



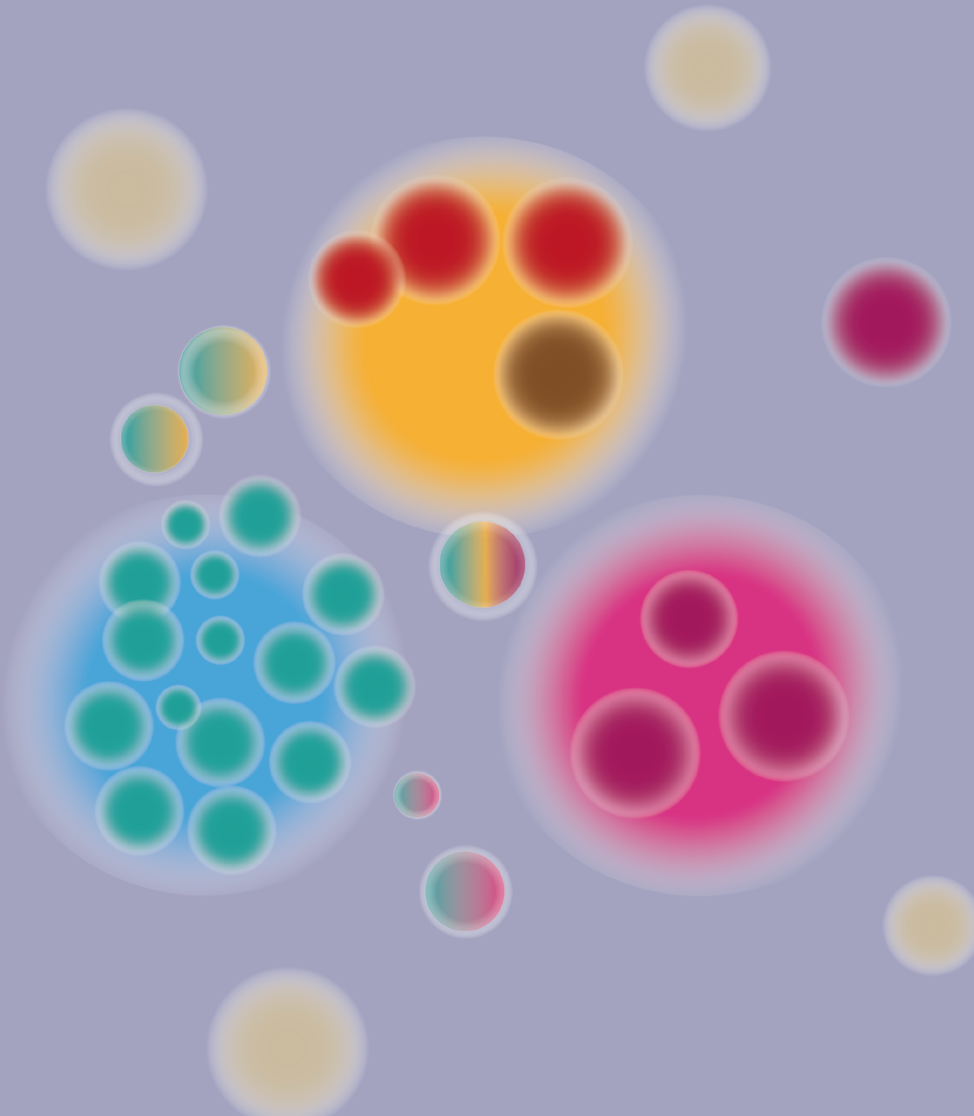
POLITECNICO
DI TORINO

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
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**Systemic Design for
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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 production models, as it will face a revolution shortly, as stated by Garretti & Taisch (2012).

Systemic Design (SD), an "integrative interdisciplinary" (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 the 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 at 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".

CONTEXT

desk research

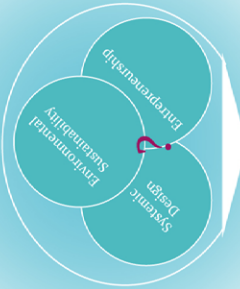
Linear thinking
Linear Economy
Linear production model

Systems thinking
Circular Economy
Circular production model

Design for sustainability
Systemic Design
systemic production model

LITERATURE REVIEW

desk research



SUSTAINABLE LOCAL DEVELOPMENT

2 MULTIPLE CASE STUDY ANALYSIS

desk + field research



for circular economy implementation

in-depth interviews

THE NETHERLANDS

SCOTLAND (UK)

PIEDMONT REGION (IT)

systemic design projects



how current actors for circular economy implementing are approaching the problem

principal opportunities and problems in SD projects implementation for sustainable local development

BACKGROUND RESEARCH

relationship between design and entrepreneurship

approach over sustainability in the entrepreneurial context

who is supporting sustainable innovation in entrepreneurial context

RESEARCH THROUGH SYSTEMIC DESIGN

PROJECT

guidelines for the ecosystem design



Project ECOSYSTEM Conceptual model

TEST

application Piedmont Region

specific application Piedmont Region - textile district

THESIS

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 Circular 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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