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Gigamaps as enabling tools for envisioning futures

Co-design toward systemic transition

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Abstract

Entrepreneurial ecosystems have gained attention for fostering innovation and sustainable transition. However, their complexity poses challenges, especially when different companies co-design for future making toward sustainable transition strategies implementation. Systemic Design (SD) offers potential solutions, employing system mapping tools like Gigamaps, that use visual synthesis to support effectively the participatory processes.

This article aims to present a formalized protocol for the use of Gigamaps as a co-design tool to trigger dialogues among industrial stakeholders, facilitating entrepreneurial ecosystem transition.

Through a case study from the master's degree SD course at Politecnico di Torino, the article will present a Gigamaps-driven co-design experience in an entrepreneurial ecosystem.

Finally, the study limitation and the need for systems-thinking and complex science-based methods to support the implementation of those envisioned scenarios are stated.

Keywords: Systemic Design, Gigamap, envisioning future, co-design

Introduction

In recent years, entrepreneurial ecosystems have gained significant attention to foster innovation, toward sustainable transition. These ecosystems comprise a complex network of actors, including entrepreneurs, investors, universities, government agencies and support organisations, working together to create an environment conducive to green entrepreneurship, considering governance and system components (Hakala et al. 2019).

As the field of entrepreneurship continues to evolve, there is a growing recognition of the importance of both adopting a systemic approach and involving stakeholders in the design and development of entrepreneurial ecosystems toward sustainable transition (Irwin 2018; Jonas et al. 2018). However, understanding and managing the dynamics of these ecosystems can be challenging due to their inherent complexity and interdependencies (Spigel 2017).

To address this challenge, the Systemic Design (SD), as a discipline, focuses on understanding and co-creating complex systems with stakeholders (Jones 2014). Furthermore, a tool like the Gigamaps within SD helps to visualise and analyse these systemic factors and supports the learning, representation, and communication of perspectives, actors, and relationships in complex system challenges (Jones and Bowes 2017). The Gigamaps enable stakeholders to identify opportunities, challenges, and potential pathways for transition (Kibler et al. 2022). However, it is crucial to recognise the limitations and barriers in using Gigamaps as co-design tools. Within SD, there is a lack of formalisation of a protocol for stakeholder engagement and the use of Gigamaps in co-design processes.

This article aims to systematise the practice of using Gigamap as a co-design tool by presenting the results of holistic diagnosis (Battistoni et al. 2019) and implementing and evaluating a protocol for collaborative use in an entrepreneurial ecosystem.

The article proceeds with a review of relevant literature on systemic approaches and stakeholder engagement, in entrepreneurial ecosystem transition, and Gigamaps as SD tools. It then outlines a detailed protocol for Gigamaps-driven co-design sessions for entrepreneurial ecosystems transition. The implementation of this proto-

col within a case study is presented, followed by a discussion and conclusion section in which the protocol and research limitations and future implications for the design discipline are reported.

Systemic approach in entrepreneurial ecosystem transition

Entrepreneurial ecosystems play a crucial role in driving sustainable transitions and fostering entrepreneurship. The existing literature on entrepreneurial ecosystems provides valuable insights into their importance, challenges, and the need to adopt a systemic approach toward this transition. Cohen (2005) examined the entrepreneurial ecosystem literature's applicability to sustainable valleys' development, emphasising the importance of a holistic perspective. Acs et al. (2017) discussed the challenges entrepreneurs face in legitimising their ventures within entrepreneurial ecosystems and the role of ecosystem dynamics in fostering entrepreneurship. O'Shea et al. (2019) emphasised the integration of the entrepreneurial process in empirical research on entrepreneurial ecosystems. Raposo et al. (2021) identified the impact of different actors in entrepreneurial ecosystems on sustainability and highlighted the need to approach entrepreneurship as a systemic phenomenon.

Stakeholder engagement is a crucial aspect of co-designing sustainable transitions within entrepreneurial ecosystems. It aims to actively involve stakeholders, such as entrepreneurs, investors, policymakers, researchers, and community members, in the design process to contribute their knowledge, perspectives and experiences (Gonzalez-Porras et al. 2021). The researcher or facilitator acts as a guide, facilitating discussions and ensuring that all stakeholders have a voice in the process (Micsinszki et al. 2022).

Stakeholder engagement protocols outline the steps and methods for involving stakeholders at different stages of the co-creation process, including co-exploration, co-design, co-experimentation, and co-implementation (DeLosRíos-White et al. 2020). They ensure that diverse perspectives are considered, fostering inclusivity and equity in decision-making (Goodman et al. 2017; Javanparast et al. 2022). Stakeholder engagement protocols also promote transparency, accountability, and trust among stakeholders, enhancing the legitimacy and acceptance of the co-design outcomes (Adams et al. 2015; Köhler et al. 2019).

By incorporating artefacts, actors within a system gain heightened awareness of new possibilities and connections, motivating them to participate in implementing transformative changes and enhancing entrepreneurial endeavours actively. Even if the role of artefacts has been little theorised by entrepreneurial research, the empowering role of design artefacts in foreseeing the reshaping of the narrative of a system has been emphasised both by:

- design research (Norman and Stappers 2015; Romani et al. 2022), as a valuable tool for Research through Design whereby designed artefacts are chief elements in the process of generating and communicating knowledge (Friedman 2008); and
- entrepreneurial ecosystems research (Berglund and Glaser 2022), supporting the theory of learning economy according to which entrepreneurs act on new opportunities that they can foresee and understand (Alvedalen and Boschma 2017).

System mapping: an essential systemic design tool

SD is an interdisciplinary approach that recognises the interconnectedness and interdependencies within a system, addressing complex problems holistically. It integrates knowledge from various fields, such as design thinking, mathematics, computer science, and social sciences, to analyse and tackle complex challenges (Stewart 2011). Within SD, mapping and visualising the complexity of a system have been used to facilitate dialogue and collaboration among stakeholders (Jones and Bowes 2017).

Gigamaps are SD artefacts that capture and represent the complexity and wickedness of problems, utilising visual and textual elements to visualise relationships within a system (Sevaldson 2011). They are employed in co-design sessions to explore and shape the future collaboratively, ensuring contextually relevant, inclusive, and sustainable solutions (Jones and Bowes 2017).

However, the effective use of Gigamaps as a co-design tool encounters limitations and barriers due to their complex structure and layered information density (Sevaldson 2011). One limitation is the need for stakeholders to possess the skills and knowledge to utilise Gigamaps effectively (Sanders and Stappers 2008). This suggests that stakeholders may require training and support to fully leverage the tool's potential.

Additionally, facilitating effective dialogue among diverse stakeholders can be challenging (Guntveit et al. 2020).

To overcome these limitations, a formalised facilitation protocol is essential to achieve a more comprehensive and contextually relevant understanding of the entrepreneurial ecosystem (DeLosRíos-White et al. 2020). Stakeholder engagement protocols provide a structured framework for facilitating meaningful participation and stakeholder collaboration (Goodman et al. 2017).

Over the past 20 years, an SD methodology consisting of five main phases has been developed and implemented at Politecnico di Torino, supporting socio-technical system co-design toward sustainable innovation. Building on Battistoni et al. (2019) and following the theorisation of the Double Diamond framework (Design Council 2005), the actual methodology steps are the follows:

1 Understanding complexity: this consists of system mapping of the current scenario, considering both the surrounding context and the company's flows of energy, matter, and information.
2 Tackling challenges: challenges are represented as much by critical issues as by the potentials (i.e. the aspects of the system not currently valued). In-depth research then allows for the following to identify possible solutions for each challenge, both at current best practices and the scientific literature level.
3 Designing the new system: scenario analysis that leads to the design of new relationships between processes and actors, which optimises information, energy, and material flows toward change.
4 Assessing the system: evaluation and impact assessment of the systemic project according to a timeframe and a scale for the possible consequences, benefits and markers of the change.
5 Implementation: activating the actions that, step by step, designed all the relationships towards the new system stability.

The tangible result of each first four phases of the SD methodology is a Gigamap that respectively consists of the visualisation of: 1) the system under consideration, i.e., the local context (1a) and the company's value chain (1b); 2) its limitations and relationship opportunities toward change; 3) how it could evolve into a new system; and 4) the outcomes and impacts.

However, there is a lack of formalisation of effectively utilising the Gigamap as a co-design tool within the formalised SD methodology. Insights from the references suggest some general considerations:

- Introduce stakeholders to the Gigamap concept, highlighting its value as a visual tool for comprehending complex systems (Kjørstad et al. 2021).
- Clearly outline the co-design session's scope and objectives to ensure stakeholder alignment (Kjørstad et al. 2021).
- Engage stakeholders in collaboratively mapping the system using the Gigamap, visualising its components and relationships (Davidová 2020).
- Analyse the mapped system to identify intervention opportunities and challenges, involving stakeholders in insightful discussions (Davidová 2020).
- Facilitate a co-creation process where stakeholders generate and design interventions based on Gigamap insights (Davidová 2020).
- Continuously refine the Gigamap and interventions through iteration, considering diverse perspectives for contextually relevant and inclusive solutions (Nousala et al. 2018).

It is important to note that while these steps provide a general framework, no specific protocol has been formalised for using Gigamaps to transition the entrepreneurial ecosystem or into other socio-technical systems.

Methodology

The work presented below is Research into Design (Frayling 1993), producing new knowledge about the tools of designing, building on the research activities conducted over the last years by the authors, colleagues, and students at the Politecnico di Torino.

Although this research is based on experience in various industrial innovation processes, just one case is reported here to exemplify and illustrate the lessons learned from implementing an industrial stakeholder engagement protocol in Gigamap-driven co-design sessions.

Data were collected from (1) visualisation results, (2) notes collected on co-design sessions, (3) student databook, and (4) feed-

back from industry stakeholders. The notes, coded during the co-design session, were generated to understand the use of the protocol, especially (1) in facilitating stakeholder dialogue and (2) in facilitating the effective implementation of strategies designed for system transition.

Gigamaps in co-design sessions: a stakeholder engagement protocol

Within SD methodology, the collaborative use of Gigamaps unfolds as follows (Figure 1).

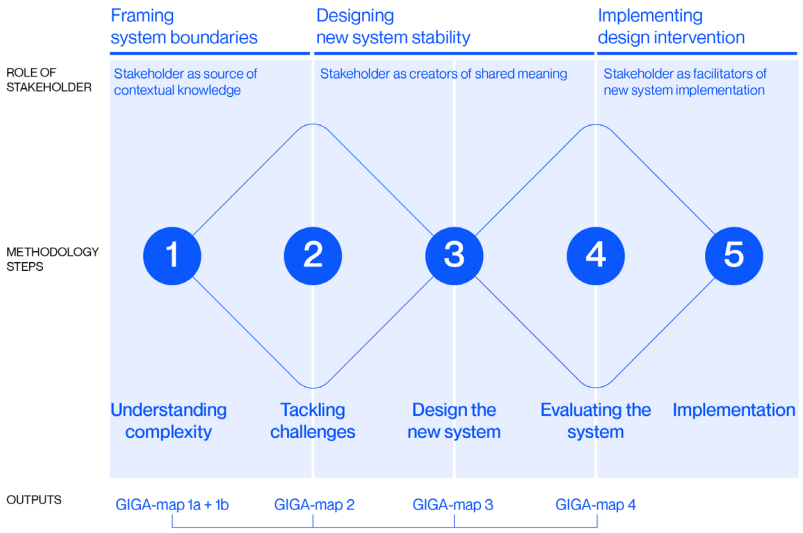


Figure 1 Systemic Design Methodology and Role of Stakeholders at Politecnico di Torino.

The primary goal of the following engagement protocol is to foster dialogue within Gigamap-driven co-design sessions among systemic designers, local entrepreneurs, and other stakeholders, ensuring that their perspectives, knowledge, and insights are integrated into the SD methodology implementation toward system transition.

Based on guidance from existing literature on stakeholder engagement from several research fields, the protocol is designed to define the purpose and objectives of stakeholder engagement clearly; provide the necessary resources and support to stakeholders (Boaz et al. 2018); promote a collaborative and inclusive environ-

ment (Dawkins 2015); incorporate stakeholder input into decision-making (Ray and Miller 2017); evaluate and report on stakeholder engagement (Petkovic et al. 2020).

Step 1: Understanding Complexity

1 Stakeholders' role: share contextual knowledge.
2 Activities:
   a Conduct desk research to gather information on the local entrepreneurial ecosystem, regional context, and the local community.
   b Conduct a field visit to the company under study and the local region.
   c Arrange interviews with company representatives, to gather insights on the local context and company value chain.
   d Create Gigamaps 1a and 1b.

Step 2: Tackling Challenges

1 Stakeholders' role: collaborate in the identification of critical issues and potentials.
2 Activities:
   a Organize a one-hour online or in-person session with the company representatives to:
      i Deepen and discuss Gigamaps 1a and 1b.
      ii Identify and discuss the challenges of the company, the local entrepreneurial ecosystem, the regional context, and the local community.
   b Conduct desk research to explore opportunities for systems transition, the company's role and the design intervention's boundaries.
   c Create Gigamap 2.
   d Organize a 30-minute online or in-person session with company representatives to:
      i Deepen and discuss the causal relationships highlighted in Gigamap 2 between the identified challenges from Gigamaps 1a, 1b and the opportunities.
      ii Discuss the boundaries for design intervention and the feasibility of the opportunities.

Step 3: Designing the New System

1 Stakeholders' role: creator of shared meaning.
2 Activities:
   a Conduct desk research and scenario analysis to envision how the selected transition opportunities can be implemented through short-, medium-, and long-term intervention strategies.
   b Create Gigamap 3.
   c Organize a one-hour online or in-person session with company representatives to:
      i Deepen and discuss Gigamap 3, facilitating sensemaking activity with stakeholders where they actively analyse potential changes in the relevant system.
      ii Encourage stakeholders to contribute to designing new strategies designing new relationships between the value chain, the regional context, and the local community.

Step 4: Assessing the System

1 Stakeholder role: partner in impact assessment.
2 Activities:
   a Conduct desk research to predict the potential impact of defined strategies.
   b Create Gigamap 4.
   c Organize 30-minute online or in-person session with company representatives to:
      i Envision the potential impacts of proposed intervention strategies on various aspects of the system, including environmental and socio-cultural sustainability, product quality, and production efficiency.
      ii Define a timeframe and the scale for implementing and assessing the consequences of the intervention strategies.
      iii Compare Gigamaps 1a and 1b with 4 to acknowledge stakeholders' role in system transition.
      iv Solicit feedback on the effectiveness and impact of stakeholder engagement activities in the implementation and monitoring.

Step 5: Implementation

1 Stakeholder Role: actively participate in system transition.

2 Activities:
   a Maintain an open dialogue with stakeholders during the implementation phase to address challenges and refine the system.

Case study: protocol implementation

The case concerns the research carried out in 2021 by a team of six master's degree Systemic Design "Aurelio Peccei" course students at Politecnico di Torino in partnership with Caseificio Pier Luigi Rosso, a renowned dairy industry located in Pollone (Biella, Piedmont, Italy). Caseificio Rosso is a family-owned business with over 120 years of experience, producing and trading typical Biella province cheeses. Under Pier Luigi Rosso's and his sons' leadership, the company has thrived, maintaining its strong ties to tradition while embracing innovation. The company has expanded its activities by actively participating in local associations and consortiums and international trade fairs, contributing to the region's economic development.

Implementation of the protocol involved engaging the current owners of the dairy, Enrico and Riccardo Rosso, as stakeholders. Adapted to the course schedule, the first four steps of SD methodology and protocol implementation took 5 months.

After being introduced to the SD methodology, students conduct a field visit to the diary in Pollone and the surrounding area. Subsequent sessions were scheduled online due to both the physical distance between the university and company locations and the COVID-19 pandemic restrictions, which did not allow students to travel easily. Gigamaps were developed by students using Miro software as a free collaborative online visual tool, and Adobe Illustrator.

Finally, company representatives were invited to participate in the project's final presentation during the final exam session held in Turin. There, they were asked to report on the engagement process and the results of the SD through a short interview.

Results

While Gigamap-driven co-design sessions often prioritise flexibility and creativity, introducing a protocol helped streamline and structure the process, leading to more efficient and effective stakeholder engagement. A protocol proved a promising enabling tool

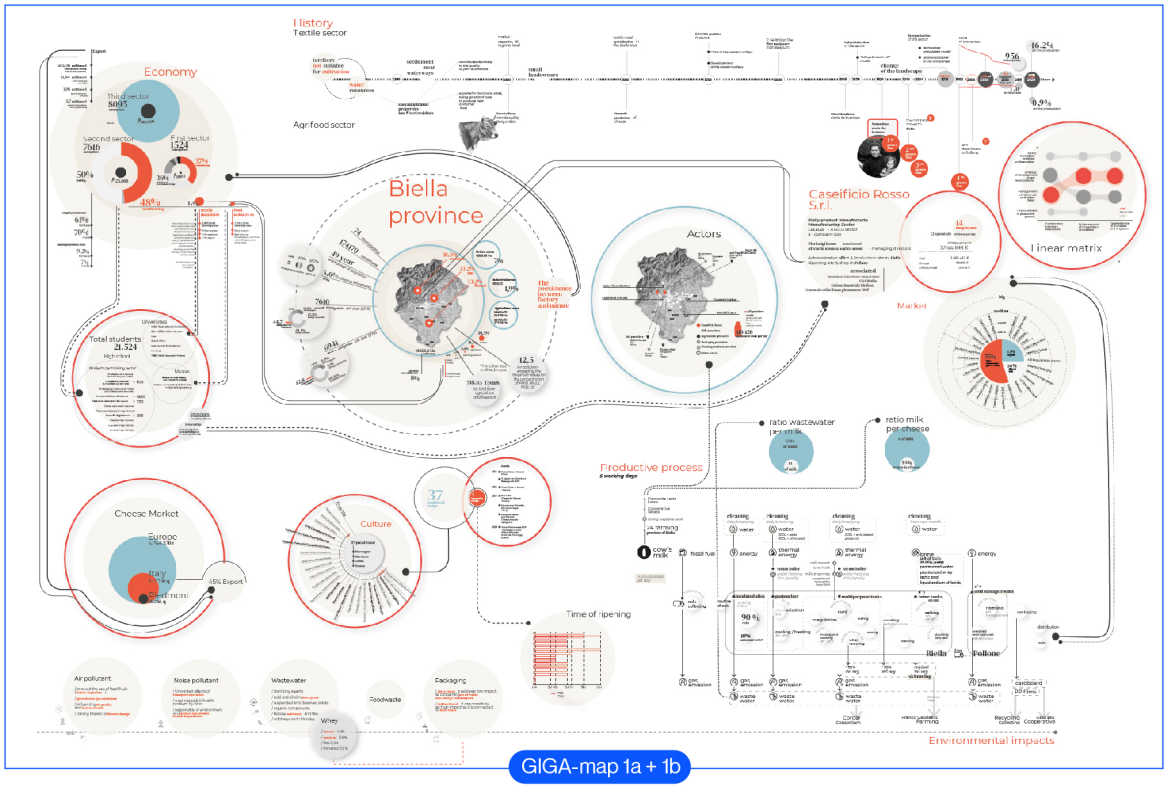
for implementing the designed strategies. The implementation of one of the designed interventions took place beyond the duration of the course, following the involvement of other local stakeholders.

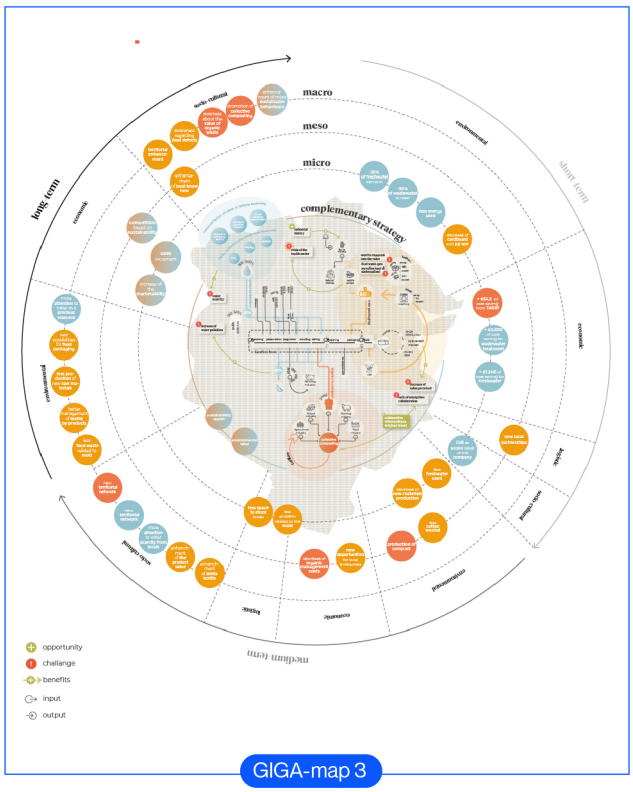
This case study identifies three main lessons from implementing a protocol for Gigamap-driven co-design sessions.

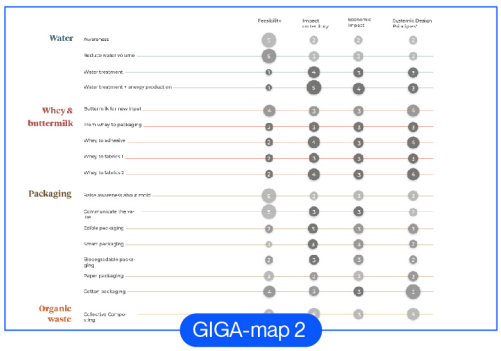
1 Clearer roles and responsibilities. According to this protocol, the role of stakeholders iteratively evolves from being a source of contextual knowledge (in steps 1 and 2) to becoming creators of shared meaning (in a sensemaking activity, step 3), until they become facilitators of the implementation of the new system (step 5). This can reduce confusion and conflicts, allowing participants to better understand their contributions and how they fit into the more extensive envisioning process.
2 Improved focus, commitment, and time efficiency. The use of a protocol helps participants better understand the purpose and goals of different co-design sessions. It provides a framework to align discussion, resulting in a more efficient management of the time and resources allocated to co-design sessions by facilitators and stakeholders, for whom time is often critical.
3 Student awareness of their role. It is well known that Gigamaps are not artefacts that stakeholders can access independently (Sevaldson 2011); rather, they require the guidance of a systemic designer to guide the co-design process and explore their contents collaboratively. A systematic and progressive student-led stakeholder engagement protocol has led to the establishment of a trust-based relationship between industry stakeholders and students. This has increased student awareness of the importance of their role as designers.

The most significant outcome of these is the heightened commitment of stakeholders to implementing system changes and solutions resulting from the co-design process.

Gigamaps (Figure 2, next page) provided a detailed overview of the relationships and dynamics in which the company operates, fostering collaboration and shared responsibility among stakeholders. The team identified key limitations to system change, including a lack of awareness about the dairy process's impacts and







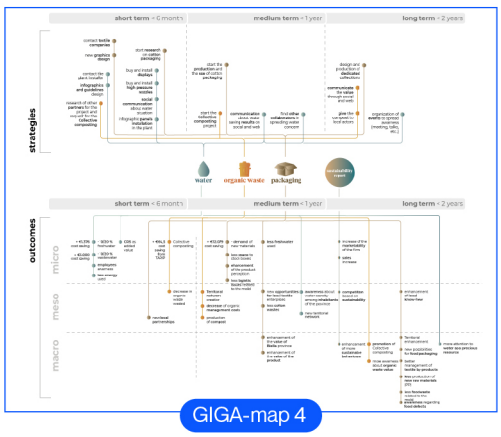


Figure 2 Gigamaps. Credits A. Marchesi, F. D. Moldovan, M. Puglielli, W. Tonelli, M. Troppino, X. Wu.

insufficient communication about product and territory value. Additionally, the high freshwater use in a water-scarce and polluted area and the inefficient use of organic residues posed challenges.

A threefold strategy was devised to address these issues. The first strategy focused on reducing water consumption through high-pressure nozzles and valves, raising employee awareness through data visualization, and enhancing communication through articles and social media. These efforts aimed to save approximately 20% of annual water usage, benefiting the company both economically and in terms of environmental impact.

The second strategy involved establishing a collective composting facility with local stakeholders to manage organic residues.

The third strategy centred on designing a coordinated image for Caseificio Rosso and Pezzata Rossa d'Oropa (Figure 3) to promote the company's commitment to a sustainable Biella dairy sector transition and using textile scraps from local production for breath-



Figure 3 System identity. Credits: A. Marchesi, F. D. Moldovan, M. Puglielli, W. Tonelli, M. Troppino, X. Wu.

able cheese packaging, preserving the quality of cheese, and creating a bridge between Biella's two heritage industries, textiles and dairy, toward industrial symbiosis promoting the valorisation of byproducts and reduction of environmental impact (Neves et al. 2020). Collaborative experiments were conducted with the University of Turin's Department of Agricultural, Forestry, and Food Sciences, Caseificio Rosso and Lanificio Fratelli Piacenza (local woollen mill) which supplied textile scraps.

Discussions and Conclusions

This article contributes to conceptualising (1) the use of Gigamaps as a co-design tool and (2) the evolving role of stakeholders in co-designing entrepreneurial ecosystem transition interventions.

The practice of using Gigamaps as a co-design tool has been formalised, facilitating the replication of successful approaches and results.

Given the empirical evidence reported, it provides methodological input for practitioners, management, and design researchers to inform and co-create collaborative intervention strategies for system transition with industrial stakeholders in an entrepreneurial ecosystem and lay the groundwork for strategy implementation. However, the proposed protocol may have some limitations, as specific protocols may vary depending on the context and objectives of the co-design session.

The role of stakeholders is formally defined in the participatory SD activity based on Gigamaps. Therefore, the regional entrepreneurs' capacities to assess and reveal the challenges and opportunities linked to their ecosystem assets toward sustainable transition and development were developed and strengthened. Consequently, following the theory of learning economy, their engagement toward system implementation through one or more strategies is increased. Finally, by applying this formalised engagement protocol, design students better harnessed the power of Gigamaps to promote meaningful and sustainable co-design processes.

Research is still needed to facilitate the implementation of the envisioned system. Although Gigamaps are valuable tools to create shared narratives for collaborative future-making, implementation rarely occurs. Therefore, it can be argued that more reflection on research is needed from two perspectives:

- lack of stakeholder literacy on Gigamaps;
- lack of systemic implementation management methods based on SD.

To overcome these limitations, it can be argued that it is necessary to enable stakeholders to use the Gigamaps after co-design sessions. In addition, there seems to be an urgent need to develop systems-thinking and complex science-based methods that support the implementation and management of systemic strategies, which could help overcome the implementation bottleneck.

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More information about the scope of research in Systemic Design at Politecnico di Torino and the case studies presented can be found on the YouTube channel: https://www.youtube.com/c/SysSystemicDesignLab

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