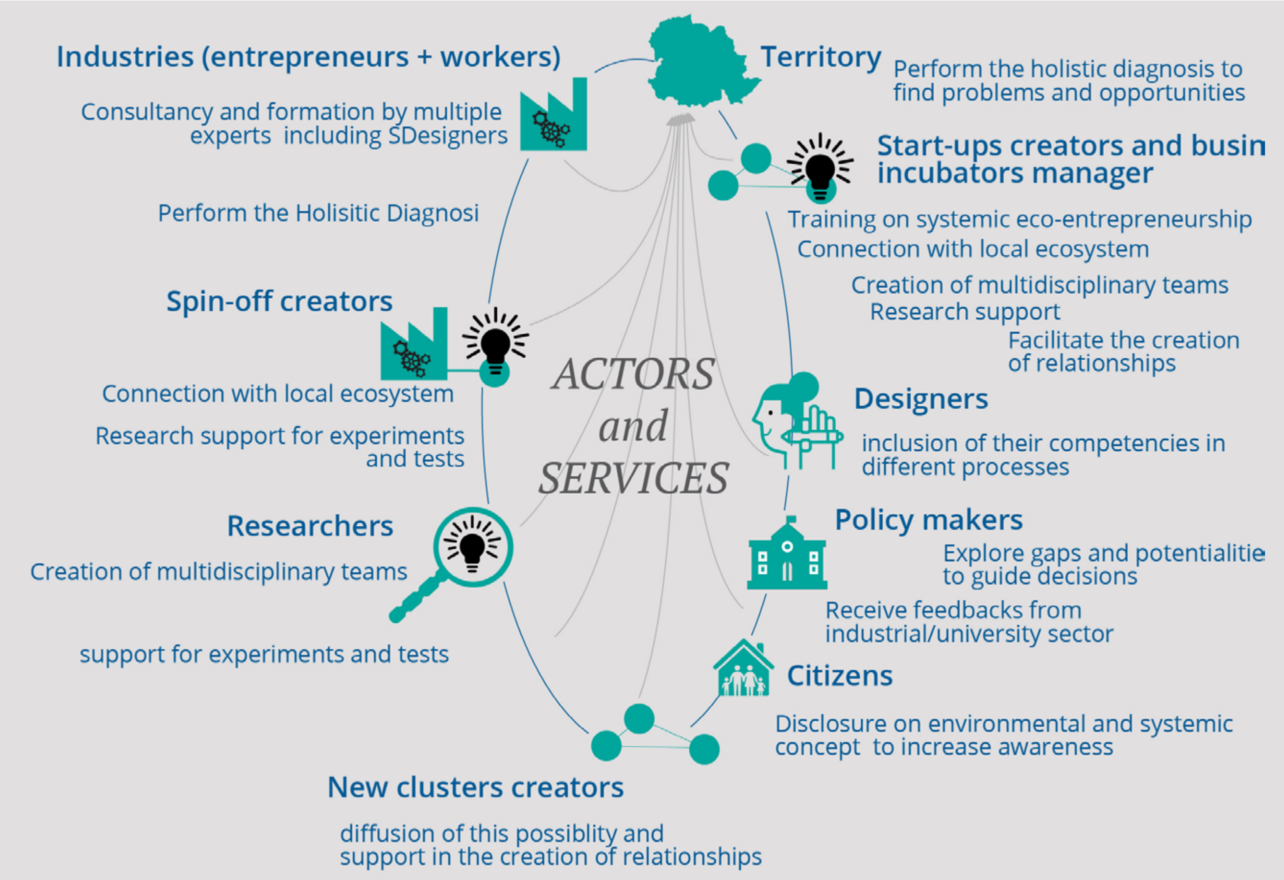


Fig. 8.2 - visual representation of the definition of the actors and the services based on the requirements identified

8.2 CONCEPTUAL MODEL DEFINITION: Ecosystem for sustainable and circular local development[2]

The definition of the implementation barriers and the opportunities created by SD projects, and afterwards, the outlining of the actors and services needed, have permitted the design of a conceptual model of the ecosystem. This entity has the goal to foster and boost the implementation of SD projects in a certain geographical area to obtain sustainable and circular local development.

After, the systemic helix for sustainable and circular local development represented in fig 8.3 is developed starting from the innovation models of the quadruple and systemic helix cited in the literature review. It is composed by:

- the university, represented by the technical and humanities division;
- the government, represented by the different

2 Based on what published in Battistoni and Barbero (2020)

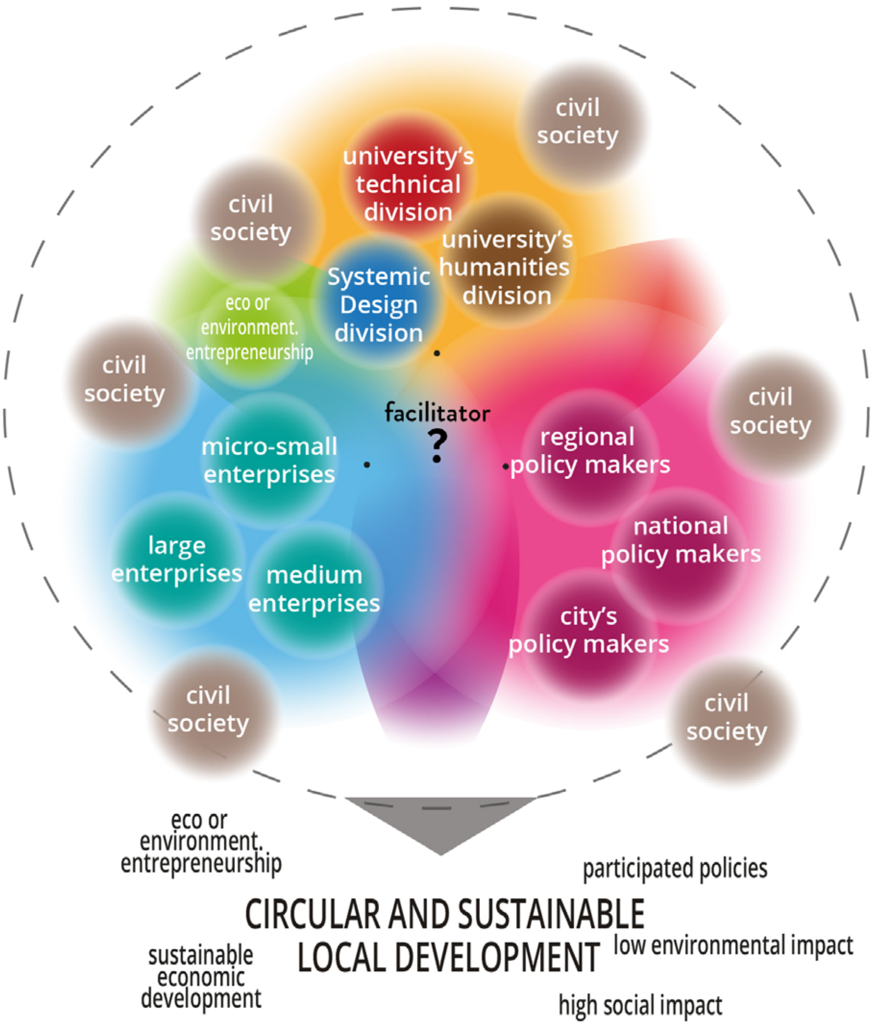


Fig. 8.3 - visual representation of the ecosystem model based on the quadruple innovation helix. In orange the university helix, in purple the government helix, in light blue the industry sphere, in brow the civil society.

levels (from city to region and nation) which act on a specific geographical area;

- the industry, composed by the three typologies of enterprises (micro and small, medium and large);
- the civil society which is not a single entity but diffuses within all the others.

Among these actors is needed the inclusion of another one able to deliver education and consulting on ecopreneurship. Moreover, one on SD education, research and project development as the 'SD division'. Both the actors are placed in between the 'University' and the 'Industry' actors of the triad for their duality.

The four components are acting as a system. Fig. 8.4 shows the systemic and non-linear interactions between them. The knowledge flows and resources circulate to create the knowledge society. The government, for example, receives feedbacks from the other actors to improve and deliver better and participated policies. In exchange, this actor delivers

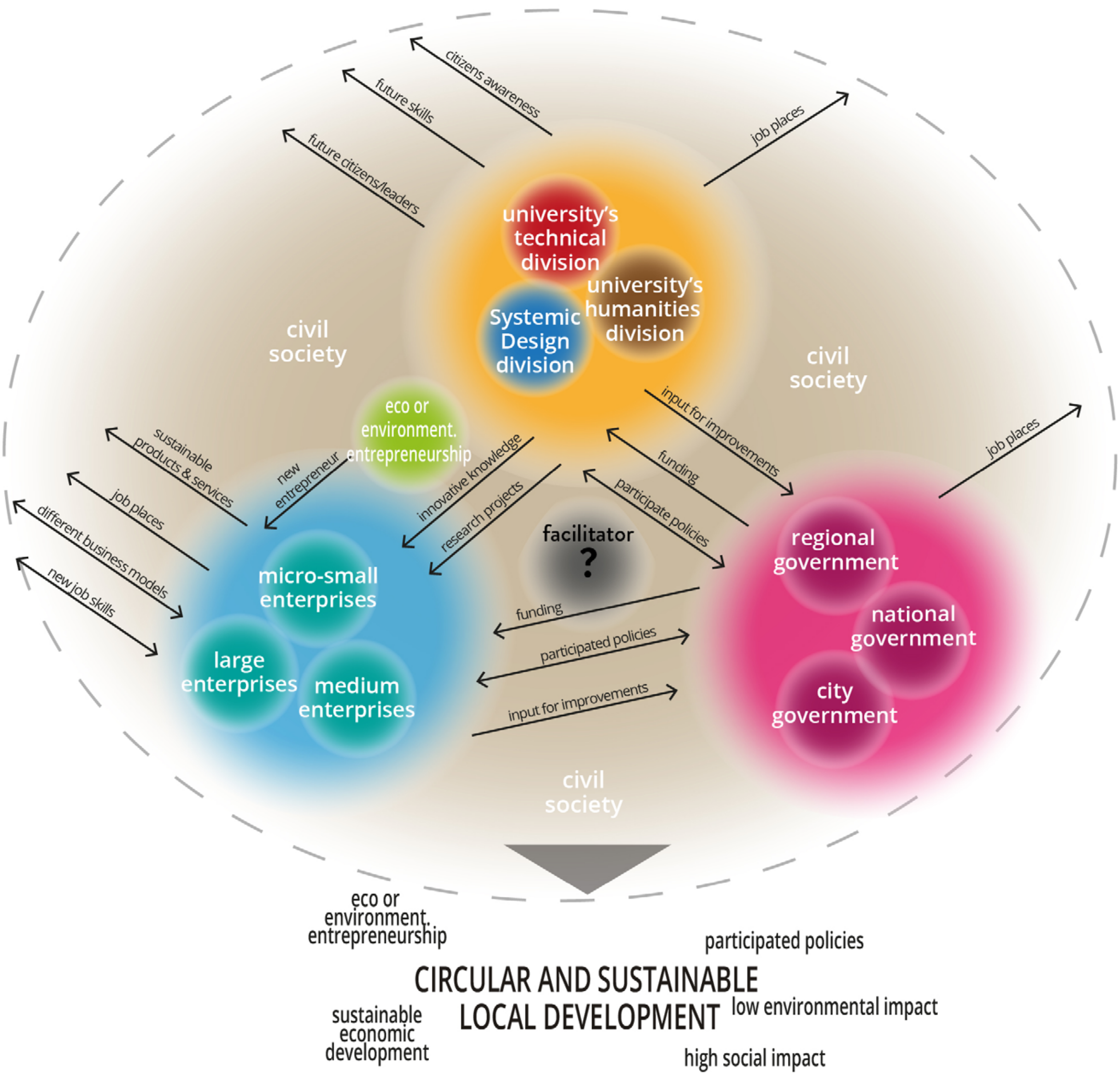


Fig. 8.4 -graphic representation of the systemic and non-linear interactions between the components of the helix for a circular and sustainable local development. Published in Battistoni and Barbero (2019,2020)

funds to improve the R&D processes. The industry, thanks to the collaboration with the university, can design, produce and deliver sustainable products and services. The actor which focus on ecopreneurship trains new ecopreneurs for the industrial sector thanks to the support of the university. Each actor is creating job places hiring people of the civil society, and the university is creating future citizens and leaders aware of the current problems for a sustainable development.
In this framework, is it necessary an actor that can play the role of the facilitator to permit the creation of these relationships? The previous literature on business and entrepreneurial ecosystems theorizes the figure of a central actor able to fuel the creation and the growth of the ecosystem and the collaborations and relationships between the different actors considering a specific geographical context. It is identified in the 'anchor tenant' hypothesis.

In this conceptual model, the role of the facilitator is identified in the Local Systemic Network Booster (LSNB).

8.2.1 Local Systemic Network Booster

The heart of the ecosystem which has the goal to ease the implementation of sustainable entrepreneurial opportunities find out thanks to SD projects, cannot be identified in a BI according to the current definition focusing on the economic sustainability of the projects in a linear economy context. It has to fill current gaps and ease the transition to a different economic model, providing services as:

- train future entrepreneurs to deal with current and future challenges, considering the complexity of the problems and tackling also the environmental situation;
- guide and support the design phase of the new

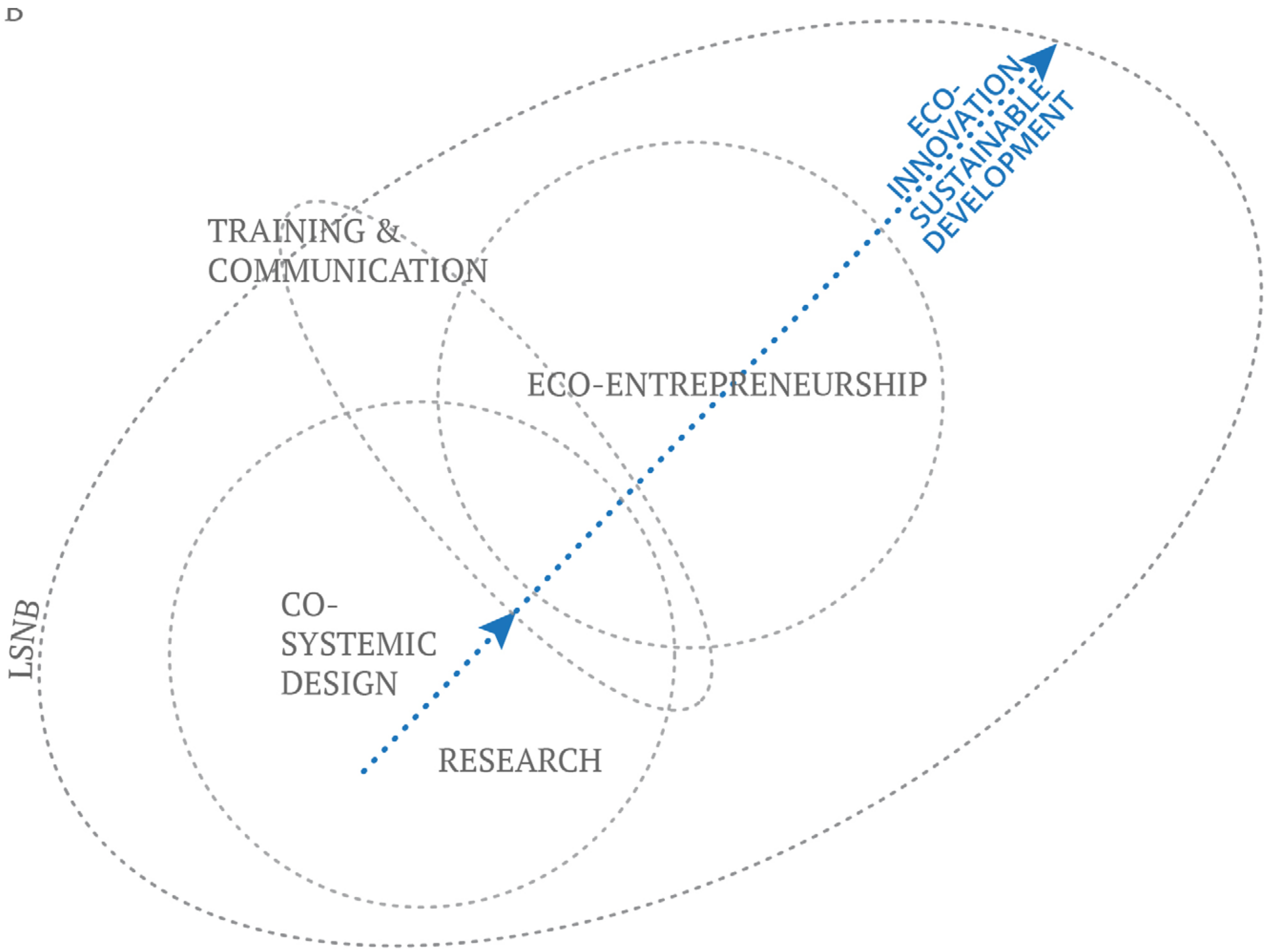


Fig. 8.5 - graphic representation of the different components that create the LSNB

- support and ease the implementation of the opportunities into innovative and sustainable products, services and processes which tend to zero emissions and respect the natural capital and are provided by firms with different business models;
- support the transition from linear to systemic production models of the existing firms thanks to co-design systemic processes and multidisciplinary projects;
- deliver educational projects;
- support multidisciplinary research projects.

To be able to provide these services, it is considered the collaboration within a BI working in a different way, a training centre, a fab-lab, the university division and the communication division (fig. 8.6).
This facilitator of the ecosystem is defined as the '**Local Systemic Network Booster',** which works for boosting new systemic businesses and also for regional sustainable development.
This facilitator can offer multiple services (fig. 8.7). The 'incubator' component (in purple) is the closest to the industry sector and it is intended as able to incubate and develop the new entrepreneurial opportunities for the creation of spin-offs, start-ups and clusters with traditional services (see chapter 3.3.2.2.). Referring to its definition Von Zedtwitz & Grimaldi (2006) it is possible to define it for the goal as a combination between a regional and a university incubator, with a strong focus on the industry as the independent incubators and company-internal incubators. It should be a physical space with working space and act as an open system, where the realities incubated are also encouraged to create networks among them, based on flows mainly of information but also people, money, energy and matter. Although the difficulties of the implementation of this concept as analysed in the Blue City case study (see chapter

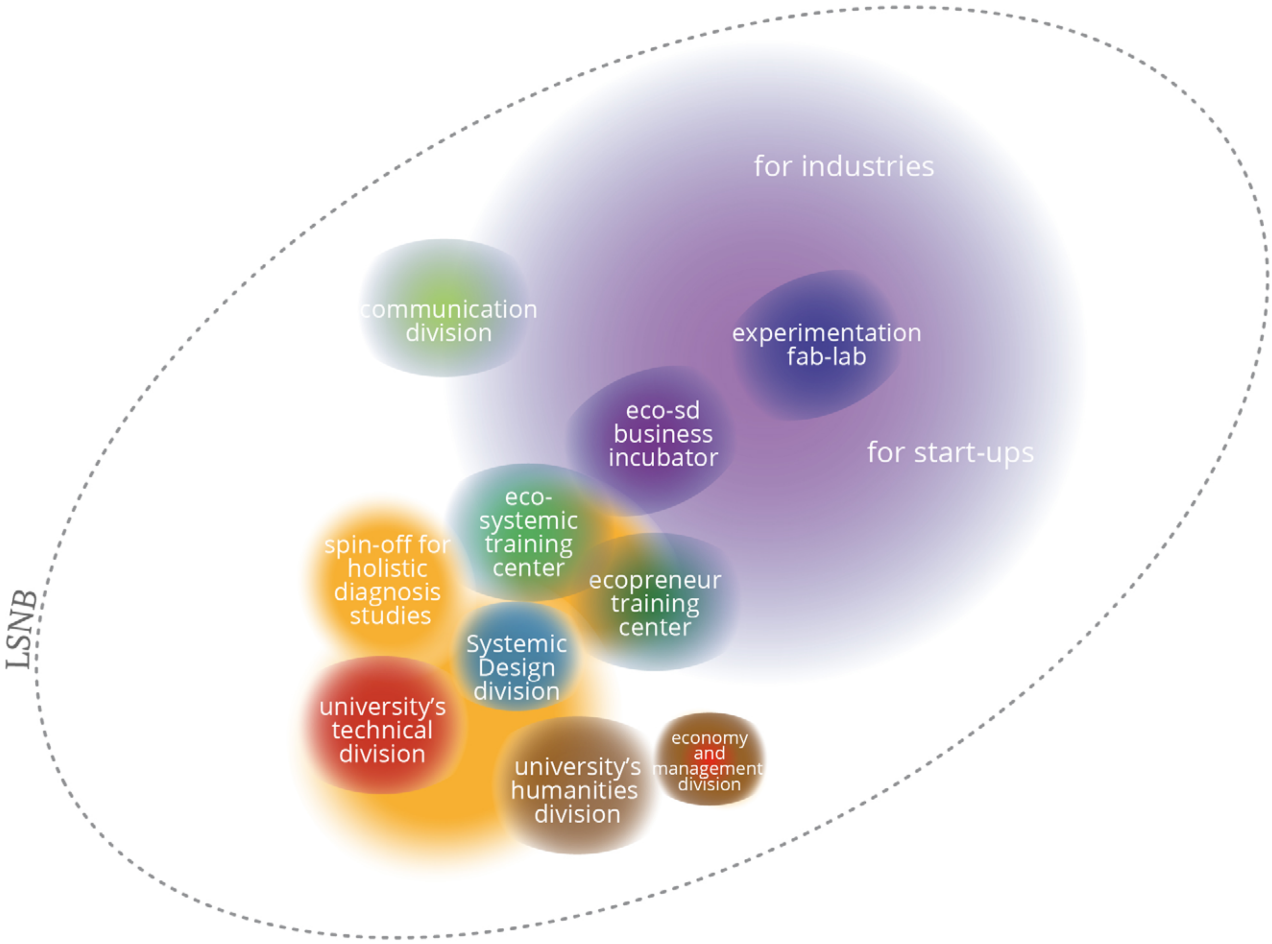
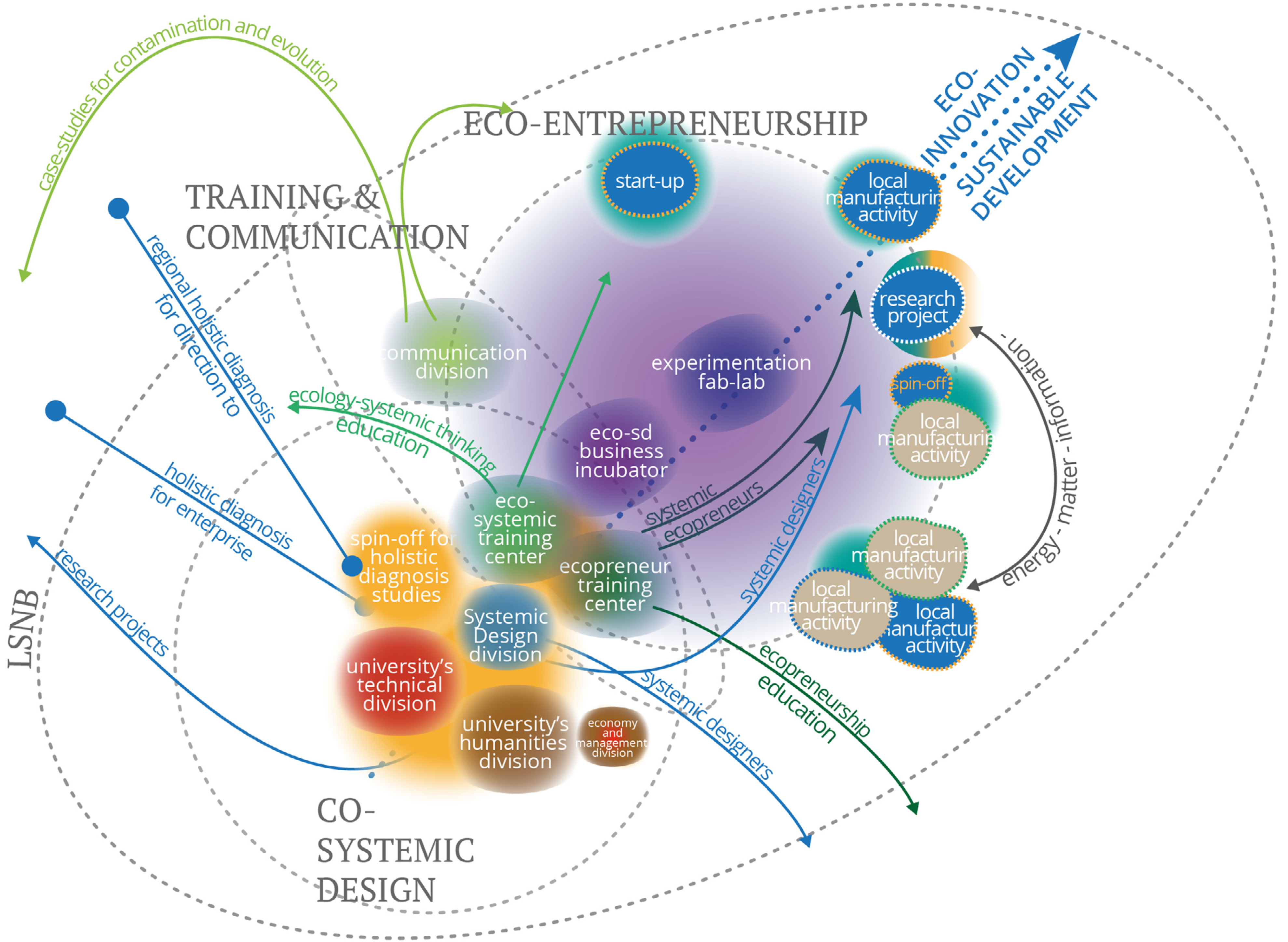


Fig. 8.6 - graphic representation of the different components that create the LSNB. Based on what published in Battistoni and Barbero

5.2). The incubation component works in strict relation to the economy and management university division to perform the services and evolve through research projects.
The incubation part is placed side by side to the experimentation Fab-lab and the training centres. The fab-lab is intended to provide a space to experiment with the innovation proposals, with laboratories and prototyping tools. The ecopreneurship and the ecology-systemic training centres (in green) collaborate with the university's divisions (in orange) The university, composed by technical and humanities divisions, where emerges the role of the SD division and the one on economy and management, collaborates with the training centres to train and create different entrepreneurs, the ecopreneurs, which came from different disciplines and have after the competencies to implement new businesses for innovative products, processes and services.
SD division trains designers to become systemic designers and moreover performs research projects. This component is located in between the university divisions because the design discipline considers inside both technical than humanities contributions (Celaschi & Formia, 2010). Systemic designers, ecopreneurs and systemic designer ecopreneurs through their collaboration, work in multidisciplinary teams. The designers in this situation can also act as *"mediator"* (Celaschi, 2008) between the different disciplines fostering the dialogue and the contamination among them. The collaboration with the university divisions supports the design phase of multidisciplinary projects and researches. Moreover, they collaborate also in the development of studies and HD in the university 'Spin-off for HD', which requires the involvement of multi competencies.
Another fundamental component is the communication division which is able to give visibility to the projects with specifics competencies and tools. The business cases can begin an inspiration for other entrepreneurs and the civil society. In addition it can influence and increase the decisions of the market.
The different components work together to follow the complete process: from the research to the idea creation and the design phase following co-design and systemic approaches, to the feasibility study, the implementation phase and the communication. They are finally arriving at the creation of eco-innovation for the sustainable development of the territory (fig. 8.8).
The LSNB, for the multiple components included and the multiple services provided, requires the involvement and collaboration of multiple actors (fig. 8.9) which have to share and believe in the LSNB goal: researchers of multiple research fields, systemic designers, ecopreneurs, business incubator mentors, experts in multiple fields, business specialists, specialists in communication next to graphic designers.
Acting as an open system, the LSNB spreads knowledge through education, disclosure and research projects both inside than outside the ecosystem, involving manufacturing activities to the civil society and the policymakers, to build the future sustainable society (fig. 8.10). It also acts as a guide thanks to the execution of the HD: analysing the territory as a system, identifying the current problems to solve and the sectors which need support or research projects, giving indications to researchers and policymakers.
Placed in the entire ecosystem, the LSNB acts as the anchor tenant to facilitate the creation of the ecosystem and boosting the creation of networks (fig. 8.10). It mainly starts with the university helix and has strict relationships with the industry sector. Mainly it works with the industries which want to take actions, but it is able also to act to all the manufacturing sectors through communication and training activities. Moreover, it is facilitated by the actions of the policy makers which can commission studies, and provide funds but also receive essential feedbacks to try to overcome the implementation barriers of the projects and direct policy actions in the right direction. It acts also for the civil society increasing its awareness on the environmental topics in general and help to build the future generations. All the actors involved are an implicit part of the civil society, which are inhabitants of the local territory. All the components together complete the "ecosystem for the regional systemic innovation"

Fig.8.7 (next page) - graphic representation of the services provided by the LSNB. Based on what published in Battistoni and Barbero (2020)



case-studies for contamination and evolution
ECO-ENTREPRENEURSHIP
ECO-INNOVATION
SUSTAINABLE DEVELOPMENT
TRAINING & COMMUNICATION
start-up
local manufacturing activity
research project
spin-off
communication division
experimentation fab-lab
regional holistic diagnosis for direction to
ecology-systemic thinking education
eco-sd business incubator
- information
energy - matter
holistic diagnosis for enterprise
eco-systemic training center
systemic ecopreneurs
systemic designers
spin-off for holistic diagnosis studies
ecopreneur training center
Systemic Design division
research projects
LSNB
university's technical division
university's humanities division
economy and management division
ecopreneurship education
CO-SYSTEMIC DESIGN

Fig. 8.8 - graphic representation of the specific services provided by the LSNB. Based on what published in Battistoni and Barbero (2020)

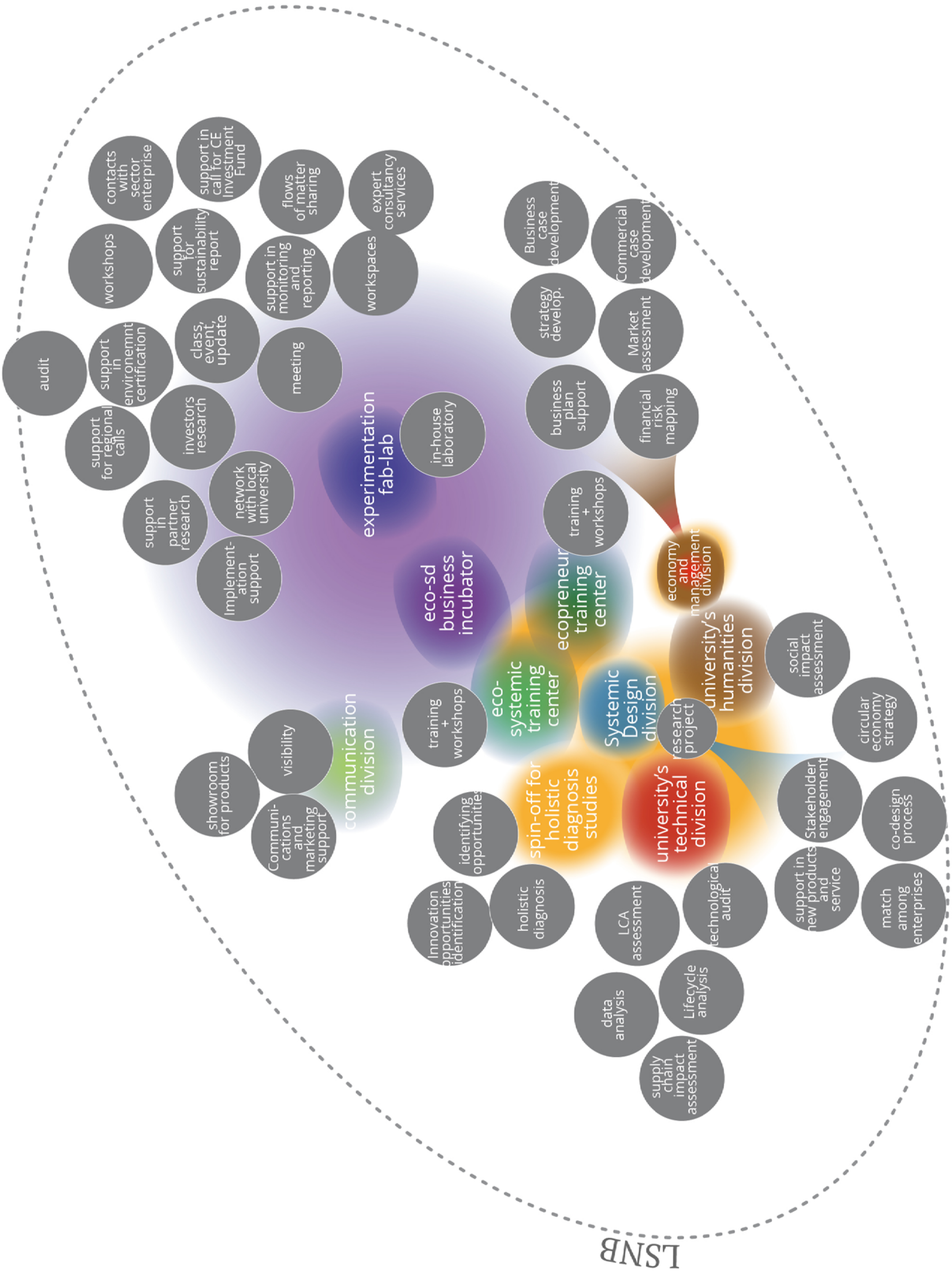
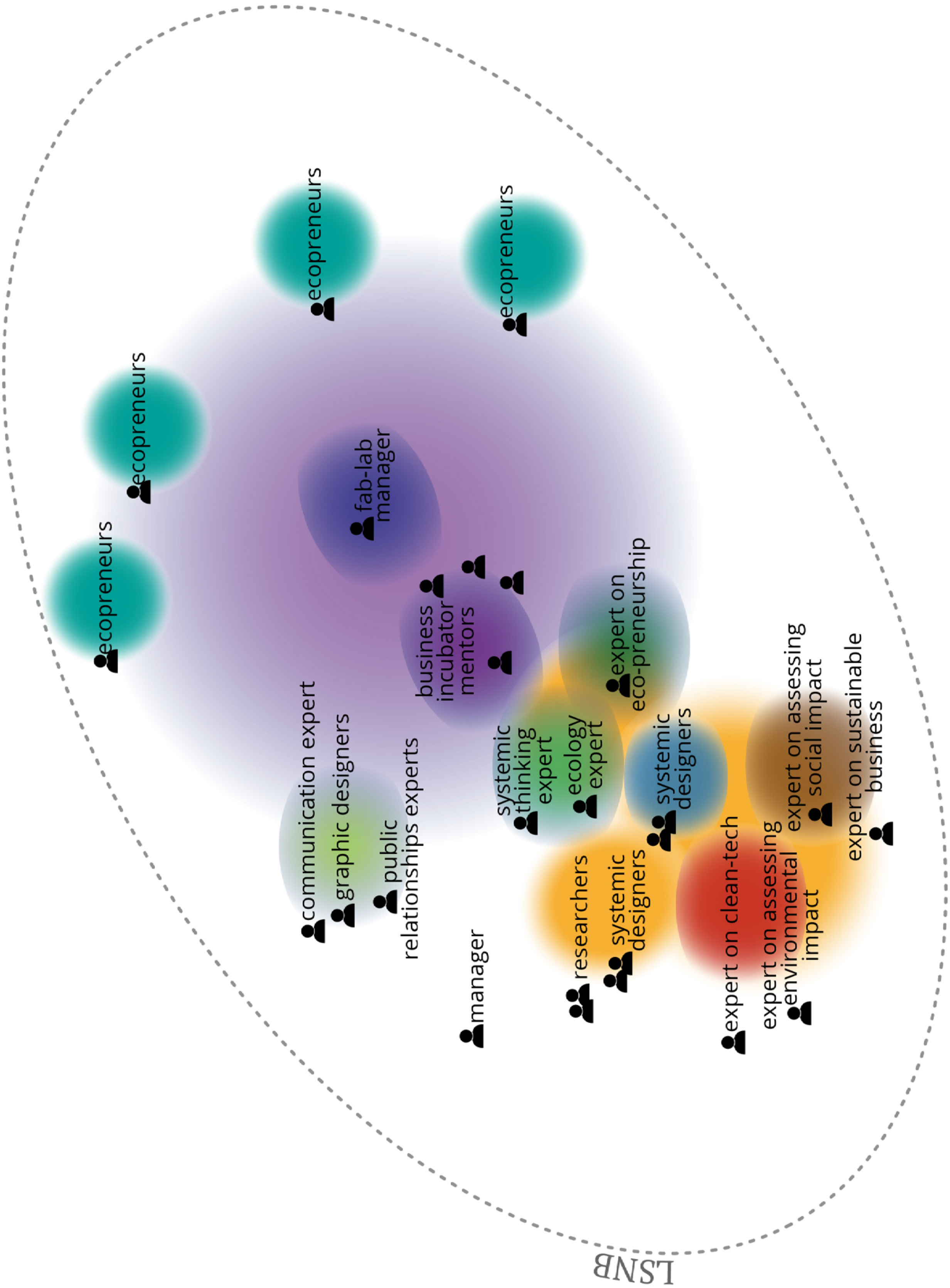


Fig. 8.9 - graphic representation of the specific actors involved in the LSNB.



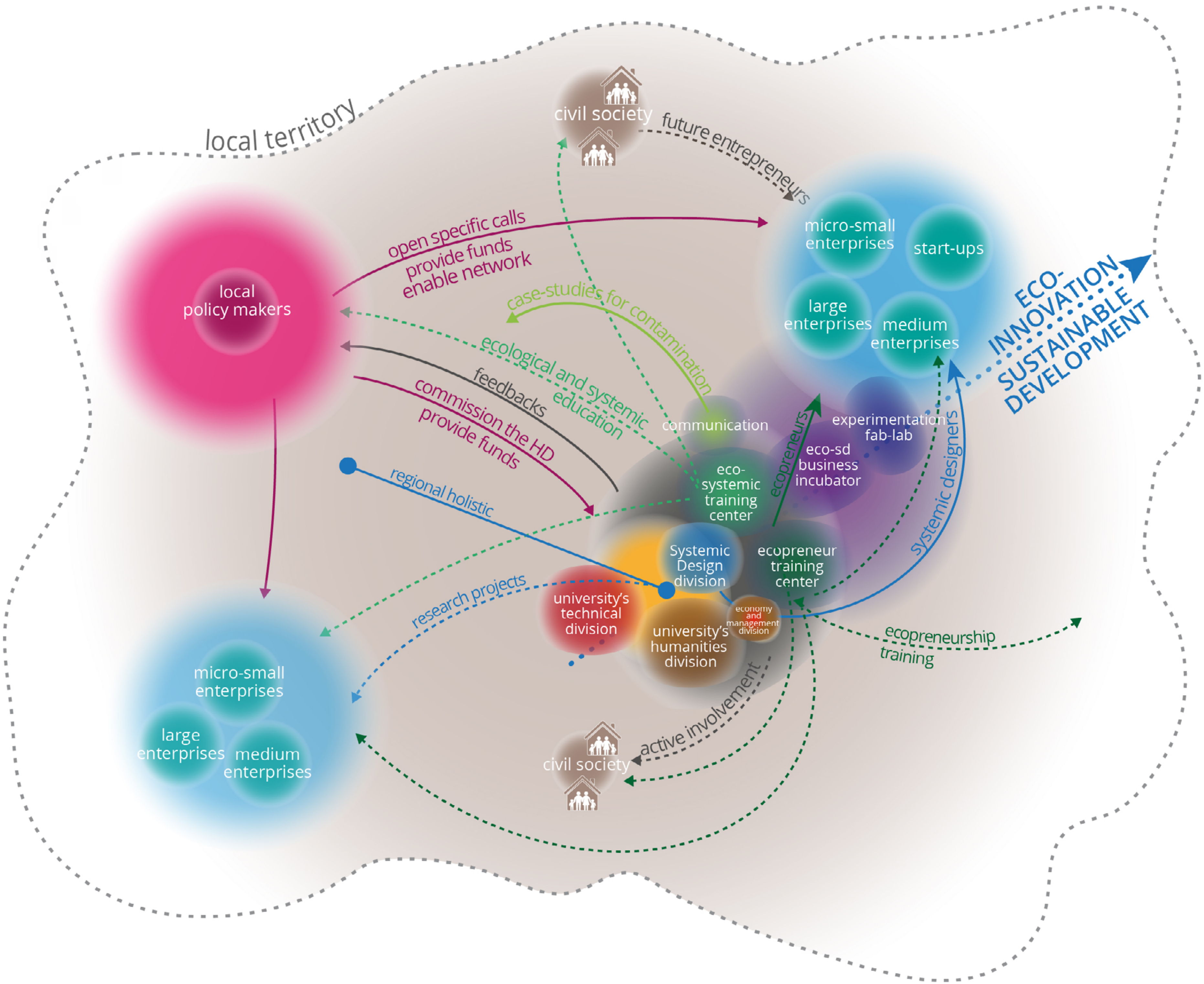

local territory
civil society
future entrepreneurs
local policy makers
open specific calls
provide funds
enable network
case-studies for contamination
ecological and systemic education
feedbacks
commission the HD
provide funds
regional holistic
communication
eco-systemic training center
micro-small enterprises
start-ups
large enterprises
medium enterprises
ECO-INNOVATION SUSTAINABLE DEVELOPMENT
ecopreneurs
experimentation fab-lab
eco-sd business incubator
systemic designers
Systemic Design division
ecopreneur training center
economy and management division
university's technical division
university's humanities division
research projects
ecopreneurship training
active involvement
civil society
micro-small enterprises
large enterprises
medium enterprises

Fig 8.10 (next page) -graphic representation of the Local Systemic Network Booster and the external ecosystem. Based on what published in Battistoni and Barbero (2020)

Chapter 9

Application in Piedmont Region (IT)

The goal of the project's application phase to a real context is to understand if the previously design ecosystem for systemic innovation change shape, and which is the impact created at local level. The context chosen is the Piedmont Region in Italy, because it is the hometown of the author and one of the regions involved in the RETRACE project. Indeed, this phase of the PhD project was facilitated thanks to the author involvement in the Interreg Europe project RETRACE, where she has mainly managed the execution of HD in partners area and executed the HD for Piedmont Region, and participated in the project meetings, specifically in the local stakeholders group meetings.
Afterwards, the application phase was applied to a specific sector, the textile industry, to understand how the ecosystem changes in a particular industrial district and what are the potential outcomes created at local level.

9.1 CONTEXT

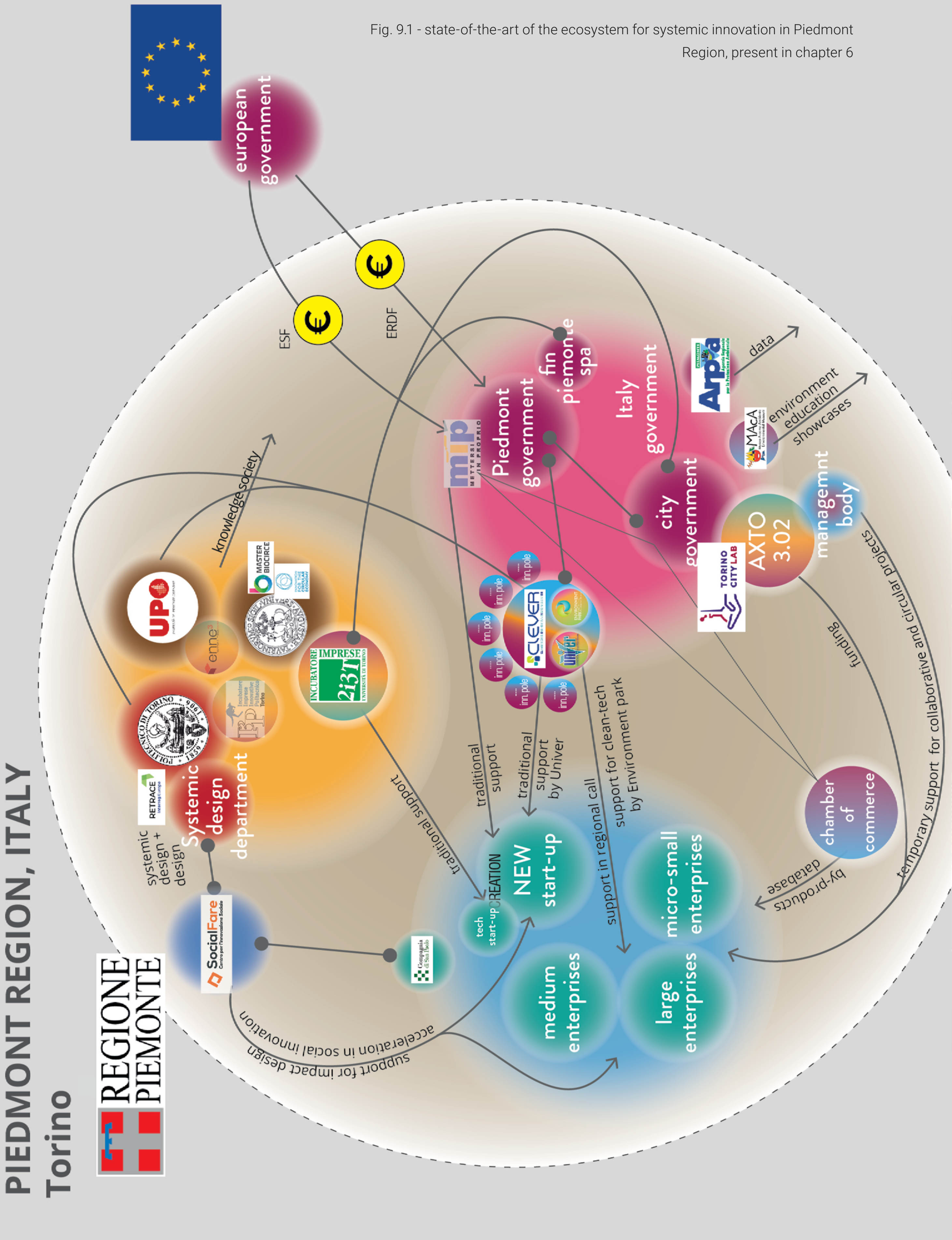
To understand the shape of the ecosystem for systemic innovation in the manufacturing sector in this region, it is necessary to consider the state-of-the-art defined in chapter 6.2.3 (fig. 9.1): this phase recognized the lack of a strong direction towards a different type of economy by the government, but many actors and many competencies are present if considering the quadruple helix.

To better understand the current situation, two studies previously conducted in the same area and in similar research contexts were analysed more in-depth: one about the entrepreneurial ecosystem and the other one on the experience of CE projects in Turin. Although these studies concentrated only on the main city and are not regional, they frame the current situation and suggest indications for the future development of the entire regional ecosystem. The first study, performed by Colombelli, Paolucci, & Ughetto (2019), is about the Turin entrepreneurial ecosystem and recognised 59 institutions (see fig. 6.36 in chapter 6.2.3): among these, they identified the university incubator i3P as the first anchor tenant which already acts this role. In addition, they underlined that this ecosystem has started with a "*hierarchical governance design, where a central actor actively fuelled the emergence of the entrepreneurial ecosystem"* and that now in 2019 the ecosystem is in a *"transition phase"* where the governance is passing from the hierarchical to the *"relational mode"*. In the ecosystem, they recognized a particular inclination towards the technological innovation, where *"Business incubators, business and innovation centres, accelerators, and science parks category is particularly lively"* with a central role of universities and incubators that are in good connections with other institutions. In this ecosystem, some actors are becoming crucial as *"Business associations, community, and coworking category"*, while others are marginal, as: business financial investors with an underdeveloped role mainly for problems of lack of money flow, and the business trade associations, which focus mainly on the early stage of the entrepreneurial activities, providing culture and education, instead of supporting on later stages the growth of start-ups. To conclude, they added that other actors have started to act as anchor tenants, with central positions but with no clear business models. Moreover, they underlined that what is missing is the *"team game"* particularly among governmental institutions. About the future of Turin ecosystem, they required the need of *"strategic planning, a spirit of engagement and a common purpose, as well as a systemic and participative approach"* [...] *"experience has taught that a public actor can start the dynamics by shaping entrepreneurial practices and norms, but cannot govern them"* (Colombelli et al., 2019).

Arguing instead about the relationships between Turin and the CE, Cuomo, Lambiase and Castagna, (2019) published the lesson learnt from the action living lab developed by the city of Turin to reach, following their words, *structure of a territorial hub of Circular and Collaborative Economy"* giving indications to improve its role as *"an ecosystem of public, private and civil society subjects that interact with the aim of bringing to value, economic, social and institutional the environment in which they operate"* with a key role of the city governance. These statements are in line with the indications give by the main actor in an interview we had (see chapter 6.2.3.3) :

- to plan a governance structure capable of effectively putting the various actors involved into relation;
- the action of the Municipal Administration in assuming the management of direction and involvement plays a key-role;
- it is desirable to create an inter-council Control Room (environment, innovation, work, social inclusion, culture and education);
- it is crucial the creation of a subject as a Circular Economy Manager Group, which acts as the executive branch of the Control Room;
- several are the key actors to be involved in the Hub governance structure
  - universities in the area: the University of Turin, through the new Doctoral School Innovation for the Circular Economy; the Polytechnic of Turin, thanks to the multiple skills related to Systemic Design; the University of Gastronomic Sciences of Pollenzo which

Fig. 9.1 - state-of-the-art of the ecosystem for systemic innovation in Piedmont Region, present in chapter 6



carries out research related to food and Circular Economy
- trade associations such as the Chamber of Commerce, Industrial Union, Confindustria, Confartigianato, CNA, Confcooperative, Legambiente.
- various utility companies are key-actors that have to be involved;

• the constituting Hub is to be understood both as a new network of territorial actors and at the same time connection of existing ones;
• the Hub has to be meant as a node of a wider network, connected to supra-local scales of action....the work of the Circular Economy Manager Group is strategic, which makes it possible to relate what is moving, developing and is learned at the Hub level with the rest of the Italian and international Circular Economy context.

Finally, they suggested the need to identify physical spaces (one or more) where the different actors can interact directly. And conclude with a great challenge: *"to bring together different actors on both a local and global scale to promote real changes in environmental regeneration and citizen services policies. A challenge that can only be faced by cities through dialogue and positive exchanges addressed to the planning of future living labs."*

The application phase of the PhD project to a real context involved also the collection of feedbacks from different stakeholders. See chapter 6 and fig.9.2 repeated.

These previous studies and feedbacks demonstrated the dynamism of the city of Turin on technological innovation and in looking for strategies to develop eco-innovation and facilitate its implementation. Moreover, they witness the role of the city of Turin as central in the Piedmont Region. However, if considering the manufacturing sector in the entire Piedmont Region, the situation is highly different. This aspect, which will be examined later, should be analysed without forgetting some particular

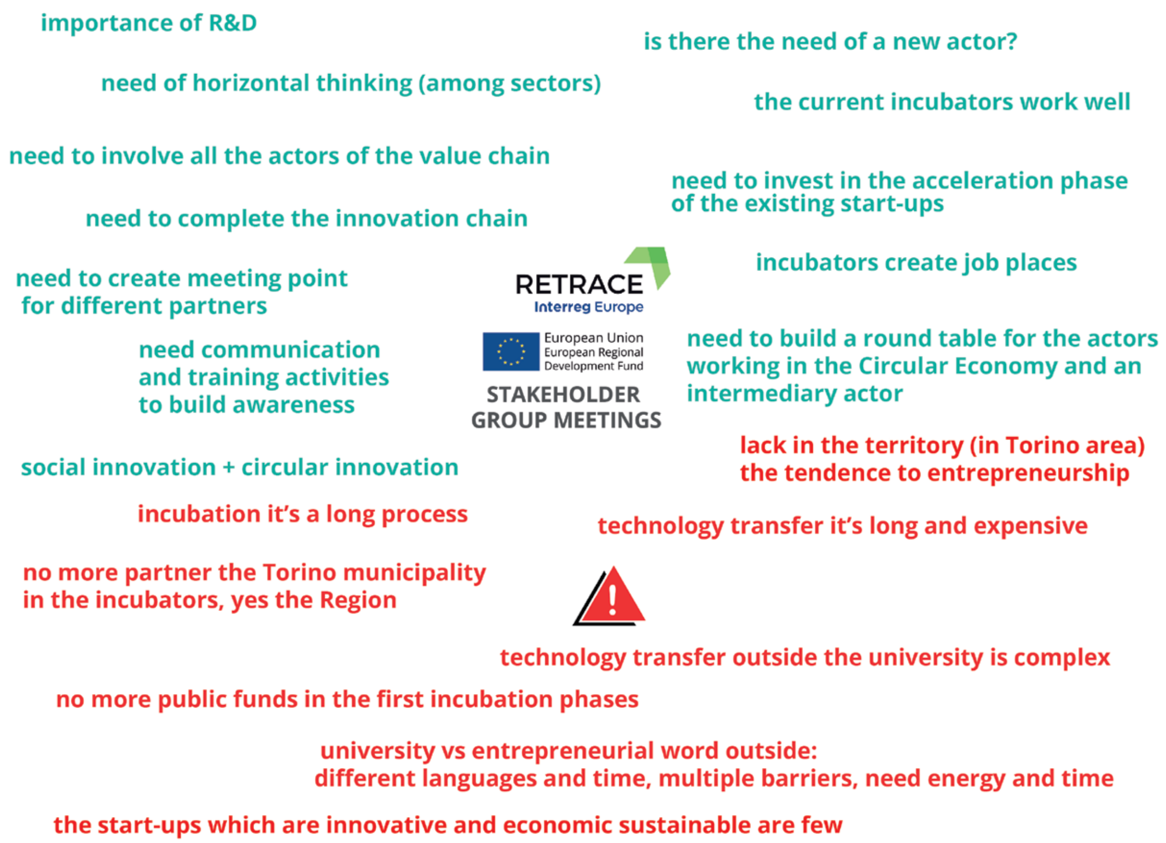


Fig. 9.2 - the principal and relevant highlights of the RETRACE stakeholders group meetings (repeated)

aspects of the Region[1]: about 51% of the territory is agricultural area and about 43% of the territory is composed of mountains (fig. 6.23 in chapter 6.2.3). The average population density is about 170 hab/kmq, and it is very low in the mountain area (less than 50 hab/kmq) while is mainly concentrated in the hilly and flat area.

9.1.1 Manufacturing sector

About the industrial sector, a research on the online Istat database[2] over the total data about regional enterprises and employees, has shown a situation

1 info retrieved from the HD executed for the RETRACE project. See chapter 6.2.3 and. (Battistoni & Giraldo nohra, 2017) annexes

2 National institute of statistics, availbale at https://www.istat.it/it/imprese?dati. Data presents in: "Istat --> imprese --> dati e microdata --> imprese e addetti --> struttura --> classe di addetti, --> settori economici (ateco 2 cifre) - prov."

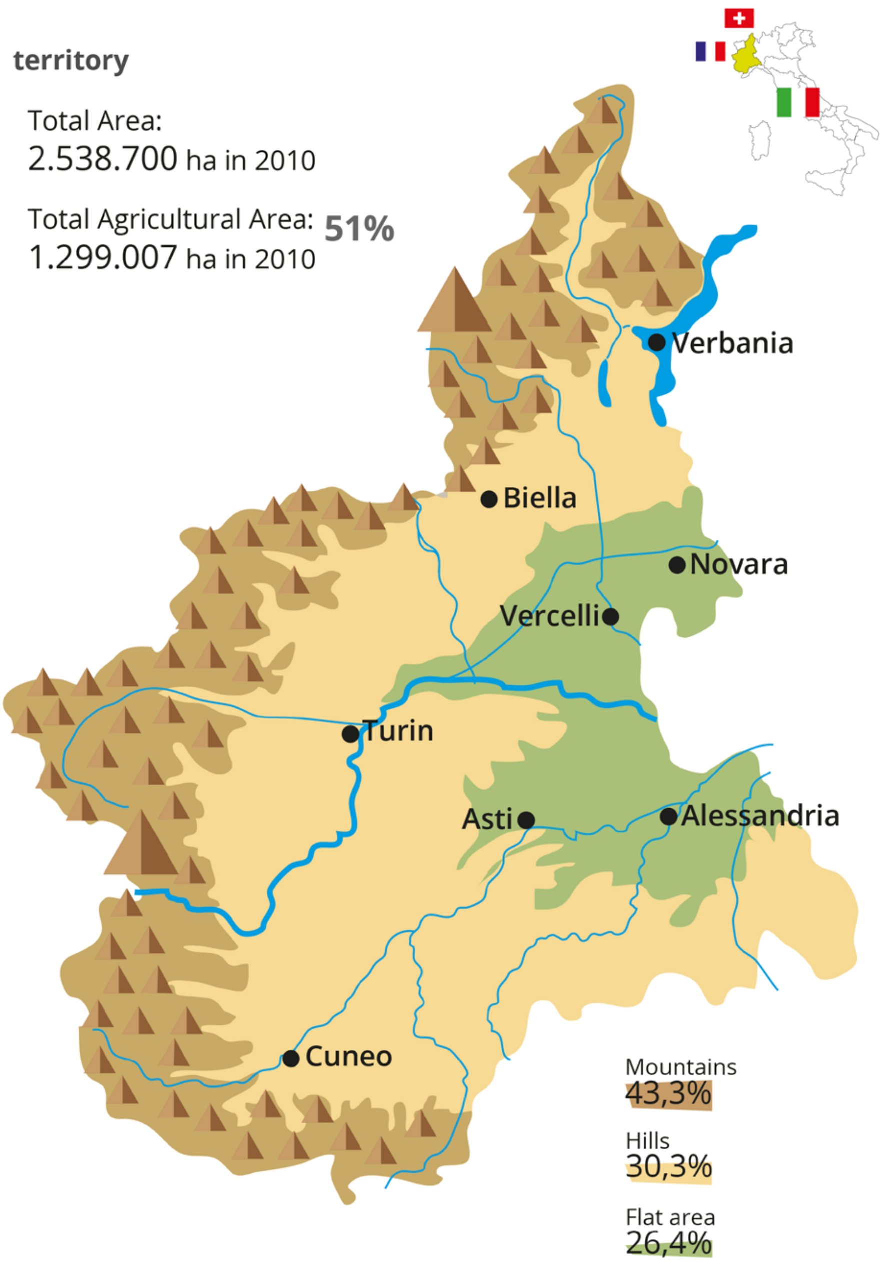


Fig. 9.3 - graphic representation about the geography context in Piedmont Region. Based on what published in Battistoni & Giraldo Nohra (2017, annexes, p. 146)

where the manufacturing sector represents about the 9% of the total enterprises, with about 30.000 units in 2017, and employed 385.591 people in Piedmont region. In 2013, the data extracted were 36.699 units and 390.961 employees (fig. 9.4). Regarding the rate between the manufacturing units and the total enterprises in Piedmont Region, the highest rate is in Biella and Alessandria province where it is close to 11%. Focussing instead on the employees, the one s working in the manufacturing sectors are about the 29%, with the highest rate in Novara province with 31,4%. (tab.9.1)
The province with more manufacturing units is the Torino one followed by Cuneo (tab.9.2). The same situation regarding the employees (tab.9.3).

Regarding the manufacturing sector in general, the turnover in 2014 was about 25.400,8 millions of euro. The 99% of the units are SMEs, mainly micro ones (34.177 units over the total 36.699 units, about the 93%), mainly one-man company involved in the following sectors (in order of manufacturing unit) (see fig. 9.4):

- other;
- metal products;
- food & drinks;
- repair cars;
- other machineries;
- wood processing;
- mineral processing;
- textile.
-

The regional government identified six areas of innovation or excellence in which is investing the most (see fig. 9.4, right part and chapter 6). The most numerous area by units reunites all the traditional sectors the *"made in Piedmont"* that includes big industries like Ferrero, Lavazza, and Martini. More

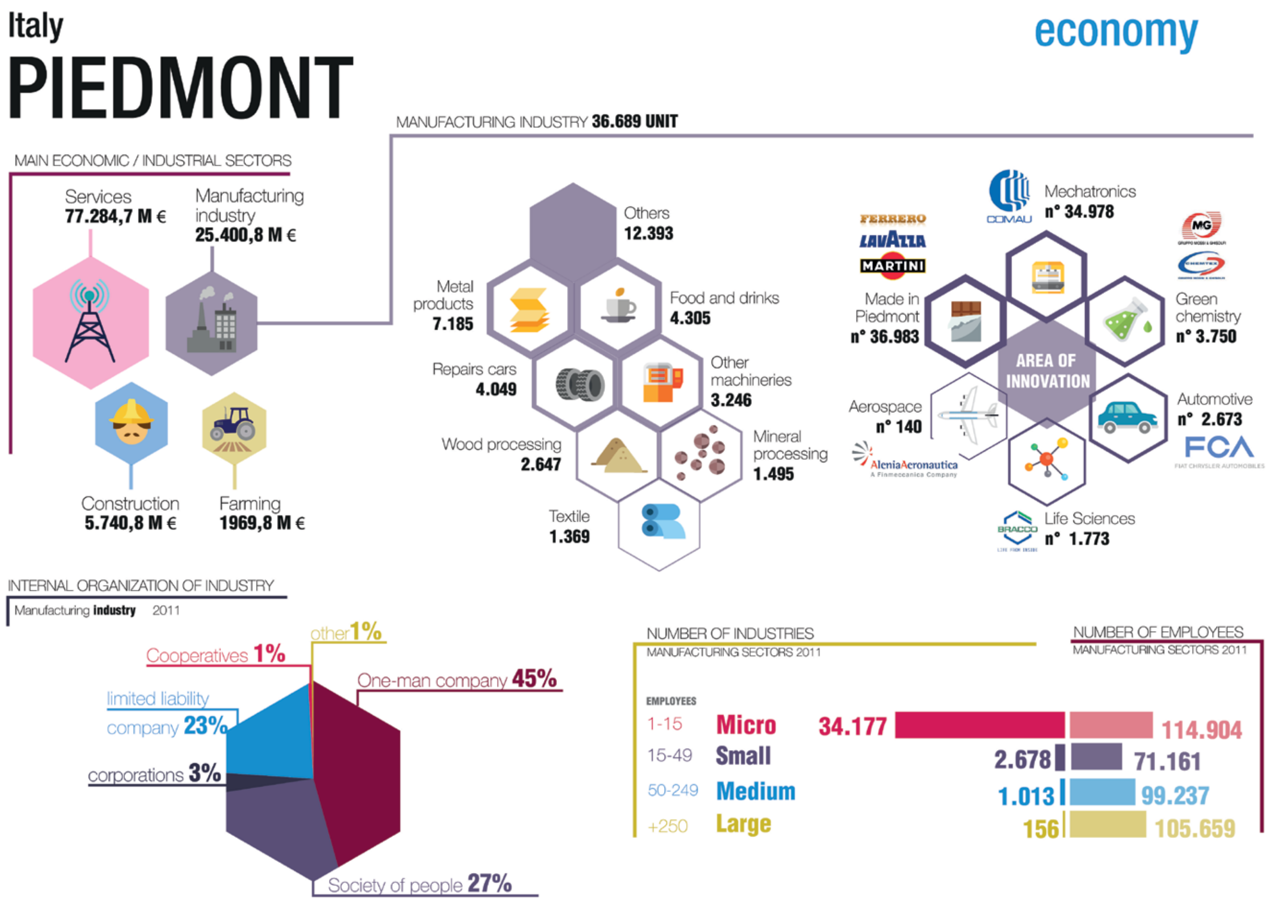


Fig. 9.4- graphic representation about the economic context in Piedmont Region. Based on what published in Battistoni & Giraldo Nohra (2017, annexes, p. 146)

related to the engineering vocation are the areas of Mechatronics, Automotive, and Aerospace, and inside this sector can be found key companies for the Piedmontese development like FCA and Comau. Other non traditional industrial sectors that have gained importance are Green Chemistry and Life Science with relevant companies like Mossi Ghisolfi and Bracco Corporate.

The data from the 'Osservatorio sulle vocazioni produttive dei territori piemontesi' report[3] (fig. 9.5) over the 'Value added at basic prices' attributes the 25,6% to the industrial sectors divided in: machineries and means of transport (35,1%), other (25,4%), metal products (15,5%), food, beverage and tobaccos (7,5%), wood, rubber, plastic, and other (9,6%) and textile (6,9%).
Along to the productive vocation of the territorial area, the Italian manufacturing sector is characterized by the industrial districts, a phenomenon studied

3 available at http://images.pie.camcom.it/f/StudiPubblicazioni/10/10899_UCCP2_30112010.pdf

Tab . 9.1.- Specific data per province. Data from Istat referring to year 2017

Province	**Total unit**	**Total employees**	**Manufacturing unit (ATECO C)**	**Manufacturing unit over the total unit**	**Total employees in manufacturing unit**	**Manufacturing unit over the total unit**
Torino	171.378	756.965	13.831	8%	215.160	28,4%
Novara	25.761	94.374	2.660	10,3 %	32.747	34,7%
Alessandria	29.828	109.350	3.289	11%	32.503	29,7%
Asti	15.400	51.125	1.581	10,2%	14.372	28%
Cuneo	46.278	184.538	4.793	10,3%	53.228	28,8%
Vercelli	11.613	47.179	1.079	9,3%	12.937	31,4%
Biella	13.210	66.864	1.474	11,1%	16.968	25,4%
Verbanio-cusio-ossola	11.700	35.150	1.131	9,6%	7.671	21,8%
Piemonte	**325.168**	**1.334.368**	**29.838**	**9,1%**	**385.591**	**28,9%**

Tab . 9.2 - Specific data per province by manufacturing units. Data from Istat referring to year 2017

Manufacturing units	**Province**	**%**
13.831	Torino	46
4.793	Cuneo	16
3.289	Alessandria	11
2.660	Novara	9
1.581	Asti	5
1.474	Biella	5
1.131	Verbanio-cusio-ossola	4
1.079	Vercelli	4

Tab 9.3 - Specific data per province by the number of employees in the manufacturing units. Data from Istat referring to year 2017

Employees	**Province**	**%**
215.160	Torino	56
53.228	Cuneo	14
32.747	Novara	9
32.503	Alessandria	8
16.968	Biella	4
14.372	Asti	4
12.937	Vercelli	3
7.671	Verbanio-cusio-ossola	2

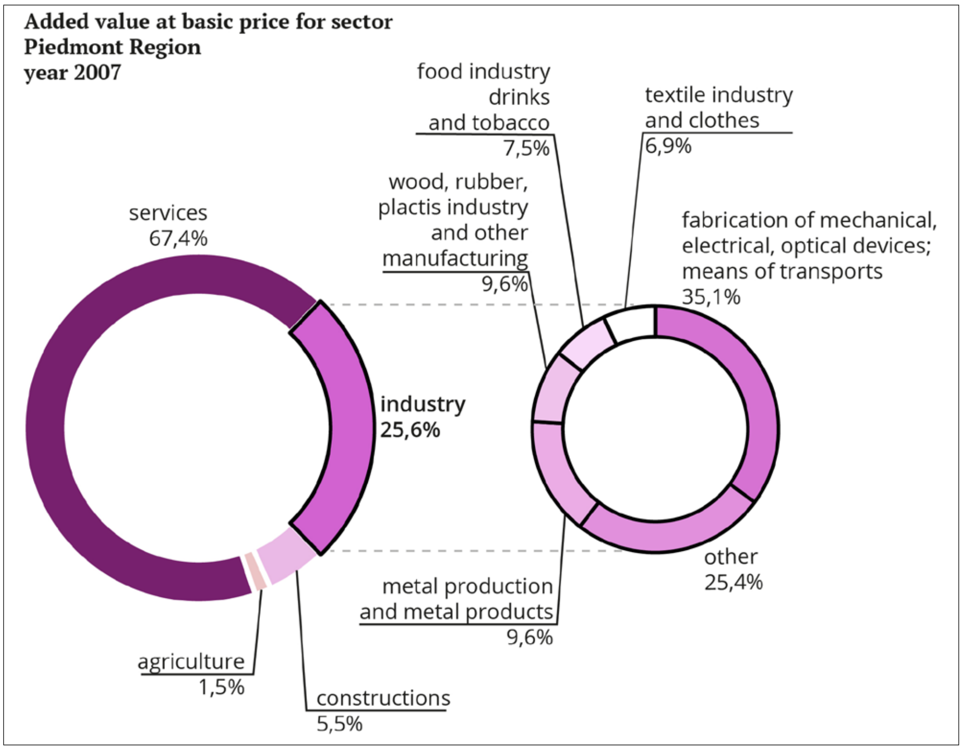


Fig. 9.5 - Added value at basic price for sector. Data retreived from the 'Osservatorio sulle vocazioni produttive dei territori piemontesi' report

Tab . 9.4 - .Specific data per province. Data from Istat referring to year 2017

Province	Manufacturing unit (ATECO C)	Manufacturing unit over the total unit	Total employees in manufacturing unit	Manufacturing unit over the total unit	Specialization
Torino	13.831	8%	215.160	28,4%	Food & beverage, metal products, electronics, digital, technology and communication
Novara	2.660	10,3 %	32.747	34,7%	Chemistry, mechanics, taps
Alessandria	3.289	11%	32.503	29,7%	Chemistry, mechanics, fridges, chocolate & wine, gold
Asti	1.581	10,2%	14.372	28%	Food & beverage, wood, metals, electrics
Cuneo	4.793	10,3%	53.228	28,8%	Food &beverage, glass wood and stones processing
Vercelli	1.079	9,3%	12.937	31,4%	Bio-medical and bio-technology, renewable energy, rice, textile
Biella	1.474	11,1%	16.968	25,4%	Textile (wool, clothes, industrial machineries)
Verbanio-cusio-ossola	1.131	9,6%	7.671	21,8%	Metal products and stones, taps
Piemonte	**29.838**	**9,1%**	**385.591**	**28,9%**	

by many scholars during the years as Becattini (1991), Bellandi (2002), Corò & Grandinetti (1999), Rabellotti et al. (2009), Whitford (2001). The national report about this phenomenon identified that "*they are characterized by relationships of interdependence and cooperation between enterprises, mainly small ones located in a specific territorial area. It has historically represented the strong point of the Italian economy, contributing to the turnover and employment grow, also pushing the research of quality and innovation. However, the globalization and the new technologies and the growing competition with foreign units were challenges but also opportunities. There was indeed a phenomenon of internal selection, reorganization and productive reconversion*"[4] (Unioncamere, 2014). The data about the vocational of the distribution of

4 in Italian: rapporti di interdipendenza e di cooperazione tra imprese prevalentemente di piccole dimensioni ubicate in un determinato ambito territoriale, ha storicamente rappresentato uno dei punti di forza dell'economia italiana, contribuendo in misura notevole alla crescita del reddito e dell'occupazione, sulla spinta anche della ricerca della qualità e dell'originalità dell'offerta produttiva. Se è vero che il modello dei distretti industriali ha consentito al nostro Paese di crescere e di imporsi sui mercati internazionali, è altrettanto vero, però, che oggi il processo di globalizzazione, le innovazioni tecnologiche

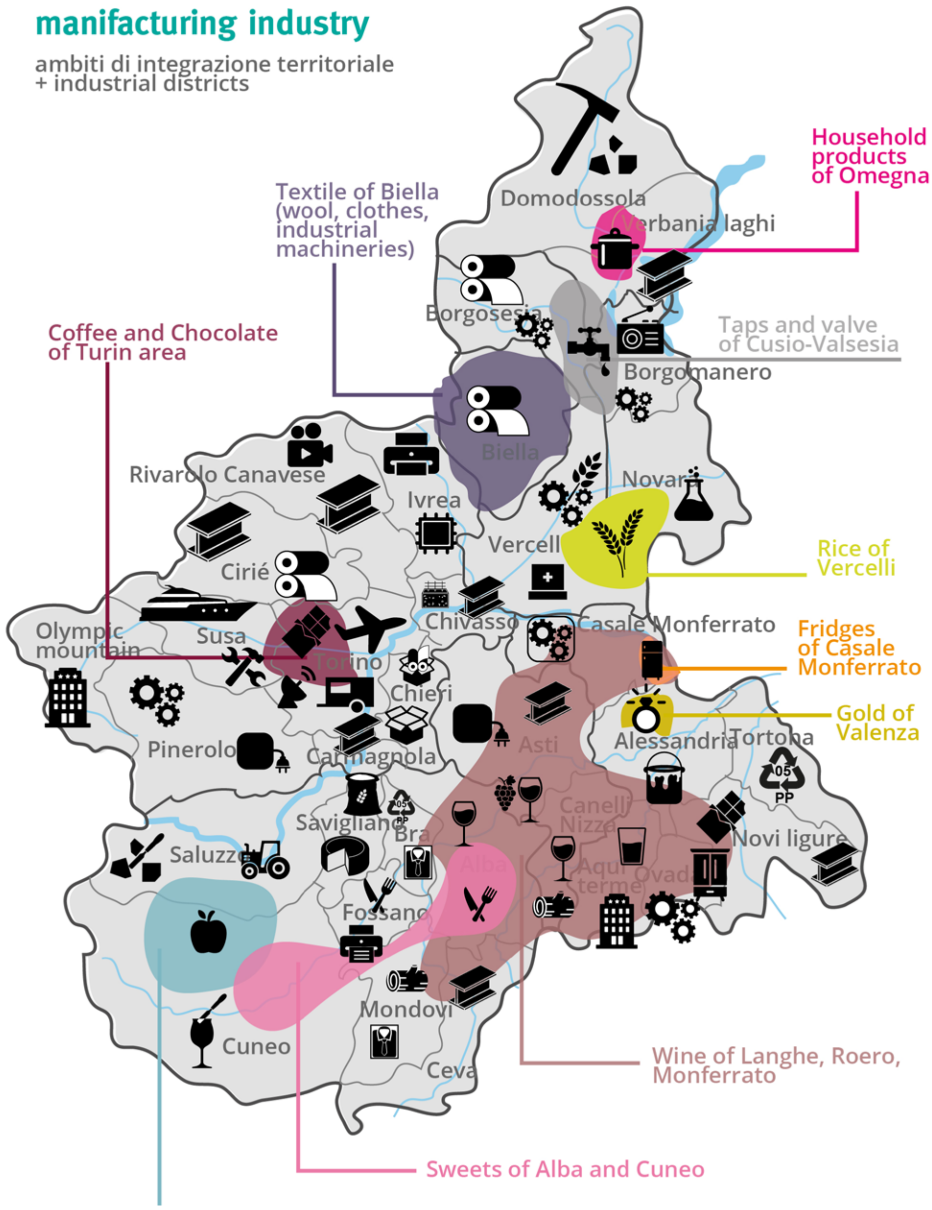


Fig. 9.6 - the map of the districts in the region, created with the available data

specialised companies for 'ait, ambiti di integrazione territoriale'[5] of the 'Osservatorio sulle vocazioni produttive dei territori piemontesi' and the ones on the industrial districts in Piedmont Region retrieved from (Intesa San Paolo - Direzioni studi e ricerche, 2017) were crossed obtaining the following map (fig. 9.6). Also, the data coming from a previous study about industrial districts were the design field is mainly involved (Germak, 2001) was taken in consideration.

Dividing data for each province area, the provinces can be represented in tab.9.4 (details in annex).

9.1.1.1 Manufacturing sector and special waste

The manufacturing industry in the Piedmont Region in 2014[6] was responsible for 1.926.199 tons of special waste which is the 35,4% of the total waste produced in the Region (Regione Piemonte, 2015).
Among them, 1.650.954 t are non-hazard while 275.244 t are hazard ones. Regarding non-hazard waste, the sector which mainly produced it is the metal processing with about 358.000 t, followed by the metallurgy with 312.000 t, the paper production with 200.000 t, the production of cars and trailers with 146.000 t and the food industry with 124.000 t. The other Ateco sectors were below the 100.000 t/ year (see annex).
Making a focus on the provinces, in 2013 Torino produced over the 45% of the total special waste, which reflects the fact that it hosts the 52% of the enterprises (see tab.9.5). Cuneo produced 16%, Alessandria, Vercelli and Novara around the 10% while Alessandria, Verbania and Biella below the 4%. The percentage of special waste reflects the distribution of enterprises for province but not the waste managers and the number of landfill (see tab. 9.5).

9.1.1.2 Manufacturing sector and sustainable good practices

On a regional industrial level, there are some active realities which believe in different and sustainable production models and are acting in a different way. However, they remain a little portion of the entire sector. Some examples and good practices were extracted from the following databases:

- the European Circular Economy stakeholder platform[7] - looking for 'good practices'[8] the results are 4 (fig. 9.7):

e la crescente competizione internazionale presentano nuove sfide e opportunità; emergono pertanto fenomeni di selezione interna, riorganizzazione e riconversione produttiva, volti a preservarne il potenziale competitivo in Italia e all'estero.

5 http://www.politichepiemonte.it/index.php?option=com_content&view=article&id=218:indicazioni-

6 last data available

7 https://circulareconomy.europa.eu/platform/en/map-search?type=cecon_good_practice&key_area=All&title=&submit=Search

8 research updated the 23 september 2019

Tab . 9.5 - Specific data per province. Data from Istat referring to year 2014

Province	Active enterprises in 2017 (%)	% of special waste in 2013	N° of Waste manager in 2014 (no landfill)	N° of landfill for non-hazard special waste
Torino	52%	45%	512	4
Novara	8%	9%	119	0
Alessandria	9%	11%	156	3
Asti	4,7%	4%	61	0
Cuneo	14%	16%	225	2
Vercelli	3,5%	10%	62	0
Biella	4%	2%	70	1
Verbanio-cusio-ossola	3,5%	3%	45	0
Piemonte	**100%**	**100%**	**1.250**	**10**

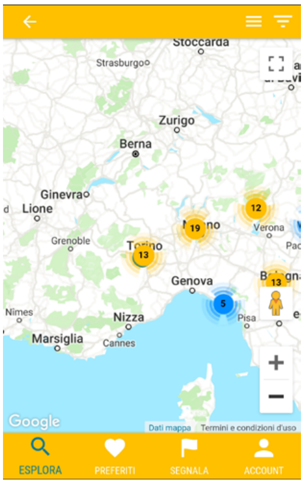


Fig. 9.8 - screenshot from 'Mercato Circolare' app done the 23 september 2019

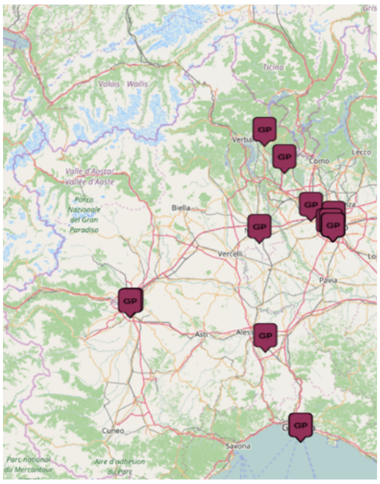


Fig 9.7 - screenshot of the research in https://circulareconomy.europa.eu/platform/en/map-search?type=cecon_good_practice&key_area=All&title=&submit=Search

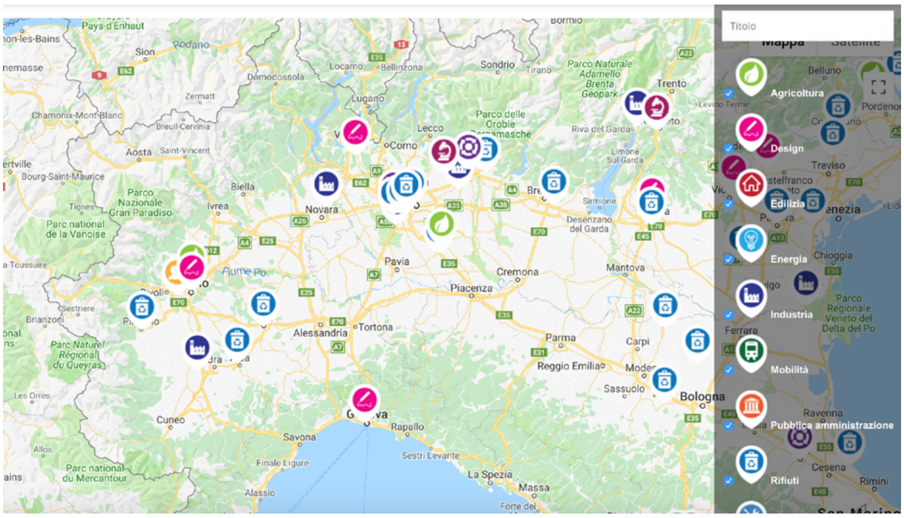


Fig. 9.9 - screenshot of the research on http://www.trenoverde.it/campioni

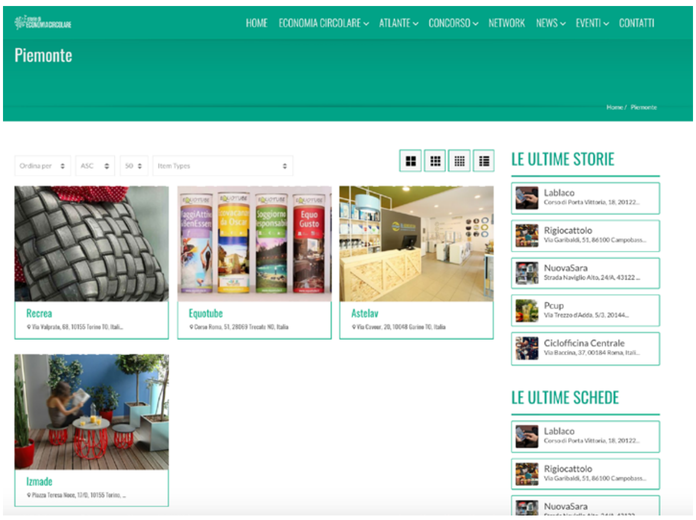


Fig.9.10 - screenshot of the research in https://www.economiacircolare.com/area/piemonte/

- Mercato Circolare (Torino)[9]
- A project in Torino municipality [10]
- Ecoplasteam with the product 'ecoallene'[11]
- The mater-bi product by Novamont[12]

• the 'Mercato circolare' digital platform, which in Piedmont group in the same application around 58 enterprises active in the topic of CE, which are mainly located in Torino city. Moreover, in this platform are also collected around 29 social initiatives and events (fig. 9.8) (see annex)
• Legambiente with the initiative 'campioni dell'economia circolare' of 'treno verde'[13] identified 8 actors which are not only industries but also waste manager and social enterprises (fig. 9.9):

- Novamont enterprise in Novara (industry)
- Gaia SpA in Asti (waste)
- MPOLI srl (waste)
- Dalma Mangimi Spa (industry)
- Acea Pinerolese Industriale (waste)
- Triciclo soc. Coop. (social)
- Recrea srl (design)
- Cascina pulita srl (agriculture)

• Storie di economia circolare database[14] includes 4 realities (fig. 9.10):

- Recrea
- Equotube
- Izamde
- Astelav

9.2 THE ACTORS OF THE ECOSYSTEM AND THEIR LOCATION

According to the different categories of actors of the ecosystem for systemic innovation, for each of them the actors were identified_

About the civil society, the Piedmontese population (more than 4.400.000 inhabitants) is distributed according to the development of economic activities and urban centres locations, concentrated in the plain and hilly area, while in the mountains the density is less than 50 hab/kmq (fig. 9.11). Torino city alone holds around 890.500 people, in Novara and Alessandria around 100.000 hab, Asti around 76.000, Cuneo 56.000, in Vercelli and Biella around 50.000,

9 https://www.mercatocircolare.it/
10 http://nws.eurocities.eu/MediaShell/media/2017cities_and_circular_economy-web-spreads.pdf
11 https://www.ecoplasteam.com/
12 http://materbi.com/en/about/
13 http://www.trenoverde.it/campioni
14 https://www.economiacircolare.com/area/piemonte/

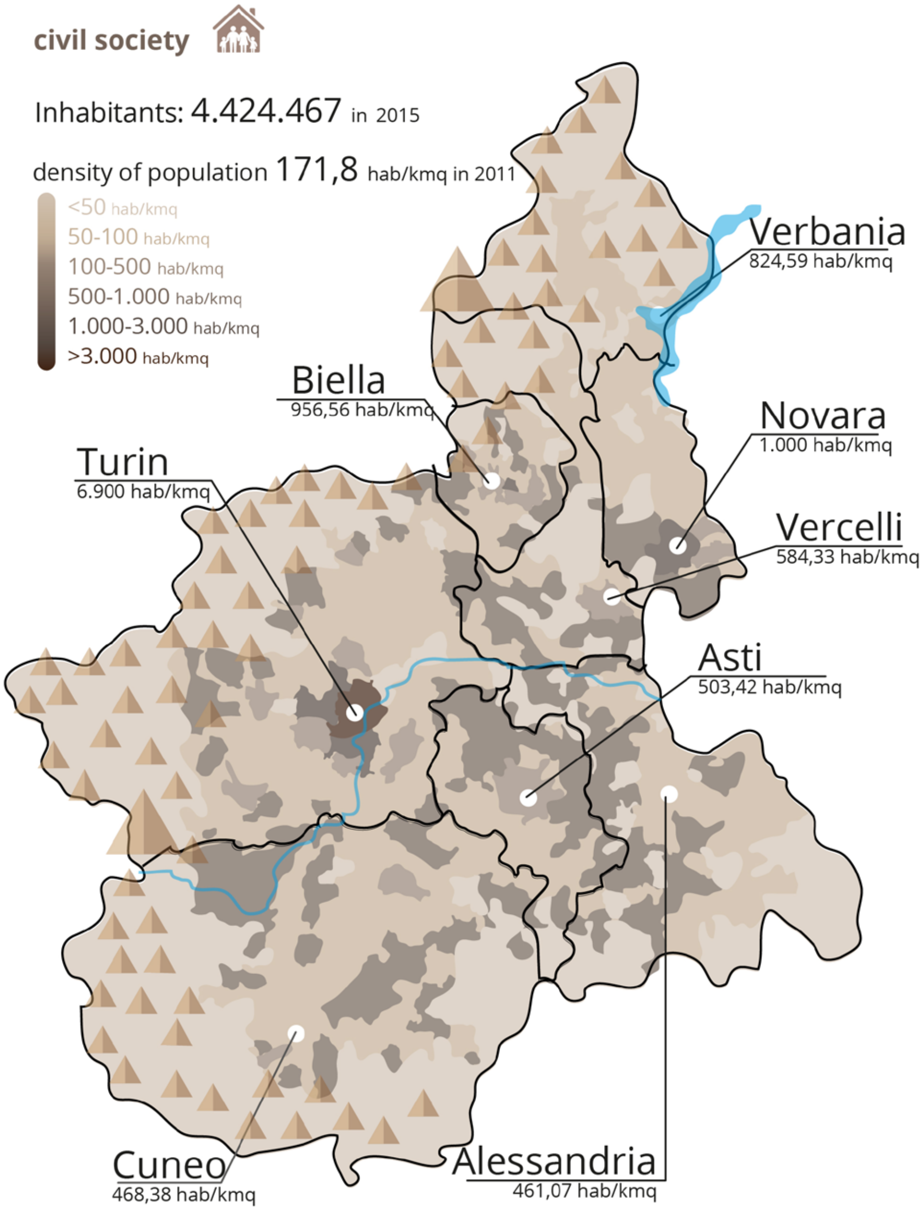


Fig. 9.11 - graphic representation about the localization of the civil society in Piedmont Region

while Verbania has around 30.000 people (data from Battistoni and Giraldo, 2017, annexes).

The population on average is middle aged, which is related to the low nativity rate and high presence of singles and couples. The region is considered 'old' for the high old age index around 182,3. Moreover, because of cultural and economical reasons, young people only reach economic independence at the age of 30. Regarding the employment, levels have improved after the 2012 crisis and it keeps at 60% with more than 1.300.000 of employees with an average income of 23.600 euro/year. However, the level of unemployment doubled in 2015 compared to 2004. The levels of emigration and immigration are still high (data from Battistoni and Giraldo, 2017, annexes).

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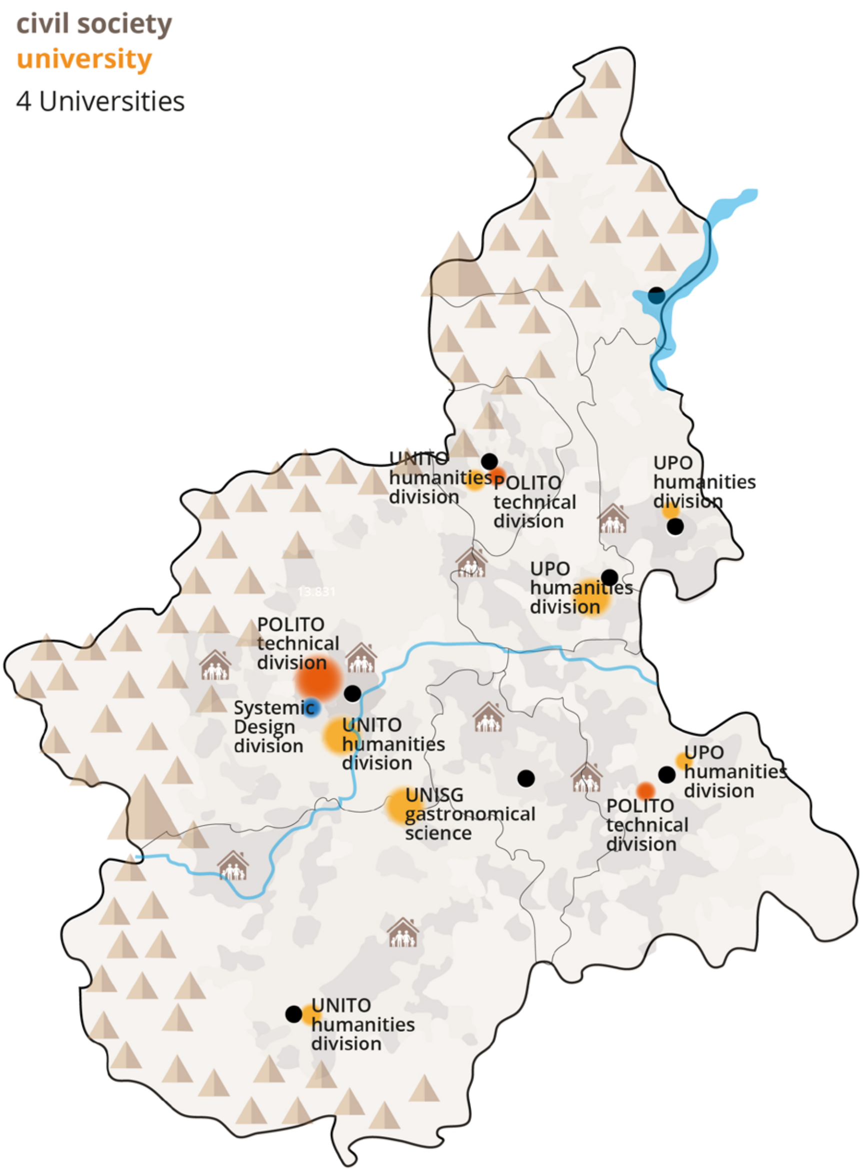
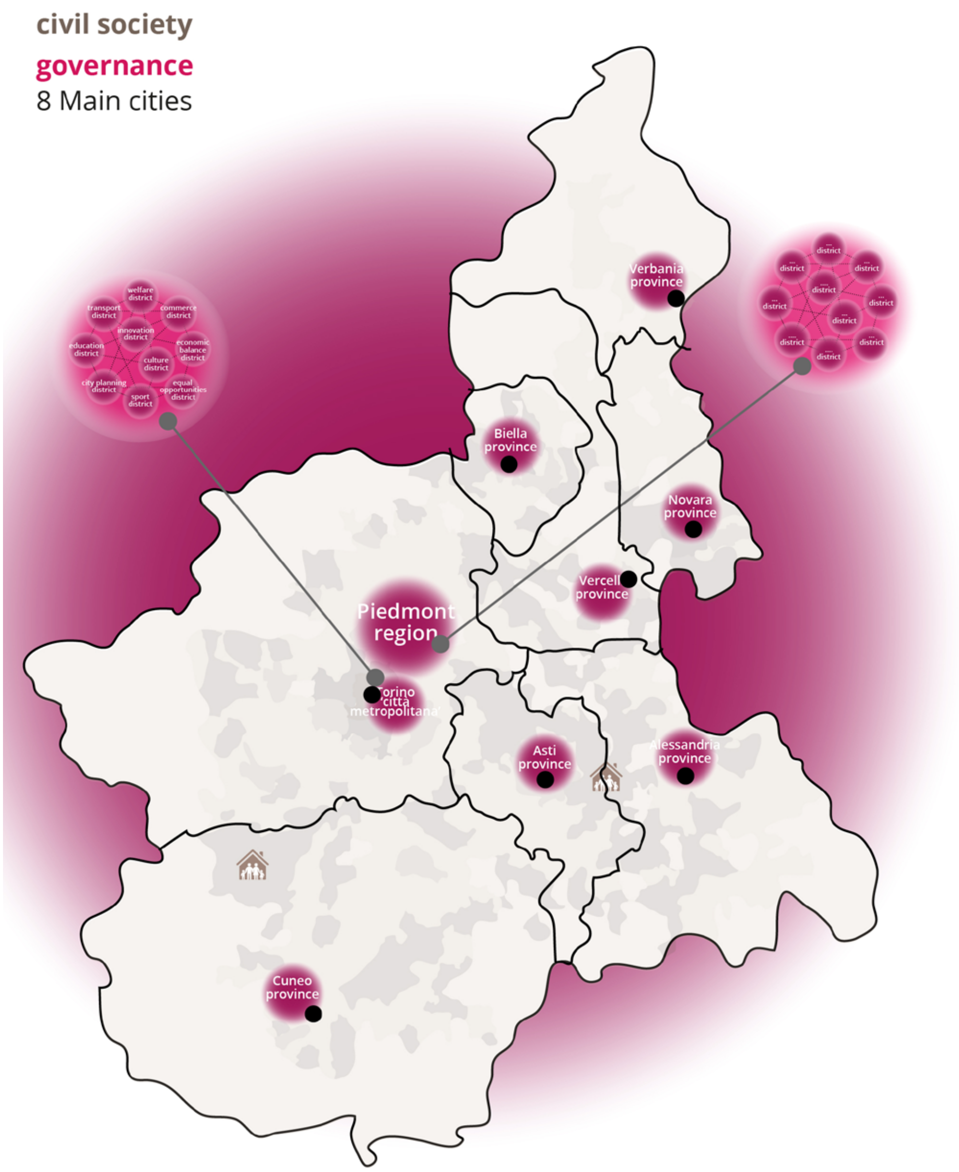
Fig. 9.12 - graphic representation about the localization of the universities in Piedmont Region



University: in terms of education, the region is a reference point at national level due to its prestigious university institutions. The most important areas of vocation are engineering and economics, and this is quite influenced by the massive automotive industry and the tertiary sector. The two main universities (see fig. 9.12), Politecnico di Torino (POLITO) and Università degli studi di Torino (UNITO) are mainly located in Torino city, with some departments of both POLITO and UNITO in other cities as Biella , and the presence of the University of Piemonte Orientale in Vercelli but with separate departments [15] in Biella, Alessandria, Novara. (see fig. 9.12) (Battistoni and Giraldo, 2017, annexes).

15 https://www.uniupo.it/il-multicampus/dove-siamo

Fig.9.13 - graphic representation about the localization of the government in Piedmont Region



<u>Governance:</u> about the governance (see fig. 9.13), the headquarter of Piedmont Region is in Torino. A problem recognized in the RETRACE and Urban Wins projects was for example the non-complete collaboration among all the 11 districts [16] .
In each territorial area, the different municipalities are grouped for province. In the case of Torino, the municipality is also the province, now called 'Torino città metropolitana". As recognized by also the study of Cuomo, Lambiase, Castagna (2019) a province is made of many departments[17] and there are problems of non-complete collaboration among them, which also limit the passage of useful information.

16 https://www.regione.piemonte.it/web/amministrazione/organi/giunta

17 Welfare; Commerce; Economic balance; Innovation; Education; Urban planning; Culture; Transports; Equal opportunities; Environment, Sport. Retrieved from https://www.regione.piemonte.it/web/temi/fondi-progetti-europei/fondo-europeo-sviluppo-regionale-fesr/ricerca-sviluppo-tecnologico-innovazione/poli-innovazione

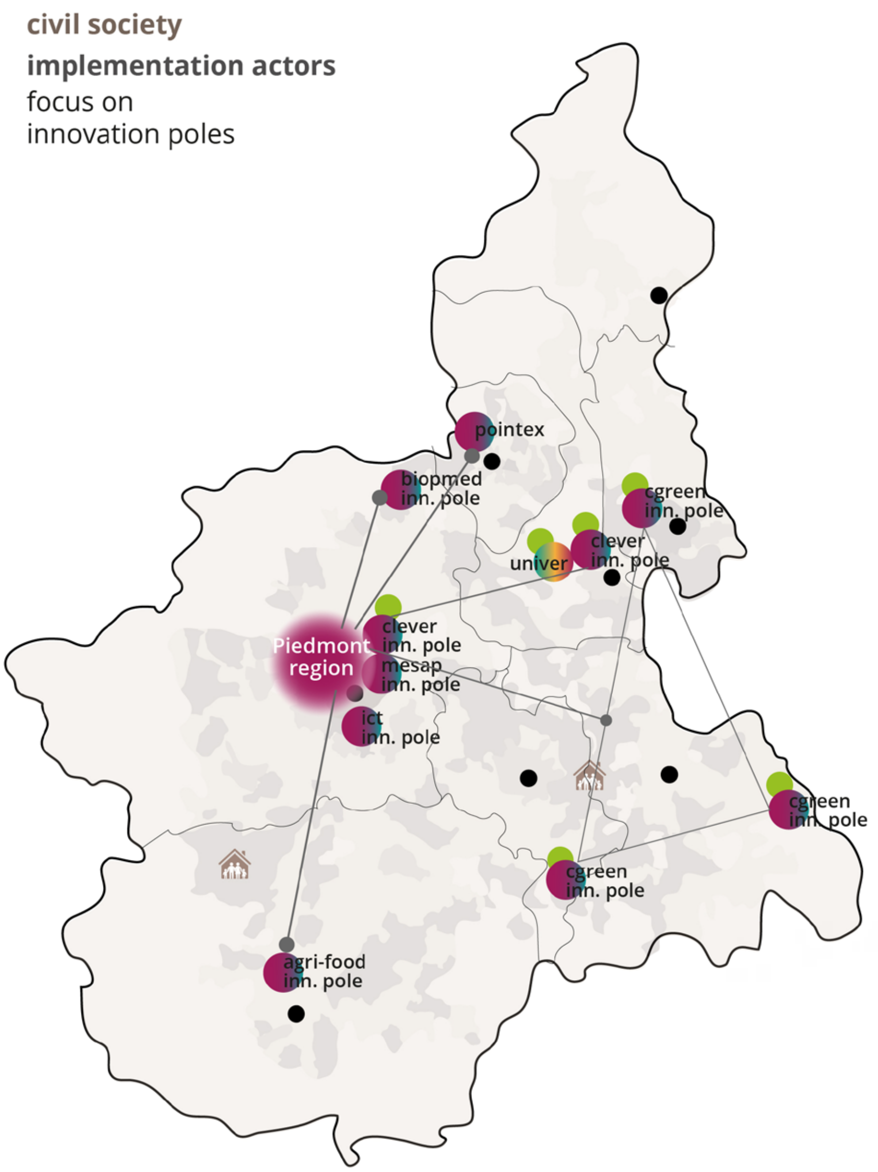


Fig. 9.14 - graphic representation about the localization of the innovation poles in Piedmont Region

About the implementation actors, two main categories are identified, distributed through the territory, although they are leaving many areas outside of their control (fig. 9.14).
The regional Innovation pole/clusters, as seen in chapter 6.2.3 are7 and spread on the regional territory following industrial districts and the specialization of the area. They are mainly concentrated in the city of Torino but for example Clever has a second head also in Vercelli city. The Chemistry Green pole is in Novara, Asti and Alessandria province (fig. 9.14). They are promoted by the Piedmont Region[18] and, the previous analysis about them, has identified them as actors very close to the industrial sector, but unfortunately only to the companies interested in innovation actions. However, thanks to the many services and competencies represented, especially the Clever pole for the focus on the CE, they can have

18 https://www.regione.piemonte.it/web/temi/fondi-progetti-europei/fondo-europeo-sviluppo-regionale-fesr/ricerca-sviluppo-tecnologico-innovazione/poli-innovazione

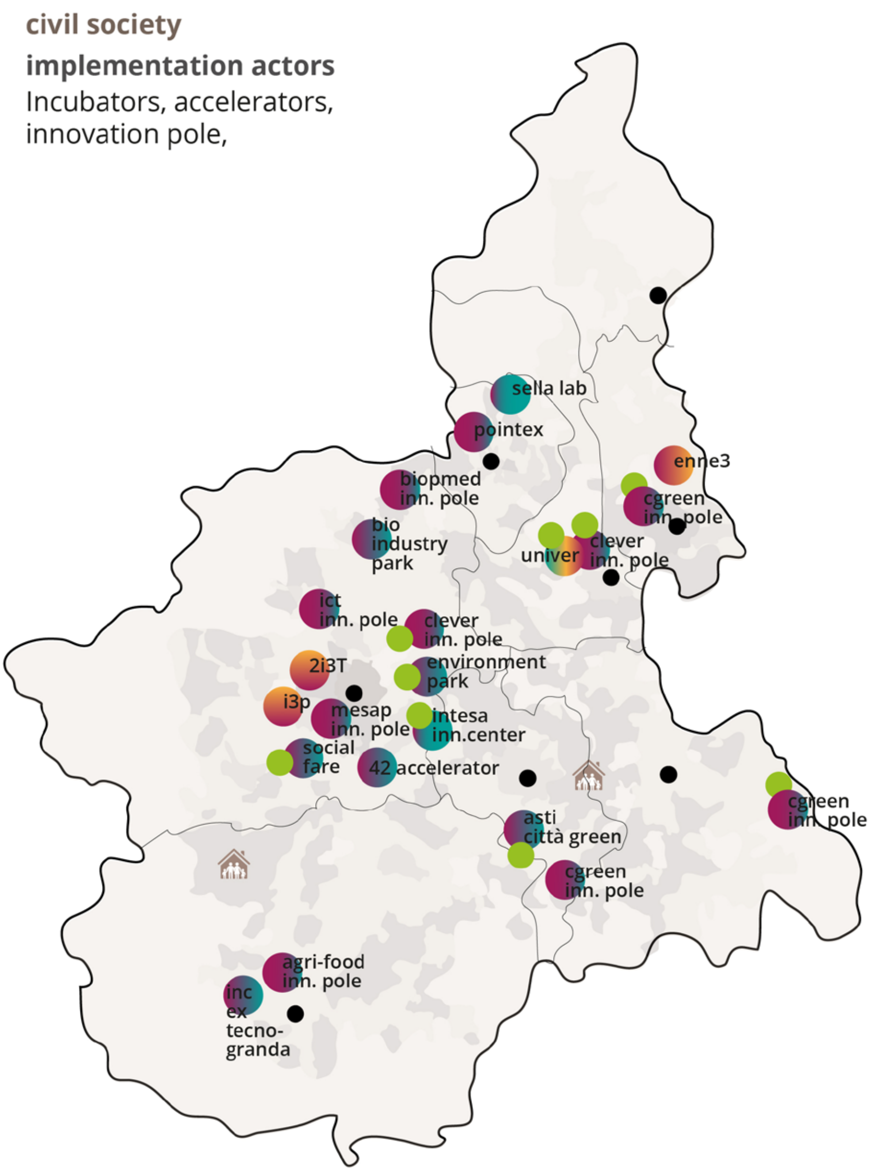


Fig. 9.15 - graphic representation about the localization of the implementation actors in Piedmont Region

a very important role in the LSNB.
About the incubators: in Piedmont Region, there can be found several entities, mainly private and university incubators (fig. 9.15) (see fig 6.28 in chapter 6.2.3.2 for more info). Torino hosts 6 of them: the university incubators of the 2 main universities, and moreover Environment Park (chapter 6.2.3.2), Socialfare, 42 accelerator and Intesa San Paolo innovation centre that can be considered accelerators. Among them, Environment Park has a strong inclination towards environmental sustainability field and Socialfare is more on the social innovation. Intesa San Paolo Innovation Centre is founded by the bank but has the CE among its missions. In the rest of the region, 3 more incubators are present in the city of Novara, Vercelli, Biella and Asti (particular cases). Two entities on specific topics are close to their specific industrial area (the Bioindustry park in canavese and ex-tecnogranda in the agro-food are of Cuneo). The area of Alessandria alone is not represented by an incubator, although there is the presence of the innovation pole Chemistry green in Tortona (fig. 9.15).

Considering all these actors who form the current ecosystem, when placed on a map (fig 9.16) it is possible to see that there is a non-uniform distribution of the actors in the quadruple helix, especially regarding the implementation actors as the regional innovation poles and the incubators, and the university poles. Indeed, there is a concentration in the city of Turin.

Moreover, the actors seem not able to reach all the manufacturing units. The innovation poles were located considering the vocation of the territory, however, the study of the location of the total companies shows that a big part is left outside. Considering also that the majority of them are micro and small enterprises with few human resources, it can be inferred that they are concentrated on managing and running the enterprise focusing on present problems, and with very limited availability of time to focus on innovation and especially eco-innovation. The majority of them have yet to learn about the principles of eco-innovation before practising it, and need a close support in this.

Important actions to support the transition of the current enterprises through different models seems needed with specific services and significant economic investments. However, the regional industry presents some good cases which are working with different approaches, although CE is not a very diffuse phenomenon, that needs to become the rules and the base to start and manage a company. For this reason, important actions at communication level need to be also taken for the involvement of citizens as future entrepreneurs to increase their level of awareness on the current ecological situation. This can also change their habits as consumers, which as a consequences can support the development of a different market.

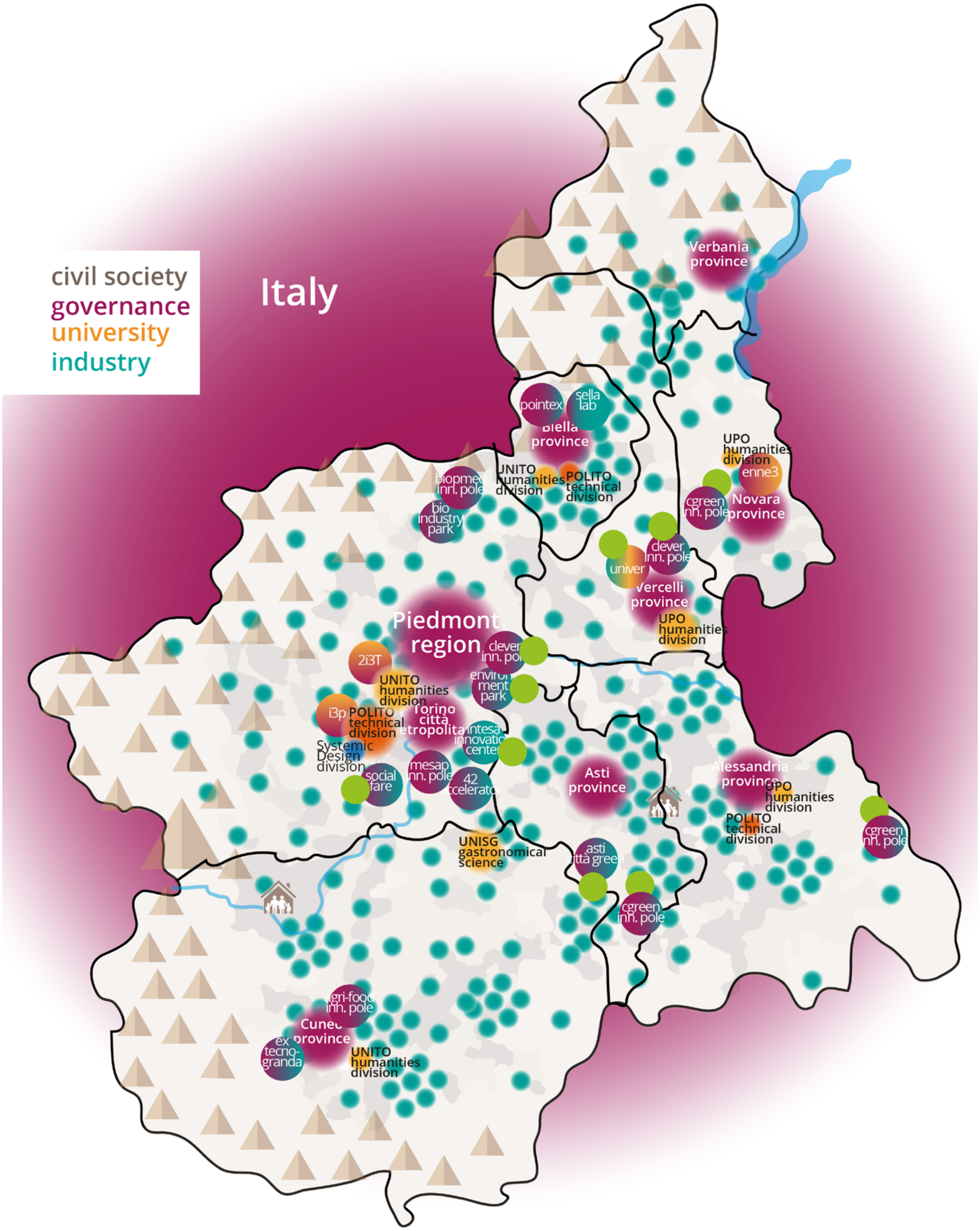


Fig.9.16 -graphic representation of the all actors working in the current ecosystem placed on the Piedmont Region map.

9.3 LOCAL SYSTEMIC NETWORK BOOSTER CONFIGURATION IN PIEDMONT REGION

Starting from the analysis of the current ecosystem in Piedmont Region for systemic innovation (see chapter 6), it is possible to notice that many actors are already existing, and that they are working on developing skills and helping the transition from a linear economy to a different model as CE. However, most of the time they are working individually and without creating networks, moreover, their real potential is not really exploited. For example: the regional innovation poles have a great experience in talking and dealing with the current enterprises, but they lack a clear regional strategy on this topic that considers a different economic model and a radical change. Also, the business incubators, as the university ones in Piedmont, have slowly created an entrepreneurial ecosystem for innovation. But they are working following linear models, considering only the level of high-technological innovation, economic impact and economic sustainability of the new start-ups or of the ideas for projects received. In this way, they are deleting the possibilities for many potentially excellent ideas that are focused on creating high social and environmental impact and working on different and soft technologies. Universities also have many skills and potentialities not yet developed because of two main reasons: a missing will to collaborate between different divisions; the presence of two different big universities focused one on technical aspects, and the other one on humanities is not helping the collaboration between disciplines. Although, this would be a requirement for the transition to a new cultural and economic paradigm.

In this framework, the need for the LSNB seems necessary and it can be created by the collaboration of current actors (fig. 9.17).
Central, in the LSNB, is the component which is working as a traditional incubator but considering other experts and delivering other services, as seen in chapter 8. As recognized by the study of Colombelli et al. (2019), in Torino the role of anchor tenant and facilitator for the entire ecosystem is interpreted by the i3P incubator. In this case, due to the different goals - not only focusing on technological innovation but social and environment high and positive impact - this particular incubator seeks the collaboration of both the university and technological incubators (i3P, 2I3T, ENNE3) for their strong experience and competencies in the field, and also SOCIALFARE for its focus on social and also environmental innovation. Being the goal of the LSNB not only the creation of new start-ups, but also the provision of support to the current manufacturing activities - which are for the majority micro enterprises with no sufficient time and money for the research and creation of new projects - in this incubator it is also considered the presence of the innovation pole CLEVER. For its experience in dealing with enterprises problems and its attention to environmental field, it has the role to stay close to enterprises and guide them in the transition to a different type of economy for all the territory to benefit. Thanks to the experience of CLEVER, the incubator is also able to provide consulting services and support for the application to European calls for funding. In this case, the support should be provided mainly in the English language, which is not very diffused among the employees of the micro and small enterprises, and should keep them updated about the new calls available and their requirements.
The incubator is also sustained by and cooperates with two training centres and the SD division in the design phase of innovative business models. The training centre on eco-preneurship is able to start the diffusion of a different entrepreneurial culture. In this case, the training is fundamental both for the entrepreneurs/tenants and both for mentors of current incubators. At the moment, it seems that the territory lacks competencies on ecopreneurship, this is the reason for this centre to exist. Also, the training centre on eco-systemic approaches is essential for both entrepreneurs/tenants and managers and mentors and all the actors involved in the incubator. Moreover, this centre is fundamental also for the spreading of the knowledge outside the LSNB, from policy makers to the civil society and the other enterprises, to start the change from the foundation and develop a different

future direction. In Piedmont Region, this centre can be composed by the collaboration of existing actors focusing on environmental education, as the MUSEOACOMEAMBIENTE eco-museum in Turin, national environmental associations as LEGAMBIENTE, which has many centres diffused in the Region[19] , and many other social initiatives (as the one reported in the Mercato Circolare platform) which can facilitate relationships and reach for the civil society.
Moreover, the incubator is sustained by SD designers of the "SD division" for the design phase of the innovative ideas, working in strict collaboration with it. The presence of the SD division placed in Politecnico di Torino in Torino city, collaborating in strict contact with the design department, it's a strong point for the Region to facilitate the transition to a sustainable local development. Indeed, this department, with its researchers and the presence on the territory of many students trained in this discipline, can be considered an important resource with a high potential that nowadays it's not well exploited. These people have received a cross-cirricular education, that is strong on environmental topics and eco-requirements for a different design approach, they are able to think in a systemic way applying the systemic approach, and moreover, they are also designers. This last fact is not to be neglected because, as seen in chapter 3, the competencies of designers were really appreciated also by the European Union, which with its studies demonstrated how the presence of designers in a company is able to raise its value. The entire field, however, it is questioning the role of designer in a different economy and claims for a different education, to pass from the focus on products to product-system-service. The SD division, with systemic designers and researchers, has the competencies to guide the design phase and develop SD projects, which involve co-design practices and research activities. Moreover, they can collaborate and involve the experts from the other university departments in the projects (POLITO, UNITO and UPO): for example, the Management and Economy department can mainly support the incubator for the circular business models' definition, which is a very current topic. The co-design and research component is focused on building new strong and solid projects for a collaborative economy and a CE, which considers the economic, social and environmental requirements for a sustainable local development. It can also intervene in assessing or modifying new ideas and projects that arrive to the incubator.
The collaboration of all these actors produces both projects implementation for existing local manufacturing activities and industrial clusters, the creation of new start-ups and new research projects. The implementation of them is facilitated by experimentation fab-labs: across the region many research labs exist in the universities, but also for example there is a lab in the Environment park, and also fab-labs (Alessandria, Torino, Settimo Torinese, Ivrea)[20] which can help the prototyping phase of innovative solutions.
Last but not least, is the presence of a communication division, which is able to help the projects supported by the incubator, to be known by the civil society. Moreover, to provide useful case-studies for the other enterprises which can undertake this journey. It can be composed by experts on graphic design, communication, external communication and social media, also with the collaboration of the universities. Based on the current actors present, the birth of a centre focused on 'eco-entrepreneurial' education and training seems necessary and urgent. The HD studies focused on the regional territory and its enterprises to discover new or tacit opportunities and give direction for a regional sustainable development. This role can be performed by a new spin-off by POLITO from the SD research group that has already great experience on it, involving maybe other European actors, as Circle Economy, identified in the case-studies analysis.

19 https://www.legambiente.it/dove-siamo/
20 https://www.stampa3dstore.com/fablab-in-italia/#FABLAB-PIEMONTE

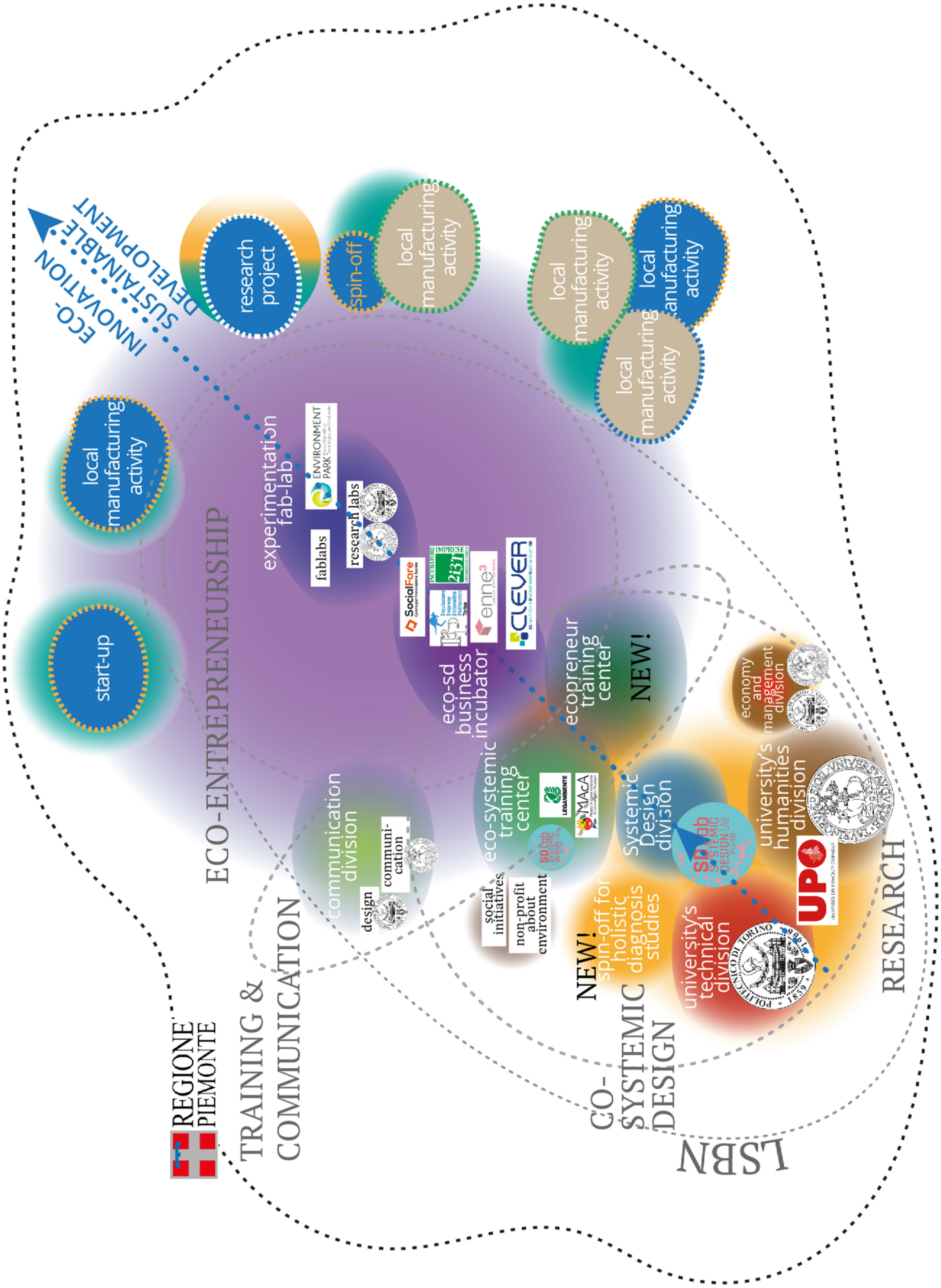


Fig. 9.17 -graphic representation of the actors that can compose the LSNB in Piedmont Region

9.4 ECOSYSTEM CONFIGURATION WITH THE LOCAL SYSTEMIC NETWORK BOOSTER IN PIEDMONT REGION

The LSNB, which mainly has all its actors in the territory, is able to facilitate the generation of collaboration and relationships among the different components of the quadruple helix innovation model to obtain the implementation of eco innovation projects. For its construction and landing in the situation described in fig. 9.18 several indications are needed, as:

- including mentors and trainer expert in eco-entrepreneurial and systems thinking, SD and design in the business incubators;
- besides the incubation phase, the co-systemic design phase has to happen or intervene to build strong and solid projects proposal for the development in new enterprises;
- building solid connection between the different university divisions for multidisciplinary research projects;
- creating collaboration between the laboratories of Environment park, university labs and the Fab Labs for creating a playground for experimentation;
- active role of the chamber of commerce to refer the needs and the requirements of the industry sector to the research one, and start the collaboration with the innovation regional pole to put in place innovative projects;
- involving the actors behind the social initiatives (see annex on Mercato Circolare) which can act as a buffer between the LSNB and the civil society, for their experience in the involvement of the citizens;
- the role of the government is to believe in this project, give strong directions and funds and 'put their face' in it to raise the awareness also of the civil society (as emerged in the Axto interview);
- Chamber of commerce and Confindustria are intermediaries and facilitate the relationships between the industry sector and the government;
- considering that the manufacturing sector is distributed in many locations, also peripheral and not any more in the city centre,it can be supposed that the LSNB, which is mainly a team of experts, should move and get closer to industrial districts.

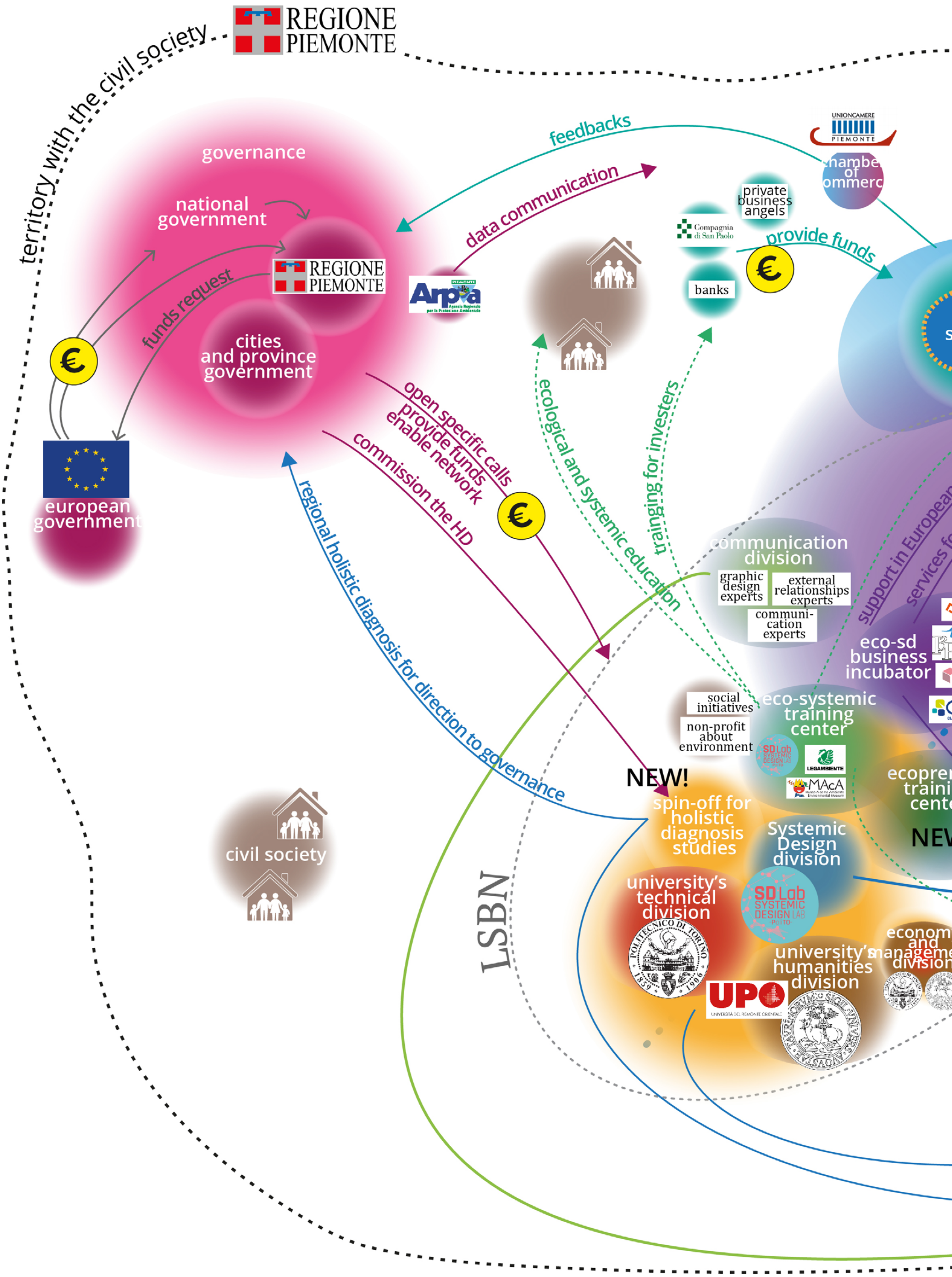
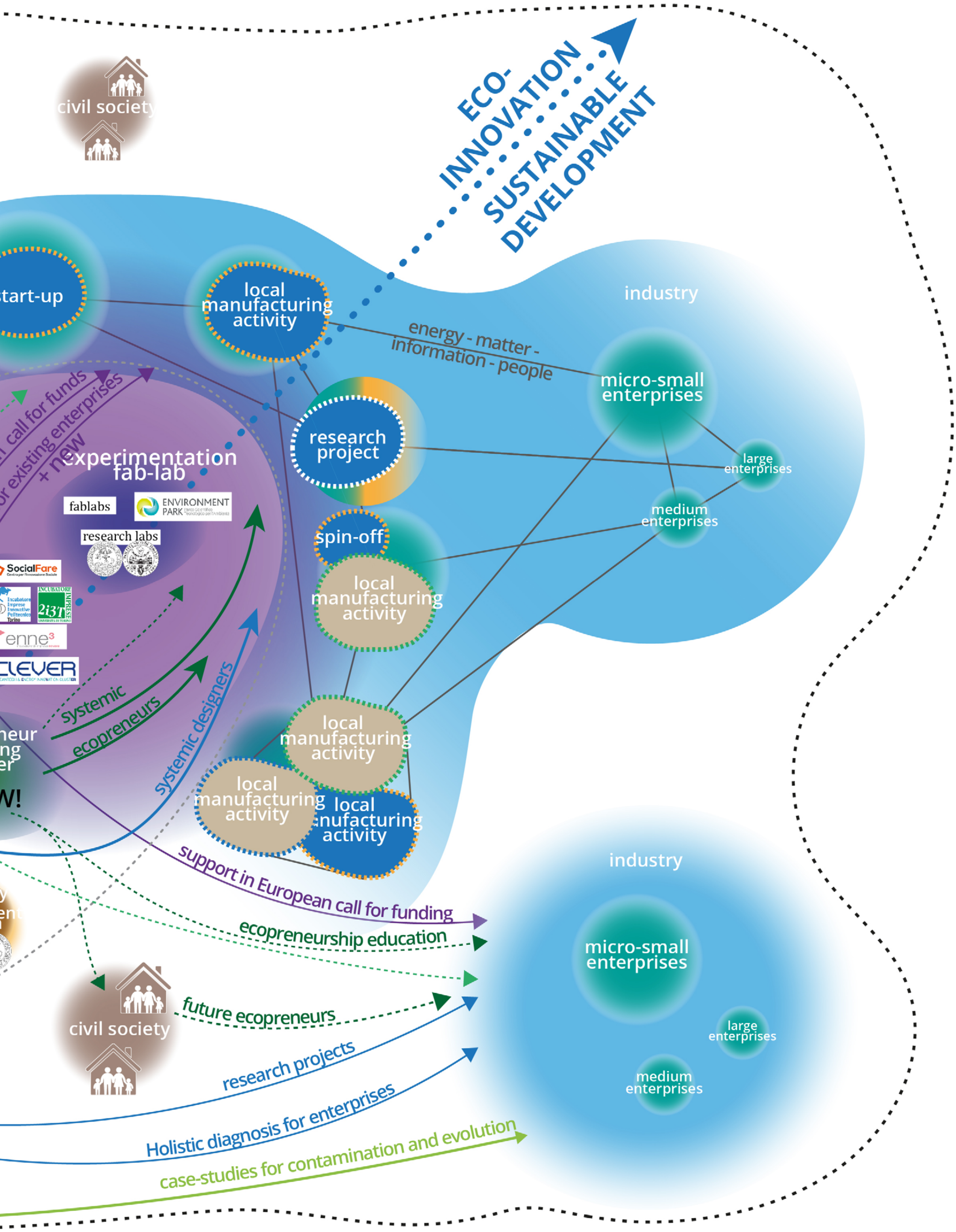


Fig. 9.18 -graphic visualisation of the ecosystem configuration in Piedmont Region


ECO-INNOVATION
SUSTAINABLE DEVELOPMENT
civil society
start-up
local manufacturing activity
energy - matter - information - people
industry
micro-small enterprises
large enterprises
medium enterprises
research project
spin-off
local manufacturing activity
call for funds
for existing enterprises + new
experimentation fab-lab
fablabs
ENVIRONMENT PARK
research labs
SocialFare
2i3T
enne3
CLEVER
systemic ecopreneurs
systemic designers
local manufacturing activity
local manufacturing activity
local manufacturing activity
support in European call for funding
ecopreneurship education
industry
micro-small enterprises
large enterprises
medium enterprises
civil society
future ecopreneurs
research projects
Holistic diagnosis for enterprises
case-studies for contamination and evolution

9.5 SPECIFIC APPLICATION: THE TEXTILE INDUSTRY

Due to the complexity encountered in the application phase of the ecosystem design, considering such a significant territorial context as the entire region and all the industrial sectors present there, it was decided to restrict the boundaries to a specific industrial sector.
In the choice process, the manufacturing sectors extracted from the previous analysis (fig. 9.4) were considered. Among them, the textile industry was chosen for several reasons:

- it represents an industrial district of Piedmont Region;
- it characterizes an entire province: Biella;
- several studies indicate how it has faced an economic decline in the last 30 years as Maggioni, (2008), Cariola (2017).

9.5.1 Context

9.5.1.1 The industrial district: textile

The industrial district in Biella province coincides with the textile and clothing sector, revolvign mainly around wool processing, with roots that date back to the pre-roman period. According to Maggioni (2008), the geographical situation of the province has facilitated the development of this sector: the presence of freshwater with many rivers which was used primarily for the wool processing and after also for the energy production. After a significant expansion and global diffusion for the quality of the product, it has suffered from global competition. Maggioni (2008) also reported that in year 2000 the production was of 36 million of meters of fabric, while in 2008 it was only 30 million. The situation of crisis was also highlighted by other more recent studies like the one by Cariola (2017). She reported that the district is concentrated in 82 towns in 900 km^2, it's about 1.575 enterprises with 17.000 employees and an exportation value of 1,8 million of euro in 2011. She also observed that in the years 2009-2011 there was an economic suffering which has reduced the enterprises of the 9% and the employees of 7%. The study also reports the statement of the president of the industrial union of Biella which in 2016 has confirmed that there was a recovery of the market in 2015 with the +0,9%, not as in the nineties, and that the sector is mainly looking for 'new rich' people as Chinese and Russian.

The data of Camere di Commercio, Industria, Artigianato e Agricoltura di Biella e di Vercelli (2014) reported that from 2001 to 2011 there was a decrease of 45% in the number of enterprises, from 998 to 549 units, and of -48,32% in the employees, from 22.736 to 11.750 The new data of Istat about the year 2017 recognize 1.076 active enterprises in Piedmont about the textile industry, which are the 3,6% of the total manufacturing activities, and 41% of them are concentrated in Biella province. In this province, indeed the textile industry covers the 30% of the total manufacturing activities and employs 2.734 people, which are 21,1% of the employees in the manufacturing sector (tab 9.6).
Regarding the composition of the enterprises in Biella in the textile industry (tab. 9.7), 64,5% of them are micro (less than 10 employees) and 26,2% are small. Micro and small enteprises altogether (401 entities - 90,7% of enterprises) employed 3.446 people. The SMEs in total are 433 (98%) and employ 6.435 people (63,5%).
Among the total industries in the textile sector in Biella (ateco 13), 53,6% is specialized in the preparation and spinning of textile fibres (tab. 9.8).

The data from the 'Osservatorio sulle vocazioni produttive dei territori piemontesi' report[1] (see annex) over the 'Value added at basic prices' ascribes 25,6% to Piedmont of which 6,9% to the textile industry. It moreover adds that Biella is specialized in the 'preparation and spinning of textile fibres (DB171), with a specialization index of 16,8. From the point of view of the liquid assets, the enterprises are in line with the Piedmont average but they seem very linked to external funds. Moreover, the report underlines an inferior productive performance and the difficulties in transforming revenues in profits.

1 available at http://images.pie.camcom.it/f/StudiPubblicazioni/10/10899_UCCP2_30112010.pdf

Tab . 9.6 - .Specific data per province. Data from Istat referring to year 2017

Province	**Manufacturing unit (ATECO C)**	**Unit in textile (ATECO C.13)**	**textile unit over the total manufacturing unit**	**Total employees in manifacturing unit**	**Employess in textile (ATECO C.13)**	**Manufacturing unit over the total unit**
Torino	13.831	286	2%	215.160	2.411	1,1%
Novara	2.660	125	4,7%	32.747	1.123	3,4 %
Alessandria	3.289	35	1 %	32.503	213	0,6 %
Asti	1.581	46	2,9 %	14.372	343	2,4%
Cuneo	4.793	62	1,2%	53.228	471	0,8 %
Vercelli	1.079	56	5,1%	12.937	2.734	21,1%
Biella	1.474	442	30 %	16.968	10.170	60%
Verbanio-cusio-ossola	1.131	24	2,1 %	7.671	76	1%
Piemonte	**29.838**	**1.076**	**3,6 %**	**385.591**	**17.544**	**4,6%**

Tab . 9.7 - .industries and employees in Biella. Data from Istat referring to year 2017

	enterprises		**employees**	
Number of employees	**Manufacturing unit (ATECO C)**	**Unit in textile (ATECO C.13)**	**Employees in Manufacturing unit (ATECO C)**	**Employees in textile unit (ATECO C.13)**
0-9 micro	1.178	285	3.074	981
10-49 small	239	116	4.752	2465
50-249 medium	46	32	4.261	2989
250 large	11	9	4.880	3734
TOT	**1.474**	**442**	**385.591**	**10.170**

Tab .9.8 - division of units for ATECO sector in Biella. Data from Istat referring to year 2017. In italian: 131: preparazione e filatura di fibre tessili; 132: tessitura; 133: finissaggio dei tessili; 139: altre industrie tessili; 13: industrie tessili

ATECO CODE		**Units**	**%**
131	Preparation and spinning of textile fibres	237	53,6 %
132	weaving	80	18 %
133	finishing	53	12 %
139	others	72	16,4 %
13	**Total of textile industries**	**442**	**100 %**

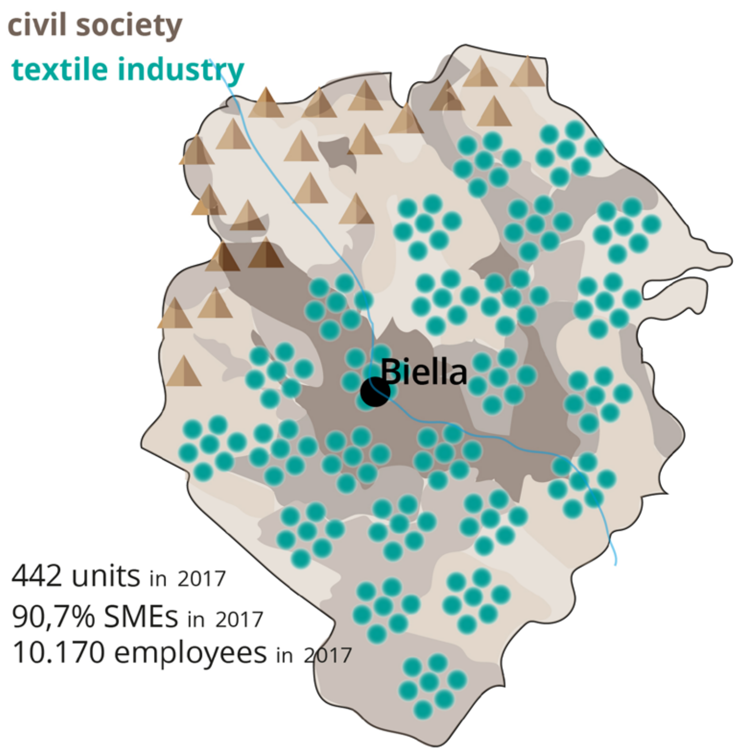


Fig. 9.19 - graphic visualisation of the current situation of the textile district in Biella

Fig. 9.20 - picture of Biella. retrieved from https://laprovinciadibiella.it/attualita/popolazione-biellese-lasituazione-ormai-livelli-guardia

9.5.1.1.1 The textile industry and the special waste

According to the report of Regione Piemonte (2015) about the special wastes, the textile is responsible for 34.906 non-hazard waste (0,76% of the total waste from the manufacturing sectors) and of 5.717 of hazard waste (0,69%).

territory

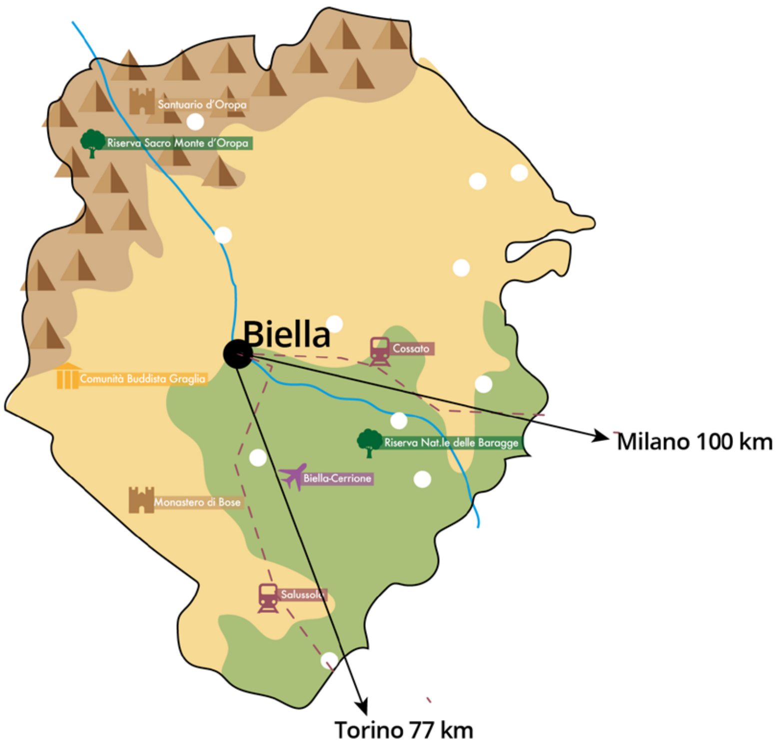


Fig. 9.21 - graphic visualisation of the greographical context of Biella province

civil society

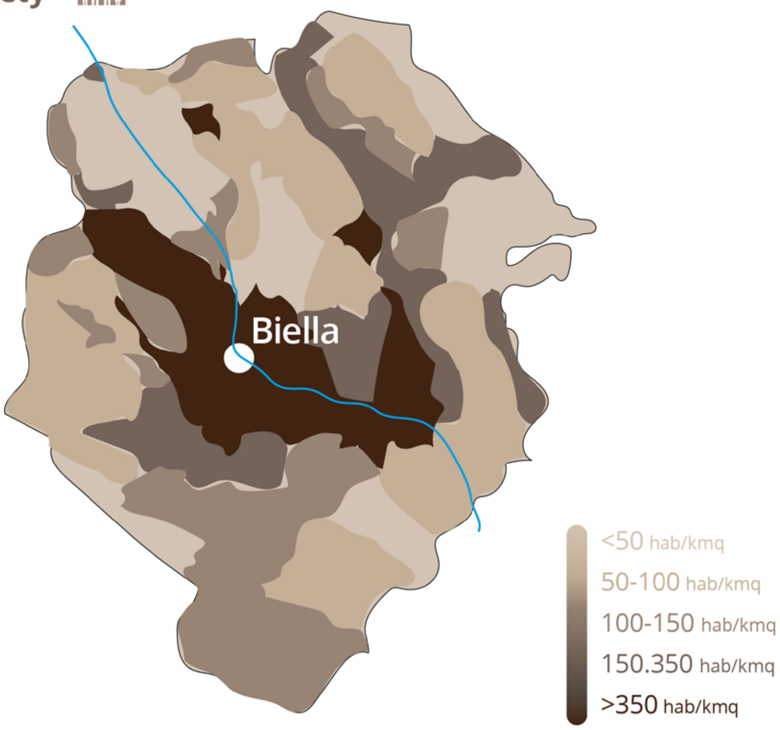


Fig. 9.22 - graphic representation of the demographic density in Biella province

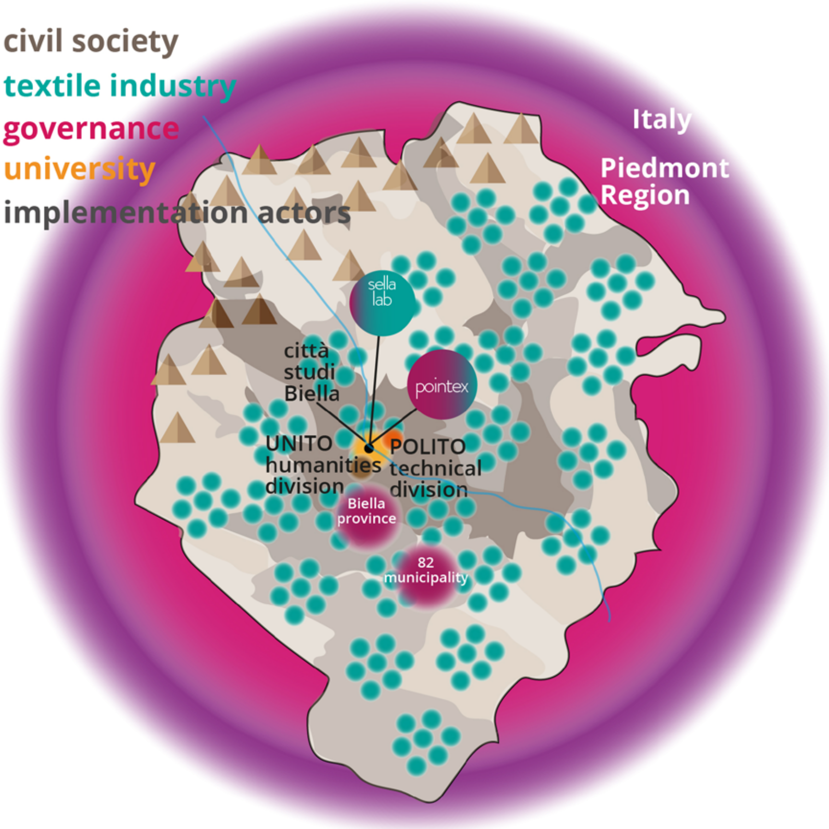


Fig. 9.23 - graphic visualisation of the current situation of the university, governance and implementation actors in Biella province

9.5.1.1.2 Textile sector and sustainable good practices

According to "storie di economia circolare"[2] , 15,2% of the good practices in Italy about the CE is in the textile sector. It can be thus considered the sector that, with the agro-food, is leading the transition to a CE[3]. The units extracted from the database in October 2019 are 41. Some of them are recovering used clothing and organizing clothes exchanging, but also transforming byproducts (output) in new resources as fibres, clothes or accessories (input) from oranges, cardboard, tyres (see annex). In Piedmont region, they mapped only the 'Recrea' project which is producing objects from tyres in Torino city.

9.5.1.2 The actors of the ecosystem and their location

The territory of Biella province [4]: it is the smallest of the entire Region, with mountainous, hilly and plain area in equal parts (fig. 9.21). There are no highways and only two secondary train lines, one directed to Santhià from Torino, and the other one directed to Novara from Milano. Biella (fig. 9.21) is situated similarly distant from Torino (77 km) and Milano (100 km).

Civil society: (fig 9.22) Biella province has seen a reduction of population in 40 years of 11%. According to the last census available, in 2011 the inhabitants were 182.192, which are about the 4% of the entire Region. The demographic decline can be ascribed to the natality rate lower than the average of the entire region. The average population density is 199/km^2 and the population is denser in the centre of the province and next to the major municipalities. Among the 82 cities, Biella has 43.818 inhabitants, followed by Cossato 14.810, Vigliano Biellese 8.180,

2 https://www.economiacircolare.com/
3 http://www.italiachecambia.org/2019/07/tessile-guida-crescita-economia-circolare/
4 http://www.sapere.it/enciclopedia/Bi%C3%A8lla+%28provincia%29.html

Candelo 7.952, Trivero 6.144, while the majorityof towns is about 3.000, 1.000 (35 of 78[5]) or 500 inhabitants. The province is one of the Piedmont region where the presence of young people (below 19 years old) is lower and where the population is 'old': indeed, the old age index is about 212. The employed people are around 47% and the unemployment rate is 7,83%. Foreign people are around 10.000. (Camere di Commercio, Industria, Artigianato e Agricoltura di Biella e di Vercelli, 2014).

University: (fig. 9.23) Città studi Biella[6] is the university pole of Biella which manages the innovation pole po.in.tex. It hosts Università di Torino, Politecnico di Torino, Università degli Studi del Piemonte Orientale e Politecnico di Milano. It works on education and research.

Implementation actors (fig. 9.23):

- Polo po.in.tex [7]: the innovation regional cluster on textile sector established by Piedmont Region and managed by Città studi (fig. 9.24). It has 80 members (76 companies, 2 research centres and 2 reference associations) with a majority of members from Biella (52) and Torino (12).*"The Cluster aims at the most complete involvement of all the textile stakeholders, national and international. Through constant contacts and synergies, relationships, projects and partnerships have been developed in order to increase business value and improve the know-how of the individual company and the entire sector. In addition, the Cluster constantly examines in-depth business needs, offers tutoring and mentoring services, monitors the latest technology available on the market and provides analysis and problem solving resources to members' projects. Moreover, the Cluster plays a key role in promoting information regarding Regional, National or European calls for funding, assessing the feasibility of a specific project and supporting each member's application"* [8];
- Sella Lab [9]: *"SELLALAB is an innovation platform for startups and companies created with the aim of supporting their growth, their open innovation processes and their digital transformation [...] aim of contributing to the growth of economic system of the territory in which it is located"*. The first Sellalab was born in Biella in the historical Lanificio Maurizio Sella[10] . They are focused on structured start-ups and consultancy for enterprises, especially in the digital sector (fig. 9.25) (see annex);
- Tcp engineering [11]: *"innovative start-up which works in close contact with companies, especially their R&D branches, in the textile, chemical and process fields." [...] "provides counselling and assistance services for the development of processes, innovation and problem solution, from feasability studies to detailed engineering and turnkey plants supply."*;
- Città study Academy[12] : managed by Città studi Biella, it started from the study of the needs of the enterprises and wants to train junior professional figures to insert in enterprises, to reconstruct the professional figure of the textile sector;
- inNovāRē[13]: the competence centre on innovation born from the collaboration of Città Studi and Digital Media Industries, as a mediator among the need of the enterprises and the innovation offer. Their first step is the analysis of the enterprise to understand the right starting point. They are focused on marketing, education, management, e-commerce, feasibility, internationalization and innovation;
- Chamber of commerce of Biella and Vercelli [14];

5 https://laprovinciadibiella.it/attualita/popolazione-biellese-la-situazione-ormai-livelli-guardia
6 https://www.cittastudi.org/
7 https://www.pointex.eu/
8 https://www.pointex.eu/about-us
9 https://sellalab.com
10 https://sellalab.com/en/coworking-biella/
11 https://www.cittastudi.org/t-c-p-engineering ; http://www.tcpengineering.com/
12 https://www.cittastudi.org/academy/
13 https://www.cittastudi.org/innovare
14 http://www.bi.camcom.gov.it/HomePage/

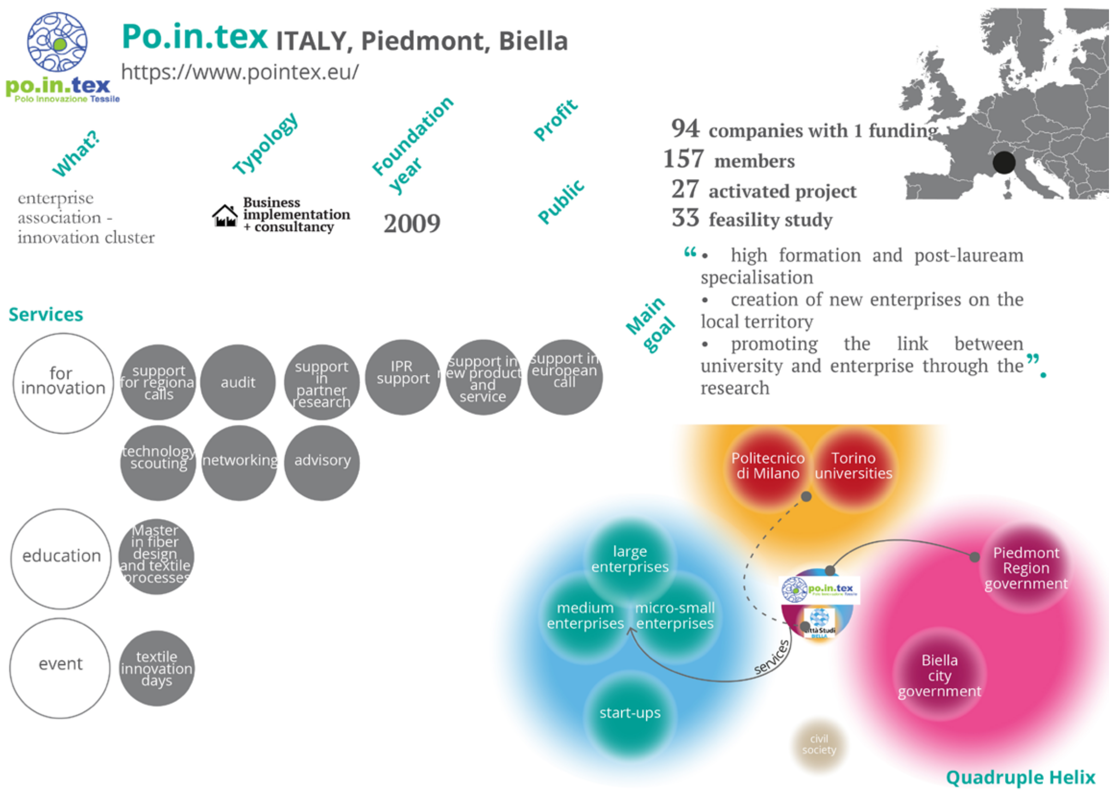


Fig. 9.24 - graphic visualisation of the principal elements of the actor ‘Po.in.tex’

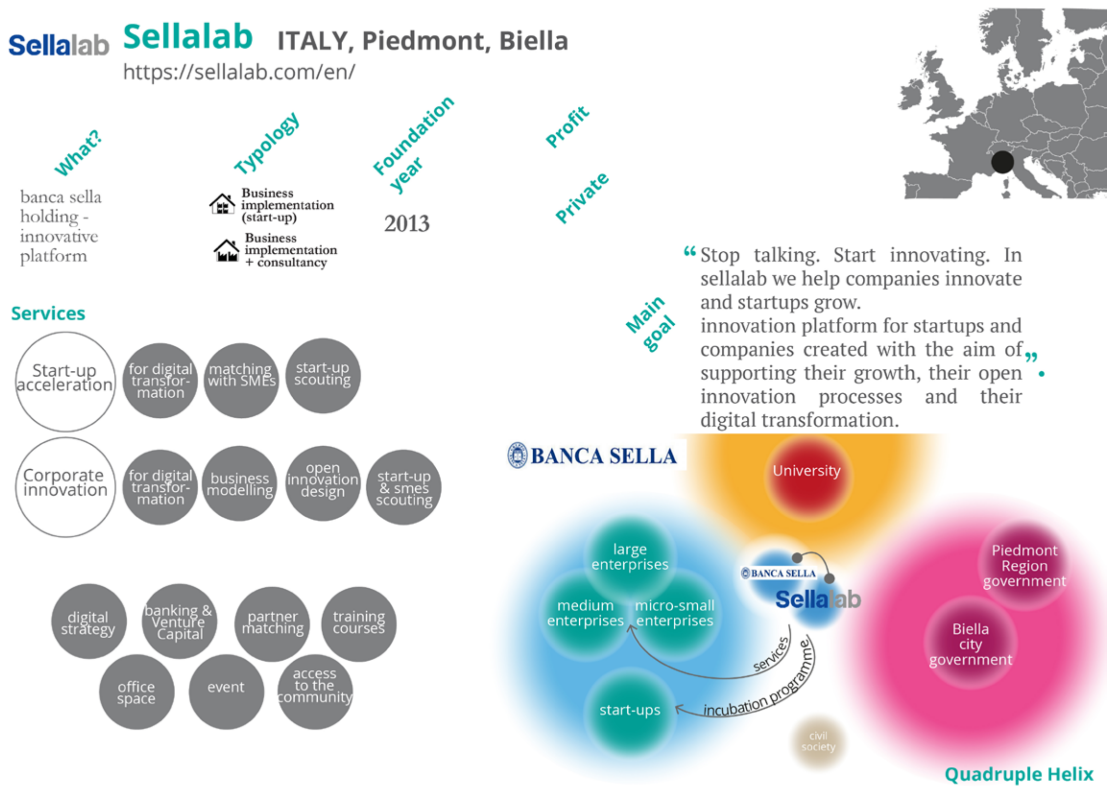


Fig 9.25 -graphic visualisation of the principal elements of the actor ‘Sellalab’

- Unione Industriale Biellese (industrial union) [15];

- Other actors needed in the LSNB:
  - Fablab Biella[16] ;
  - Research labs of Città studi.

9.5.2 Potential opportunities created by a systemic design project in the textile sector in Piedmont Region[17]

To understand the outcomes produced by a SD project in textile industry, a project done by a group of students in SD in academic year 2017/2018 that the author has tutored is taken as case study. At first, an industry in the textile district of Biella, focused on wool transformation. was chosen and agreed to participate in this project. The students followed the SD methodology applied into the course to do the project (see chapter 7). They initially performed the HD thanks to many field visits, to understand the local context. Afterwards, they mapped and studied all the inputs and outputs involved in the production that currently are: raw resources bought, products sold and waste released in the environment (see fig. 9.28). Subsequently, with a desk research, the principal problems at environmental, social and economic levels were found. This first analysis let them understand the current situation. Nowadays, they are treating the wool coming especially from Australia, South America and New Zealand to export it everywhere in the world, because the fibres from local sheep breeds are short and heavy (fig. 9.26-9.27). This is causing principally a high environmental impact due to the transport system, and leaving on Biella area many waste to manage. Given around 350 t/year wool processed (data from the industry analysed), it is possible to calculate that the process is using and producing as:

- around 900.000 kWh of energy : in the best case provided by solar panels;
- 60.000.000 l of water: coming mainly from the well that can reduce the quantity of water presents in the aquifers;
- around 34 t of short fibres and broken threads from the spinning: currently sold to retailers that are bringing their values out of the region;
- around 32 t/year of sludge from the treatment of the water full of chemicals from the dyeing and cleaning.

Following the SD guidelines and methodology (see chapter 7), many new opportunities were created to transform the problems into resources, which in the end produce outcomes at a regional level at the environmental, economic and social scale (tab. 9.9).

The project designed (fig. 9.30) includes the use of local wool, reducing by 40% the import of wool from other countries. This wool, mixed with fibres as hemp and bamboo produced locally, is able to increase the quality of the final fibre (fig. 9.31). Moreover, it involves and sustains the local agriculture. The change of chemical dyes with natural dyes, using 99% less of harmful substances, sustains the production and research in the local territory of these new substances and the potential creation of new start-ups (fig. 9.32). Even though these changes increase the investment cost and the introduction of new technologies, it is balanced by the savings generated: indeed, the amount of water needed for the washing phase can be reduced up to 30% with the use of natural dyes, as the cost for the management of the waste. Moreover, the residual water, including fewer pollutants, increases the quality of water in the rivers and doesn't exploit the well water, which can produce negative impacts at environmental level. Moreover, sludges from the water depuration is lower and can also be processed by the construction industry. As well, textile outputs as broken threads can be regenerated by a new actor (regeneration plant) and used for the construction industry, furniture, agro-tech and packing, generating new products for new markets (see fig. 9.33). Also, it is possible to reduce the high quantity of energy used, exchanging heat from the water used in the dying and cleaning process, and generating a reduction in methane consumption. Among these new opportunities, it is possible to create a school for professional tailors and a fab lab for textile prototyping to improve local competencies that are disappearing with the industrialization and globalization, supporting the local know-how trasmission (see fig. 9.34). These

15 http://www.ui.biella.it/Prj/Hom.asp

16 http://www.fablabbiella.it/

17 based on what published in Battistoni and Barbero (2019) EAD

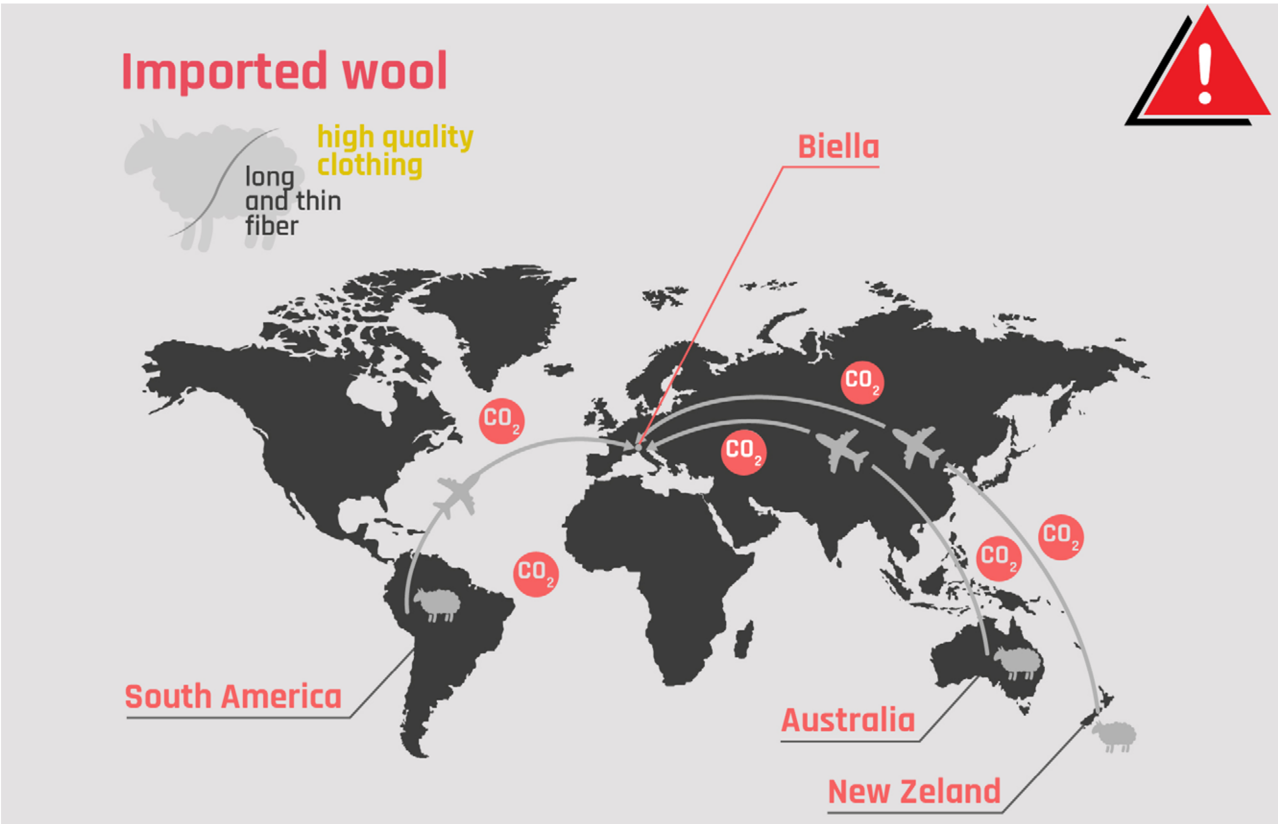


Fig.9.26 -current situation for the textile sector in Biella (Italy). Visual representation by students.

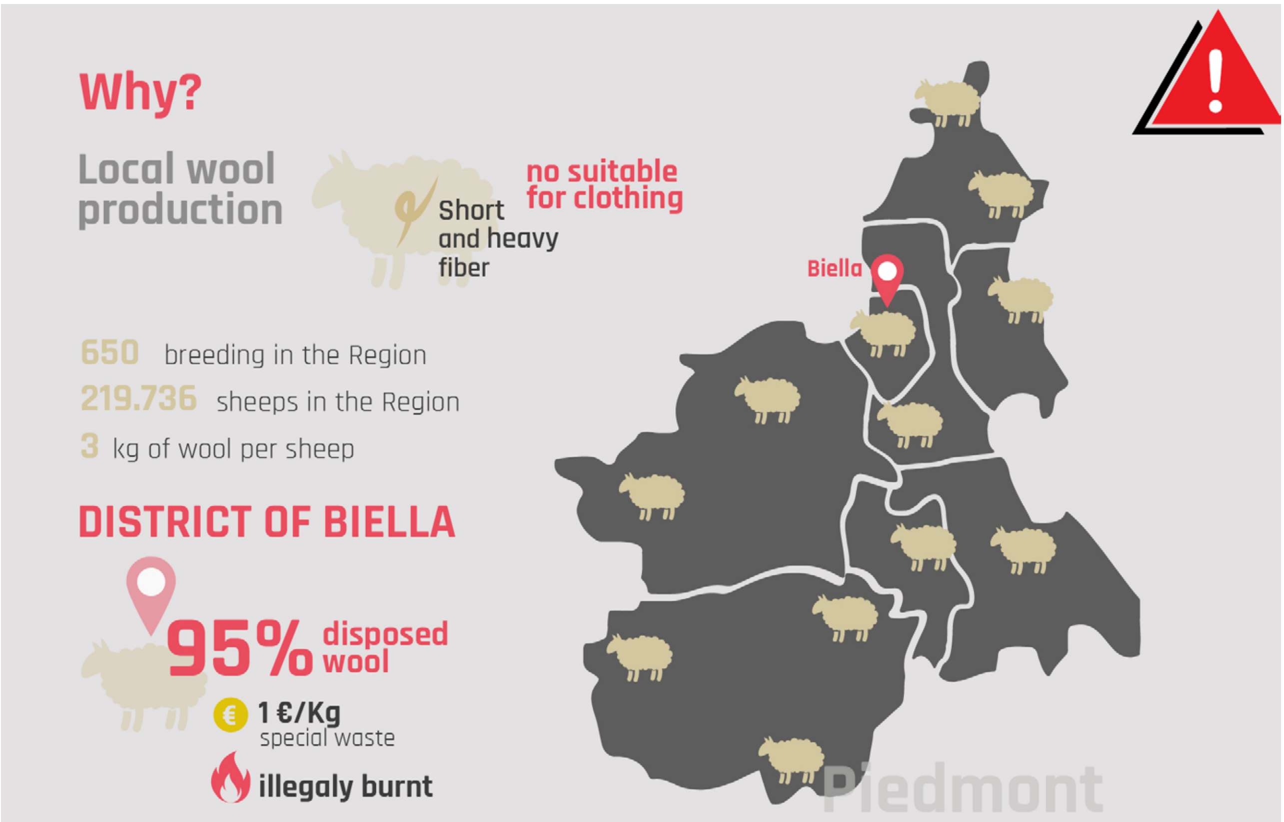


Fig. 9.27 -current situation for the textile sector in Biella (Italy). Visual representation by students.

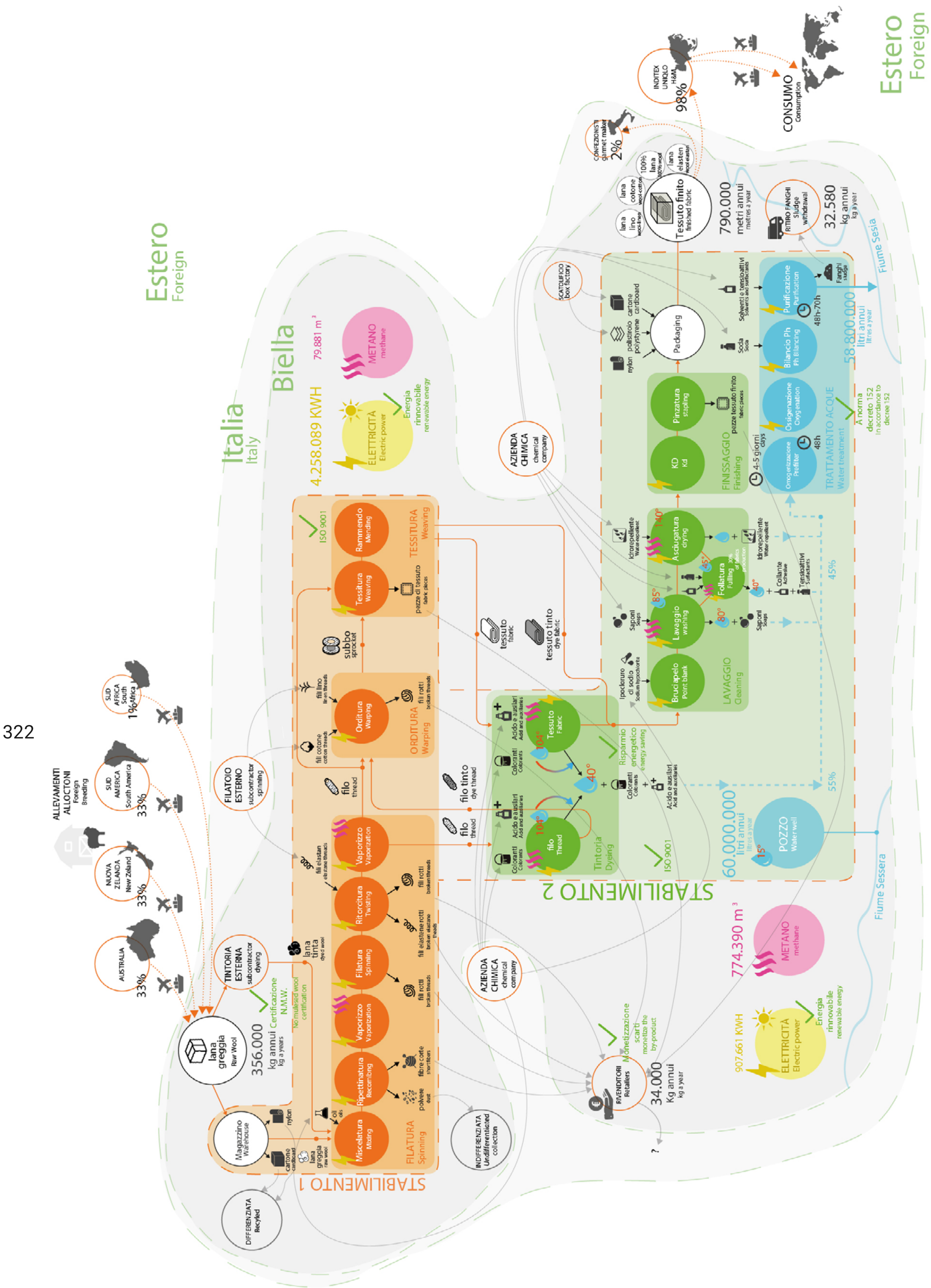


Fig. 9.28 -graphic representation of the linear situation of the production model taken in analysis. Visual representation by students.

finally also contribute to enhance jobs opportunities..

The system generated promotes the increase of local sales, which can decrease transports and stimulate the local economy, create new entrepreneurial opportunities, increase the stakeholders (fig. 9.29), partnerships and the creation of cross-collaborations between different sectors thanks to the creation of

Tab . 9.9 - examples of opportunities created by the SD Approach applied to wool transformation, with related outcomes created. Each one is grouped for level of impact (environmental, economic, social and cultural). Published in Battistoni and Barbero (2019).

OPPORTUNITY EXAMPLE	OUTCOME	LEVEL
Replacing synthetic colorants with organic ones	reduction of toxic substances in water, decreasing of temperature in dyeing process, decreasing in quantity of water used to dye, easier water purification	Environment
Use of local wool	decrease transportation	
New products and new production processes	increase in the revenues	Economy
	increase work places	
Waste as resource (threads)	reduction of costs for waste disposals	
New fabrics from mixing local wool with imported one; fabrics from regenerated yarns	birth of new products and value chains	
New raw materials in various combination for clothing and furnishing	birth of new market sectors	
Working with local farmers for organic colourants (fig.183)	increase of partnerships	
Sharing of machinery between industries	sharing economy	
Necessity of organic colourants; Regeneration plant	opportunities for research on bio-materials and new technology	
Support to local wool farmers	support of local traditions	Society and culture
Fab lab for textile prototyping; school for tailoring (fig. 186)	improve local competence / support to local know-how	
Communication and local shop	increase awareness from the final buyers about the entire production chain, closer relationship between producers and final buyers	
Products quality increasing	increase in well-being	
Less noise, high temperature and dust in the working environment	increase the quality of the working conditions	
Creation of new fibres and fabrics (fig. 184-185)	creation of new job skills	
Creation of Fab lab and a school for tailoring (fig. 186)	enhancement of jobs opportunities for specialized workers and researchers	
	Increase awareness on waste	
Use and communication of local wool	re-establishment of the relationship between people and environment.	

new products and productive chains.
The benefits for the industry are at social level, as it increases its position in the territory; at environmental level for optimizing the production with less impact on the local territory, acting without destroying the natural resources; at economic level for the economic benefits created.

This project gains an “Honourable mention” in the LENS – student design competition in 2019 and was published in the catalogue. It was also published in a poster at the RSD (Relating systems and design) conference in 2018.

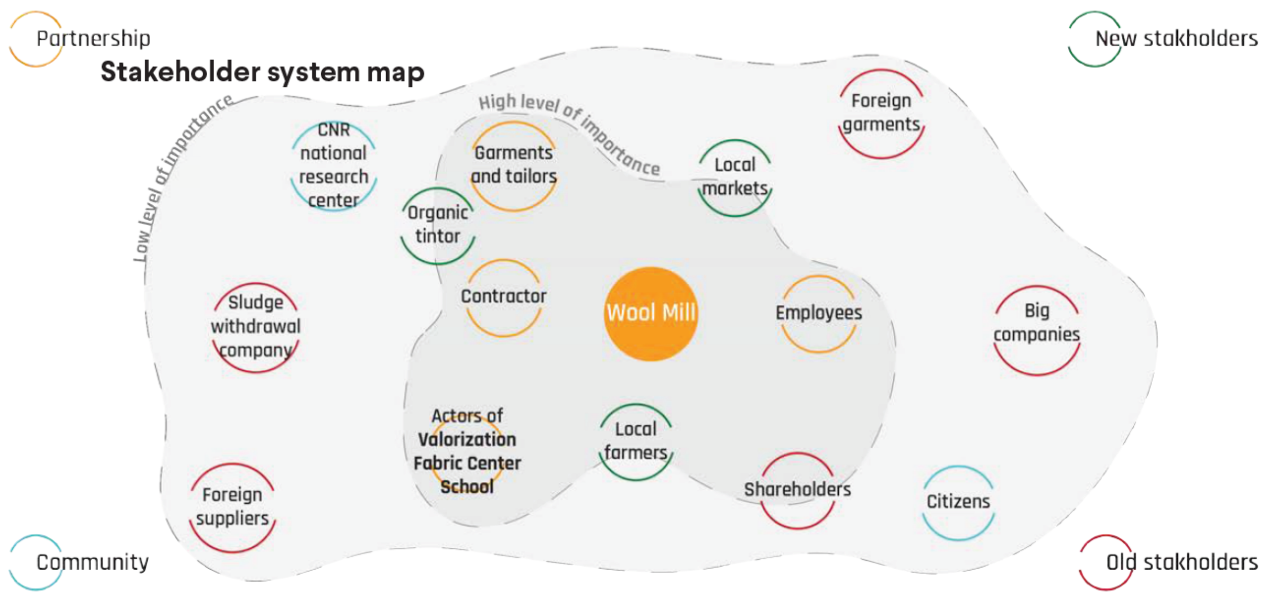


Fig. 9.29 -graphic representation of the the stakeholders involved. Visual representation by students. Retrieved from LENS - student design competition 2019, catalogue. P. 51

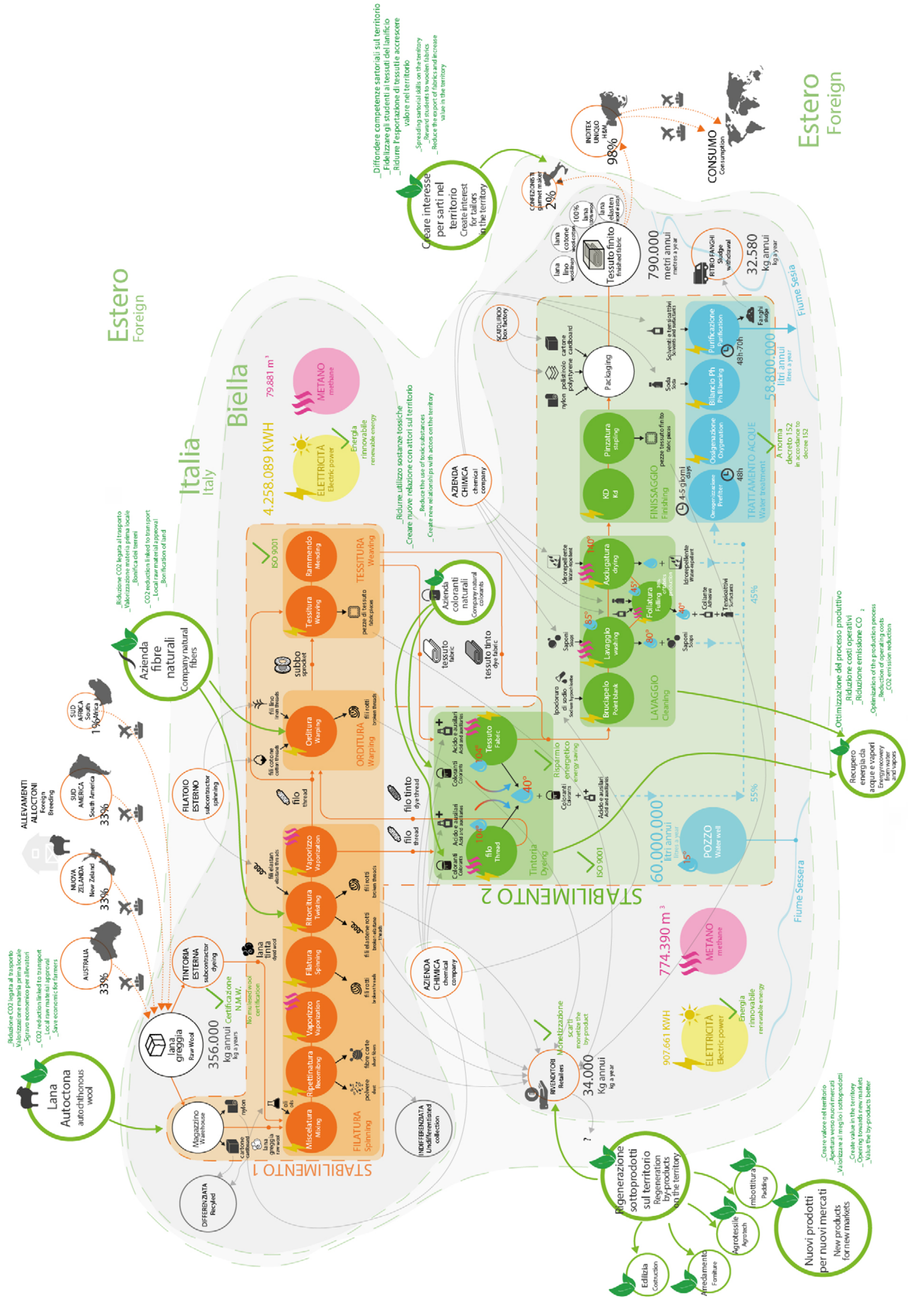


Fig. 9.30 -graphic representation of the system inc and circular the production model designed. Visual representation by students.

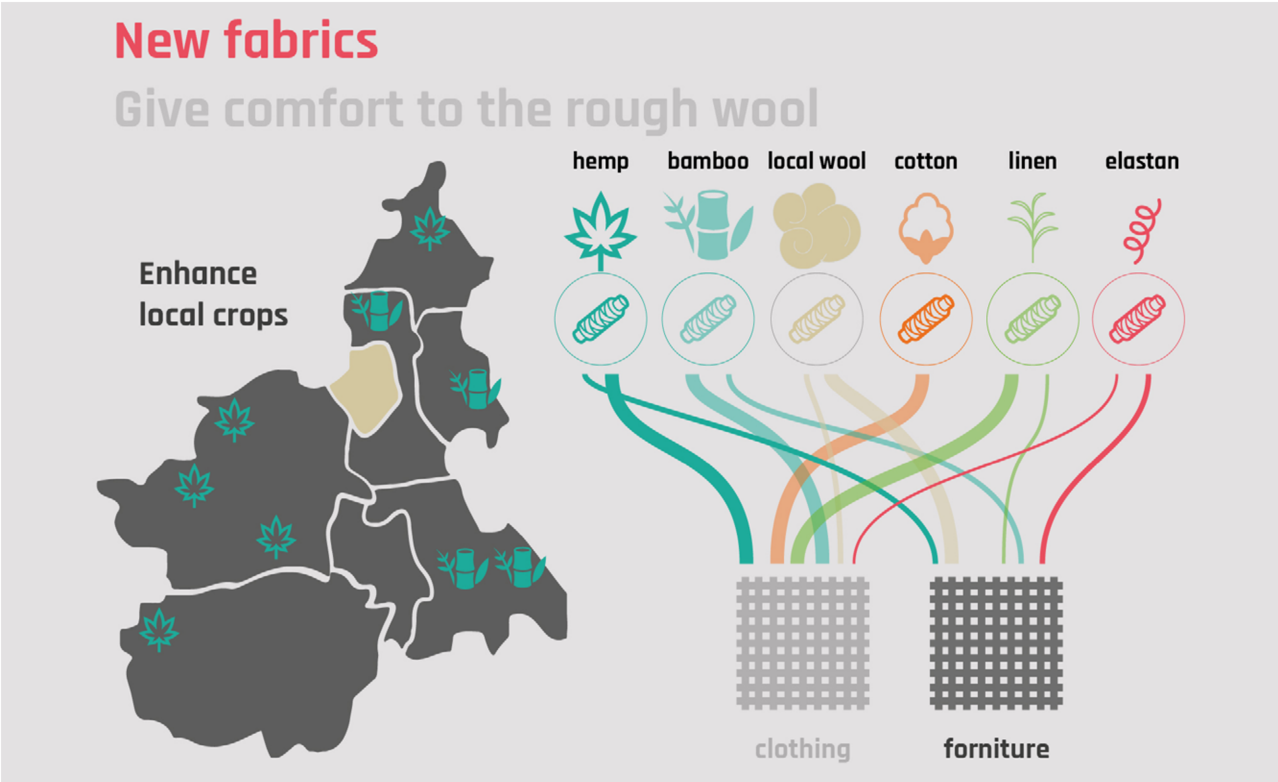


Fig. 9.31 -Focus on the opportunities for the textile industry - creation of new raw materials. Visual representation by students.

Fig. 9.32 -Focus on the opportunities for the textile industry - creation of new markets from raw materials. Visual representation by students.

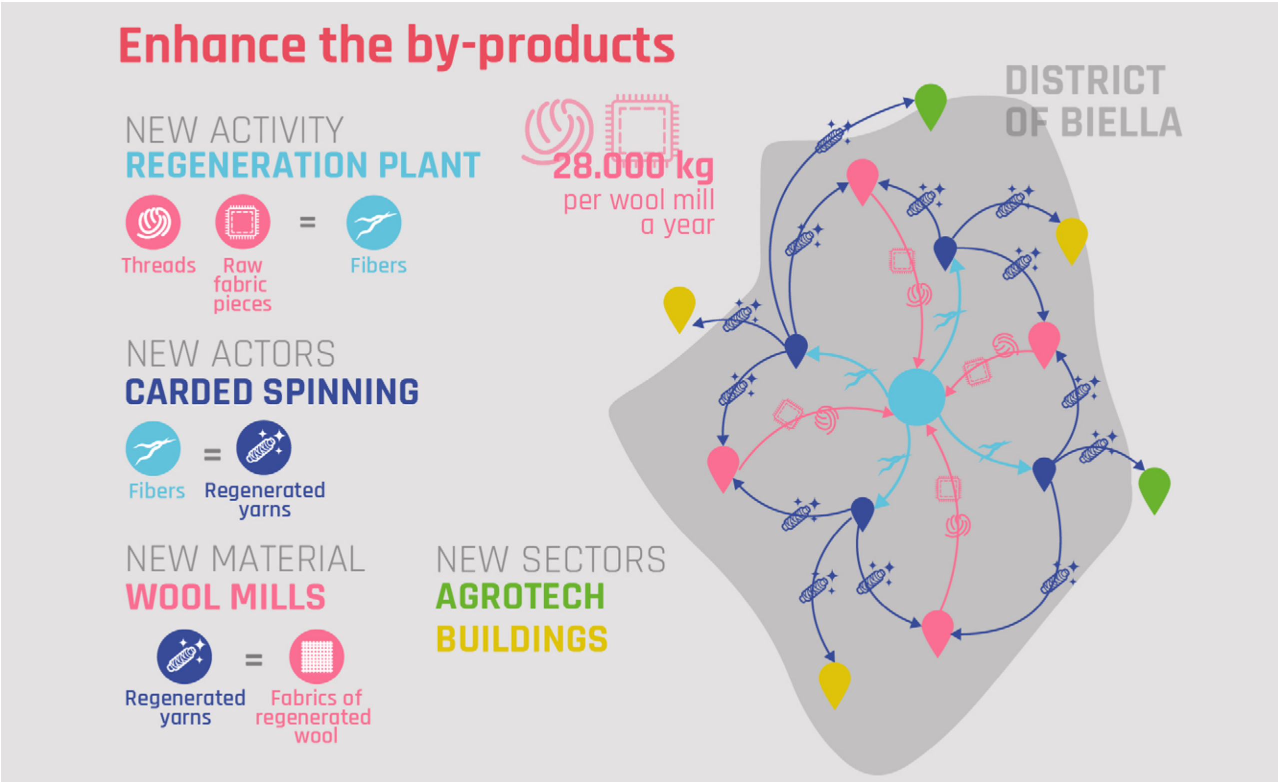


Fig. 9.33 -Focus on the opportunities for the textile industry- the regeneration plant. Visual representation by students

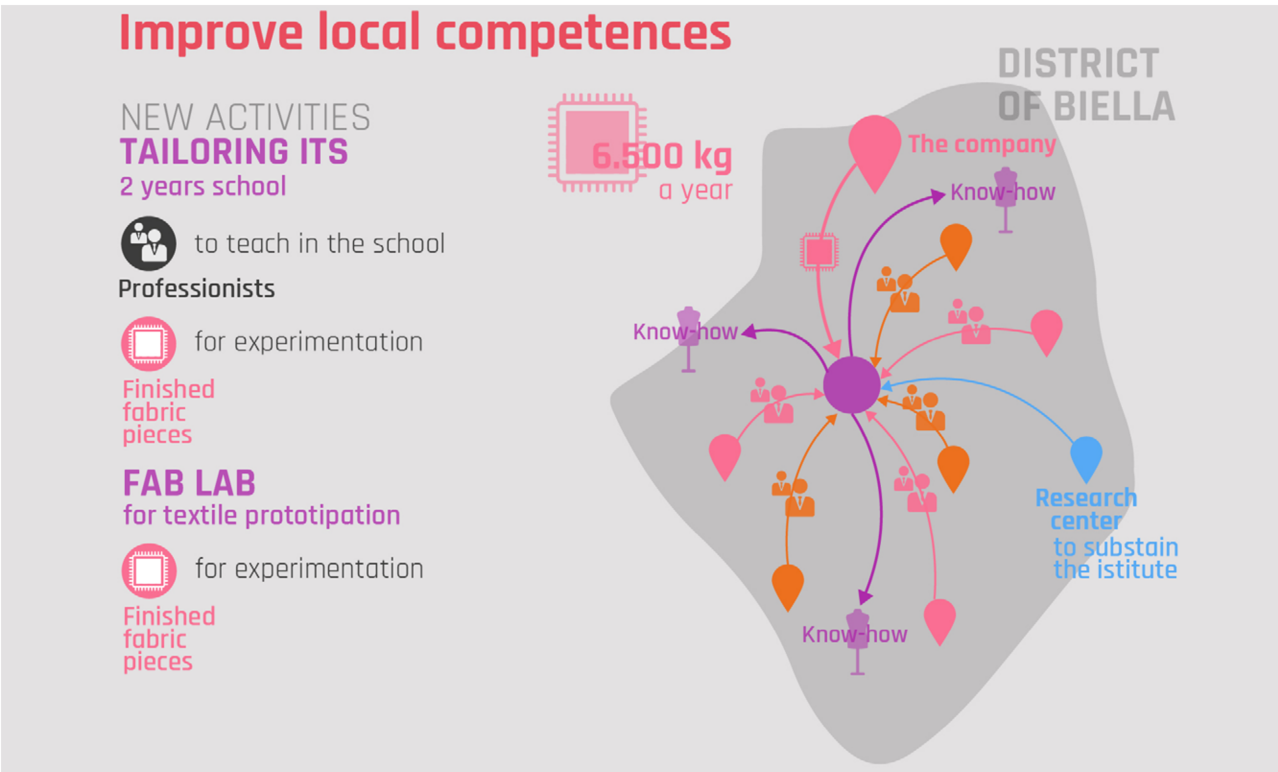


Fig. 9.34 -Focus on the opportunities for the textile industry- the school and the fab-lab. Visual representation by students

9.5.3 Local Systemic Network Booster configuration in the textile district and the ecosystem design

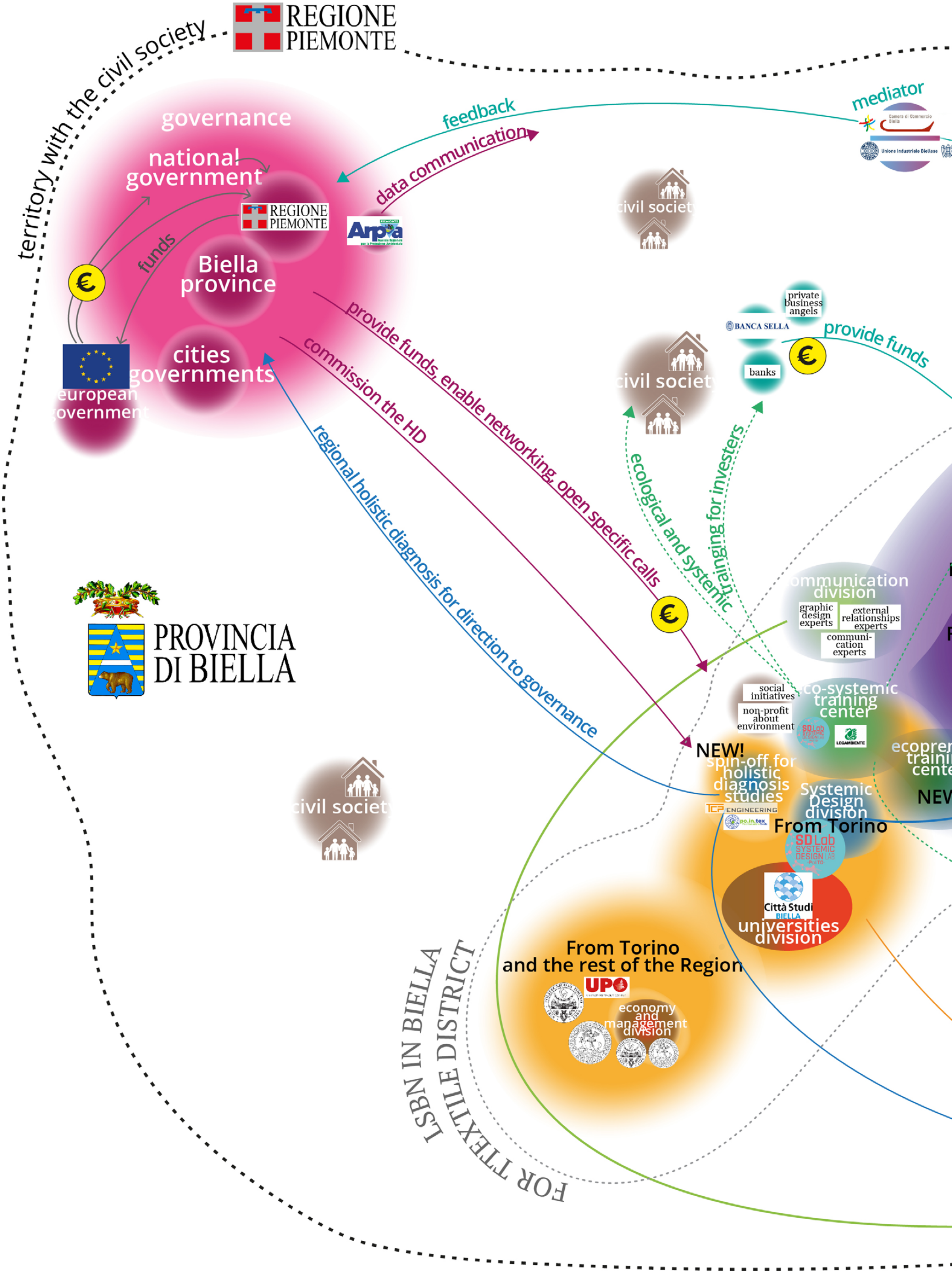
The current situation of the actors of the ecosystems considering the entire context of analysis results are the one showed in fig. 9.23.

The application of the LSNB project to the Biella area (the result is shown in fig. 9.35) is focused on the central role of Po.in.tex pole, because it is very close to the industry sector, and foresees also the collaboration of the universities and government. Acting in the triple helix innovation model, the pole can be the central actor. However, it needs to add services and relationships with partners and stakeholders, because it is not focused enough on the environmental sustainability of innovation projects, as needed. For example, they are currently just performing the "audit" service (see annex) which means to collect the needs and the feedbacks of the enterprise and understanding gap and potentialities, which is the starting point for the performing of an HD. It should also collaborate with the InNovāRē project, which is also providing analysis of the current system. This service, if connected to experts on SD and others, can result in a more complete HD for the enterprise. Moreover, they should also be focused on the environmental sustainability assessment of the innovation actions, which can be provided with the support of the Clever pole, with the multiple university's divisions' expertise, and with the involvement of the local actor Tcp engineering, which among its services is also providing the LCA analysis.

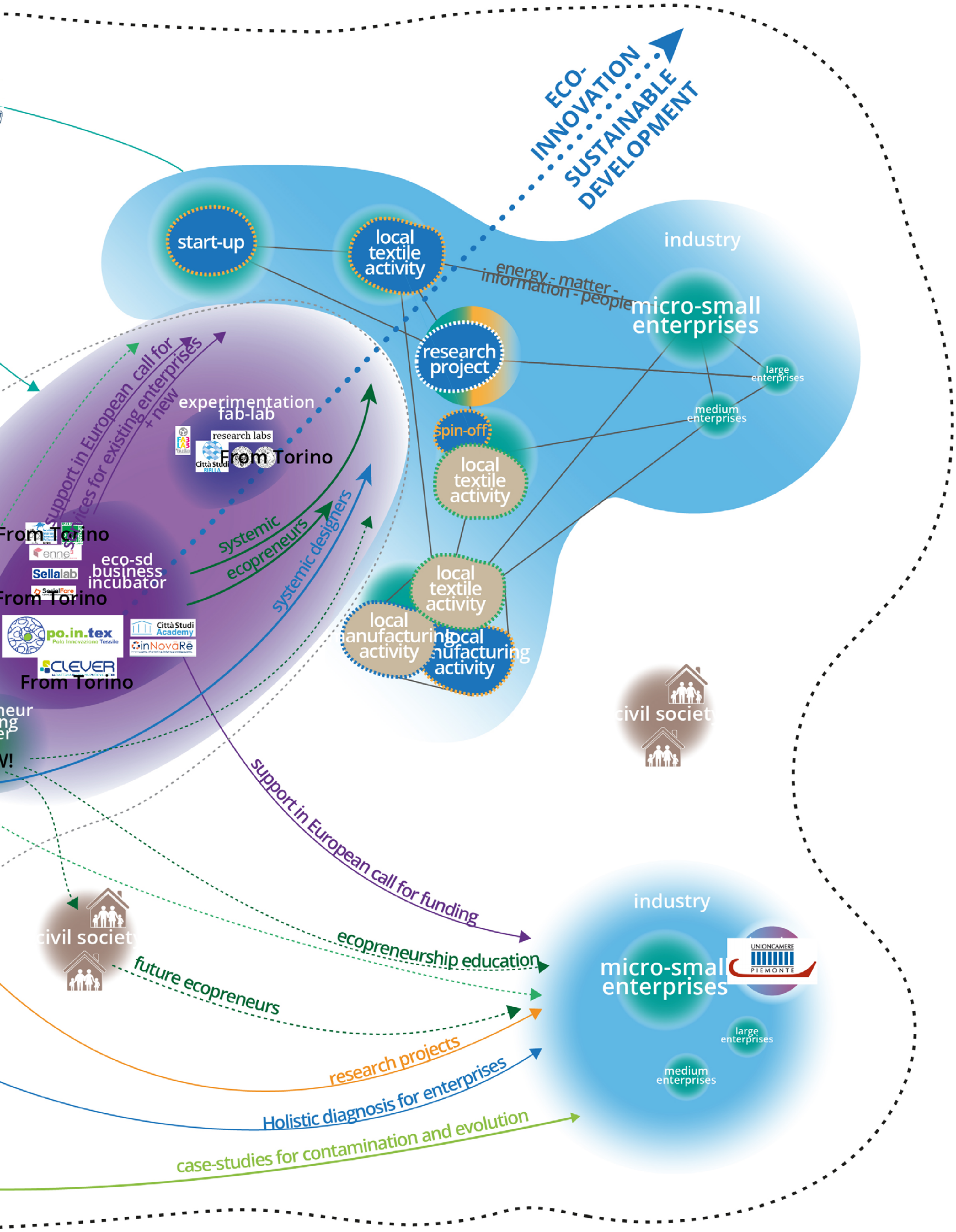
The Po.in.tex is a central actor of the new typology of incubator which plans the involvement of the traditional incubators to provide support for implementing new entrepreneurial opportunities discovered in the HD: Sellala, located in Biella, can be the location to also host mentors from other regional incubators, and expand their core topic not only to digital transformation, but also to environmental and social impact. This incubation part is supported by the work done by training centres and the universities. Also, in the case of Biella province, the training centre on ecology and systems thinking needs the collaboration of experts which can come from the SD division and other environmental agencies and local social initiatives p as Legambiente Biella[18]. Although, also in this case, the ecosystem lacks competencies on ecopreneurship; those need to be created and included in the activities of incubators and in the managers' training. Moreover, the Chamber of commerce and industrial union can mediate among factories and the government to facilitate relationships and receiving of feedback to improve policies. In addition, the current school, academy by Città studi Biella, evolves and can also become a creative network between companies and students of the textile sector to generate learning practices, waste valorisation and new fabrics for developing new markets.

18 http://www.legambientepiemonte.it/dove/circoli-sul-territorio/

Fig. 9.35 (next page) -graphic visualisation of the ecosystem configuration in Biella province



territory with the civil society
REGIONE PIEMONTE
governance
national government
REGIONE PIEMONTE
funds
Biella province
cities governments
european government
feedback
data communication
mediator
Unione Industriale Biellese
civil society
civil society
civil society
private business angels
BANCA SELLA
banks
provide funds
provide funds, enable networking, open specific calls
commission the HD
regional holistic diagnosis for direction to governance
ecological and systemic
trainging for investers
PROVINCIA DI BIELLA
communication division
graphic design experts
external relationships experts
communi-cation experts
social initiatives
non-profit about environment
eco-systemic training center
LEGAMBIENTE
NEW!
spin-off for holistic diagnosis studies
TCP ENGINEERING
po.in.tex
Systemic Design division
From Torino
SD Lab SYSTEMIC DESIGN LAB
Città Studi BIELLA
universities division
From Torino and the rest of the Region
UPO
economy and management division
LSBN IN BIELLA FOR TTEXTILE DISTRICT



ECO-INNOVATION
SUSTAINABLE DEVELOPMENT
start-up
local textile activity
industry
energy - matter - information - people
micro-small enterprises
research project
large enterprises
medium enterprises
spin-off
local textile activity
local textile activity
local manufacturing activity
local manufacturing activity
experimentation fab-lab
research labs
From Torino
support in European call for funding
services for existing enterprises + new
From Torino
eco-sd business incubator
Sellalab
From Torino
po.in.tex
Polo Innovazione Tessile
Città Studi Academy
inNovaRe
CLEVER
From Torino
systemic ecopreneurs
systemic designers
civil society
support in European call for funding
ecopreneurship education
civil society
future ecopreneurs
research projects
Holistic diagnosis for enterprises
case-studies for contamination and evolution
industry
micro-small enterprises
UNIONCAMERE
PIEMONTE
large enterprises
medium enterprises

9.5.4 Outcomes created in the textile district by the ecosystem for systemic innovation

Supposing that all the companies present in the textile district of Biella are similar to the one analysed in chapter 9.3.2, the project before explained can be replicated for 221 factories. They are half of the total, considering that this company is a particular case because it has two plants and is doing both the spinning than the weaving and finishing process. It means that nowadays:

- around 6.188.000 kg of wool are treated per year (28.000 kg of wool treated *221);
- around 1.141.630.750 kWh of electric energy (5.165.750 kWh *221);
- around 188.800.300 m^3 of methane (854.300 m^3 *221);
- 198.900.000 l of water - coming mainly from the well that can reduce the quantity of water presents in the aquifers (60.000.000 l of water*221);
- 3.321.188 of short fibres and broken threads from the spinning currently sold to retailers that are bringing their values out of the region (34 t*221);
- 7.072 t of sludge from the treatment of water full of chemicals from the dyeing and cleaning (32 t*221);
- 95% of local coarse wool is disposed and it is treated as a special waste.

Considering that this project is implemented thanks to the action of the LSNB placed in the textile district, it is possible to obtain the following outcomes in the entire district, which are both quantitative and qualitative:

- reduction of 40% in the import of wool from other countries, with consequent reduction of CO2 emitted from the transportations;
- reduction of 30% in the amount of water needed for the washing phase;
- reduction of 20% in quantity of water for each 1 kg of wool dyed;
- reduction of electric energy and methane consumption;
- retention in the region of the value which comes from the use of short fibres and broken threads;
- use of the local coarse wool which can reduce the waste and support the local breeders;
- increase of the profit with consequent increase in job places;
- valorisation of the local know-how and of the local economy;
- birth of new products and partnerships, and consequent new start-ups (see table 9.9).

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Chapter 10

Discussion of the results and research outcomes

This chapter concludes the PhD research with the answers to the research questions stated at the beginning (see page 44). Starting from the critical discussion of the project's results and of the application phase, afterward reasoning about the overall research outcomes and the contribution to the research knowledge, finally contributing to the evolution of the SD as a design discipline and a research field. During the process, several new research questions came out.

10.1 SUMMARY OF THE ANSWERS TO THE RESEARCH QUESTIONS

This thesis wants to answer the main research question:
How SD projects can be implemented and supported by local context in order to boost CEs in Europe?

This paragraph aims to summarize the answers to the sub-research questions that came out in the process to answer the main one. Moreover, how the 'ecosystem' conceptual model and the presence of the LSNB theorized in chapter 8 are the entities identified as the facilitator for this process of support for the implementation of SD projects and can address some identified gaps.

Which are the problems in the implementation of SD projects for the manufacturing sector?

This question was answered thanks to the analysis of previous SD projects, described in chapter 7. This multiple case study analysis led to understand the significant barriers faced by SD projects in their implementation process, which can be assimilated to those faced by the implementation of the CE, thanks to the similarities between SD and CE (see chapter 1.2.4.2). In CE projects, problems identified are related to the culture, economy, technology, product innovation, market, and to the regulatory system. Instead, in the case of SD projects, this research identified problems related to the projects itself and cultural barriers (a shift from linear to systemic thinking is needed). Furthermore, some implementation problems are due to several requirements: mainly the involvement of multiple actors and stakeholders in multiple disciplines, and a co-design process. Another requirement is the need to shift from a linear design process to a more looped one with multiple feedback loops. Also the need to know and understand the local territory where the project is located very well and in deep to find leverages for the change should be noted. Furthermore, dealing with the industry sector means that radical change over the production model requires radical choices and strong decisions that consequently need significant investments and external funds. In summary, the analysis identified problems:

- related to the project itself (internal);
- related to the industry sector (internal);
- related to citizens, entrepreneurs and policy makers (external).

Which are the opportunities created by SD projects for the manufacturing sector and how can the territory benefit from them?

The result of the analysis on previous SD projects in chapter 7 has highlighted their great potential in decreasing the environmental impact of production processes and in increasing the social and economic ones. Indeed, a SD project can transform an industry that currently is a profit and waste producer into a profit and value creator. This shift happens with the creation of partnerships and cross-collaborations between different sectors, arriving at the design of new products and productive chains. The eco-entrepreneurial opportunities can be different spin-offs, new enterprises/start-ups, symbiosis of existing industries with the creation of clusters. These new economic realities can be profit as well as non-profit ones (e.g. for the biological ecosystem protection and restoration). New opportunities can also be represented by activities that are less classified as economic activities as: new research projects on specific outputs or processing them, new projects on eco-designed products, and also educational projects (workshops, laboratories, lessons,..) for improving the awareness within the disclosure on systems thinking and ecological concepts to the community, which is potentially composed of future designers, researchers, entrepreneurs, customers…

Who are the actors that are playing a role in the support and implementation of economic realities for the transition to a CE in Europe, how are they currently acting and what is their contribution for the implementation of CE in a specific territory?

This PhD research has pursued the identification and analysis of the current actors that are working for a CE implementation (see chapter 5) to understand how they are acting. It was conducted over this topic because, at the moment, there are no actors explicitly facilitating the implementation of SD projects.

A particular aspect that was found is the missing attention over the implementation of CE in a specific territory, except for a few cases that value this local aspect (see ZWS). Moreover, this analysis identified that only a few of them had enlarged their vision both on supporting the existing enterprises and on creating new ones. Indeed, most of them are concentrated only on new start-ups (see BIs) or are government funding programs for SMEs. Moreover, the majority of them is providing traditional services, following a linear economy framework and cultural paradigm. Some of them are providing many services of interest for the research scope as: the collection of case-studies and the realization of showcases aimed at inspiring future business; or the Circle Scan service by Circle Economy, which is a very similar tool to HD of SD methodology, identifying opportunities and future strategy from the analysis of the local territory and of value chains. Another important insight from the analysis is that a strong statement by the political sector, with a public strategy, can drive the ecosystem's creation, as it is happening in the Scottish case study. However, the public strategy doesn't represent the quantity of bottom-up actions that enterprises are making alone.

10.1.1 The ecosystem rooted in the quadruple helix for regional systemic innovation

Which is the configuration of the entity that facilitates the implementation of opportunities from SD projects for the creation of a local CE?

The final 'product' designed of this thesis is an ecosystem that has roots in the systemic quadruple helix innovation model (Stanford University website[1]), which includes the industry, university, government and civil society to obtain innovation. However, in this case, the goal of the helix is not only the creation of innovation, but a sustainable and circular local development reached thanks to:

- systemic innovation,
- participated policies,
- the application of the systemic approach,
- the creation of low environmental impact,
- high social impact and ecopreneurship.

The first draft of the ecosystem, a regional ecosystem, can provide a partial solution to the current environmental situation, which is asking to change the track and the economic models. Although the results are more qualitative than quantitative, this ecosystem, if it works as designed, can foster the transition to a different entrepreneurial class. This fact can refer both to the 'entrepreneurs' which are leading an existing industry, and to the ones that want to start a new entrepreneurial activity. The need to include both these two faces, related to the entrepreneurial world, was required because it reflects the industry sector's current situation.

The ecosystem designed based its roots on the necessities emerged from the research phase:

- the need to change the production and economic model, as underlined in chapter 3, which is a very modern debate. Not everyone agrees to this need, and for this reason, different beliefs and behaviours arise, which are limiting studies about the implementation phase of innovative projects also looking at their environmental sustainability. The research on the case studies has shown the appearance of actors working in this field. However, many are using traditional business models with traditional methods, which cannot be seen as working for a really different economic model. In this transition, there is the need to look both at the emerging ventures and at the existing ones, especially SMEs which have more difficulties in financing and conducting R&D processes. This hypothesis is also proven by the services provided by many implementation actors, some of which are also

1 https://triplehelix.stanford.edu/3helix_concept

trying to strengthen the collaboration among enterprises and start-ups;

- the transition to a different model affects everyone and needs the involvement of many disciplines and the diffusion of training activities to spread the message, with an active role of the universities;
- the need to complement the incubation phase with a design phase. Usually, business incubators do not intervene in the idea creation but are limiting to judge only the idea for the high Technological Readiness Level (TRL), the business models and the potentiality of increasing the profits, considering only the economic sustainability. This brings to accept in the incubator programme only a few parts of the idea received, not considering the impact at the environmental level. However, this last aspect has to become mandatory in the near future. Furthermore, this cannot only be calculated at the end of the project process but should be at the beginning. Indeed, the idea creation cannot be a simple process of invention, but it needs to be the result of a long process of analysis of the current situation and the development of a project. For this purpose, the design phase needs to complement the incubation phase, as according to Van Weele et al. (2018), incubators are evolving the entering services more related to the idea creation. This requires the intervention of experts in projects, such as designers, which can be included among the experts working in the incubators as mentors, and directly in the project creation both in start-ups or enterprises;
- the need to focus the attention at the local level, in the territory where the civil society is living. This because the manufacturing sector usually is a polluting sector, with direct effects on the liveability of a territory and its healthiness for its inhabitants that live it day after day. Although it's essential to open the mind and explore what is happening on the entire planet, the human being is living every day in a small portion of this planet. Thus, the environmental situation requires strategies at local level, where everyone is involved in little actions in order to obtain a sustainable development in total. Because problems as pollution have no territorial boundaries, there is the need to "think globally but act locally" to have an effective impact;
- the need of a governance which really believes in this transition, which can influence directly the behaviour of industries and the society, as seen in the case of Scotland and The Netherlands.

How can the model help overcome the SD implementation barriers and implement eco-entrepreneurial opportunities provided by SD projects?

The model wants to overcome and solve the implementation problems facilitating the creation of the significant eco-entrepreneurial opportunities created by SD projects for an alternative economic model.
The model provides the inclusion of all the most important actors that facilitate the process of creating a regional systemic innovation: the industry sector, which is the principal beneficiary of the implementation of the model in the region; the university, that boosts the research sector and educates future entrepreneurs and consumers, and that, thanks to the SD division, leads SD projects and educates future SD designers; the government, with the policy makers that can create new policies or modify existing ones, and can orient the financial sector; the civil society which through associations is very close to citizens and, more importantly, is composed by them and knows their needs very well.
The last but not the least component of the model is the 'territory', which is represented as a 'real person' that has its needs and requirements to respect to assure a sustainable future.

How is the model different from the current actors that are playing a role in the support and implementation of CE?

The entity wants to foster and boost the implementation of SD projects in a certain geographical area. It sees the collaboration of the actors of the innovation models of the quadruple and systemic helix (cited in the literature review) to overcome the implementation barriers. Moreover, it also includes two more components: the focus on ecopreneurship and on SD, to obtain a sustainable and circular local development.

The theorized ecosystem model is a crucial result as the definition of the LSNB.

It considers the collaboration within: a BI working in a different way, a training centre, a fab-lab, the university division and the communication division.

In the application phase, it was defined and designed the stage required to act as an open system, which needed a different organization management than the traditional and common ones. The different components of the ecosystem model are related to each other and cope together for the common goal; it is self-regulating producing its pattern of behaviour over time, and also self-generating, evolving and producing what needed; it is open and interacts with the other systems and the environment; it is complex but also resilient (Capra & Luisi, 2014).

10.1.2 Discussion of the application phase

What is the situation in the Piedmont Region (Italy) over the CE implementation? How can SD projects be best implemented there? What is the configuration of this entity in this territory?

The application phase (see chapter 9) has permitted discussing critically the ecosystem model designed and its potential application, shifting from the current situation (on the left in fig. 10.1) to the designed situation (in the right in fig. 10.1). In this case, the application was made considering the total area of the Piedmont Region, and for this reason, it is difficult to think about an ecosystem able to involve each component of the quadruple helix. The region is indeed inhabited by 4 million people and hosts 30.000 manufacturing units in roughly 25.000 km2. In this context, also the LSNB configuration is tricky because it needs the involvement of many experts coming from different organizations that are placed in many different places but should reach all the manufacturing units scattered around the territory. To solve this problem, a solution can be its flexibility: the LSNB should be able to move and go near the productive areas because, if they are mainly dealing with SMEs, these have very little time to dedicate to external activities which are part of their usual business. Instead, in the case of a district, the problem of distances is very limited for the concentration of industries in a small portion of the territory. In addition, in the case of Biella province, there are already some actors working there that can compose the LSNB. In this particular context, the LSNB can be related to the long history of this district, its importance in the past, and the current moment of crisis. In this case, it is possible to argue that the principal problems are related to the industrial competition because there is the risk that many opportunities found in this sector could be similar. However, the basis of a SD project is to start from the analysis of the current situation, which is different for any case. Based on the quality and the quantity of the flows of matter and energy and their management, different solutions can arise and different decisions can be taken. Moreover, the goal of the ecosystem is to create a different economy based on collaboration and not competition. Indeed, the companies, opening to the other ones acting in the same sectors or to the other ones present in the local area, can create collaborative projects. In this situation, the opportunities for new enterprises, start-ups or spin-offs are increased and developed. Considering the quantity of matter processed in the case of a district, the entrepreneurial opportunities related to the creation of new activities are multiplied because they can define the viability of opening a new market. For example, in this specific case study, the significant amount of natural dyes required by the textile industry can sustain the producers and researches around this topic. Similarly, regarding short fibres produced by a company, the case of a large quantity can lead to the birth of a spin-off sustained by a single company or the creation of a new specific company. While in case of a little quantity, the creation of a new business can be participated by many existing companies. Moreover, the potential of the matters' use in other markets can be discovered by research projects in collaboration among industries.

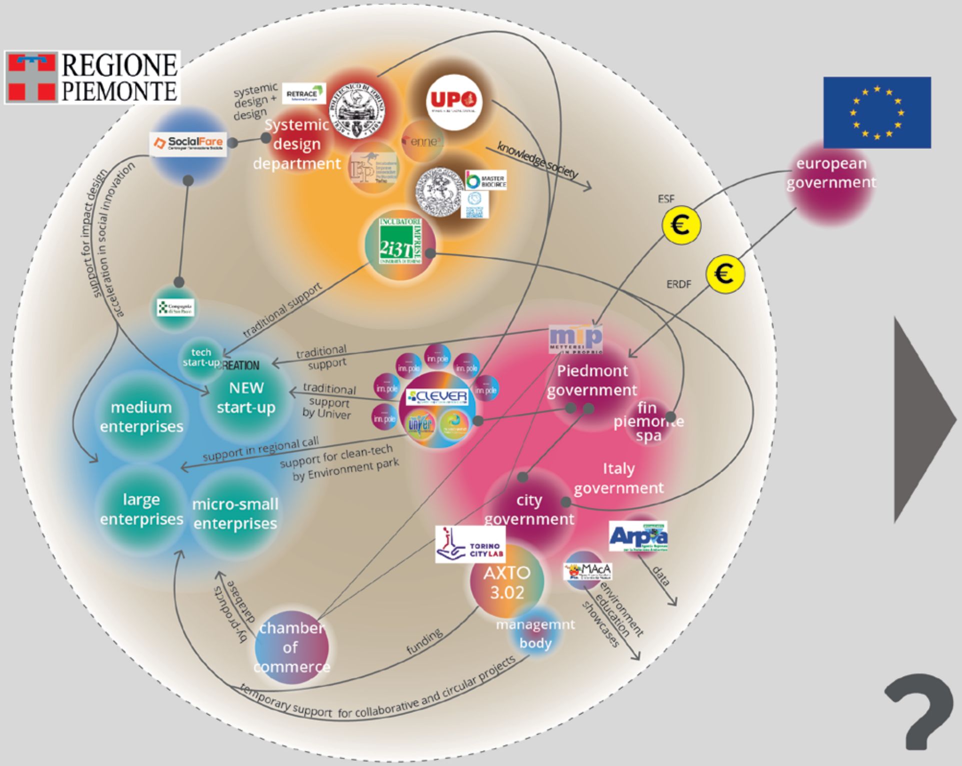
From the application phase, it emerged that this ecosystem and the LSNB, which want to facilitate the implementation of systemic innovation, are a systemic project itself, so they also have problems related to their implementation. This fact requires the needs of further reasoning about its creation.

Another research questions that came out after the

Fig. 10.1 -graphic representation of the comparison of the ecosystem in the Piedmont Region (next page)

PIEDMONT REGION, ITALY

FROM



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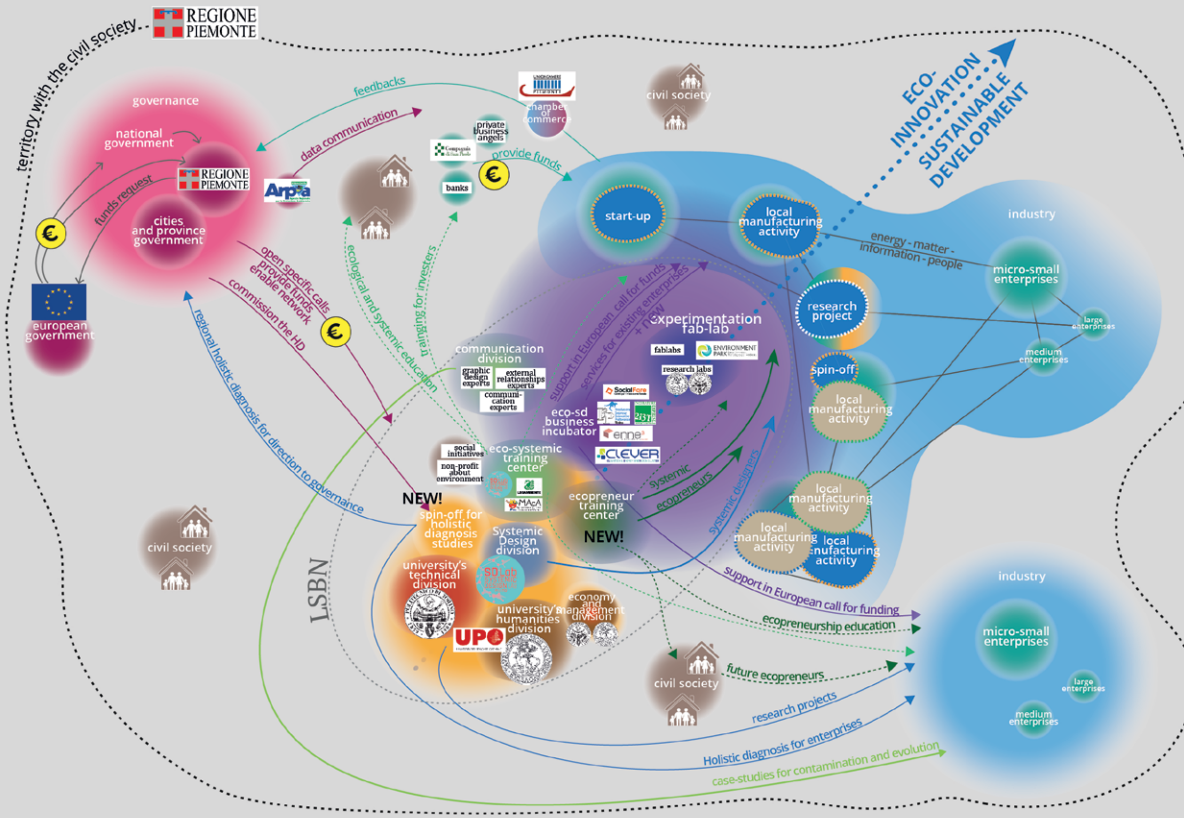


sustainable economic development
participated policies
systemic approach
LOCAL SUSTAINABLE AND CIRCULAR DEVELOPMENT
eco or environment entrepreneurship
low environmental impact
high social impact

Ecosystem for Innovation

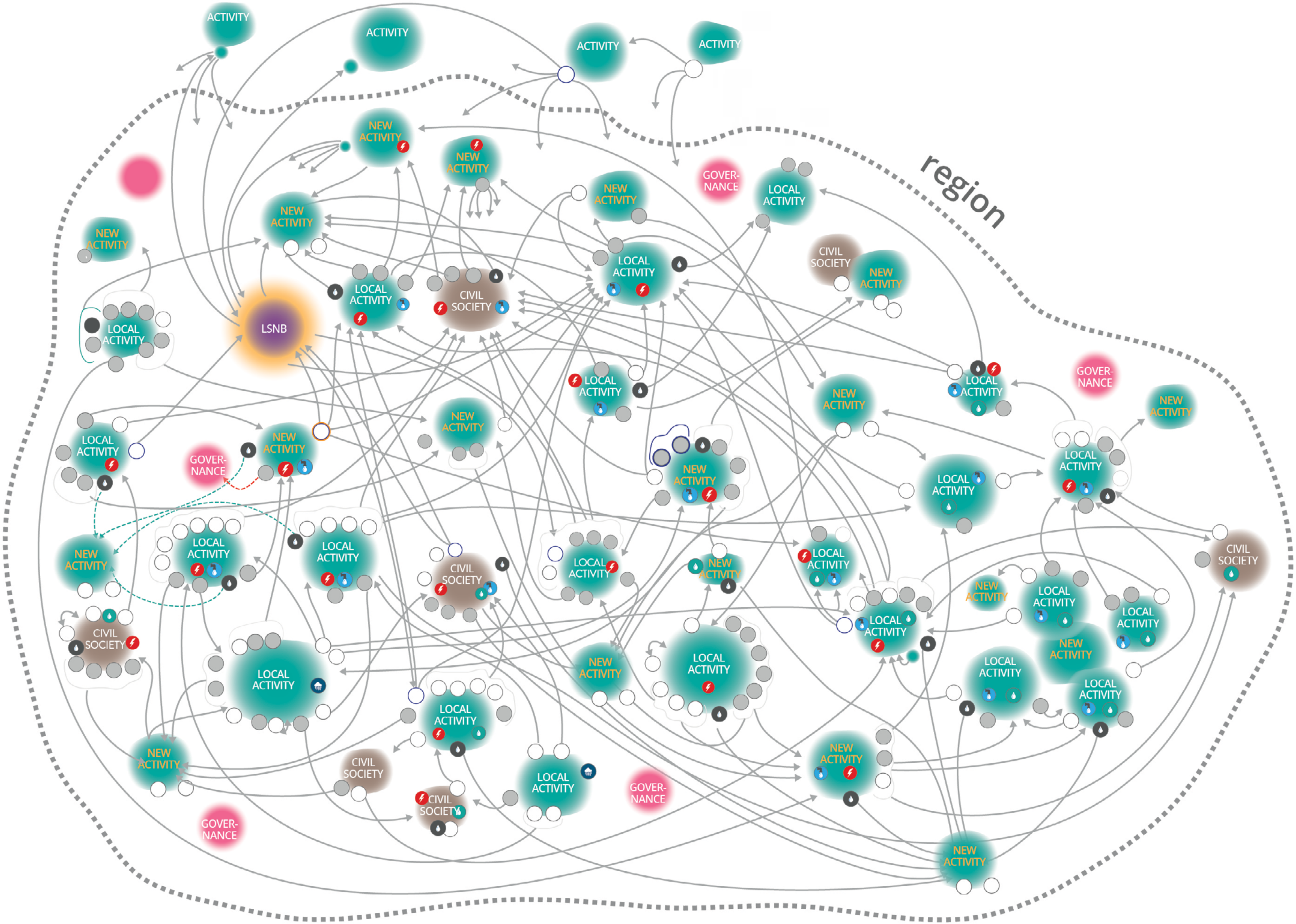
sustainable economic development
participated policies
systemic approach
LOCAL SUSTAINABLE AND CIRCULAR DEVELOPMENT
eco or environment entrepreneurship
low environmental impact
high social impact

Ecosystem for Systemic Innovation

design process is:
What happens to the local territory with the introduction of the regional ecosystem model and the LSNB?

The results of the implementation of the theorized ecosystem for the regional systemic innovation model in a region can be those shown in fig. 10.2. In a region constellated by manufacturing activities (the one in green blu), the introduction of the LSNB acts as the facilitator and the engine of a regional network among the manufacturing activities. It helps to implement the regional system that is created by flows among them of energy, matter but also information, people and money. All the activities that are managing these flows are included: from the manufacturing to the agricultural production to the services industry. In this ecosystem, there are also actors from the government and the civil society. Moreover, the households of the civil society are included because they can be considered as processing units: producers of blue and grey water, consumers and potential producers of energy, consumers of food and producers of food waste, et cetera.

Fig. 10.2 (next page) - graphic representation of the possible future situation inside the region created by the ecosystem. As in the previous representations of the ecosystem, in green there are the manufacturing activities, in red is represented the governance, in brown the civil society and the LSNB is in purple and orange. Thanks to the addition of the LSNB in a region, there is the creation and implementation of multiple fluxes (matter, energy, money, information, ..) among the manufacturing activities thanks to output-input.



region
LOCAL ACTIVITY
NEW ACTIVITY
CIVIL SOCIETY
GOVER-NANCE
ACTIVITY
LSNB

10.1.3 Indications for the ecosystem creation

The design process of this model and the consequent application phase has created new research questions as:
How to create the ecosystem in a territory?

To pass from the current situation (on the left in fig. 10.1) to the designed situation (in the right in fig. 10.1) where all the relationships are active, taking for example the Piedmont Region in fig. 10.1, it takes several indications to the actors involved to evolve at least from phase 0 to phase 1 of the implementation process.

The LSNB wants to act as the anchor tenant to facilitate the creation of the ecosystem and boost networks' creation. It mainly starts with the university helix and works with the industries which want to take action. Moreover, it is also able to act with all the manufacturing sectors through communication and training activities. It is facilitated by the policy makers' actions, which can commission studies, provide funds, and direct policy actions to solve implementation barriers. It also works for the civil society increasing its awareness on environmental topics in general and helps to train future generations. All the actors involved are an implicit part of the civil society, which are inhabitants of the local territory and consumers of the products sold.

Further studies need to analyse the evolution of the creation of the system and its behaviour, with the involvement of dedicated experts. Moreover, the study should focus on the future situation that is possible to create in the manufacturing sector, considering a specific area (fig. 10.2).

The development of a new kind of entrepreneurship requires, at the same time, the development of a different ecosystem able to boost this kind of different innovation actions. To do so, there are some indications for practical strategies that the different actors can adopt to facilitate the creation of a new ecosystem: policy makers, entrepreneurs, researchers/workers in the university, citizens and designers.

The first indication is <u>for everyone</u>: be conscious and responsible about your actions as citizens.

<u>For policy makers:</u>
1. be open to learn new things (continuous learning) and be updated;
2. have the role of facilitator, in terms of giving directions and funds;
3. update the concepts of 'waste' and 'by products' which for normative regulations are limiting lots of projects, although a debate on it is ongoing in the European Union (Bourguignon, 2016);
4. co-design future policies receiving feedbacks from the 'operative actors' to be more active, efficient and problem solver;
5. unblocking funds to provide economic support for economic activities to support their transition to a different model which requires expensive investments (as changing or updating of machinery/vehicles with some less energy-intensive or more advanced technologies);
6. support the 'virtuous' example providing tax concessions and tax breaks to enhance the best actors and start the process of imitation;
7. facilitate the cross-collaboration between sectors which nowadays are blocked by the 'ateco' code and the reception of different economic treatments;
8. enhance the creation of a sharing and CE with less legislative barriers;
9. facilitate the relationships among the different departments and competencies present in government offices;
10. stand up for the policies, to involve the majority of citizens as possible;
11. support the development of services to facilitate cross-collaborations. For example, in Piedmont Region the online database on regional by-products[2], it is based on voluntary actions by the companies so unfortunately, it has very few data, although it can be a significant tool for starting to understand the need of local companies;
12. let the waste management be more easy and transparent for everyone, making verifications

2 which can be consulted at the website https://scrivania.elencosottoprodotti.it/ (managed by the Chamber of Commerce)

and extracting data;

For entrepreneurs (industry sector):
1. be open to learn new things (continuous learning) and be updated on what is happening outside;
2. be ecopreneurs sustainability oriented: *"seek to solve societal and environmental problems through their entrepreneurial activities…focus on environmental, social, and economic issues simultaneously"* (Gast et al., 2017);
3. be open and facilitate the collaborative projects;
4. don't be scared by the university world: they will not question your level of preparation;
5. be updated about the world of the disciplines to be able to involve in your activities more and new competencies;
6. be in contact with the association of enterprises.

For those who work in universities (education and research sector):
1. facilitate the relationships among the different departments, the different competencies and the other universities;
2. involve industries in research projects;
3. prepare experts for the future (the university is the only one that can think with long-term vision);
4. train students and teachers in all the disciplines in transversal soft skills as the systemic thinking;
5. alternate in the research phase moments where the focus is on some very specific things with moments with a large vision on the complex system;
6. train the future generations focusing on complex problem solving, critical thinking and creativity, as stated by the World Economic Forum in 2016 (World Economic Forum, 2016).

For citizens:
1. be open to learn new things (continuous learning) and be updated on what is happening outside;
2. be conscious and responsible about buying actions because with it you can support good enterprises;

For designers:
1. be open to learn new things (continuous learning) and be updated on what is happening outside;
2. be conscious and responsible about your decision as designers;
3. be open and curious about the other disciplines;
4. use your capacity of visualization and communication which make easy to explain the projects to everyone;
5. use your capacity of visualization to contribute in the management of the complexity;
6. *"work to help ensure that what is designed makes sense in the future lives of people"* as reminded by Sanders & Stappers (2014);
7. use your creativity in problems solving and opportunity creation;
8. recognize the local know-how and design according to it (Bozzola & De Giorgi, 2016)

10.1.4 Replicability and scalability of the theorised model

How is the model scalable and replicable?

Discussing the theorized ecosystem model, it is crucial to understand if it is scalable and replicable for the success of this project. As reminded, also, this model is an SD project with its problem of implementation. For this reason, it shares with them the difficulties regarding the scalability and replicability. Indeed, as reminded by Barbero & Bicocca (2018), the scalability helps grow the outcomes for the territory, but without arriving to the exploitation of its resources, that are given to human beings for free. Furthermore, the replicability helps underline the project's critical elements to extract its role in another context. However, talking about an SD project, it is born from the peculiarities of the territorial context where it is placed, and for this reason, the replicability should take in consideration these factors, which are 'personal' and different for each context, as: culture and material culture, quality and quantity of natural resources, presence of human capital and specific competencies,… Based on it, is it necessary for an SD project to be scalable and replicable?
In terms of scalability, the improvement can be not only in quantity, but also in the intensity of innovation, and in the expansion of successful projects/programs/policies over time to increase the impact (Barbero & Bicocca, 2018). This is precisely the framework to consider scalability also for LSNB, more focusing on quality than quantity. After the activation, the LSNB can involve more actors who help obtain the goal shared among all:

'local sustainable development with systemic eco-innovation'. Moreover, its success can be defined by the number of activities supported, both regarding the creation of new ones, and the transition of the existing ones. Another critical factor is the increase of relationships among the actors of the ecosystem and the diversification of the production models. The elements that need to be scalable are the creation of the network and the reproduction of the model, not its size. Indeed, a context may require the need for having multiple LSNB and not only one. Also, in the Piedmont Region application, this is a question that remains open for future researches.
In the case of replicability of the LSNB, for example, the SD division is recognized as fundamental for its creation. The future potential application in the Piedmont Region is facilitated thanks to its presence in the Region. Indeed, its presence is a fundamental pillar for creating the LSNB, and for this reason, in another territorial context a new SD division should be created or found. However, integrating systems thinking in the design processes and actions means a cultural paradigm shift that requires specific competencies and skills, and especially time. This could be a possible barrier in the implementation of others LSNB.

10.1.5 Contribution to research knowledge

What is the contribution of SD in the transition to a sustainable local circular economy to design different production and economic models? And in the creation of new entrepreneurial realities?

This thesis deepens the knowledge of the design discipline contributing to the debate around the relationship between design and entrepreneurship, providing theories and approaches collected in the context and literature review phase. Moreover, it enlarges the strategic role of design in innovation development, reminded by many scholars, to the one of SD in innovation for sustainable development, strengthening the relationship between design, innovation and environmental sustainability, which at the moment is not present in scientific contributions. Also, this doctoral research contributes to the development of the SD discipline application in the manufacturing sector, with the

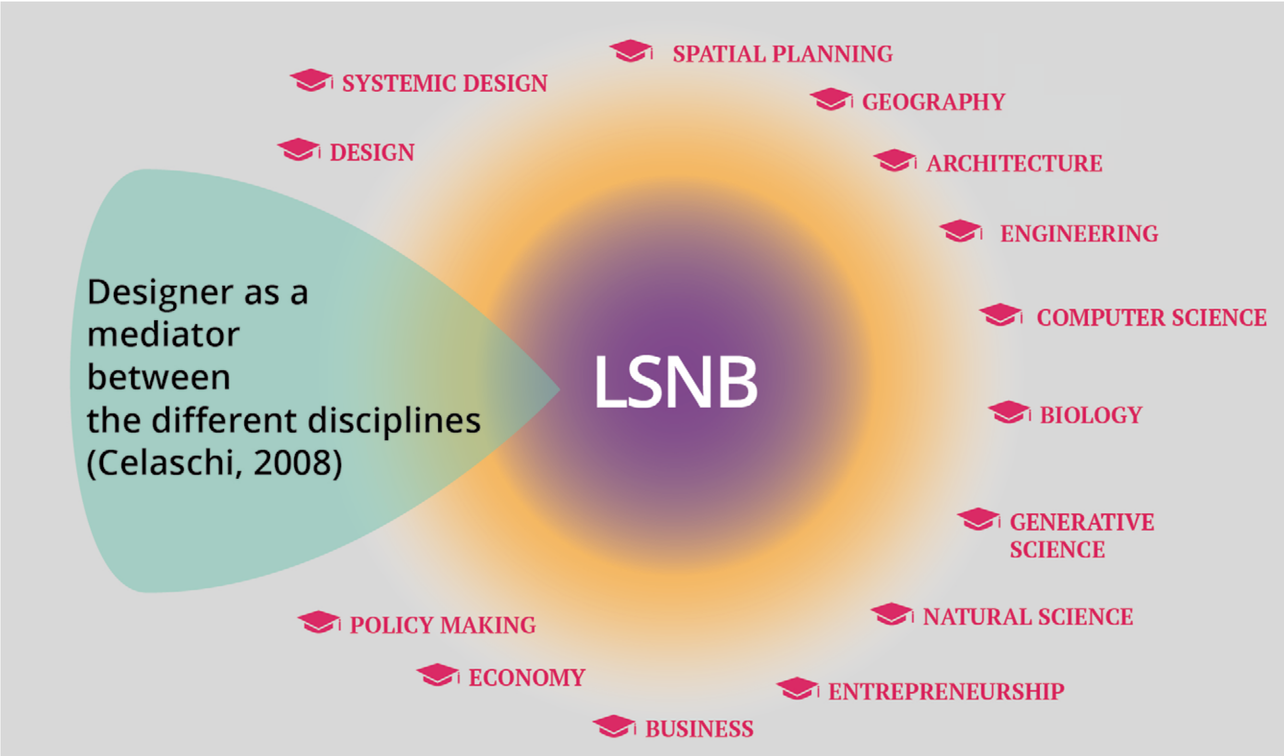


Fig. 10.3 - graphic visualisation of the role of the designer in the ecosystem and in the LSNB

definition of the implementation barriers faced by SD projects, the potential ecopreneurial opportunities created by these projects, and critical analysis of the methodological process.
SD indeed has demonstrated to be able to connect the territory, design and environmental issues in the projects. Looking at the territory and its productive sectors with a systemic approach can trigger several new opportunities and potentialities linked to a development that is far away from the current economic evidence, centred exclusively on the increase of the GDP. Indeed, shifting the attention from the single actors to the relationships that can be created between them, it is possible to obtain different results, as the theory of system suggests: *"the whole is greater than the sum of its parts"* (Aristotle), or better in the words of the Gestalt psychologist Kurt Koffka *"the whole is other than the sum of its parts"*. Shifting the goal of the productive system from individual ways of acting to collective ones, focusing on collective needs rather than the economy in the first place, can guide to sustainable local development of the context where the production model is placed. A development that *"meets the needs of the present without compromising the ability of future generations to meet their own needs"* (Mitlin, 1992), that is not only focused on the economic growth, and operates in the Nature's limits, as the ecological economics remind (Daly & Farley, 2011). The application of SD approach to the manufacturing sector forces the need to co-creating the design phase. This because SD projects faced many different challenges which

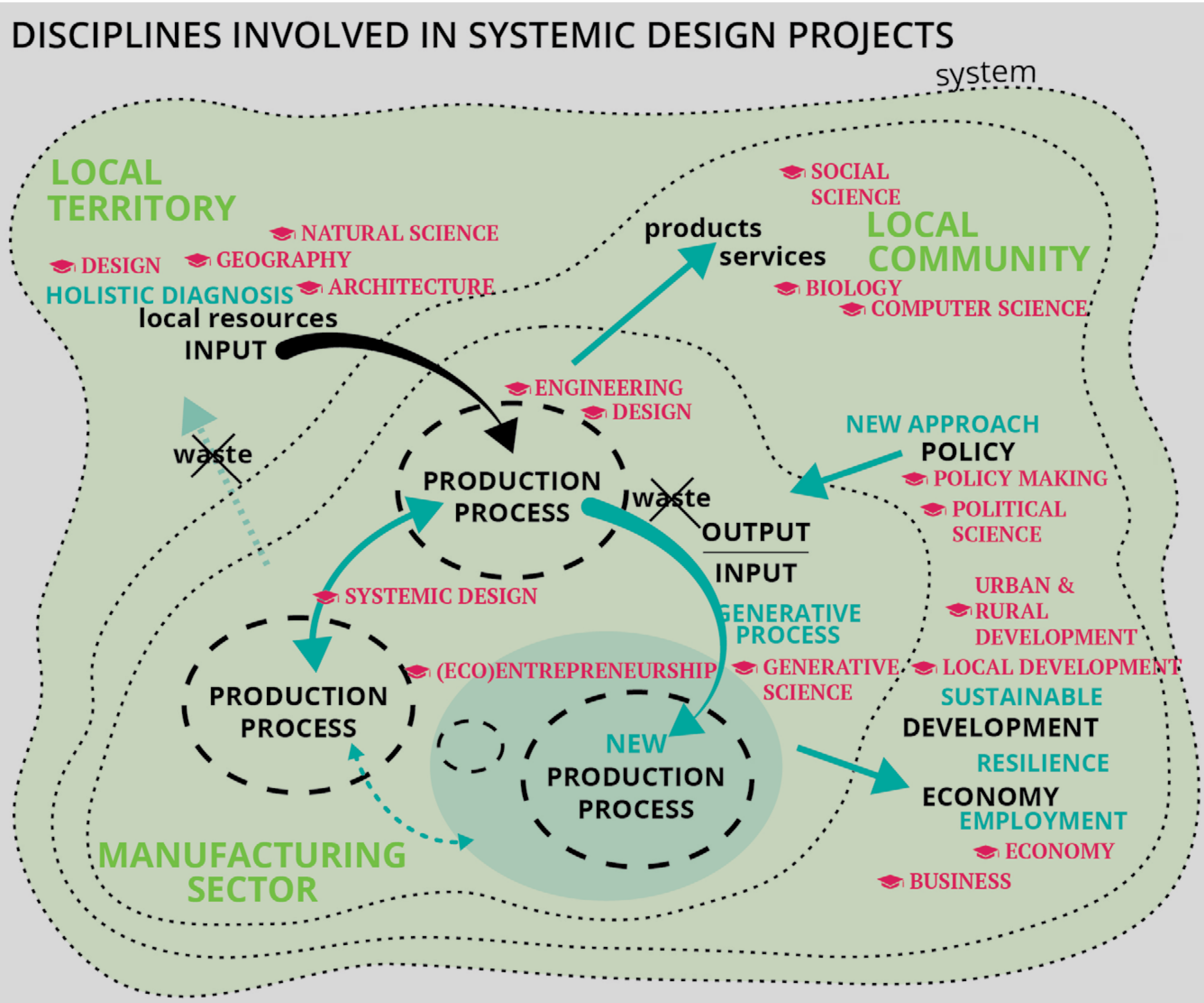


Fig. 10.4 - graphic visualisation of the disciplines (in pink) involved in a SD project for the manufacturing sector. Published in Battistoni and Barbero (2019, 2020)

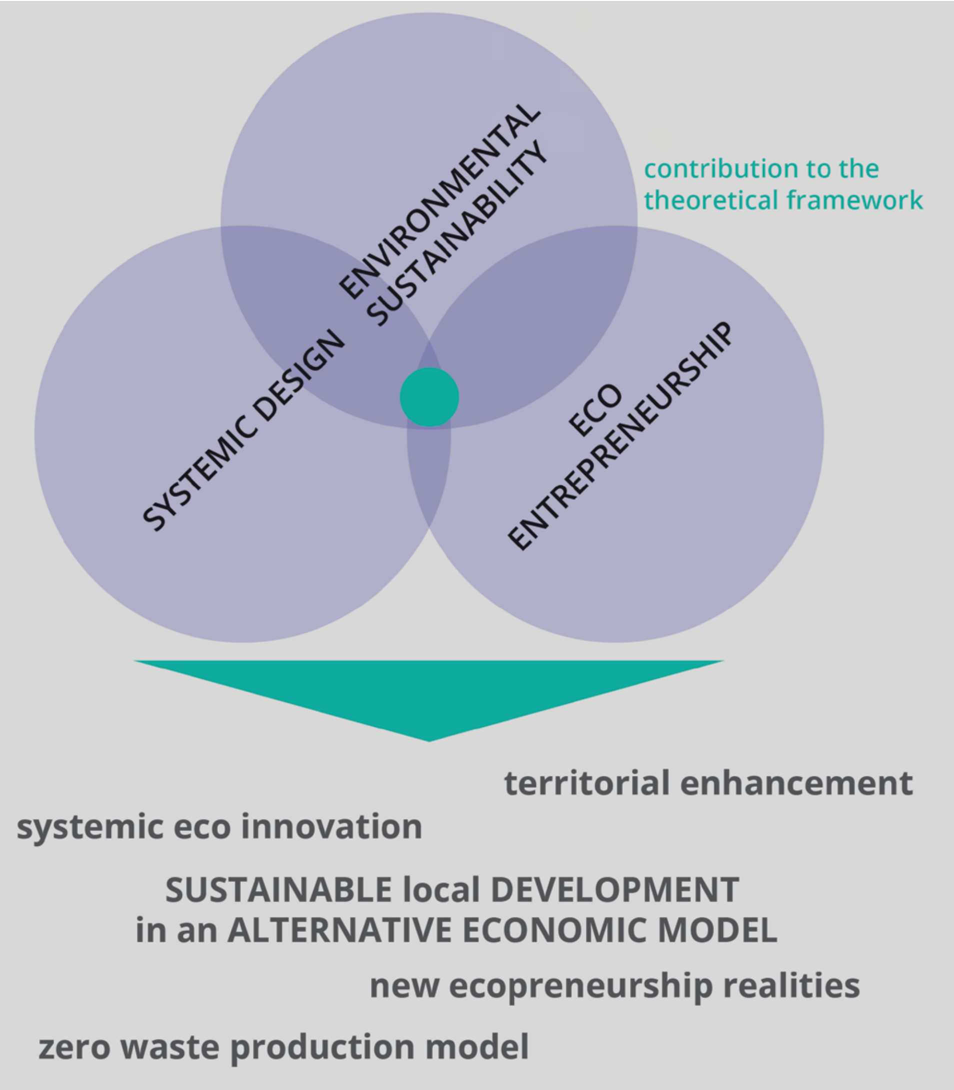


Fig. 10.5 - graphic visualisation of the contribution to the theoretical framework

required the participation of experts from diverse background disciplines to achieve innovative solutions, activating possible dialogues among technicians, economists, humanists and many more, as it is possible to see in fig. 10.4. For example: the HD analysis of the territory should involve experts in natural science, geography and architecture; the HD analysis of the current production system involves engineers and designer; while the generative part of eco-opportunities at entrepreneurial level needs the involvement of experts on generative science and entrepreneurship. The impact of these projects at economic, social and environmental level should be analysed at least in collaboration with economist, environmental engineers, and sociologists.

The results of the research phase and the projects phase of this doctoral thesis can be valued not only by designers but also by policy makers, entrepreneurs, industrial entities, decision makers, and stakeholders around eco-innovation mainly in the European context.

The main results are:

1. the identification and analysis of 28 case-studies that can provide a general vision on the phenomenon of the CE implementation actors;
2. the analysis of the local ecosystems with direct interviews in Scotland, the Netherlands and Piedmont Region that contribute to their assessing and evolution;
3. the deep analysis of the situation in Piedmont Region that gives many elements to the policy makers to think about the current situation and on which policies need a revision and which ones

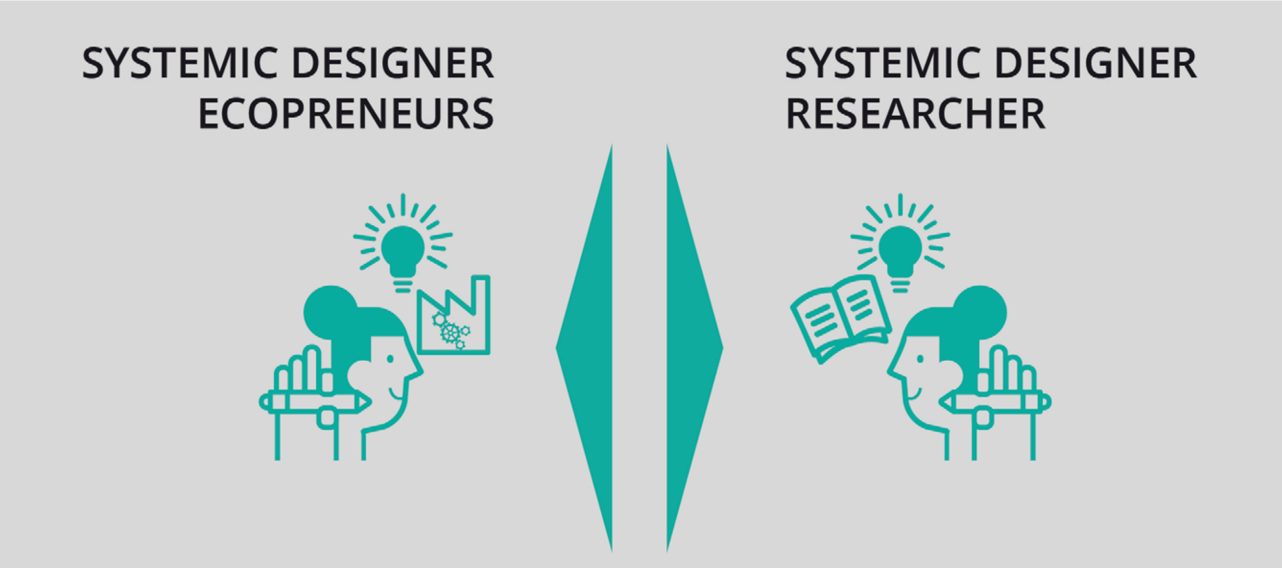


Fig. 10.6 - graphic visualisation of the role of the systemic designer ecopreneur and the systemic designer researcher

need to be created;
4. the definition of the LSNB.

Significantly, the contribution of this research regards the need of the collaboration of three different fields interested in this research: if SD, entrepreneurship and environmental sustainability act together, they have a great potential to facilitate the transition to a sustainable and circular local development (fig. 10.5).

In this framework, two new figures emerged (fig. 10.6):

- the systemic designer ecopreneur: trained as an ecodesigner and systemic designer, he/she has a great potential to become an ecopreneur after specific training in entrepreneurship. Thanks to the competencies in design and opportunities discoveries, he/she can propose a different entrepreneurial idea and follow the design process until the new products development. Moreover, with communication skills, he/she can also intervene in communication strategies. He/she can build the entrepreneurial activity thanks to the collaboration with other people from other disciplines, and in this process, he/she is facilitated thanks to the skill of "mediator" (Celaschi, 2008);
- the systemic designer researcher: trained as an eco-designer and systemic designer, he/she acquired in the university path also the competencies of the researcher, a knowledge that can increase in a doctoral programme. In the end, he/she is able to conduct the research process behind the design project, and also use the design project as a tool for research as in the 'Research through Design'. Also in this case, he/she collaborate in the process with other disciplines, assuming the role of "mediator" (Celaschi, 2008).

Both the two figures work for the realisation of the ecosystem, but with differences in their relationships with the exterior of it: while the systemic designer ecopreneur with its activity sells the final products/services within the ecosystem and outside of it exporting the local excellence, the systemic designer researcher is more oriented in understanding what is happening also outside the system and import the knowledge inside the system.

10.2 CONCLUSIONS

SD demonstrated to be an approach and a methodology able to design out of waste and to reach environmental and economic sustainability at a local level, connecting the territory, design and environmental issues. Indeed, spotlighting a specific territorial area and the productive sector operating there, applying a systemic thinking, the focus shifts from the single actors to the relationships that are possible to create among them, obtaining a different result. This change of cultural paradigm can produce a different economic development model, going over the current one centred only on the increase of GDP. It can also support the economist acting in another way as Raworth (2017) suggests.
The application of SD to the manufacturing sector was examined in depth in this doctoral thesis, which defined that SD is able to create eco-opportunities and eco-innovation which can be exploited by the entrepreneurial local ecosystem to finally obtain a sustainable local development, going over the potentialities of design in creating opportunities for innovation as the design discipline have just demonstrated with contribution as Bertola & Teixeira (2003); Brown (2009); Celaschi & Deserti(2007); Franzato & Celaschi (2017).
This research study developed an answer to the main research question, that crossed the fields of SD, environmental sustainability and entrepreneurship, furthermore, it develops a way to support the implementation of SD projects which is always tricky, mainly due to the current linear cultural paradigm.
The methodology used has the basis in the research as an academic activity, the 'research by design' and SD. It started with a long and complex literature review over the three main fields to investigate the point of contacts. Afterwards, a double multiple case studies analysis was performed, both on previous SD projects and on the actors that today are working to foster circular innovation, for the contemporaneity of the topic. This analysis finally makes a focus on the Dutch and Scottish ecosystem to understand how to develop the ecosystem in the Piedmont Region. This complex and long background research has permitted to build the roots for a research through SD, with results both on a design level and on a research one.

The result at the design level is the definition of a new entity, the Local Systemic Network Booster (LSNB) that can develop and foster these projects, interacting with the entire local ecosystem composed by the main element of the quadruple helix model of innovation: university, industry, government and civil society. The application phase demonstrated that at the end also the ecosystem designed is a SD project with problems in its implementation, however, its creation in the Piedmont Region is on the way because it has all the elements to start.
The results of the research phase demonstrated the need to have the three fields working together for the transition to a sustainable development of our territories.
This doctoral thesis indeed at the end has become a research through SD, from SD and for SD, which can contribute to the development of this discipline, especially in the line of research of "SD for territorial metabolism and flourishing economies".

Analysing this doctoral research critically, it is possible to consider it as very ambitious, since the goal settled at the beginning and the approach used, due to many aspects as:

- the multidisciplinarity: the goal of the research indeed required enlarging of the focus from the SD discipline, including also contributions from the business and management fields, and territorial approaches;
- the inclusion of every manufacturing sectors instead of focusing on only one;
- the inclusion in the analysis of multiple innovation dynamics, from what is happening both in existing enterprises and in start-ups.

However, the approach used was based on opening research boundaries instead of closing them, applying a systems thinking to understand the complexity of the current situation, regarding *"wholes and relationships rather than splitting it down into its parts and looking at each in isolation"*(Ramage & Shipp, 2009). It was indeed a necessity, in contrast to the approach of the current scientific production, which is made of always more specific studies in always more narrow disciplines. In this case, the attempt was to enlarge the point of view and the focus as much as possible to have a bird's eye view of the situation: this vision is the one needed to change the things and give another direction. This integrative approach seems the one needed by design for sustainable territories.

In the end, this research can be considered a thesis which can give a small contribution to the reach of the following goals of the Sustainable Development Goals settled by the United Nations in 2015 with the Agenda for 2030 (see chapter 2.2):

- Goal 12 (responsible production and consumption), for the reasoning about the change in the production model;
- Goal 11 (sustainable communities and cities), for the
- Goal 13 (climate actions),
- Goal 17 (partnership for the goal)

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10.2.1 Research limits

As recognized before, the ambitious goal of this thesis and the application of a Systems thinking can also be considered a research limit, for making it also maybe too generalist and superficial from some points of view. For example, the multidisciplinarity happened mainly at the theoretical level, and this can be considered reductive. Nevertheless, it should have needed more involvement in the thesis of experts figures since the beginning as a co-tutoring of the thesis. However, it was difficult to realize in the academic world, due to the lack of a different vision on topics as economy and entrepreneurship. However, it was realized thanks to the involvement of many people: the one that the author has interviewed; annual meetings with prof. Colombelli from Politecnico di Torino who is doing research on entrepreneurial ecosystems and who give interesting feedbacks to the research; and in the visiting period in Strathclyde University where feedbacks were received from experts in other fields.
Another limit was the inclusion of every manufacturing sectors instead of focusing on only one, but an effort was made in tackling in depth only one, the textile sector, in the final application phase.

10.2.2 Future works

The design of the ecosystem is a preliminary result which needs to be further investigated also in its implementation phase. Moreover, future considerations should concentrate on a more in-depth analysis of the outcomes on the territory with also quantitative studies with the involvement of other experts, which probably are more than the ones distinguished by this study. Also, it should need to understand what is the best way to create the LSNB, starting from the current actors and obtaining the draft of the ecosystem in stage 1, once the facilitator is starting to act. The application phase should also need to be replicated in other contexts where is not present the expertise of the 'SD' division, to understand how it can be shaped. Another suggestion would be to increase the studies on similar realities which can also have consequences on increasing scientific contributions that are crossing design, entrepreneurship and environmental sustainability.
The future research questions can be:

- Should the LSNB be the only one significant entity in the territorial context or multiple facilitators are needed?;
- What are the stages for the creation of a different ecosystem starting from the LSNB?;
- Is it useful in boosting the implementation of systemic innovation or are there some criticalities that were not taken into consideration?;
- Can this action be taken as an example for the European Union to develop more policies for the development of ecoinnovation and ecopreneurship, as funding programmes?

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Publication list

JOURNAL ARTICLES

Battistoni, C., Dominici, L., Barbero, S., & Comino, E. (2020). Systemic Design Methodology applied to hazelnut processing. *International Journal of Design Sciences & Technology*, 24(1), 39–65.

Battistoni C., Barbero S. (2020) Design of an ecosystem to foster systemic eco- innovation. Systemic design for autopoietic local economies. *Formakademisk. Research Journal of Design and Design Education, 13(2).* https://doi.org/10.7577/formakademisk.3408

Battistoni, C., Giraldo Nohra, C., & Barbero, S. (2019). A Systemic Design Method to Approach Future Complex Scenarios and Research Towards Sustainability: A Holistic Diagnosis Tool. *Sustainability*, 11(16), 4458. https://doi.org/10.3390/su11164458

BOOKS CHAPTER

Battistoni C., Giraldo N.c. (2017) The RETRACE holistic Diagnosis (annexes). In: Barbero, S. (edited by), *Systemic Design Method Guide for policy maker: a circular Europe on the way*. Torino, Allemandi, 2017. http://ilgiornaledellarte.com/articoli/2017/10/128271.html

Battistoni C., Giraldo N.c. (2017) The RETRACE holistic Diagnosis (annexes). In: Barbero, S. (edited by), *Systemic Design Method Guide for policy maker: a circular Europe on the way*. Torino, Allemandi, 2017. http://ilgiornaledellarte.com/articoli/2017/10/128271.htmll

Battistoni C., Ferru A., Fiore E., Pallaro A. (2017). Anzasca and Chisone Valley. In L. Bistagnino (edited by). *microMACRO, the whole of micro systemic relations generates the new economic-productive model*. Milano, ed. Ambiente (italian edition 2016, english edition 2017) http://www.edizioniambiente.it/libri/1157/micromacro/

Battistoni, C., Bicocca, M., Pallaro, A. (2017). Social values, economic, ethical and well-being. In L. Bistagnino (edited by). *microMACRO, the whole of micro systemic relations generates the new economic-productive model*. Milano, ed. Ambiente (italian edition 2016, english edition 2017) http://www.edizioniambiente.it/libri/1157/micromacro/

Battistoni, C., Daghero, A. (2017). High Sangone Valley (Torino), territorial potentialities. In L. Bistagnino (edited by). *microMACRO, the whole of micro systemic relations generates the new economic-productive model*. Milano, ed. Ambiente (italian edition 2016, english edition 2017) http://www.edizioniambiente.it/libri/1157/micromacro/

CONFERENCE PROCEEDINGS

Battistoni, C., Barbero, S. (2019). Is design playing a role in the realisation of circular economy projects in Europe? A case study analysis. In: *Designing sustainability for all*. Proceedings of the 3rd LeNS World Distributed Conference, Milano, Mexico City, Beijing, Bangalore, Curitiba, Cape Town, 3-5 April 2019. Volume 2 www.lensconference3.org

Battistoni, C., Lambiase, N., Barbero, S., Barbera F. (2019) . What really matters? Systemic Design, motivations and values of the Circular Economy companies in Italy. In: *Designing sustainability for* *all*. Proceedings of the 3rd LeNS World Distributed Conference, Milano, Mexico City, Beijing, Bangalore, Curitiba, Cape Town, 3-5 April 2019. Volume 2 www.lensconference3.org

Battistoni, C., Barbero, S. (2019) Systemic Incubator for Local Ecoentrepreneurship to Favour a Sustainable Local Development: Guidelines Definition In: *The Design Journal*. Volume 22, 2019 - Issue sup1: Running with Scissors: 13th International Conference of the European Academy of Design, Dundee, 10-12th April, 2019 https://doi.org/10.1080/14606925.2019.1595851

Battistoni, C., Barbero, S. (2018) Systemic design for territorial development: ecosystem to support autopoietic local economies In: *Proceedings RSD7, Relating systems thinking and design 7*, 24-26 October 2018, Torino , Italy, 2018 https://systemic-design.net/rsd7/proceedings/

Battistoni, C., Barbero, S. (2018) The holistic diagnosis as a method to support urban mining actions: the case study of the European project Retrace for Piedmont region (Italy). In: *Proceedings SUM2018, Fourth Symposium on Urban Mining*, 21-23 May 2018, Congress Center Giovanni XXIII, Bergamo, Italy, CISA Publisher.
https://www.urbanmining.it/en/papers-publication

Battistoni, C., Barbero, S. (2017). Systemic Design, from the content to the structure of education: new educational model. In: 1*2th International Conference of the European Academy of Design* - Sapienza University of Rome (IT), 12-14 April 2017
https://www.tandfonline.com/doi/abs/10.1080/14606925.2017.1352661

Barbero, S., Battistoni, C. (2016). From the sustainable biscuit production to territorial development through systemic incubator. In: *8th International Scientific Conference Management of Technology - Step to Sustainable Production (MOTSP 2016)*, Porec (HR), 01–03 June, 2016

The current global environmental situation needs to be tackled now for its severe consequences on human and planet health. One of the causes identified by scholars is the 'take-make-dispose' model defined by the linear economy, which has affected the production and consumption models. In this framework, also the design field is called into question for its responsibility in the decisions taken in the design phase of new products and production processes. Nowadays, alternative economic models are emerging as the Circular Economy and the Blue Economy. However, they required a radical change, especially in the cultural paradigm. Indeed, to tackle the current complexity, holistic approaches are necessary to be put in action. To meet the challenges for a sustainable future, also the manufacturing sector needs to reconsider its productions models, as it will face a revolution shortly. Systemic Design, an emergent integrative discipline, using the Systems Thinking into the design process and practice, applied in the manufacturing sector has demonstrated to be an approach able to create sustainable production processes, zero waste and a sustainable local development. Moreover, a method to create eco-innovation and eco-opportunities which can be exploited by the local entrepreneurial ecosystem. Despite the high value of these projects, SD projects implementation is difficult and complex, operating in a framework which implies many changes compared to the current one.
This PhD thesis fits precisely in this context and wants to fill this gap exploring the relationships between SD, environmental sustainability and innovation related to entrepreneurship. It was carried out to answer the following research question: *"How SD projects can be implemented and supported by local context in order to boost Cicular Economies in Europe?"*. The goal is to understand the significant eco-entrepreneurial opportunities created by SD projects that can be caught by a new generation of entrepreneurs – the ecopreneurs - to overcome the implementation barriers faced, to ease, foster and support their realisation for their important outcomes and positive impact to change the current environmental situation. After this definition, the final 'product' designed is the 'best' ecosystem to ease, foster and support the SD opportunities implementation, which can boost local circular autopoietic economies and create a future sustainable local development, based on the quadruple helix model of innovation. The creation of this ecosystem is facilitated by the Local Systemic Network Booster, a theoretical model defined in this thesis, after the analysis of twenty-eight cases studies and three European regional ecosystems (Scotland, the Netherlands, and the Piedmont Region in Italy).

This doctoral thesis can be considered a research through SD, from SD and for SD, which can contribute to the development of this discipline, especially in the line of research of 'SD for local circular economy'.

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