MODULE 1
Circular economy in rural territories: principles and working methodologies

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INTELLECTUAL OUTPUT 5

MULTITRACES

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1. CIRCULAR ECONOMY PRINCIPLES

1.1 Systems thinking, Sustainable development and Systemic Design: an introduction.

Social and ecological transitions require future generations to be able to grip the complexity of the world while living and evolving in an efficient way within it. The role of designers is to imagine and create future artificial systems that should in turn serve the evolution and prosperity of humanity.

Figure 1 World Design Organisation - Sustainable development goals

Consequently, the role of educational institutions should be to develop students' ability to understand the complexity of these interactions between natural and artificial systems in their holistic dimension.

Design means project that comes from the Medieval Latin *projectum*, projectus, past participle of *proìcere*: to throw forward. It contains the idea of forecasting and forward projection.

Since the Sixties, Design has been able to grasp the topics of the environmental issue, strengthened by a sensitivity rooted in the Arts and Crafts of William Morris. At the dawn of the international debate on the limits of development, Victor Papanek (1972) called on designers to make a social and moral commitment to guide the transformations of society, a position also supported by Tomás Maldonado who invited designers to come out of the "waiting room" to respond to a "scandal of society" that he saw as being strongly connected with the environment: "There are not, as was once believed, two accounts: on the one hand, accounts with society; on the other, accounts with nature. It is now clear that if the accounts do not add up with society, they do not add up with nature either. But the opposite is equally true" (Maldonado, 1971). In the nineties the design discourse has therefore a solid awareness of its own role, in which a "new ecology of the artificial environment" that Manzini (1990) proposes to read contemporary design and production as a complex phenomenon, in which the systemic relationships between subjects are recognised and have weight without an idea of subjectivity being able to dominate the whole system. A systemic vision therefore takes shape that requires the designer to make a strategic effort to go beyond the single product and design the complex of relationships between artefacts and actors, towards overcoming the production-wellbeing binomial.

However, the European Commission has recognized this role only few years ago:

2009 - Design as a Driver of User-Centred Innovation

2011 - Design Board
2012 - Design for Growth and Prosperity

2015 - Closing the loop - An EU action plan for the Circular Economy
2016 - RETRACE - A Systemic Approach for Regions Transitioning towards a Circular Economy

2020 - Circular Economy Strategy – New Circular Economy Action Plan (European Green Deal)

Today A New European Bauhaus (NEB)

2021 NEB (design phase)

In this new scenario, it is crucial to stress the mediating nature of Design, as a discipline that intersects and unites fine arts and humanities, but also technology and economics.

The contribution of innovation focuses on four main knowledge areas:

1. Meaning
2. Value
3. Form
4. Function

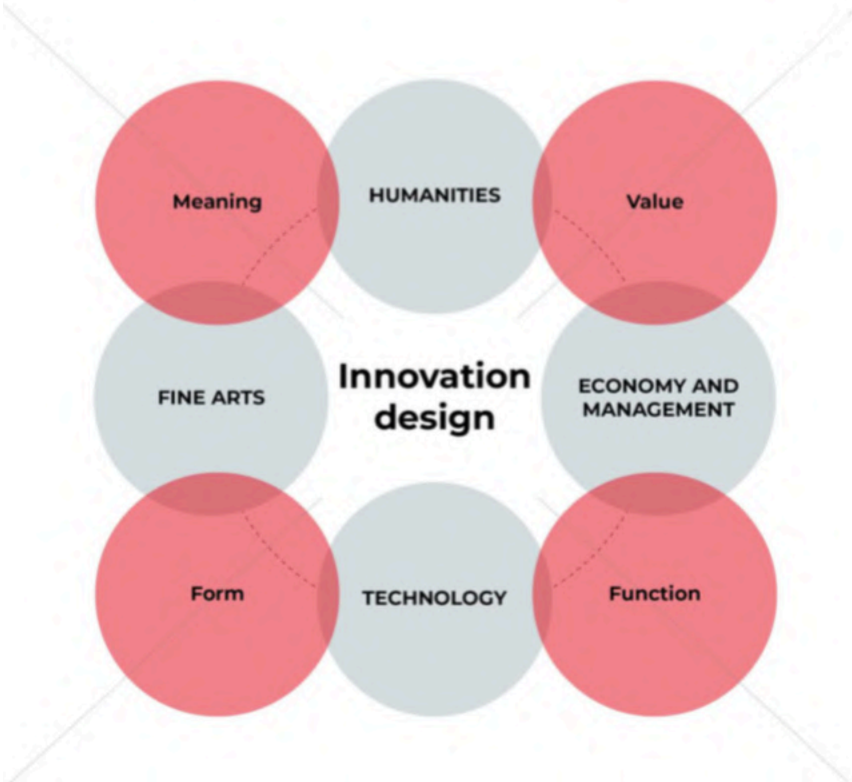


Figure 2 Innovation Design, Flaviano Celaschi, 2008

Although these knowledge areas apply to the design of products, services, strategies, systems, experiences, etc., it is important to focus on the design of systems.

Why?

During last year's pandemic, the Italian economist Giovannini (2020) pointed out a fundamental aspect of the health crisis, which also applies to the global crisis of our economic and production model: *"The crisis we are experiencing is systemic in nature. Can we therefore respond to a systemic crisis by adopting sectoral policies?"*.

This call for the urgency of a systemic approach has deeper and more distant roots. In the Eighties, Aurelio Peccei, founder of the Club of Rome, stated: *"It is necessary a change in the system of values and in the "new education" which must be "anticipatory" and at the same time "participatory": it must prepare generations for a better future through the involvement of citizens in the elaboration and evaluation of policy programs for society"*.

In 1972, the study on the limits of development commissioned by Peccei to the Massachusetts Institute of Technology (team: Jørgen Randers, Jay W. Forrester, Donella H. Meadows, Dennis L. Meadows and William W. Behrens III) was based on the application - for the first time - of a systemic vision to our growth model, by analysing the interactions of five global variables (population growth, resource consumption, pollution increases, agricultural and industrial production).

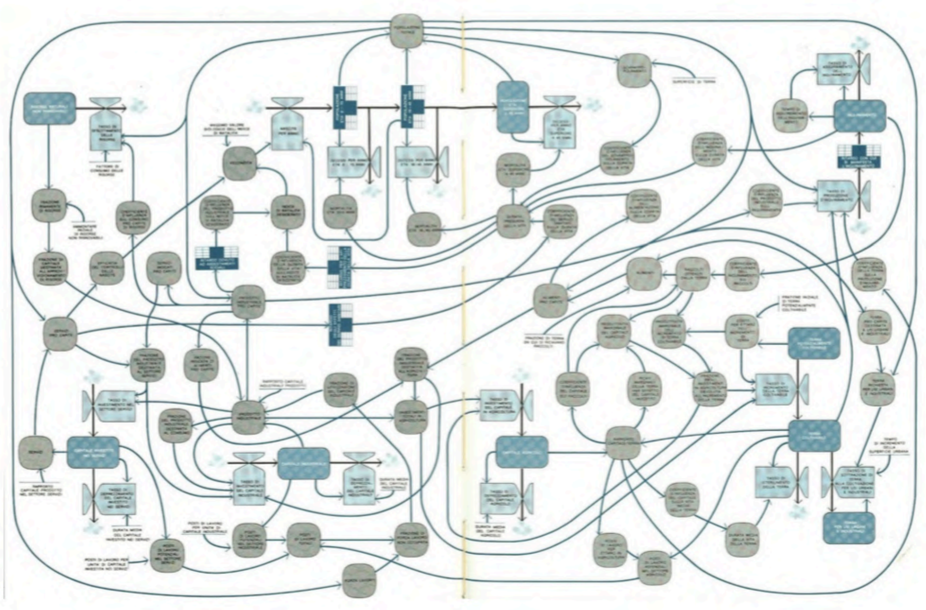


Figure 3 Stock and Flow Chart of World System from The Limits to Growth, 1972

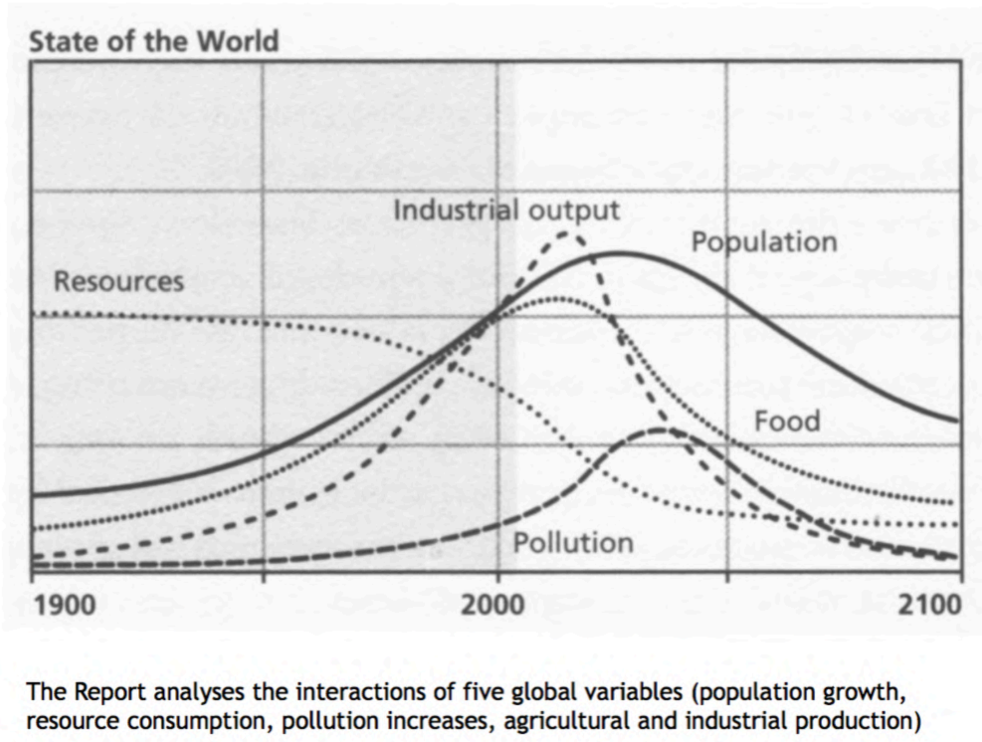


Figure 4, Schema from "The Limits to Growth", 1972

The same years saw the emergence of complex systems theories, which reinforced the need for systems thinking. As Von Bertalanffy (1968) states:

"Systems Everywhere. If someone were to analyze current notions and fashionable catchwords, he would find "systems" high on the list. The concept has pervaded all fields of science and penetrated into popular thinking, jargon and mass media. Systems thinking plays a dominant role in a wide range of fields from industrial enterprise and armaments to esoterie topics of pure science".

Figure 5 The key actors of the Systems origins

Today, this thought is even more recurrent and crucial as we live in the fourth age of Modern Humanity, also defined as the Shift Age:

- Tools defined the **Agricultural Age**
- Machines defined the **Industrial Age**
- Technology defined the **Information Age**
- Consciousness will define the **Shift Age**

In the Shift Age, design is becoming increasingly holistic, and the role of the discipline of Systemic Design is particularly relevant since *"Systemic design considers the design from a systemic viewpoint, i.e. as dealing with a complex set of interacting systems forming wholes. It aims at imitating the Nature in anthropic activities, and claims for the adoption of a holistic approach in design in order to raise the future generations' awareness of their responsibility regarding sustainability"* (Trevisan, Peruccio, & Barbero, 2018).

It is urgent to reform the current educational system still based on quantitative knowledge and on linear teaching and learning models, defined on the assumptions of the first industrial revolution.

This is a paradigmatic shift: from a linear teaching model to a systemic learning one.

Breaking the boundaries of traditional competencies and disciplines is not an easy task, but it is necessary to address impellent global issues with the exploration of new learning directions. The fluidification of disciplinary boundaries is a necessity of keeping up with the times and to educate designers to their role of mediators and integrators of knowledge (Celaschi, 2008).

1.2 Circular economy in rural areas

The crisis of rural areas is a complex phenomenon that has roots in the middle of the nineteenth century, with the sprouting of industrialization.

Deruralization has transformed the countryside – shaped by centuries of human presence – because the traditional forms of production faded away.

Figure 6 The last resident in abandoned village in south of Italy

Over time, the desertification of vulnerable territories has increased the loss of agricultural biodiversity and local wealth.

The recent COVID-19 pandemic has exposed the fragility and limitations of the production systems and invited us to reflect on our development models. It is necessary to open up to new perspectives, step out of a vicious circle, and respond to the crisis: rethinking an appropriate use of the soil is the logical consequence of an inevitable revolution.

Already in the second half of the eighteenth century, the doctrine of physiocracy recognized the centrality of nature and the role of agriculture. The economist Quesnay, its initiator, argued that agriculture is the basis of all other productive activities and that the weakening of the agricultural sector would lead to an impoverishment of the global population.

Rural areas have great potential, starting with quantitative data: according to Eurostat (2016), more than 70% of the European population lives in urban agglomerations, mainly in medium-sized cities with populations between 250,000 and 5 million inhabitants. Economic activities in Europe are mainly concentrated in urban regions, which have generated 53% of all gross domestic product in recent years. The European territory is incredibly vast and diverse, and not largely urbanised: around 51% of the EU’s land area is within rural areas.

Rural areas are thinly-populated areas outside the main urban centres, which consist of both agricultural fields, but also municipalities with a limited number of inhabitants, small towns, and villages. Rural areas are vital for the sustenance of cities and urban dwellers.

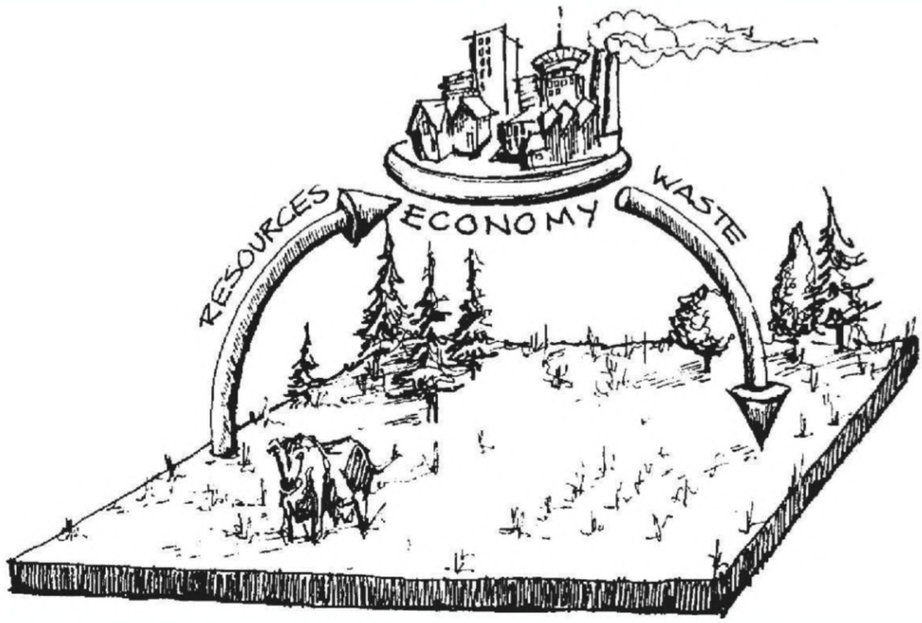


Figure 7 Industrial metabolism of a city

It is estimated that around 10 million people are directly employed in rural agricultural activities in Europe.

The productive excellence of rural areas is not only linked to the agri-food sector but also to manufacturing. Compared to a few decades ago, the number of European industries has fallen in favour of an economy predominantly based on services.

As Menzardi, Peruccio, and Vrenna (2018) state:

"In some areas, small local craft activities are still thriving economically, due to the quality products that are created with centuries-old techniques by master craftsmen. Nonetheless, this sector is affected by globalisation that has delocalized many production chains, but also by profound changes in the usage and consumption habits of modern societies".

In a transitional period like the one we are experiencing, the Old Continent must look to the future by learning from its historical roots.

In this scenario, the common understanding of the need for a change towards a Circular Economy can be fundamental to give new development to rural areas. Circular economic systems are designed to self-regenerate and reuse the flows of matter and energy. These systems consider waste as important resources, to be re-valorised and integrated again in the biosphere.

The circular economy is a development paradigm supported by the European Union that reflects the optimist spirit of our times concerning the success in large scale implementations (Bonciu, 2014).

According to Salvia, Andreopoulou, and Quaranta (2018), *"the holistic approach to the circular economy could prove particularly successful in rural areas because it [...] could aid rural territories in designing sustainable and resilient development strategies"* (p.5).

The circular approach in rural areas could provide new development opportunities, for instance through the innovative use of biomass, optimise the use of limited natural resources, preserve the environment in its biodiversity, and make it liveable even for future generations. Circular projects would have a great economic and social impact.

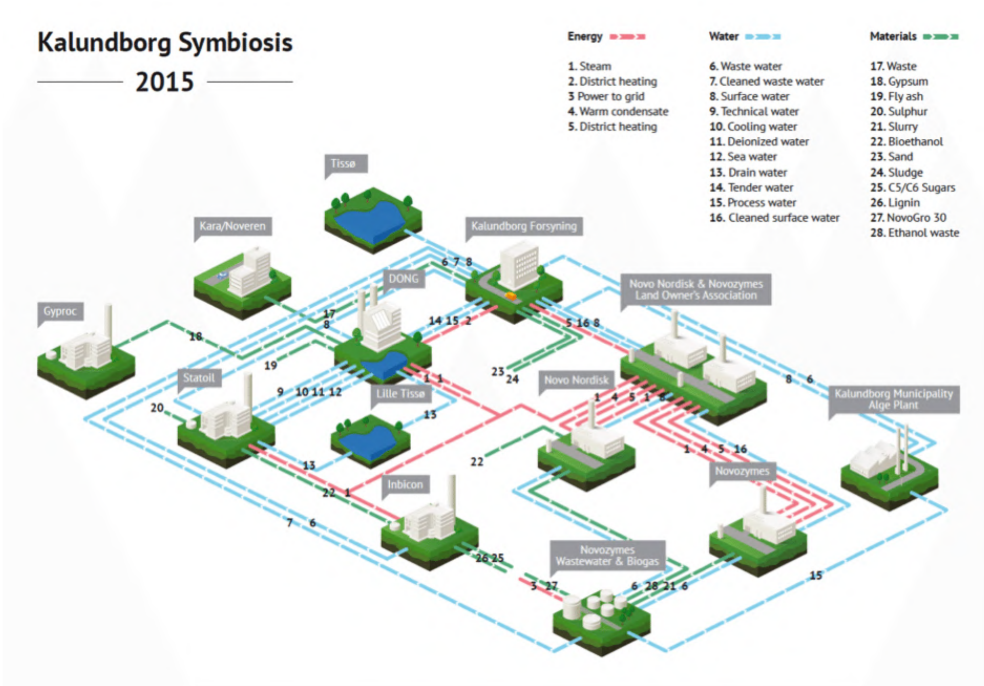


Figure 8 The Kalundborg Symbiosis workflows, 2015

To that end, it is urgent to train professionals – for instance, designers – on how to propose concrete solutions to real-world problems. A strong ethical imprint and a solid cultural base are needed for shifting the focus *"from the environment as externality to the biosphere as precondition for social justice, economic development, and sustainability"* (Folke, Biggs, Norström, Reyers, & Rockström, 2016, p. 1).

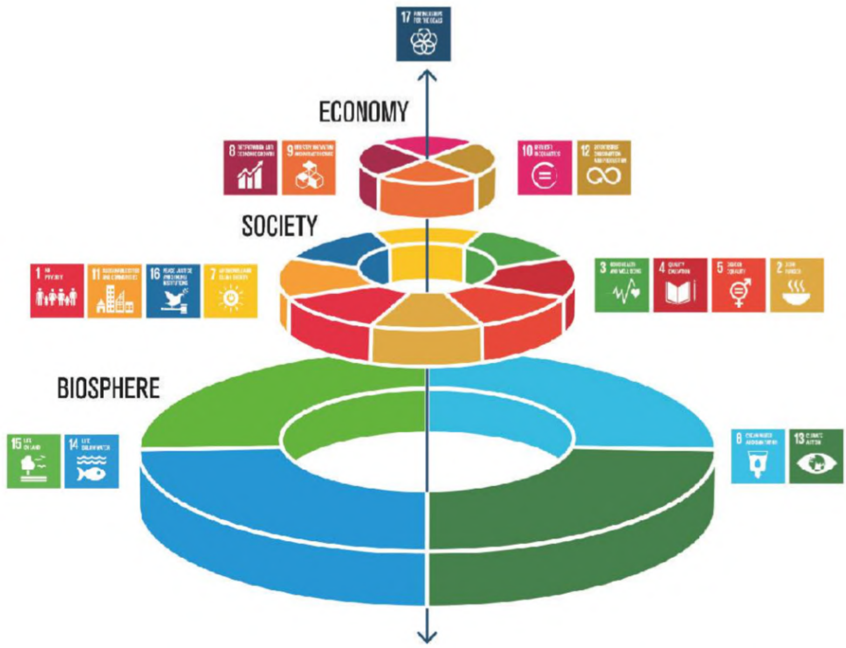


Figure 9 The interconnection between SDGs

This is even more essential when it comes to rural areas. Indeed, as Bistagnino (2009) states, *"When we talk about productive activities, we do not mean only the industrial ones but, on the same level and with equal dignity, also agricultural ones. [...] The harmonious co-presence of agriculture, industry and the community with the natural system, within the same territorial context, is the fundamental key of a production model of sustainable development"*. (p. 20).

2. A SYSTEMIC APPROACH TO CIRCULAR ECONOMY

Today, we are used to think of and design products and services that we assume as part of delimited, determined, stable, and objectifiable systems.

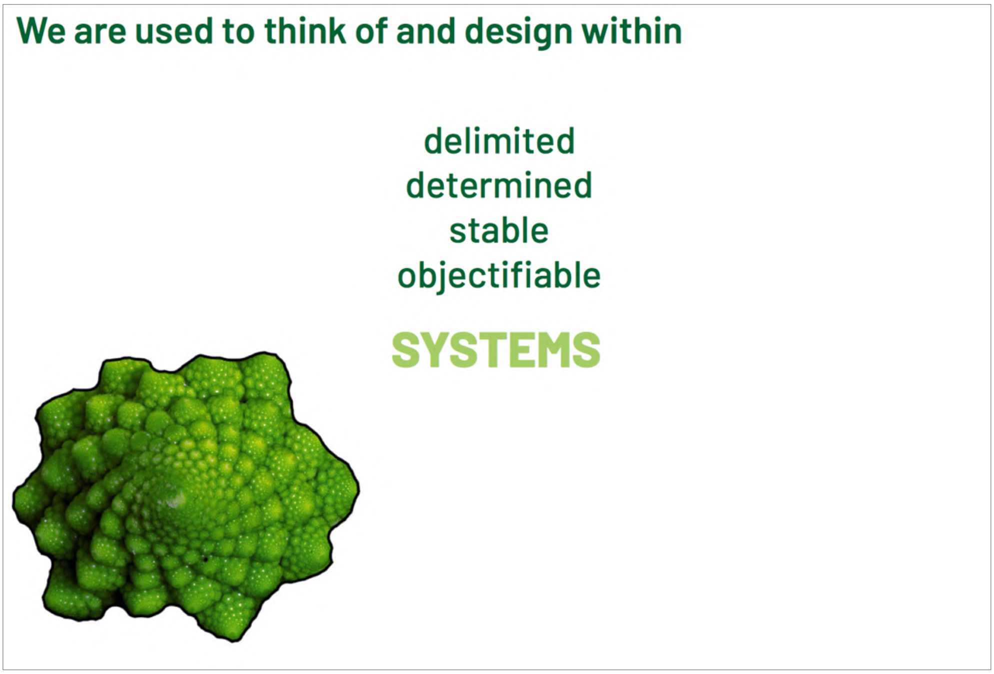


Figure 10 Delimited Systems. Credits: Amina Pereno

Actually, we live and act within open, wicked, changing, and multi-faceted systems: the new paradigm implied by the economic model of the Circular Economy requires precisely this view of reality as an interconnected system of networks.

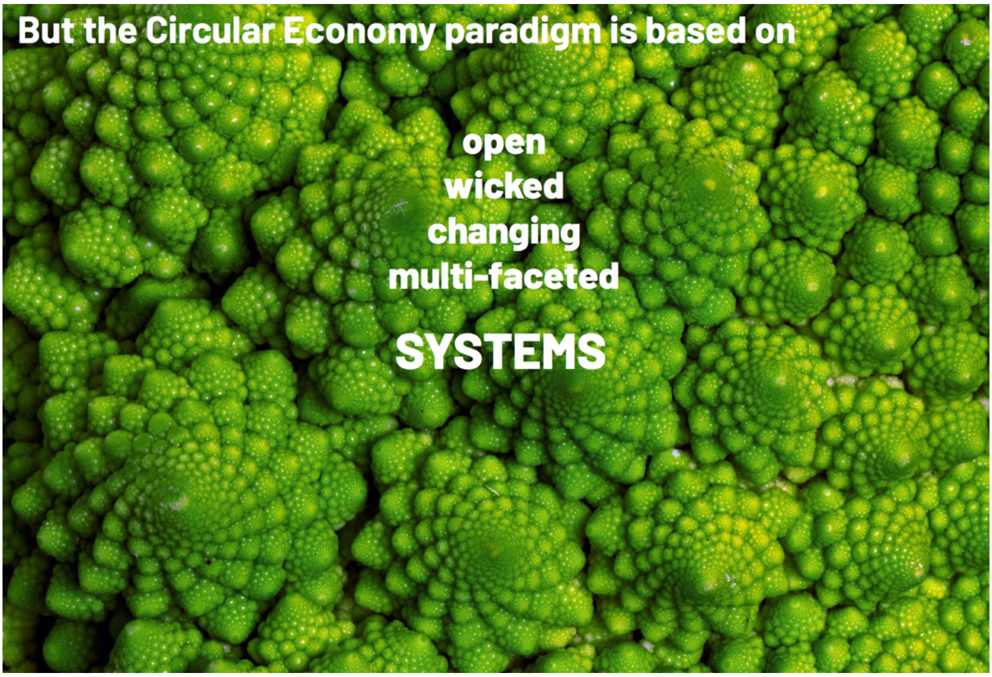


Figure 11 Open Systems and Circular Economy. Credits: Amina Pereno

This transition between economic models is neither simple nor obvious nor linear, using the words of Rittel and Webber (1973), we can state that the transition towards Circular Economy is a wicked problem, i.e. *"open and complex problems that cannot be defined in a unique, objective, and unambiguous way; therefore, they cannot be analysed through standard methods of problem-solving"*.

While acknowledging its complexity, the urgency of this transition is undeniable, and it is evident from some important signals that our economic and production systems are giving us, such as:

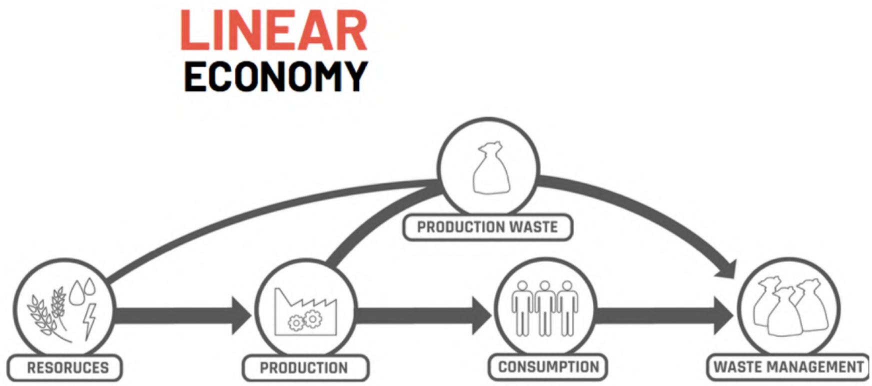


Figure 12 Linear Economy

- Resource scarcity. The limit of resources compared to unlimited demand. Demand for water, food, energy, land and minerals is increasing dramatically, making natural resources increasingly scarce and more expensive, to the point of being unaffordable.
- Rising raw material prices. Resource scarcity leads to increasing raw material prices, which undermine linear business models focused on affordability and cost externalisation.
- Weakness of the global supply chain. Wars, political tensions, and natural disasters demonstrate the instability of a global supply chain based on mere profit and subject to delocalised production and socio-environmental dumping.
- New protectionism of raw materials to guarantee strategic reserves. Race for resources reinforces inter- and intra-country social inequalities.
- Waste management costs. Waste disposal and management is an increasingly important issue also from an economic point of view.

The Circular Economy addresses these problems and comes up with a radical paradigm shift that can solve the inevitable crisis of our linear system.

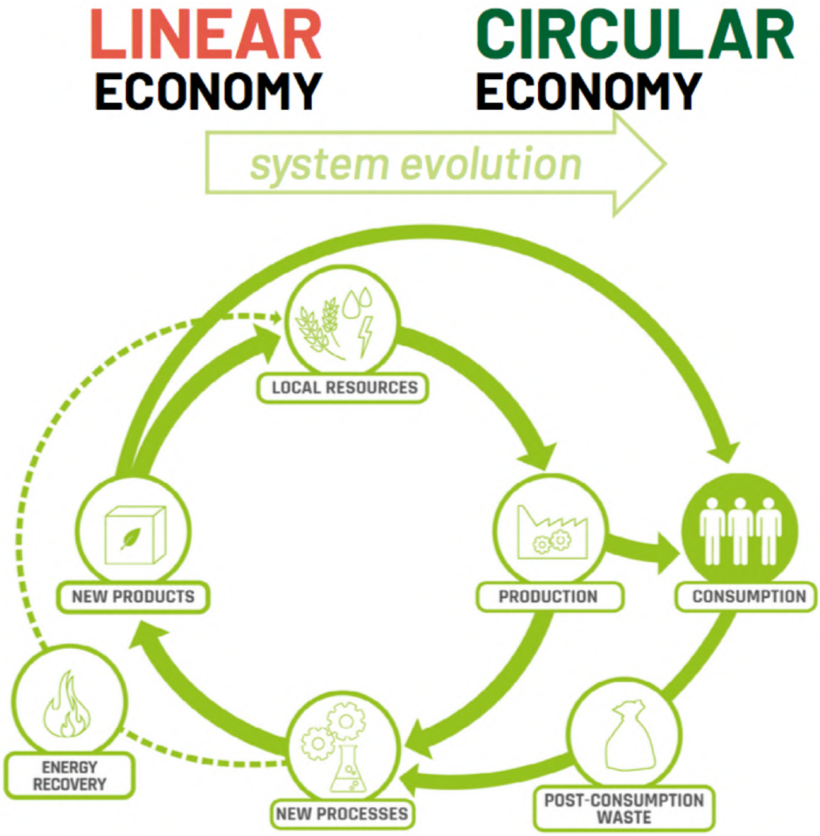


Figure 13 From Linear to Circular Economy

One of the first definition of Circular Economy is given by Ellen Macarthur Foundation:

"Looking beyond the current "take, make and dispose" extractive industrial mod- el, the circular economy is restorative and regenerative by design. Relying on system-wide innovation, it aims to re-define products and services to design waste out, while minimising negative impacts. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural and social capital."

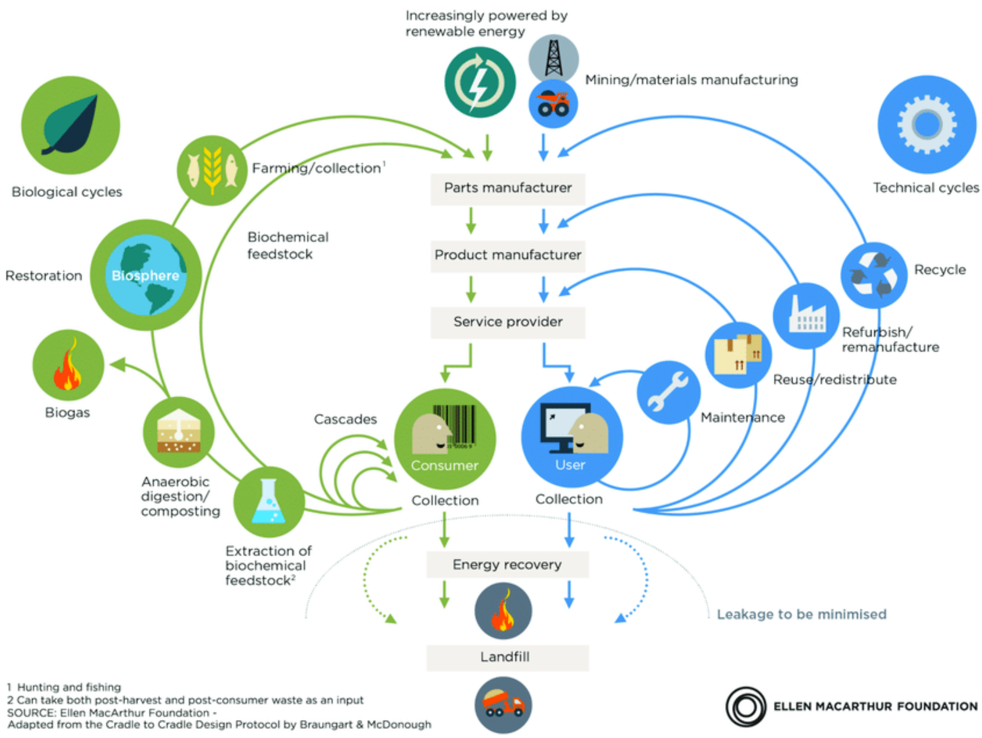


Figure 14 Ellen MacArthur Foundation Circular Economy schema

Some important points emerge from this definition:

- In a circular economy we design the whole life cycle, moving beyond the concepts of recovery and reuse, which are naturally embedded in every production process.
- The change in the production system requires product and service innovation.
- The waste concept no longer exists: every process generates by-products that are resources for other processes.
- The circular economy promotes environmentally, socially and economically sustainable local production and development.

But what are the drivers that can guide the transition to this economic model? The three principles of the Circular Economy paradigm elaborated by Bompan (2018) are certainly valid:

1. **To rediscover discarded matter as sources of material, limiting processing as much as possible**. Secondary sources of raw materials are many and not yet fully explored: waste collection, recycling systems, production waste, unsold items.
2. **To end the unused value of the product, even before being discarded.** We often observe unnecessary 'depreciation' of goods with unused value: warehouses full of products waiting to be disposed; boxes in our storerooms that are full of clothes with no affective value; objects bought and used once a year.
3. **To stop the premature death of materials**. Although recycling and reuse are key strategies to recover material, we often throw away perfectly good materials. It doesn't matter if the material will be recycled: often only one part of an object breaks or spoils, while the other components remain perfectly functional, yet we throw it all away. Deep-rooted obsolescence practices need to be reviewed and changed to stop this waste of material.

But in practice, how can we professionals foster this transition?

The words of Fritjof Capra (2012) are enlightening:

"Everything that lives is complex, and to understand this complexity we must acquire the tools to find a synthesis that unifies the four dimensions: biological, cognitive, social and ecological. It is essential to move towards a vision of life as a network of relationships, manifested on these four levels".

The first step is to build a new vision, to provide the tools to really understand the complexity of our industrial and economic systems. In a word: connect the dots!

The discipline of Systemic Design originates from the theories of complex systems, to which it combines the ability to frame problems and find creative solutions that characterise all design disciplines.

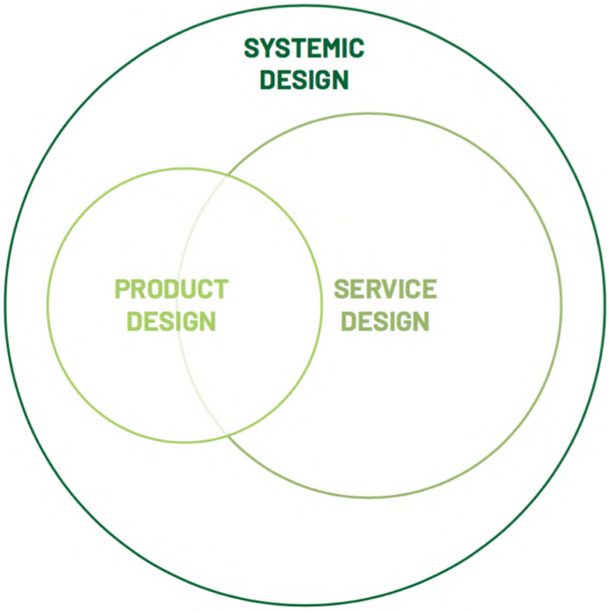


Figure 15 Systemic Design

According to Giraldo Nohra, Pereno and Barbero (2020),

"Systemic design is a design discipline that provides practical tools to approach complex scenarios with a holistic perspective, while supporting active cooperation among involved stakeholders".

Theoretically, the assumptions of Systemic Design are equivalent, with regard to the production approach, to those of the Circular Economy in economic terms.

Systemic Design opposes today's linear model of production based on:

- Product = Quantity
- Economic Value
- Strong competition
- Low interest in waste

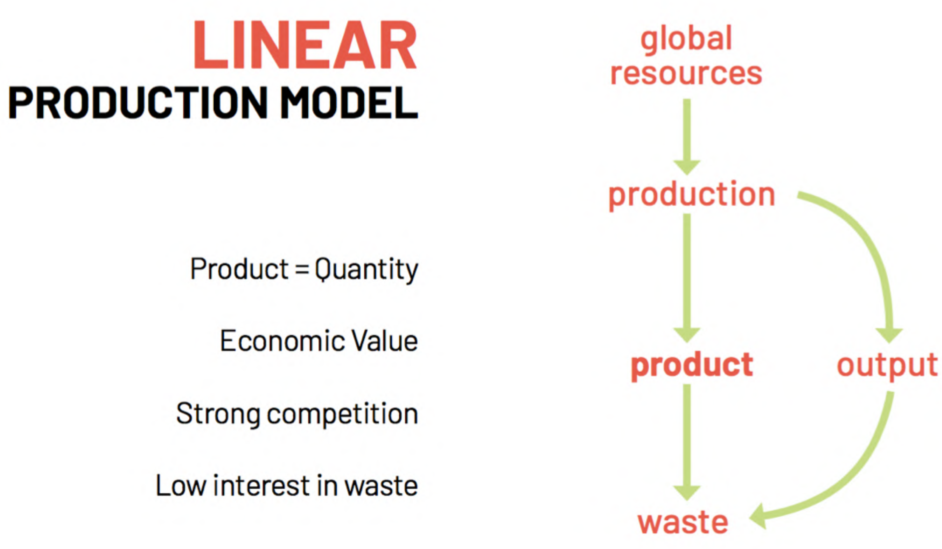


Figure 16 The elements of linear production model

Proposing a systemic production model based on:

- Balanced engagement of all actors
- Networks of local relationships
- Waste turns into a resource

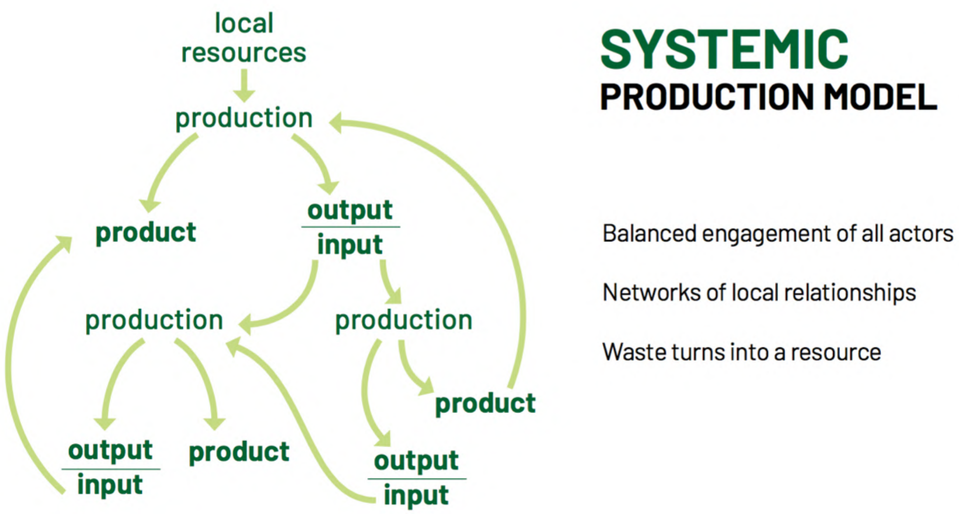


Figure 17 The elements of Systemic production model

Therefore, the design aims to foster an industrial evolution from a paradigm of competition to a new approach of collaboration.

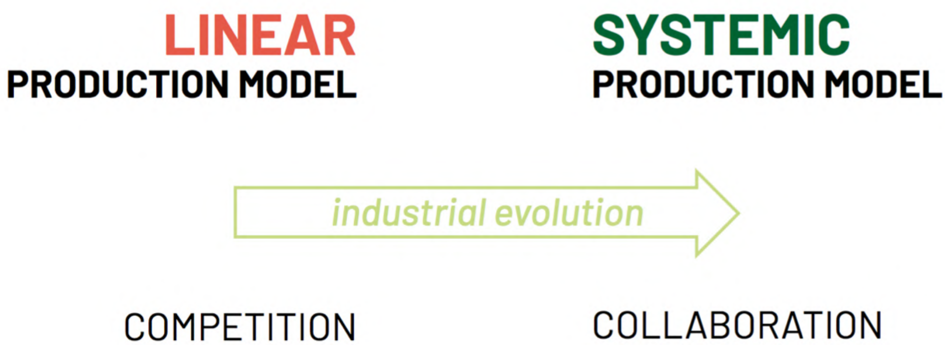


Figure 18 From linear to Systemic production model

3. SYSTEMIC DESIGN WORKING METHODOLOGIES

3.1 Systemic Design methodology

Systemic Design is a design discipline that provides practical tools to approach complex scenarios with a holistic perspective, while supporting active cooperation among the involved stakeholders. Complex scenarios need transdisciplinary approach; the Systemic Designer works as a mediator, promoting a horizontal dialogue between all the actors thanks to her/his co-disciplinary skills. Design disciplines have developed a systemic approach providing major connections with the transition sciences, encompassing system analysis, multi-level design, and co-creation processes. Design disciplines contribute to the foresight process by addressing two different levels: on the one hand, they support companies or organisations in developing a strategic vision of themselves in relation to the broader vision of the socio-territorial system; on the other hand, design disciplines become a medium for envisioning large spatio-temporal contexts in which individual stakeholders identify shared strategies to balance their needs and interests.

Systemic Design deals with material, energy and information flows in order to develop open systems in which the output of a process becomes the input for another one, avoiding waste and reaching zero emissions. The Systemic Design approach aims at designing productive processes that imitate the Nature and how it works, so use the output as input for other systems. This methodology can be successfully applied and adapted to numerous contexts like SMEs and industries from different sectors (agri-food, buildings and constructions, energy etc.), cities, regions and territorial/cultural heritage sites.

The main pillars of the Systemic Design are:

1. **Outputs > inputs**: The outputs of a system become the inputs for another productive chain.
2. **Relationships**: Relationships generate the open system itself.

3. **Autopoiesis**: Autopoietic systems support and reproduce themselves by co-evolving together.
4. **Acting locally**: The context in which we operate is fundamental and has priority over the outside world.
5. **Human-centred design:** The human being in relation to his or her environmental, social, cultural and ethical context is the focus of the project.

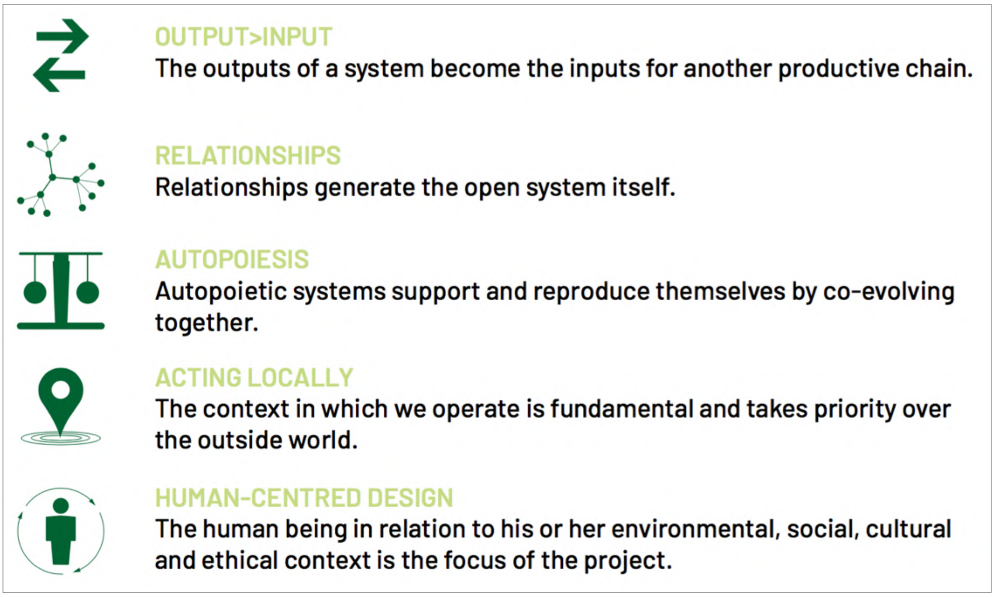


Figure 19 The five key points of Systemic Design

The methodology of Systemic Design consists in 6 steps:

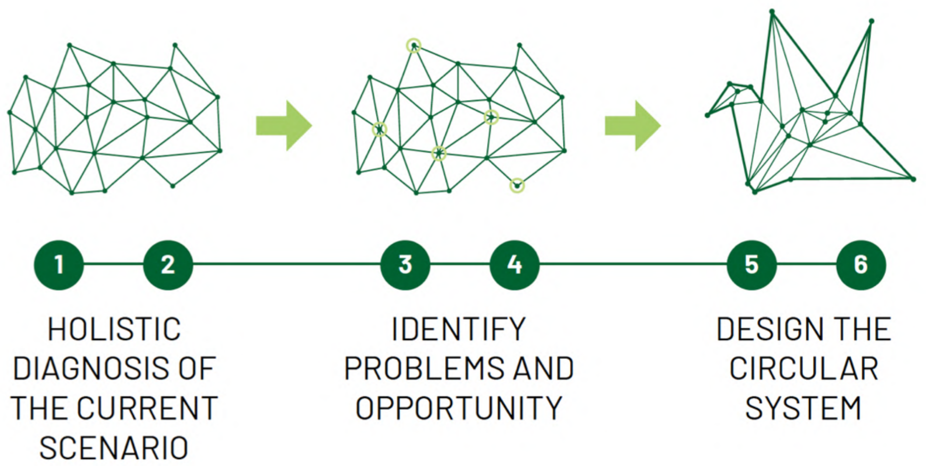


Figure 20 The six steps of Systemic Design

1. **Holistic Diagnosis of the territory**: The deep analysis of the territorial context at different levels of investigation, in order to better understand the current scenario.
2. **Holistic Diagnosis of the company**: The analysis of the current production process of a certain company and its flows of energy and matter.
3. **Identification of the challenges**: The identification of the challenges of the current productive process and its flows.
4. **Identification of the opportunities**: The research of new opportunities to improve the current scenario and its criticalities.
5. **Systemic project**: The design of a new systemic model based on relationships between processes and actors, which optimizes energy and material flows and gives value to waste as resources.
6. **Study of the outcomes**: The identification and the study of the new outcomes generated by the new systemic model.

The sustainable transition of large territorial systems requires effective research methods and tools to manage its systemic complexity. Envisioning processes are needed to collectively identify problems, build alternative visions and establish the strategies required to implement them.

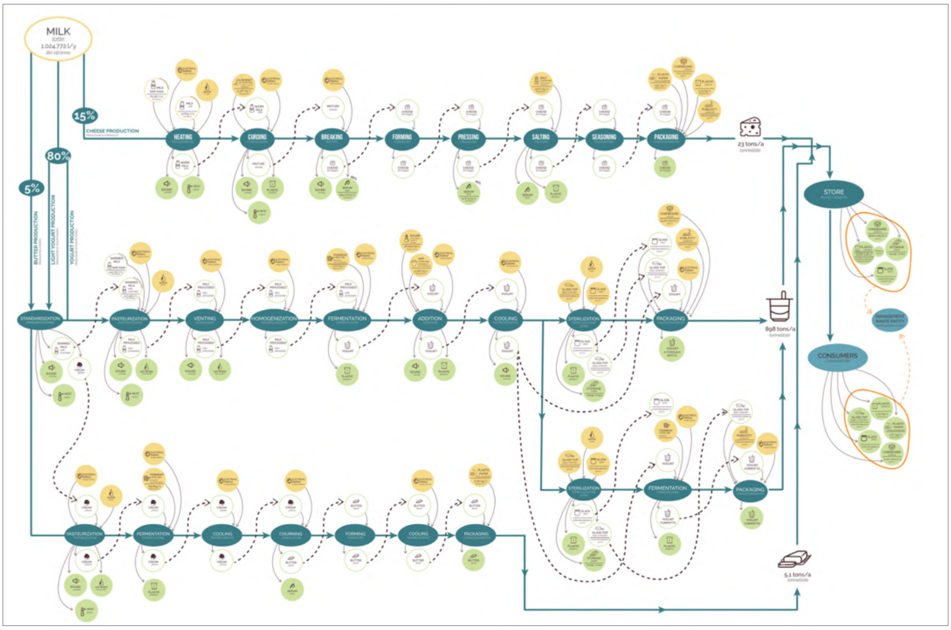


Figure 21 The analysis of productive system

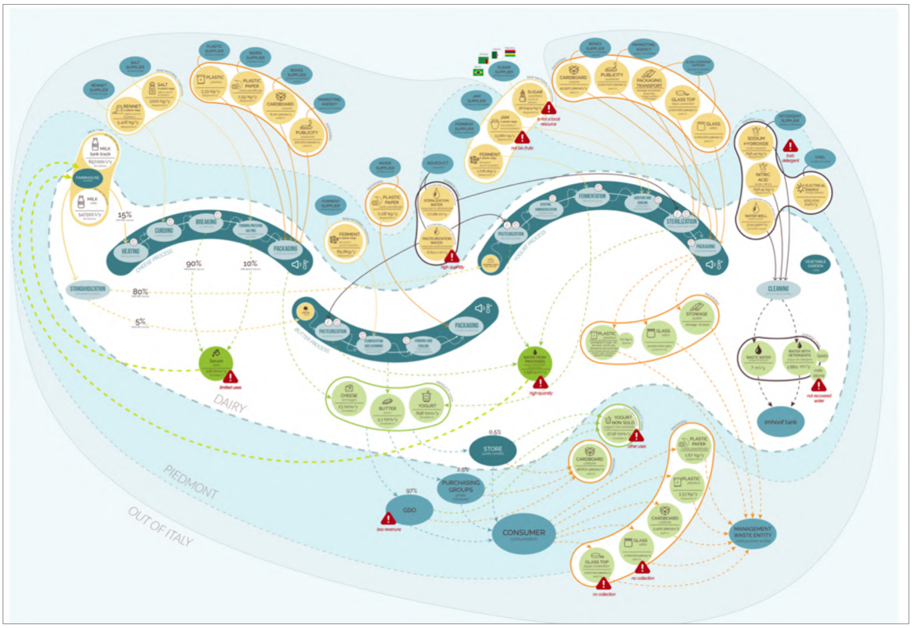


Figure 22 The identification of problems

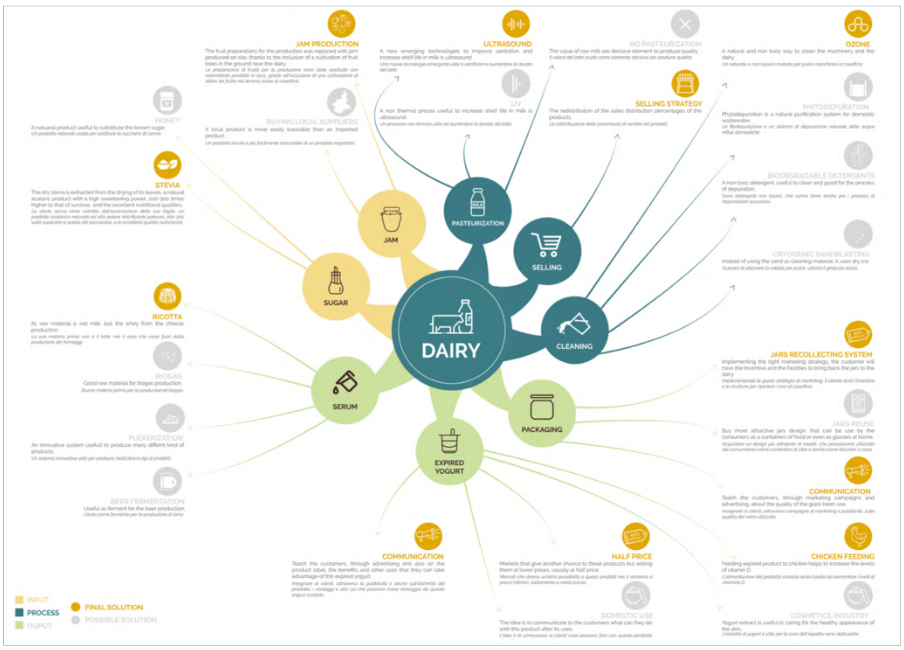


Figure 23 The identification of opportunities

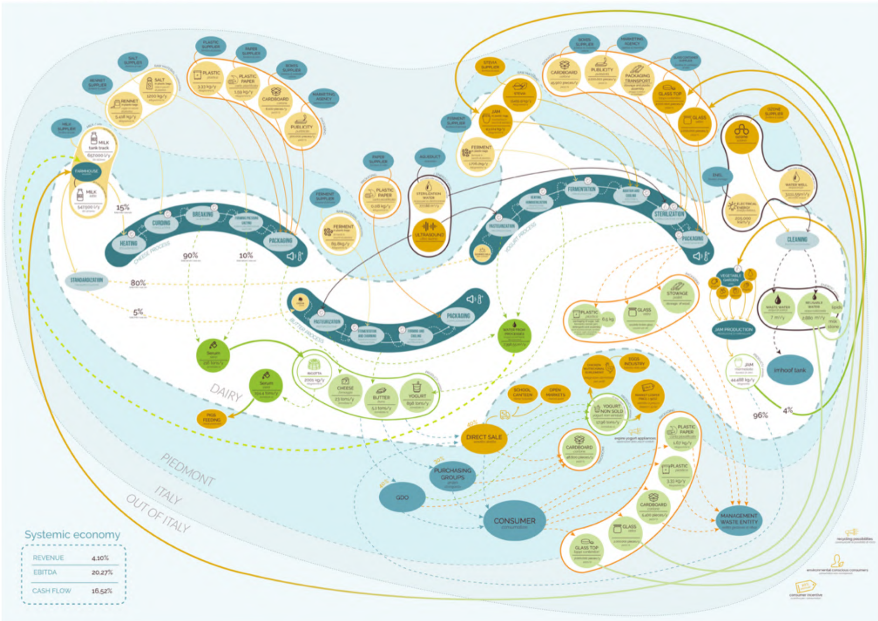


Figure 24 Example (made by students) of a Circular System

3.2 Holistic Diagnosis

The Holistic Diagnosis is defined as a mapping of the state of the art of a context, a product, a process or a service that takes advantage of different means of investigation, at different levels, to provide an overview of the components of the system and their mutual interconnections and relations.

This tool aims to promote a horizontal dialogue among all involved actors, be they experts belonging to different disciplines or citizens.

This term comes from the union of “Holistic”, deriving from the Holistic Theory which states that the whole is more than the sum of its single parts, and “Diagnosis”, which refers to the doctor’s opinion in the healthcare field.

The Holistic Diagnosis is defined as a mapping of the state of the art of a context, a product, a process or a service. It is carried out with different means of investigation at different levels, environmental, economic, sociocultural and so on and it provides an overview of the components of the system and their mutual interconnections and relations.

Holistic Diagnosis is based on a two-fold research:

1. **Desk research**: focused on seeking information and consolidated data on scientific databases, journals and magazines, reports, official documents.
2. **Field research**: looking at first-hand information collected through formal and informal interviews, surveys, field visits, etch.

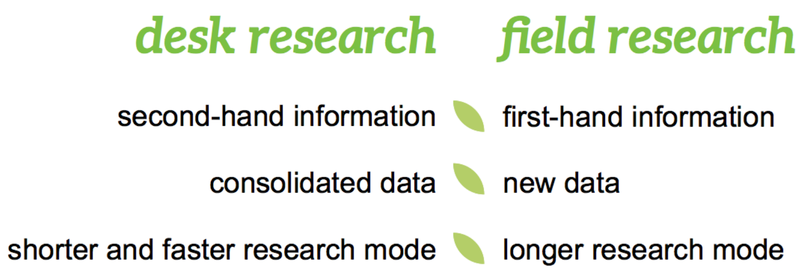


Figure 25 The main elements of Desk and Field Research

All those information are visualised in an accessible way, capable of supporting data interpretation for a wide and inclusive variety of actors.

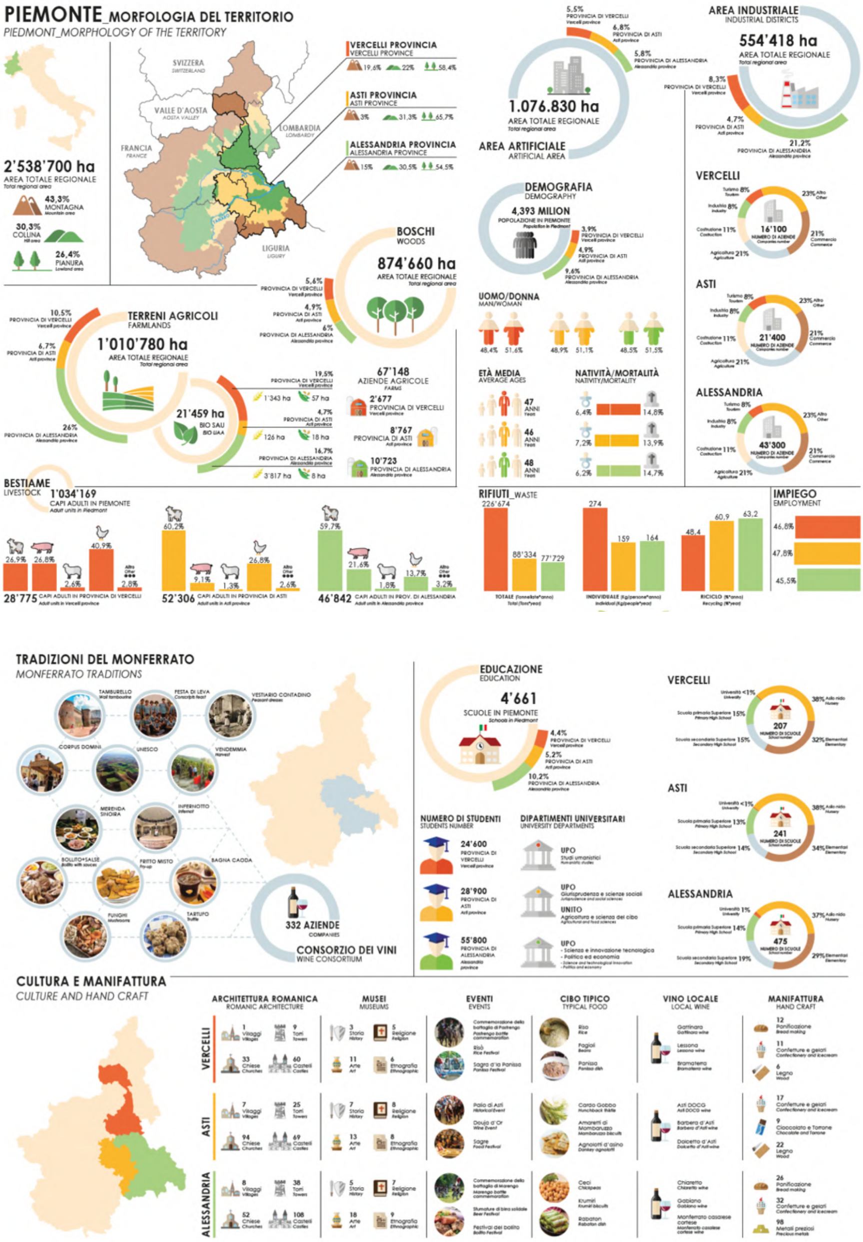


Figure 26 Holistic Diagnosis visualisation

The Holistic Diagnosis is based on 5 steps:

1. **Assess:** The definition of a customized research format, based on four parameters (scope of the project, system boundaries, research topics and data categories); for example a key topic for the HD of a certain territory could be represented by its demographical aspects, whose main categories could be the population density, its average age, the employment rate and so on.
2. **Research**: The research of quantitative and qualitative data with a desk research of conventional and unconventional sources, and a field research with direct observation and interviews; these two phases take place simultaneously, in order to mutually complete and verify the collected data.
3. **Collect**: The assembling of the retrieved data in the custom database, providing detailed references for each information; it is fundamental to include references for each data in order to guarantee an accurate and traceable analysis.
4. **Visualise**: The elaboration of a clear and accessible visualization of the collected data in the form of infographics and giga maps; is the key to place the information on a common ground, accessible by all the actors involved in the research, from experts to citizens.
5. **Interpret**: The multidisciplinary and holistic reading of the scenario in order to interpret its complexity, by determing the relations between the components of the system and the emerging properties of the system; visualization enables the interpretation of the data's flows, as well as the relational factors, encouraging an overview of the existing relations between components of the system.

These steps are repeated for the Holistic Diagnosis of the territory and for the Holistic Diagnosis of the companies that can be conducted in parallel. The Holistic Diagnosis framework has been successfully applied to several Systemic Design projects belonging to different fields like industrial production, local communities and even policy making.

The Holistic Diagnosis is capable of creating a new, solid reference point, fundamental for the following steps of the Systemic Design methodology.

3.3 Visualisation tools for Systemic Design

The multi-layered nature of information has led society towards radical change, especially in this era where data production and collection is reaching levels that could not even be imagined a few years ago. From relationships to components, from process to systems, the importance of making these elements more visual has become essential to enable new scenarios, innovative systems and creative mindsets in an educational and training way.

The ability to collect, cross-reference, visualise and investigate quantitative and qualitative information about phenomena and their patterns is itself at the heart of design, becoming strategic to enable new systems of thinking and their design application. Identifying the relationship between the components, thus ensuring personal expression, horizontal communication and visual thinking, is the first step in improving a more conscious and transparent decision-making process with a view to sustainability.

Why we need to visualize information?

→ remember information
→ convey meaning
→ improve working memory
→ facilitate research
→ enabling discovery
→ support cognitive inference
→ improve recognition
→ provide real and theoretical models

Figure 27 Design for information, Isabel Meirelles, 2015

From a design perspective, visualisations represent the process from data to knowledge. Indeed, they are able to collect data, information and knowledge (materials) and visualise them to create new knowledge (goal) (Masud et al., 2010). Moreover, Wurman (1989) suggests that one of the main purposes of information representation is to help readers avoid the black hole between data and knowledge. Through the relationship with context, unstructured information (reality and complexity) can be encoded into structured information and thus knowledge and insights for a more informed data-driven decision-making process. Visualisation thus becomes a fundamental tool and means to clarify and simplify information, favouring the exploration of complex phenomena, allowing the observer to have a deep understanding of the causes and effects of specific choices, comparing the effects in the most diverse situations, showing relational changes and distributing chaotic information in ordered and organised structures. From this scenario it is possible to deduce the importance and urgency of showing data, but above all of making it coherent and understandable.

Design knowledge does not focus on the choice of shapes and colours, but rather on the transmission of the message and the organisation of variables and categories according to the set objective. Behind an abstract map, it is recognised that the greatest value of an image is to guide the observer in exploring and understanding the potential and characteristics of an area. Awareness acquired, moreover, by the possibility offered to the reader, also thanks to the application of the basic principles of interaction design, to undertake and intervene in the very construction of his or her own interpretative path: a freedom of choice of reading paths, a possibility of constructing comparisons, historical causes, intuiting subsequent evolutions.

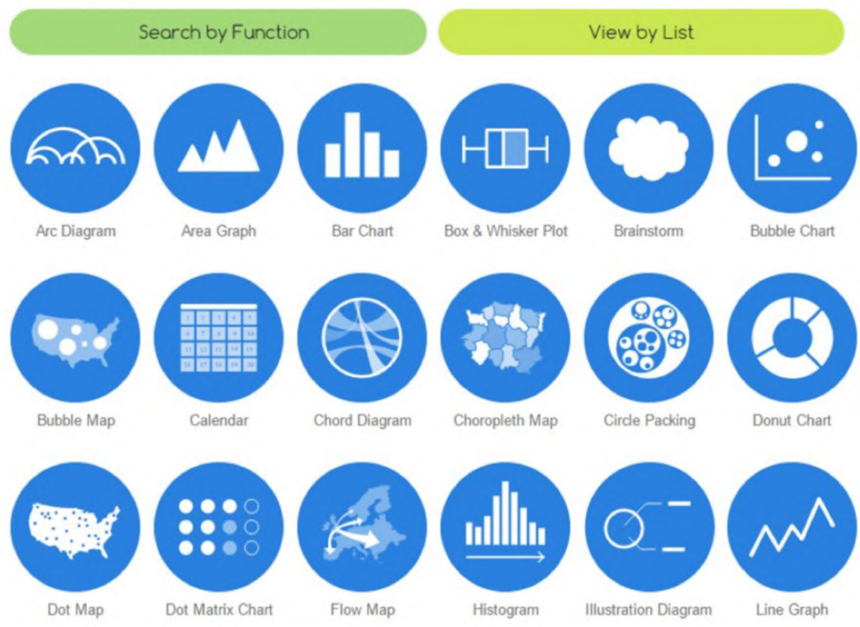


Figure 28 The Data visualization catalogue

We need a new graphic alphabet, within a framework of functional rigour (Colin, 2014), to find the right code to give a visual order and visually synthesise complexity to convey qualitative messages and narratives (Ciuccarelli, 2014). A new language is needed for sharing knowledge, opening up the boundaries of communication in unexplored ways. Multi-disciplinarity is one of the most strategic and successful approaches for this to happen, an approach that actively involves different disciplines, from technical-scientific sectors to statistics, from the world of social sciences to urban planning, up to the inclusion of artistic and more design-oriented sectors, reaching the expansion of the traditional definition of digital humanities.

How to approach the topic of data visualisation and complex systems in a practical way?

There are concrete tools that can support professionals in this. In particular, the **Visualisation Method Toolkit** was created by the Innovation Design

Lab of the Politecnico di Torino and the Digital Society School of the University of Amsterdam.

Figure 29 The Visualisation method toolkit. Credits: PoliTO IDL and Chiara Lorenza Remondino

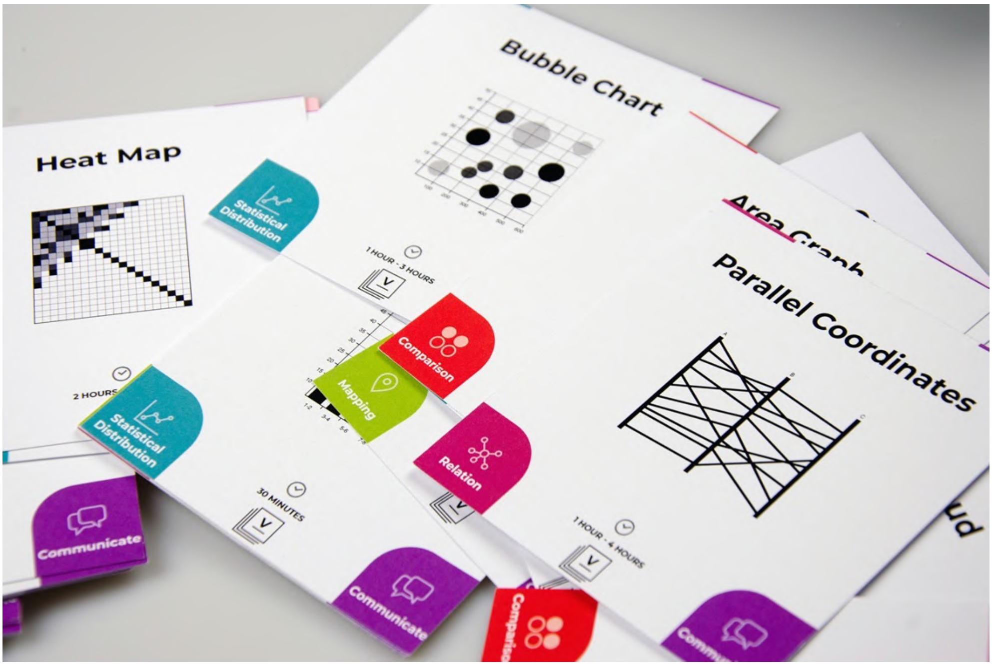


Figure 30 The Visualisation method toolkit. Credits: PoliTO IDL and Chiara Lorenza Remondino

The Visualisation Method Toolkit investigates the potential of data visualisation as a means of bringing design closer to the core business as well as supporting students and other organisations in communicating both analysis and scenarios, supporting dissemination actions towards a more informed quantitative/qualitative decision-making process that can always enable new innovative and sustainable good practices.

A collection of 55 cards encompassing 55 visual models categorised through different keys of interpretation. A selection of different ways to analyse, explore and communicate quantitative/qualitative information.

Specifically, it is possible to divide each card into two main operational functions: "select" and "execute". The first function, "select", corresponds to the front side of each map and provides all those useful expedients to discriminate the choice or not of the visual model from the dataset in possession. The back of the card, on the other hand, corresponding to the "run" function, is intended to accompany the user step by step in the pragmatic realisation of the visualisation.

Finally, the project saw the definition of a specific format. An experiential workshop conceived as a continuous cycle between analysing, evaluating, conceptualising and communicating, expanding the conversation in an inclusive and collaborative way among the participants.

4. PRACTICAL ACTIVITY: MINI-CHALLENGE

4.1 Introduction to the mini-challenge

In order to foster cross-fertilisation between the students' different skills, in addition to the lectures given during the first module, working groups composed of students from the different universities were set up to carry out the mini-challenge.

The training course based on Module 1 of MULTITRACES is characterised by a learning methodology based on an approach: learning by reading, understanding, doing and the complementarity of three pedagogical approaches: a learner-centred approach, an action-oriented learning, a transformative learning (UNESCO, 2017).

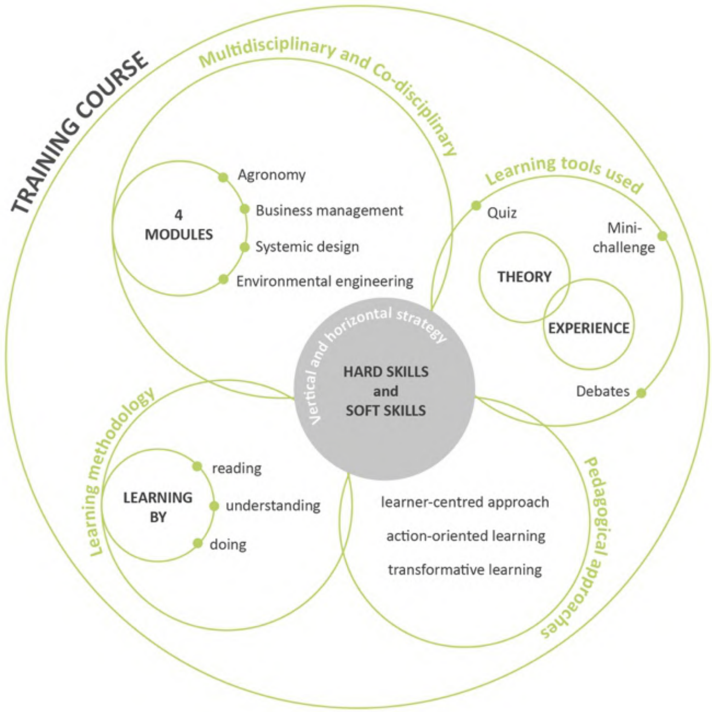


Figure 31 Summary scheme about the key elements of MULTITRACES. Credits: Aulisio, Barbero, Pereno, Rovera, 2021

The three key points of the work to focus on are:

1. **to involve** the partner companies
2. **to put into practice** the theoretical insights seen during the lessons
3. **to identify innovative solutions** for the analysed products and supply chain

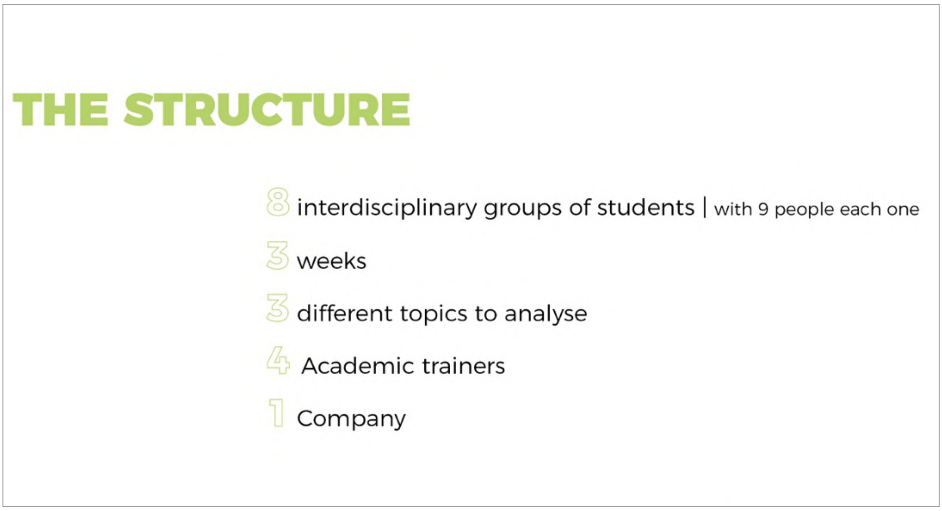


Figure 32 Mini-challenge structure

As can be seen from the image, the structure of the mini-challenge involved dividing the students into 8 multidisciplinary teams, which worked for 3 weeks on three topics chosen together with the project partner company.

This mini-challenge aims to demonstrate that the competitiveness of companies can be improved through the application of Circular Economy and the innovative suggestions from university students and academics. In the MULTITRACES project, the aim is to give students the opportunity to think about the latest technologies or to search for local know-how to enhance the untapped qualities of agri-food products and wastes to achieve environmental, economic and social benefits.

The Circular Economy requires constant collaboration between the various disciplinary fields, requires dynamism and continuous exchanges of information in order to be strengthened and grafted onto a territory. MULTITRACES plays a key role in transmitting these dynamic elements in a practical and collaborative manner. And it is precisely for this reason that it was decided to turn our attention to those disciplinary approaches that aim at the interconnection and enrichment of knowledge, such as interdisciplinarity, transdisciplinarity, codisciplinarity for the development of an innovative and *ad hoc* training course.

Thus, the aim is basically to promote the co-disciplinary aspects provided by experiential learning John Dewey (Dewey, 1938). Having students from four different countries and backgrounds is an important experience in itself. For this reason, developing an experiential activity in collaboration with the company made it possible to implement a learning-by-doing approach based on teamwork, fostering cultural and skills contamination among the students, and enhancing design skills acquisition.

TASKS

1. DELIVERABLE

HOLISTIC DIAGNOSIS DATASHEET

It is a methodologic tool to dialogue with other disciplines. 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 of the territory in relation with the topics of each team.

↓

2. DELIVERABLE

MAIN PRODUCTION AND PROCESS GAPS AND OPPORTUNITIES

This step of the mini-challenge identifies the main **problems associated with the supply chain** you are analysing. The analysis takes into account the whole supply chain, from production to consumption, the technologies and the know-how in order to realise a list of existing gaps and opportunities.

↓

3. DELIVERABLE

CASE STUDIES AND GOOD PRACTICES COLLECTION

The case studies collection lay the foundations for the definition of possible solutions starting from **projects and companies or concept that already exist** in other part of the world.

↓

4. DELIVERABLE

DEFINITION OF THE POSSIBLE SOLUTIONS AND SYSTEMIC PROPOSAL

Completion of **worksheets establishing the pros and cons of the solutions** found that may be applicable to the topic assigned to the group. Systematise the solutions identified in order to define the **final proposal to be presented** as the conclusion of the work carried out.

4.2 Circular Economy topics

Thanks to the close collaboration with the MULTITRACES partner companies, three main practical topics for these mini-challenges were identified. These are based on the real needs of the Company, giving added value to the work carried out by the students.

AGRINDUSTRIA®

owner **Giuseppe Tecco**
from **1985**
based in **Cuneo (Italy)**

For Module 1 held by the Politecnico di Torino, the company carrying out the project is Agrindustria Tecco, which is present in the Piedmont region. The company in a constant comparison that further highlighted the unexpressed needs of the agri-food sector. Agrindustria Tecco is a small company, located in the area of Cuneo, it has been operating since 1985 and was born to transform secondary vegetable materials into industrial products useful for man.

Figure 33 Agrindutria Tecco buildings

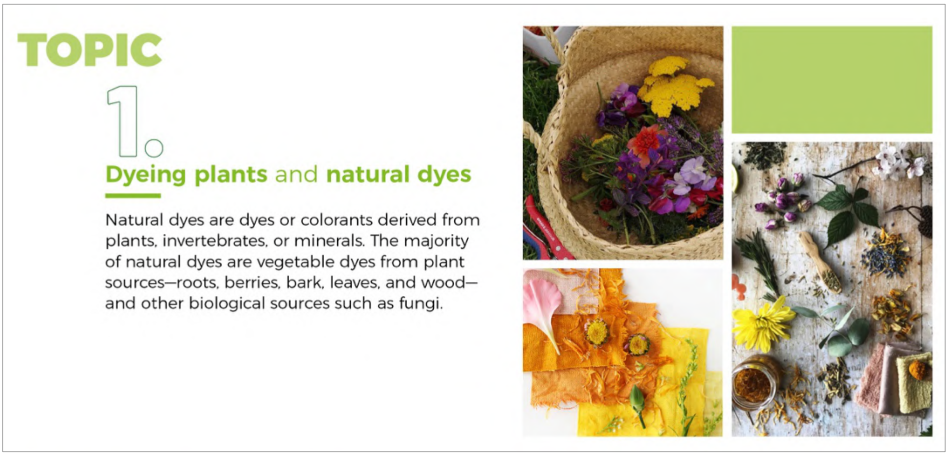
The company started reusing local waste to produce new sustainable vegetable products, moving from the agro-industrial sector to other fields of application, anticipating what we now call Circular Economy issues.

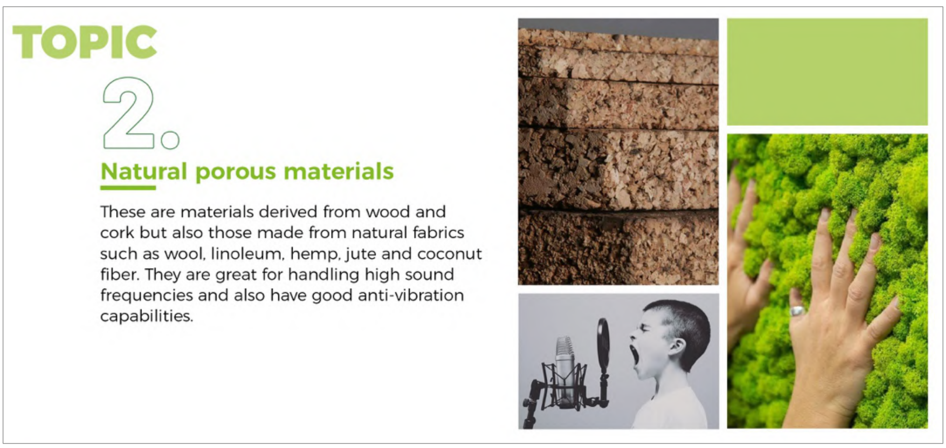
Figure 34 Agrindustria Tecco products

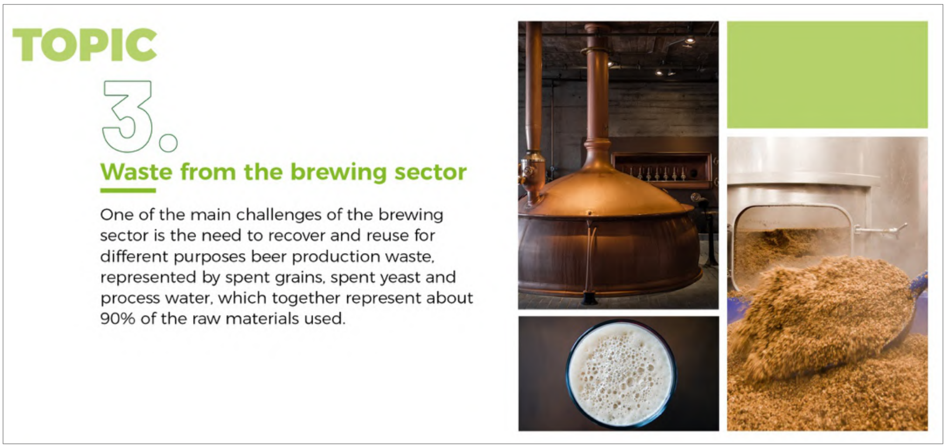
The company, aims to treat niche products with the care and seriousness of an artisan business, boasting customers in Italy and abroad, as well as a series of assiduous collaborations with universities, innovation centres and other national companies, always with a view to enhancing the value of local products and fully respecting what nature teaches and makes available.

The Company's attitude to establishing virtuous connections within local territorial systems, was important in the MULTITRACES course, providing a practical view on how to interconnect and consciously exchange resources. Agrindustria Tecco and Politecnico di Torino, collaborated in defining the topics for the students to work on within the mini-challenges. The three topics selected and proposed to the students were:

1. analysis of the use and re-use of processing waste of dyeing plants,
2. mapping and study of natural porous materials, with a focus on their possible use as soundproofing materials,
3. valorisation of waste from the brewing process.







Thanks to several discussion sessions with the student groups, it was possible to directly involve the CEO of the company, who provided effective and practical feedback to the groups for possible implementations of the circular solutions presented per each topic.

4.3 Mini-challenge results

After the presentation of the themes to the students, the groups were formed and from then on, they would investigate the theme assigned to them. There was a total of eight multidisciplinary groups divided into the following themes:

- three groups dyeing plants
- three beer waste groups
- two porous materials groups.

In order to receive regular updates and to monitor the progress of the students' work, two review meetings with professors and trainers were scheduled during the weeks.

During these virtual meetings, students were able to report on the progress of their work. In addition, the revision also became a moment of debate between the groups based on questions and doubts of some students. In this way, feedback from teachers and tutors became useful for the others.

It is important to emphasise that the choice of digital tools to be used was fundamental in the running of the whole MULTITRACES course, but particularly in the mini-challenges. The implemented digital training system in MULTITRACES has employed, from one side, standard tools (such as video lessons) for acquiring hard skills, while it has made use of innovative interactive and teamwork tools for acquiring soft skills. The educational approach based on the experiential learning theorised by John Dewey (Dewey, 1938) can and should be a constant reference also in digital training education contexts.

In this way, in addition to relational and cultural exchange skills, the level of digital adaptation also brings learning. From the point of view of the tools used to digitise the material to be shared with the teachers, research was carried out to suggest the most effective tools to the students. The Google Data Studio digital tool was suggested to the students to create dashboards and graphs concerning aspects related to Holistic Diagnosis.

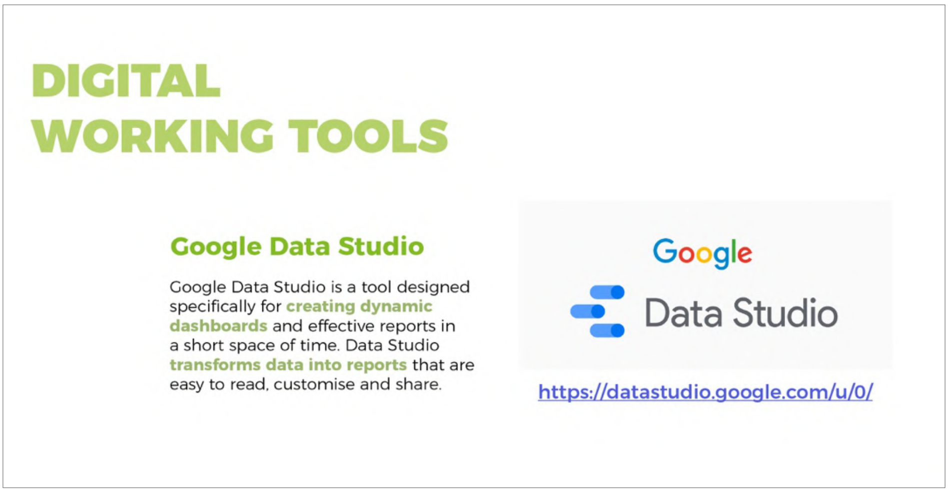


Figure 35 Google Data Studio

One of the most effective digital tools used during the course was MIRO, a platform with a well- designed User Experience, that enhances workflows and shared dashboards, both in real time and asynchronously. The complexity of Systemic Design projects, especially in multidisciplinary teams, requires a tool able to support different students in assessing and visualising the socio-technical system they take into analysis. To do this at remote locations, the authors have assessed different tools to support students in performing this task remotely.

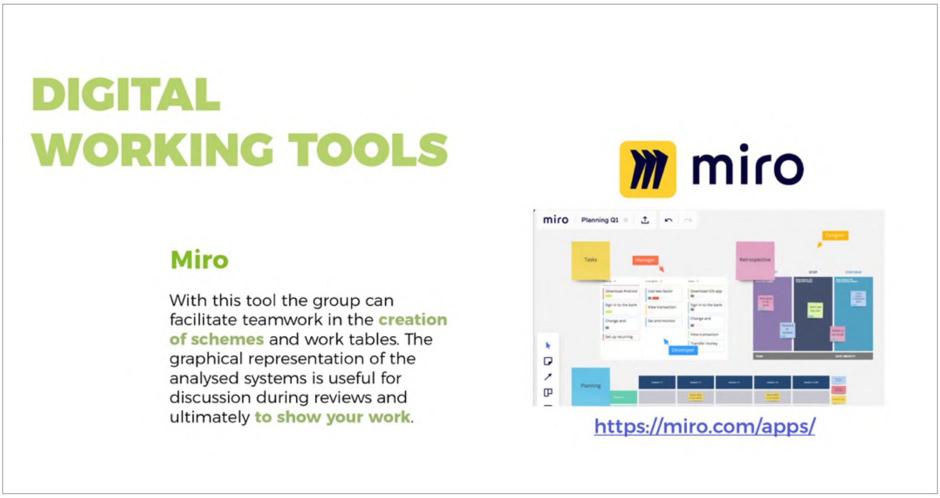


Figure 36 Miro app

Thanks to the integration with the Moodle platform and the use of applications to share files and work simultaneously, students carried out remote work effectively and efficiently in order to present tangible results.

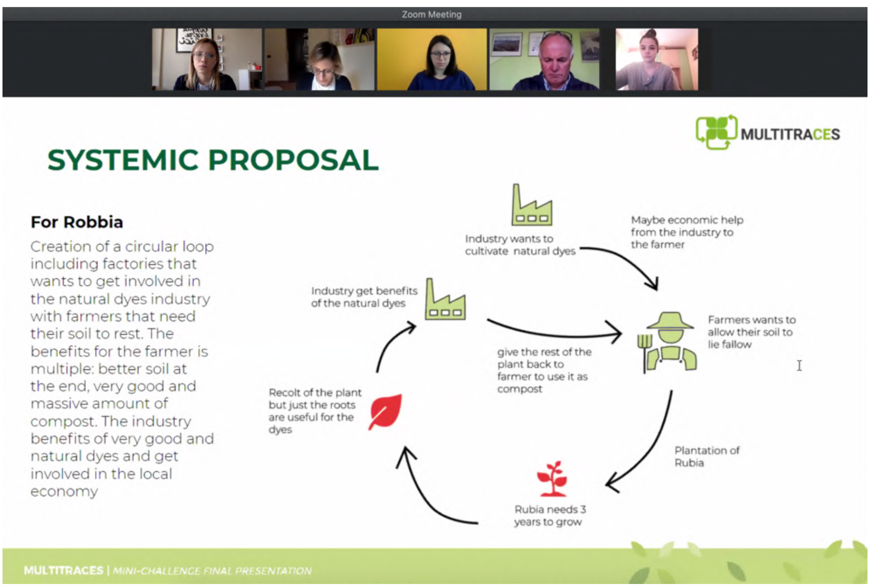


Figure 37 Screenshot during the final presentation of Circular Economy proposals by students to teachers and the company

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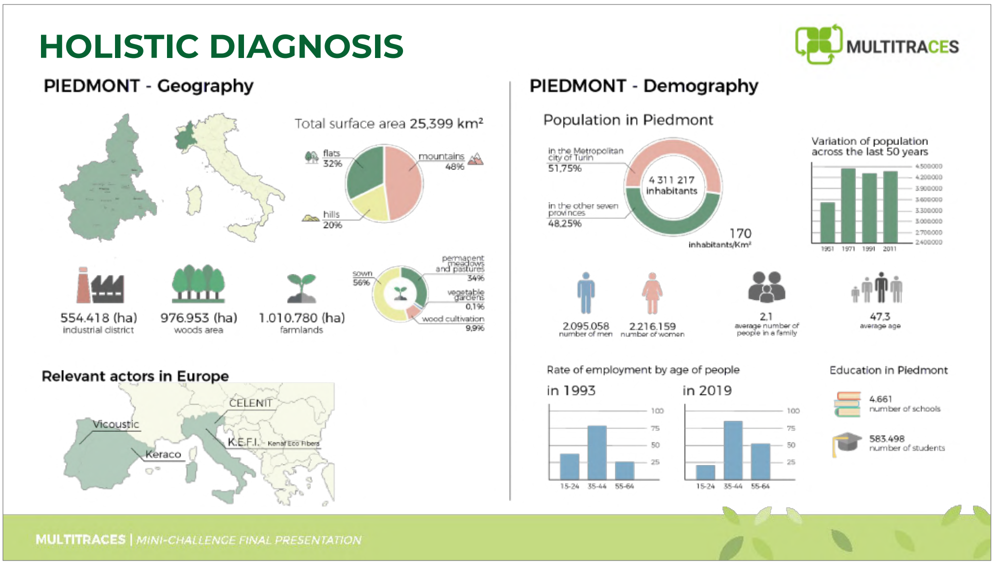
ANNEX 1 – MINI-CHALLENGE RESULTS

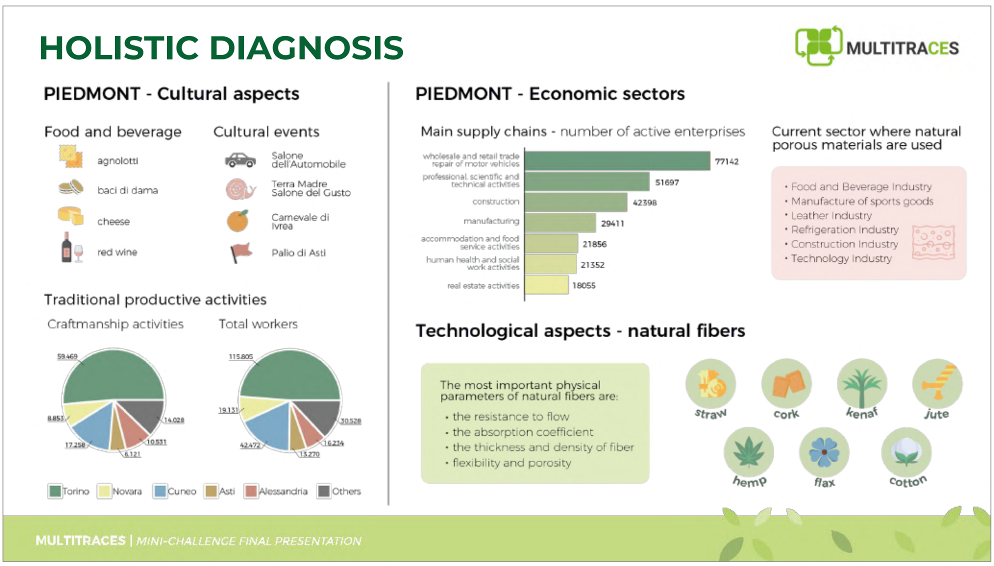
In this annex you can view the presentations made by students during the MULTITRACES programme. The order is in ascending order from group number 1 to 8 and for each presentation there is an initial incipit on each proposal submitted.

GROUP 1 – NATURAL POROUS MATERIALS

Group 1 carried out an in-depth analysis of the territory and the project partner company. Thanks to this analysis, it developed an interesting proposal related to the circular economy. The aim is to re-use corn cobs from industrial production processes.

GROUP 1 – NATURAL POROUS MATERIALS





GROUP 1 – NATURAL POROUS MATERIALS

PIEDMONT'S INDUSTRIALIZATION

- Although Piedmont used to be an **agricultural area**, the need for a shift on the economic sector during the late 19th century, lead to a **modern industrialised model**.
- The implementation of a **systemic approach** to this industrial model has managed to **repurpose agricultural wastes** as **resource materials for the local economy**.
- **Thermal and acoustic insulation panels** made of cork scraps, rice husk, coffee chaff, **corn cobs**, and end-of-life granulated tires are examples of such products.

MULTITRACES | *MINI-CHALLENGE FINAL PRESENTATION*

MAIN GAPS AND OPPORTUNITIES

- The main gaps for corn cob valuation are:
  a. **Limited bibliography** and **research** on the material
  b. **Lack of knowledge** about the **equipment** used to transform corn cobs into panels
  c. **Mistrust by modern consumers** about the effectiveness of the product

MULTITRACES | *MINI-CHALLENGE FINAL PRESENTATION*

GROUP 1 – NATURAL POROUS MATERIALS

MULTITRACES

MAIN GAPS AND OPPORTUNITIES

Proposed Solutions:

- Thorough **education** of potential investors with analytic graphs of the product's usage.
- **Establishment** of research with the purpose of improving the current product's **structural reliability** and **image**.
- Proper **advertisement** of the product's qualities.

- **Prevention of possible competitors from discrediting the product.**
- **Better introduction to the market** via dynamic marketing techniques such as public demonstrations of the product's properties.

MULTITRACES | *MINI-CHALLENGE FINAL PRESENTATION*

MULTITRACES

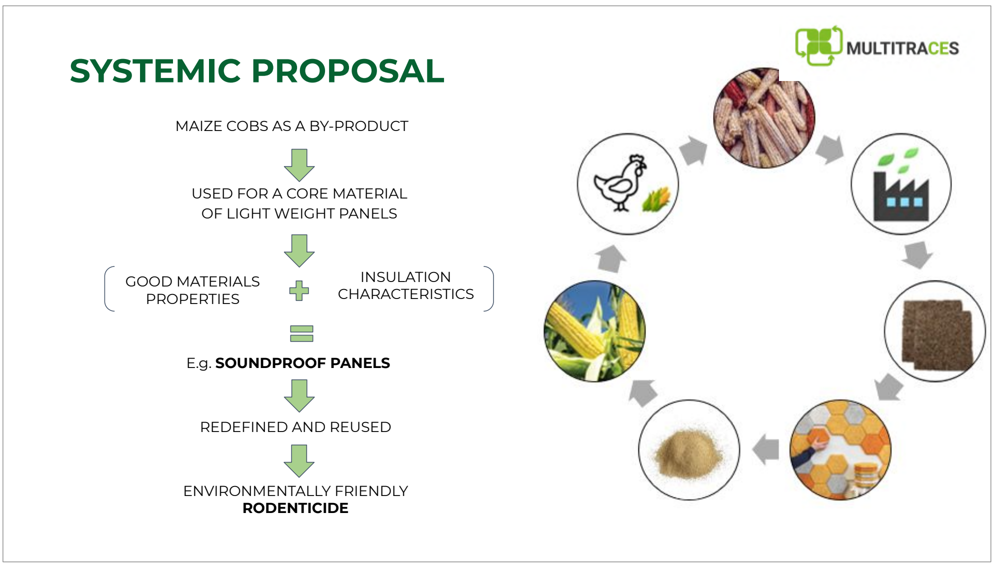
MAIN GAPS AND OPPORTUNITIES

Business Opportunities:

- **Employment** of innovators and **researchers** for further development of the product aspects.
- **Recruitment** of **expertised personnel** who possess the appropriate **marketing skills** for the products demonstration.
- Funding of **social media experts** for better **promotion** of the product.

MULTITRACES | *MINI-CHALLENGE FINAL PRESENTATION*

GROUP 1 – NATURAL POROUS MATERIALS



GROUP 2 – DYEING PLANTS

Group 2, after analysing the characteristics of a number of dyeing plants, decided to focus on plants that produce the organic compound called Alzarin, developing proposals linked to solar cells.

PIEDMONT REGION

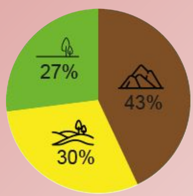
Population: 4.311.217

Agricultural area: 960.500 hectares

Agricultural workers: 3,2%

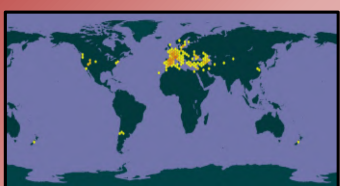
Foreign labour force: 22.000

ARPA Piemonte evaluates the gaseous emissions from the management of agricultural crops



TEXTILE INDUSTRY

Biella's textile district of today is one of the largest international centres for the wool industry and the production of fabrics made from wool and other precious fibres (cashmere, alpaca, mohair): with an area of 930 square kilometres, Biella's district counts over **2000 production plants**, **28000 employees** and exports around 30% of the total turnover. As well as worsted and carded yarns used for weaving and knitwear, the district also specialises in cotton, polyester, acrylic and nylon. Alongside woollen mills and spinning mills, there are many combing, **dyeing** and finishing shops that round off this **technologically advanced supply chain**, focused also on **protecting consumer health and the environment**.



We find Rubia in different areas. But the majority are in the **Central and West Europe**. It is also present in **North Africa** and very few in other places scattered.

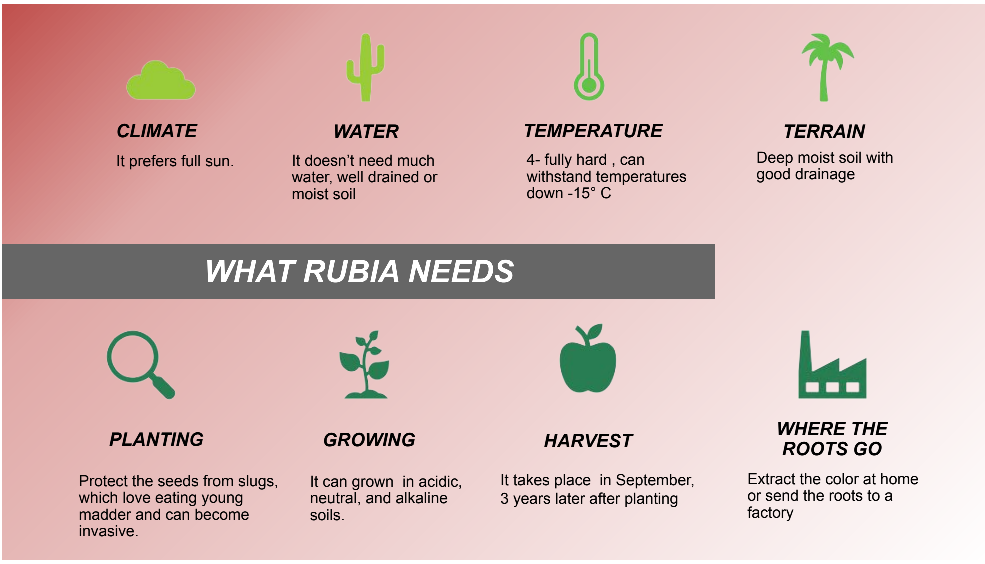
Early evidence of dyeing comes from **India** where a piece of cotton dyed with madder has been recovered from the archaeological site at Mohenjo-o. The oldest European textiles dyed with madder come from the grave of the **Merovingian queen Arnegundis** in Saint-Denis near Paris (between 565 and 570 AD). Also the **red coats of the British Redcoats** were dyed with madder.

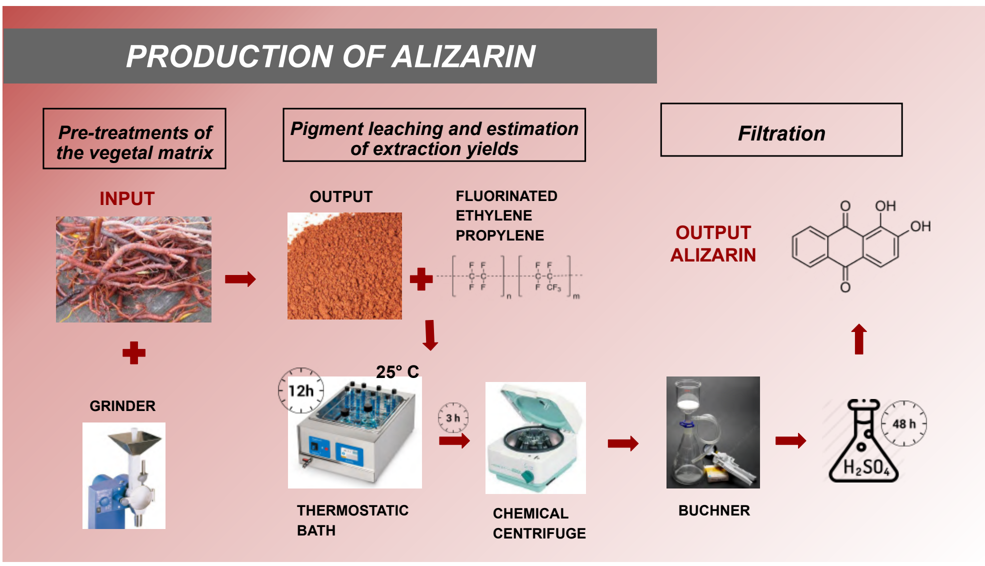
HISTORY AND CHARACTERISTICS

A plant native to the Mediterranean that has been used for centuries to make reliably vivid red dye.

The **leaves** : **large** and **evergreen** in tropical species, deciduous in temperate species, and needlelike or scalelike in desert species.
Single **flower** or many small flowers clustered together.
The **fruits** can be berries, drupes, capsules, or schizocarps (dry fruits that split into segments of a single seed).

GROUP 2 – DYEING PLANTS





GROUP 2 – DYEING PLANTS

- In **clinical practice**, it is used to stain synovial fluid to assess for basic calcium phosphate crystals. Alizarin has also been used in studies involving bone growth, osteoporosis, bone marrow, calcium deposits in the vascular system, cellular signaling, gene expression, tissue engineering, and mesenchymal stem cells.
- In **geology** it is used as a dye, to indicate the presence of calcium carbonate minerals (calcite and aragonite).
- It has current application in analytical **chemistry** for the determination of metals by complexion.

ALIZARIN APPLICATION

Alizarin is an organic compound with formula C14H8O4 that has been used throughout history as a prominent red dye. In 1869, it became the first natural dye to be produced synthetically.

FLAINOX COMPANY

The Flainox company, based in **Quaregna (BI)**, is a leader in the sector, its **rotary dyeing machinery** allows the dyeing for all types of garments; with a strong focus on the sustainability of the process Flainox was able to **reduce the water** used and have a **low environmental footprint.**

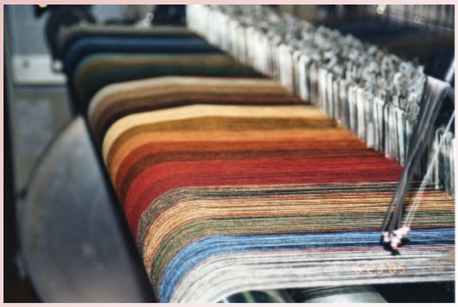
GROUP 2 – DYEING PLANTS

CASE STUDIES

Maglificio Giordano's

Email info@maglificiogiordanos.it

-is firmly anchored in territory
-ensures the fostering of local skills and the continuous crafting of unique creations.
-heritage , an **ethical mindset** that has championed social and environmental **sustainability**.



CIRCULAR SOLUTIONS

SOLAR CELLS AND ECO-FRIENDLY BATTERY

In the future it may have a very important role in the manufacture of DSSC photosensitized dye **solar cells**.

Researchers at Rice, in collaboration with chemists from **City College of New York and the U.S. Army Research Laboratory**, say that they have developed a component for a promising, **new lithium-ion battery powered by purpurin**.

it can also be used as the basis for a **sustainable and eco-friendly** alternative to conventional lithium-ion batteries.

a) Schematic illustration of sequence of lithiation/de-lithiation mechanism in the purpurin molecule: (1) Molecular structure of pristine purpurin; (2) Intermediate of lithiated purpurin and (3) Binding of lithium ion with carbonyl and hydroxyl groups of purpurin at C-1 (–OHa) and C-4 (–OHc) respectively.
(b) Photograph of (1) pristine purpurin and (2) Chemically lithiated purpurin (1:2ratio)

COMPOST

In the third year, you can cut leaves that can be used as compost.

Only then extract the roots.

MEDICAL PROPERTIES

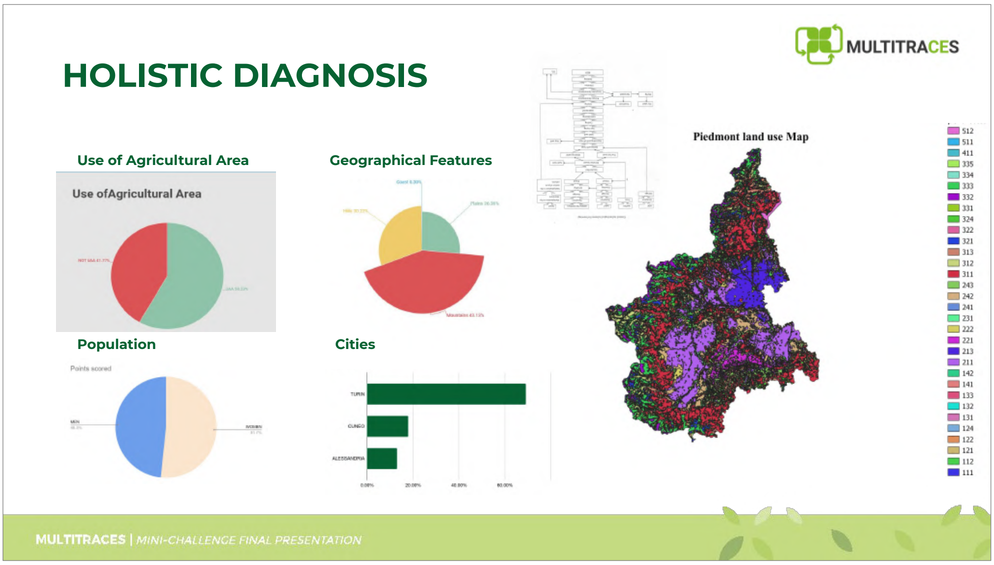
ROOTS: decoction is depurative, It also cure sciatica and some forms of paralysis

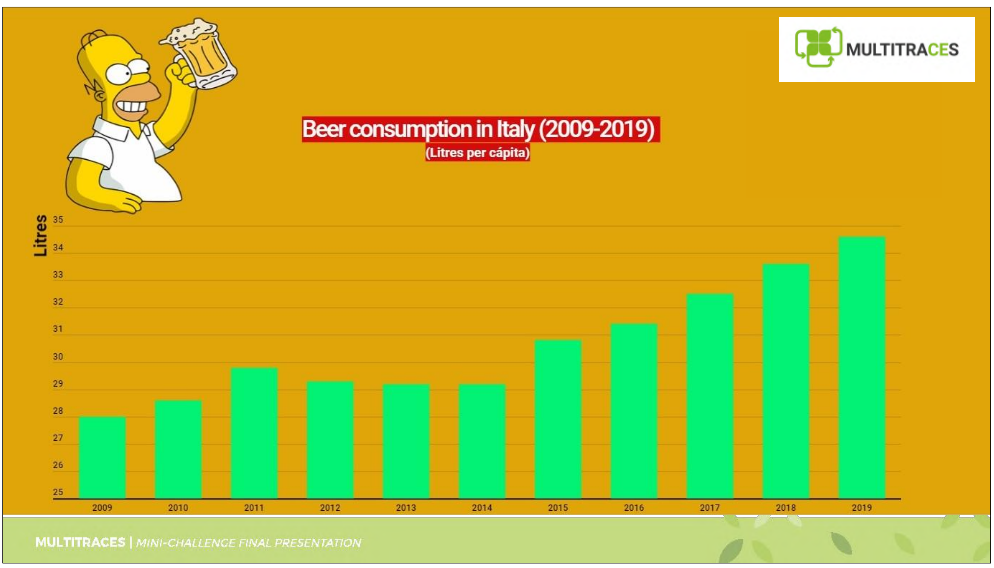
LEAVES: juice benefits snake bites

SEED: with Honeyed Vinegar, the enlarged and hard spleen decreases

GROUP 3 – BREWING SECTOR

Group 3 starts to design and develops a Circular System aimed to create a longer life cycle, allowing companies to repair and remanufacture their products and services. The creation of this production cycle made it possible to recover and eliminate waste from the brewing industry, using the output as a new input.





GROUP 3 – BREWING SECTOR

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The EU Green Deal sets a variety of objectives for the future of the union that will totally reshape the reality that we live in. Its main goals are to:

- *boost the efficient use of resources by moving to a clean, circular economy*
- *restore biodiversity and cut pollution (net zero emissions by 2050)*

This policy shows the attitude of the European Institutions towards the economic future of the region. That's why it is important for the industries to follow the established "green" trajectory now, because by that we way the enterprises can benefit from the new opportunities that the circular economy offers and to give back to its local community.

The WFD (Waste Frame Work Directive) is one of the first legal provisions that sets a common waste management policy in all of the EU countries. The 2008 directive sets an historic legislative distinction between waste and by-product. It is also important to mention that it confirms the "polluters-pays principle" whereby the original waste producer must pay for the costs of waste management.

This normative should impulse the producer to be more aware about the harm that the industry causes. So when environmental regulations tighten, the only way an industry can survive is by adjusting to the new normality, in this case by innovation and waste repurposing

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MAIN GAPS AND OPPORTUNITIES

MAIN PRODUCTION GAPS:

1. **Inefficient input use**
2. **Simple waste management model (livestock feed)**
3. **High cost of effective waste storage**
4. **Low environmental responsibility**
5. **Lack of innovation in the production process, due to the linear production system**

OPPORTUNITIES:

1. **Diversification of the waste management:**
   - Water filtration
   - Brewers spent grains repurposing in the food, beverage and agricultural industries
2. **To establish multilateral connection with local industries that will create a WIN-WIN situation**

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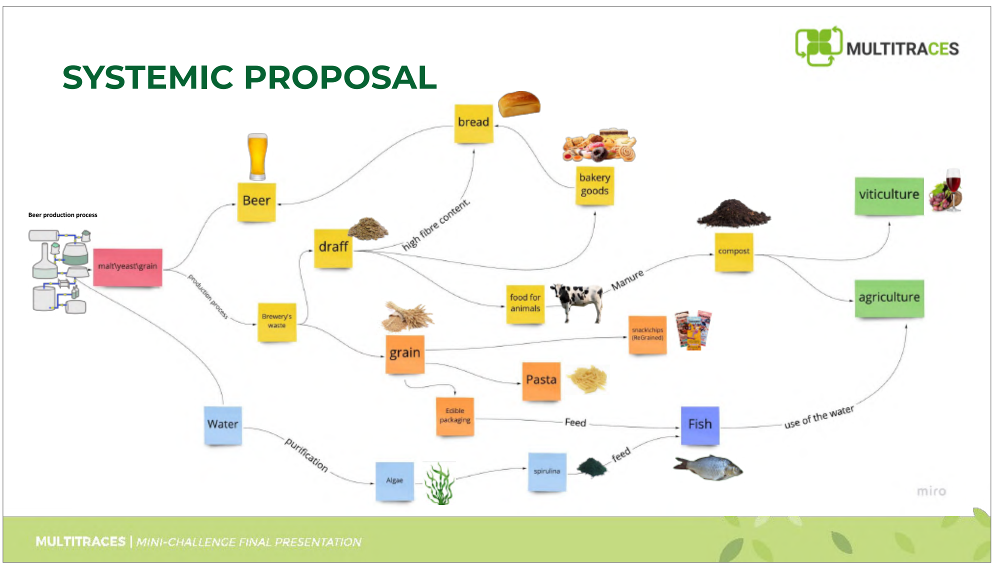
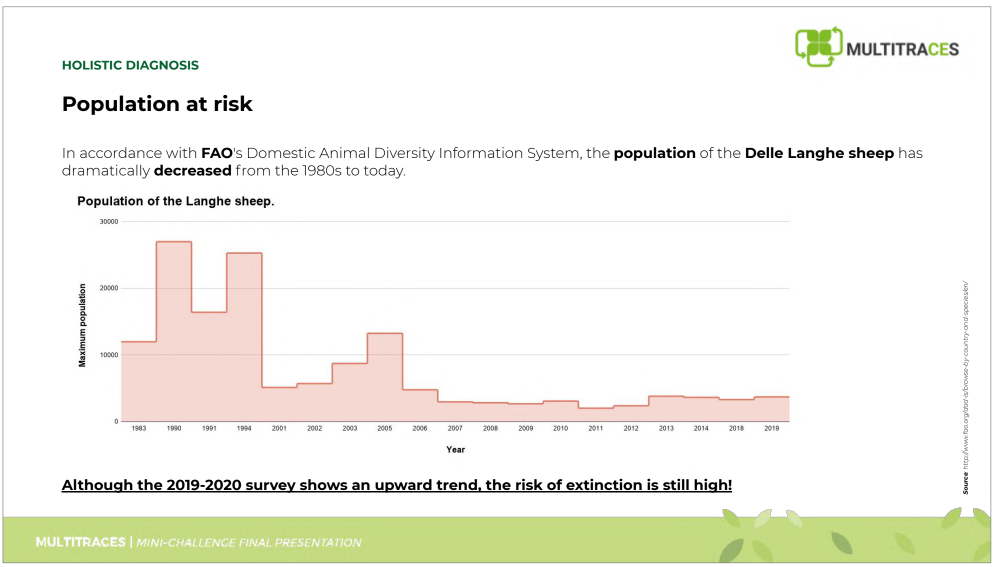
GROUP 3 – BREWING SECTOR



GROUP 4 – NATURAL POROUS MATERIALS

Group 4 proposal works in line with existing regulations and actions (at provincial, regional, national and international level) which also aim to avoid the extinction of the Langhe sheep breed and to foster the economic and cultural development of the area.



GROUP 4 – NATURAL POROUS MATERIALS

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HOLISTIC DIAGNOSIS

Wool as sound absorbing material

> EASY PROCESS

It's a material obtained by hot pressing or cold pressing of wool fibers that could be easily processed and manipulated.

> SOUND ABSORPTION PERFORMANCE

The acoustic absorption is very good with a coefficient values of over 0.7 for the frequency range of 800 ÷ 3150 Hz.

SHEEP WOOL HAS A COMPARABLE SOUND ABSORPTION PERFORMANCE TO MINERAL WOOL OR RECYCLED POLYURETHANE FOAM.

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MAIN GAPS AND OPPORTUNITIES

GAPS

> Missed potential of making profit out of selling the discarded wool
> Absence of companies producing sound-absorbing panels in Piemonte

OPPORTUNITIES

> Creation of a circular economy based network between the local breeders and Agrindustria

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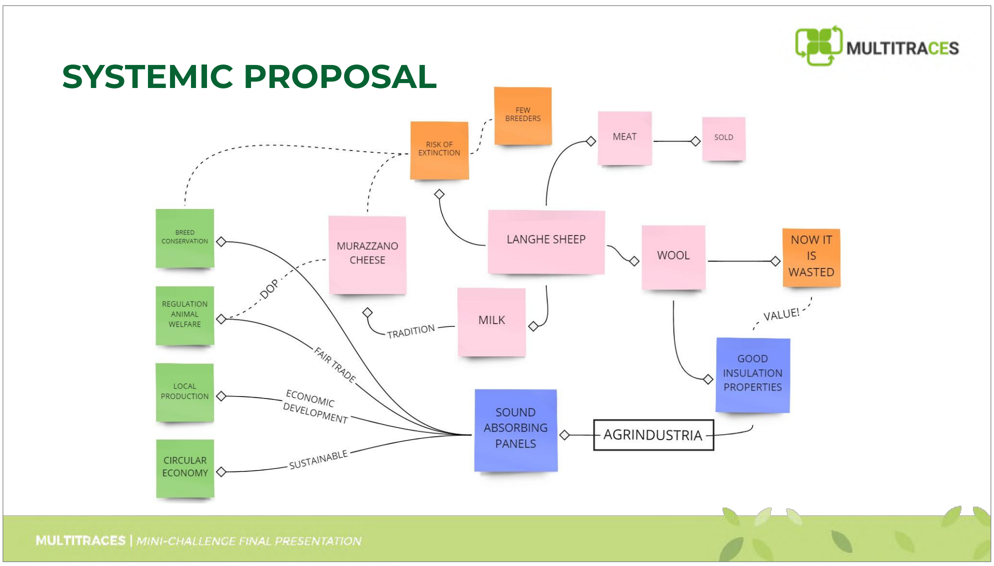
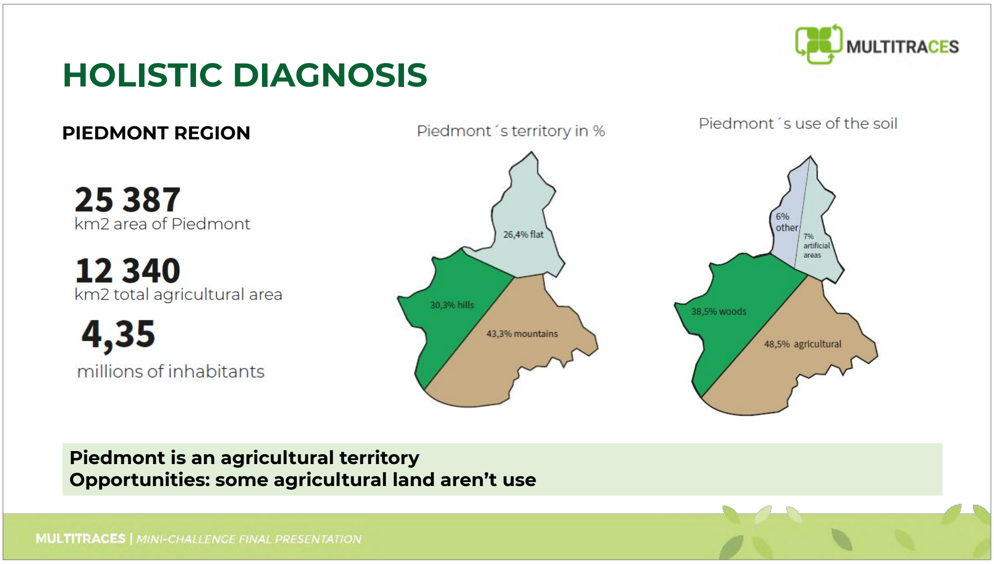
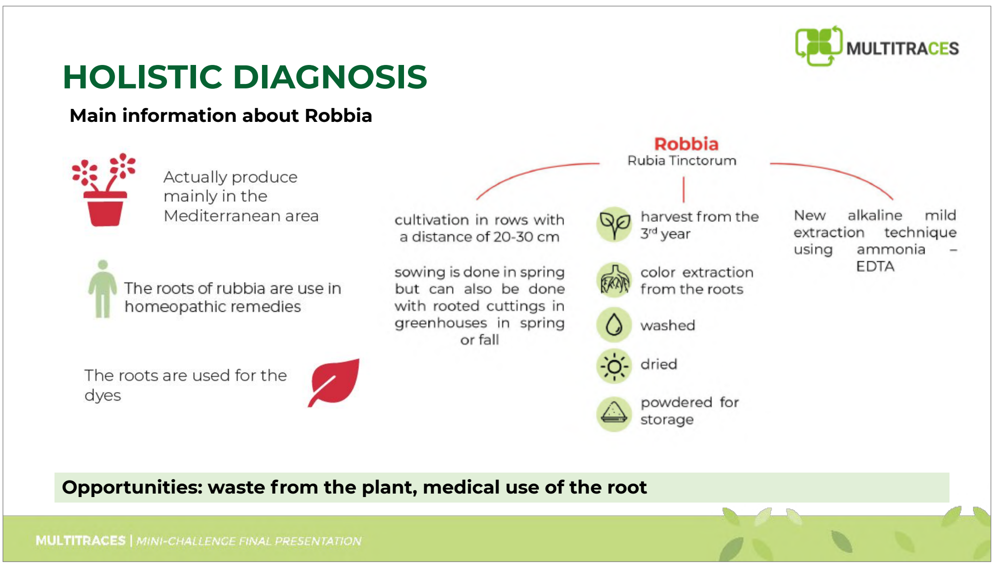
GROUP 4 – NATURAL POROUS MATERIALS



GROUP 5 – DYEING PLANTS

Group 5 proposed a double solution for both the Guado plant and the Robbia, creating an interconnection and an exchange of materials between the two sectors.





GROUP 5 – DYEING PLANTS

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HOLISTIC DIAGNOSIS

Main information about Guado

Actually produce in Asia, south and Central Europe mainly

Good exposure to sunlight and resist to cold climate common spontaneous plant

The leaves are used for the dyes

People in Sicilia use to eat the sprout of Guado

Main sectors for natural dyes

- Textile
- Cosmetic
- Food and beverage

[mostly B2B transactions]

Types of industries for the natural dyes sector

- Artisanal
- Niche realities

[Natural dyes are still little used by large industries]

Opportunities: comestible plant, spontaneous plant

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MAIN GAPS AND OPPORTUNITIES

GAPS

- Variability
- Unavailable areas needed
- Sustainability
- Cost
- Lack of scientific/ technical Knowledge

OPPORTUNITIES

- Uniqueness
- Promote niche markets
- Improvement of environmental friendliness
- Process development
- Wide potential
- Social benefits

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GROUP 5 – DYEING PLANTS

MULTITRACES

CASE STUDIES AND GOOD PRACTICES

NIA THOMAS

#NATURALDYES
#ORGANICCLOTHING

Website: https://niathomas.co/

BIONAP

#ZEROWASTE
#SUSTAINABLEPRODUCTS

Website: --https://www.bionap.com/

LUSH Fresh Handmade Cosmetics

#NATURALHAIRDYES
#ORGANICPRODUCTS

Website: https://uk.lush.com/

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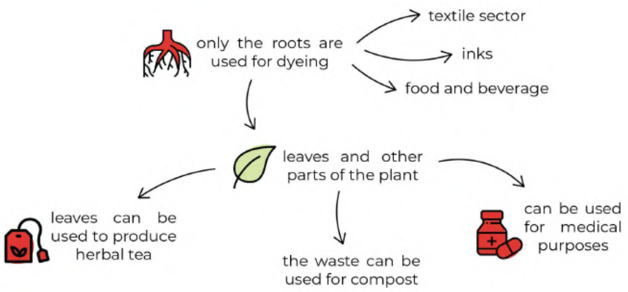
SYSTEMIC PROPOSAL

For Robbia

The roots are used to create a dye that can be used in different sectors.

Focusing on the other parts of the plant, the "waste", we found some alternatives that could make the process more circular, for example the leaves could be used for producing herbal tea or natural medicines.

The roots can also be used to make baskets or soap in a cold press process.



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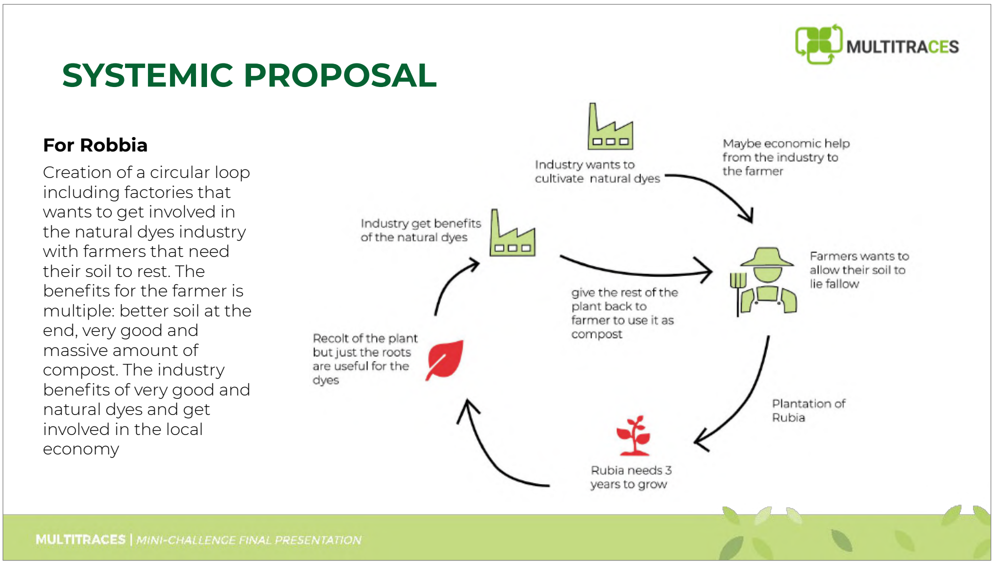
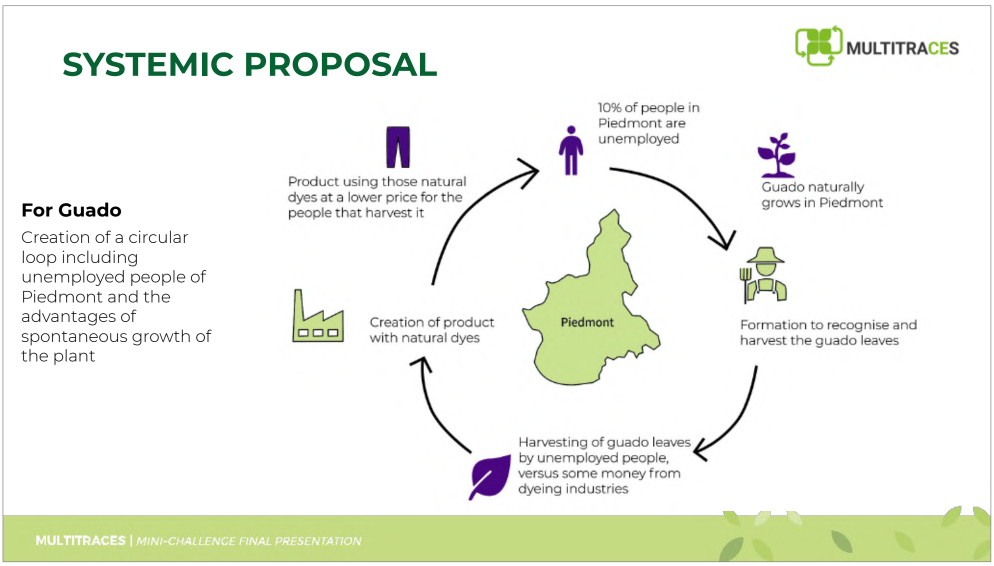
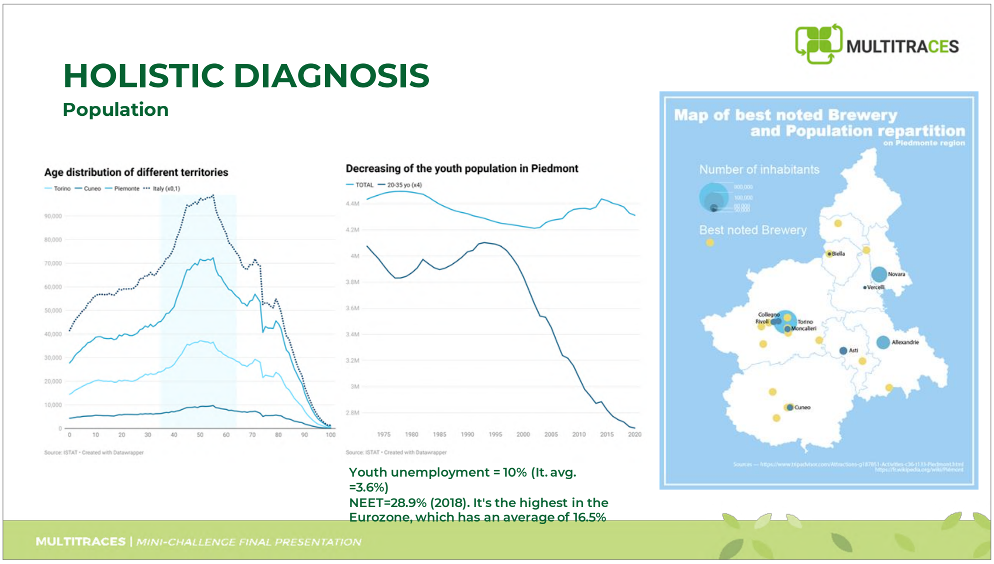
GROUP 5 – DYEING PLANTS

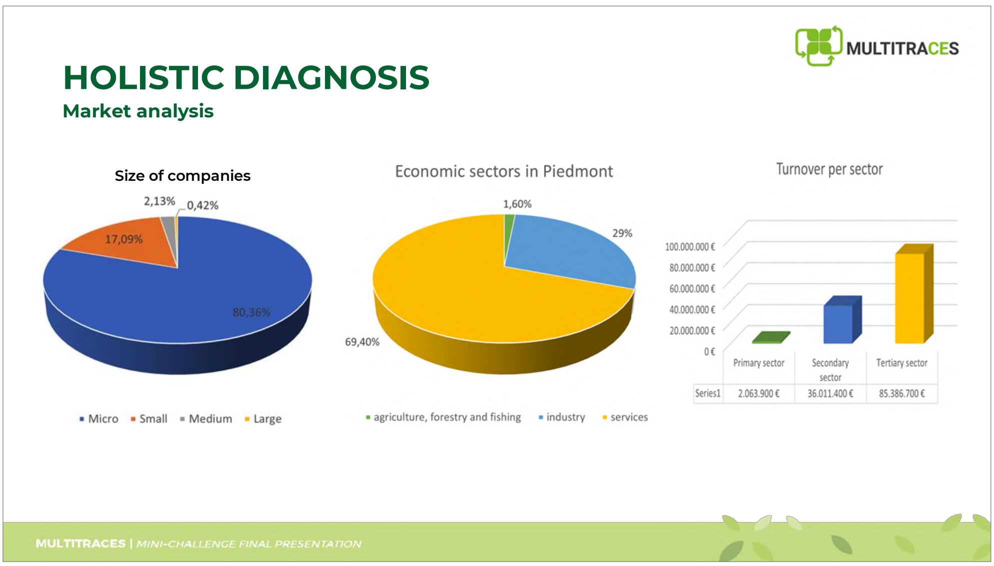




GROUP 6 – BREWING SECTOR

The proposal of Group 6 aims to involve the youth population located in Piedmont. By collaborating with local farmers and investors, they would create an area where separate facilities will exchange primary resources and waste, to create a self-reliant synergic system, environmentally sustainable and socially inclusive.





GROUP 6 – BREWING SECTOR

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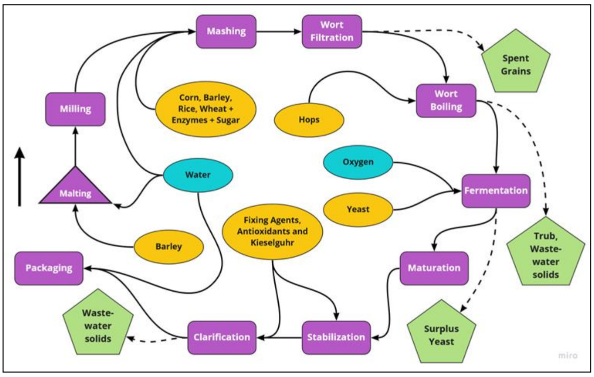
HOLISTIC DIAGNOSIS

Brewery process



INPUTS
Different Grains & Cereals
Hops
Yeast
Water

OUTPUTS
Spent Grains (85% of wastes)
(how many grains/litter)
Spent Rootlets
Spent Hops
Spent Yeast
Discarded beer
Wastewater & Cooling water

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MAIN GAPS AND OPPORTUNITIES

The territory economy is mainly based on the third sector (restaurant, bars, services in general): they constitute a huge network that could be improved

Youth employment

NEET = 28.9% (2018)
-> The highest in the Eurozone ! (average of 16.5%)

Youth unemployment (under 25 yo looking for a job)) = **28,6 %**

In 2015, **youth homeless** represents 13.012, 25 people between 18 and 34 yo, so **25,.7%** of the total amount of homeless (ISTAT 2015)

Food saving

Food wastes represent the **3rd greatest contributor** of greenhouse gases (after US and china)

~2L of beers represent **450g of cereal** wasted

Circular Economy

Build up **resilience** for the future

Consider waste as a resource

Create **interdependence** between different sectors of activities

https://www.npr.org/sections/money/2020/02/18/807025154/ciao-italia-why-italys-youth-are-leaving-in-droves?t=1615482238156

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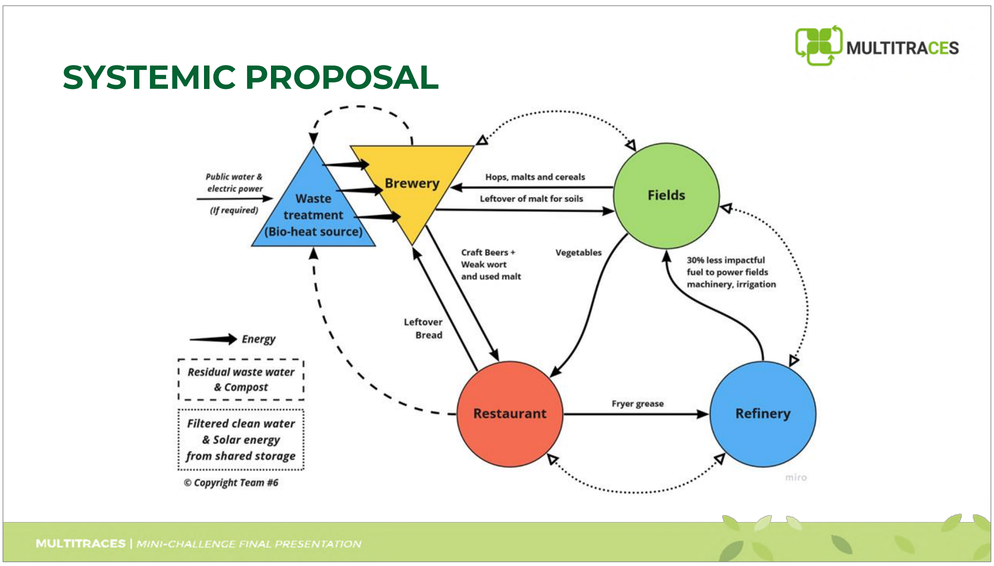
GROUP 6 – BREWING SECTOR



GROUP 7 – DYEING PLANTS

A very important aspect for Group 7 was to create a link with the territory and with the historical origins of the Guado plant, used for body painting. This is why their attention was focused on companies in Piedmont that could in some way create a link with Agrindustria Tecco, and we found the perfect solution in Carioca (which produces colours) to link body painting sector.

Details about the cultivation

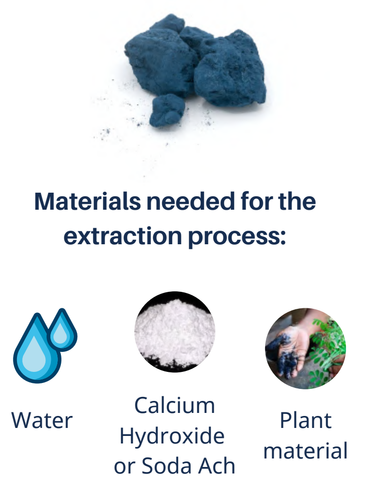
- Guado is a plant of easy cultivation that is re-seeded on its own even if it does not like to exploit the same soil twice.
- Guado is a biennial, or occasionally a short-lived perennial plant, usually monocarpic, perennial.
- Treating the soil with nitrogen can help produce a deeper blue dye.

Can we make the growing process more sustainable?

We surely can!

For example, organic fertilizers such as bone meal can be used in order to increase the amount of nitrogen in the soil

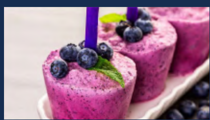
GROUP 7 – DYEING PLANTS



GROUP 7 – DYEING PLANTS

Case studies and good practices

COLORGANICS



#Territory
#Healthy

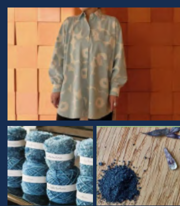
www.colorganics.co

BAN LAN GEN

#Roots
#Naturalmedicine

www.ncbi.nlm.nih.gov

FINNISH INDIGO



#Environment
#Protectyourskin

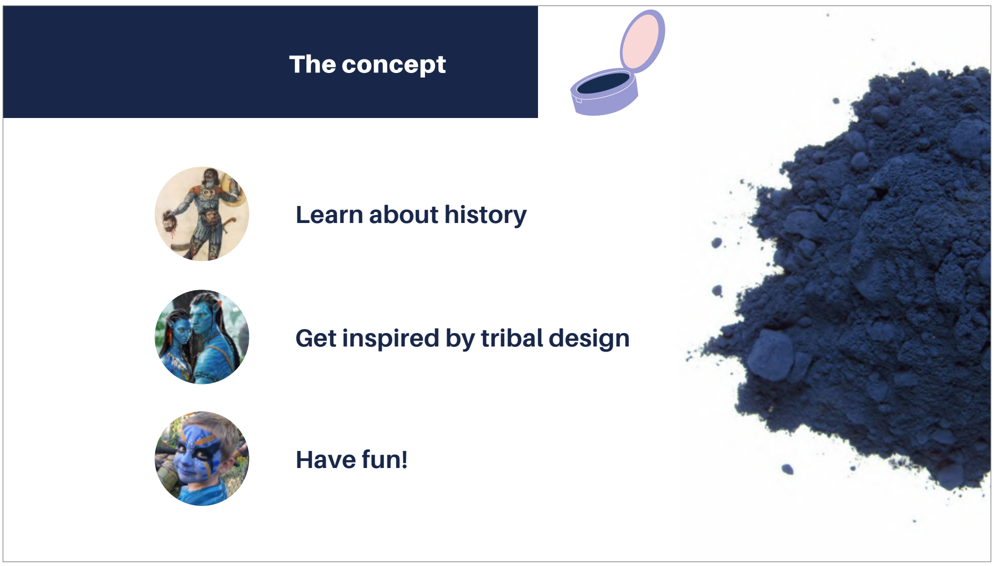
www.marimekko.com

What are we going to use the dye for?

FACE Paint!

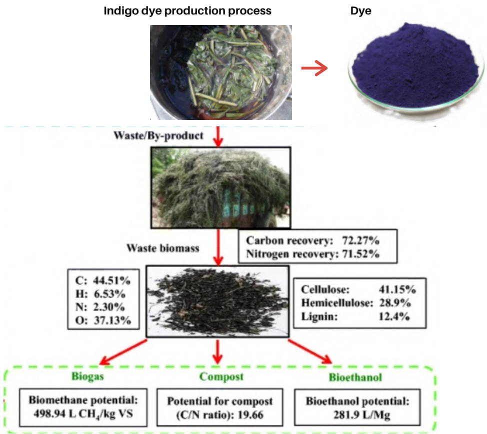
The indigo dye that is extracted from guado has an extremely intense color, making it a perfect pigment to be used for paints.

GROUP 7 – DYEING PLANTS



GROUP 7 – DYEING PLANTS

What could we do with the leaves after the extraction?



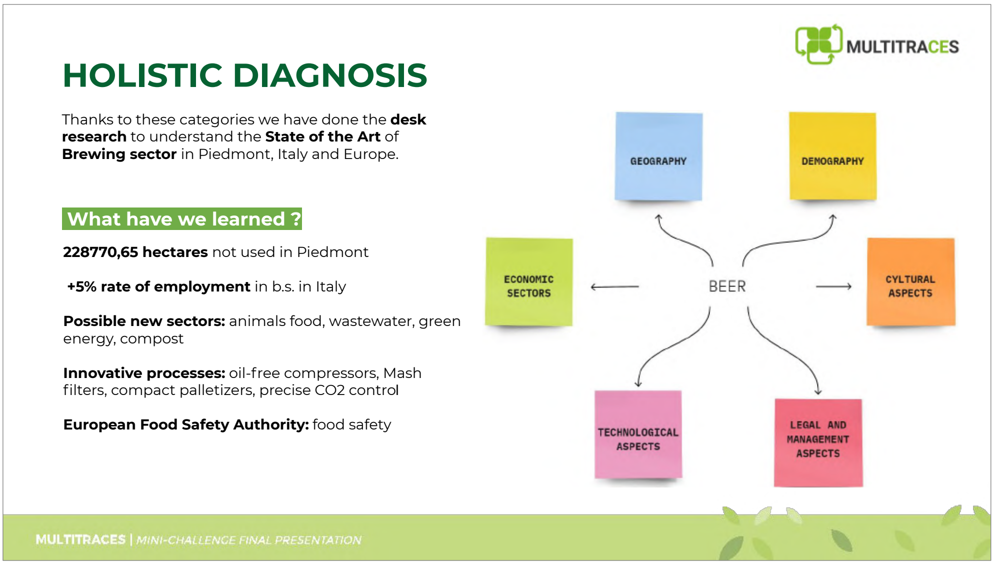
What could we do with the rest of the plant?

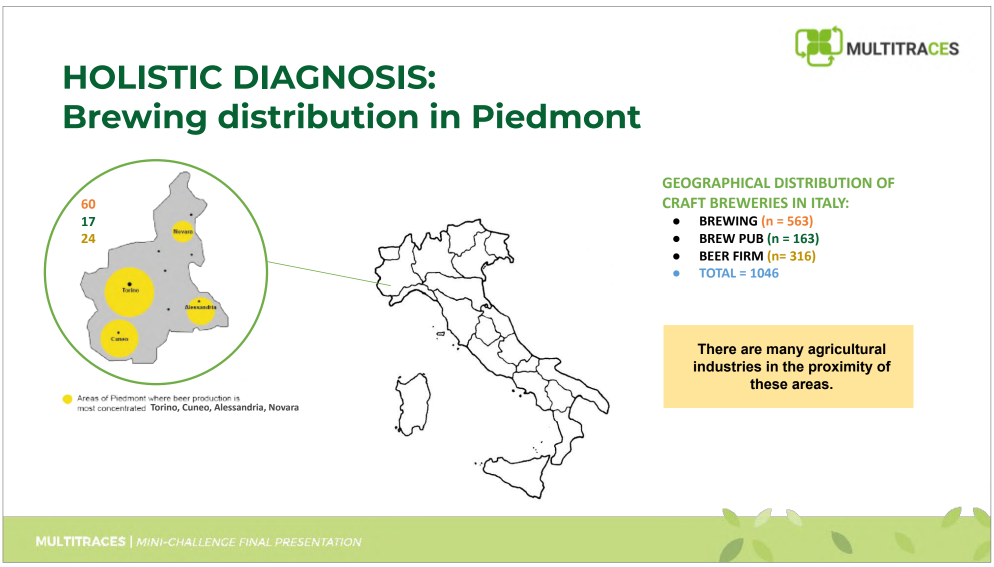
Having antibacterial and antibiotic properties, guado is one of the most common herbs used in TCM (Traditional Chinese Medicine)

Specifically, the roots can be used to remove inflammations and toxins in our bodies, for cooling the blood, relieving sore throats and treating scratches or swellings. The root is simply dried up to make an extract or chopped in small piaces.

GROUP 8 – BREWING SECTOR

A solution highlighted by group 8 was to improve the power of the piedmontese industries giving them new possibilities to exchange their waste products (fruits, vegetables, wealth...) with local breweries to include their production cycle in a circular economy strategy, to made new and innovative products.





GROUP 8 – BREWING SECTOR

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MAIN GAPS AND OPPORTUNITIES: SWOT Analysis

STRENGTH

- The **hop plant** adapts well to different Piedmontese microclimates
- **Centennial tradition** of craftsmanship
- **Partnership** with local/agricultural industries

WEAKNESS

- Excessive **water consumption**
- **High energy demand**
- **Rejects in all production steps**

OPPORTUNITIES

- Development of a **traceability system** for companies involved in beer production.
- **Four innovative methods**: the oil-free compressors, the mash filters, the compact palletizers and the Precise of the O2 control.

THREATS

- The **adulteration** of food
- **Fraudulent practices** that deceptives the consumer
- Weather
- Competitive prices

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CASE STUDIES AND GOOD PRACTICES

PROFLOC

#NEW WAY OF ANIMALS NUTRITION

Website:https://www.cronachedibirra.it

CANVAS

#NATURAL ENERGY DRINK FROM BEER

Website:https://www.green.it/riciclo-degli-scarti-alimentari/

REGRAINED

#RESCUES NUTRITION GRAIN CREATED WHEN BEER IS BREWED

Website: https://www.regrained.com/pages/about-us

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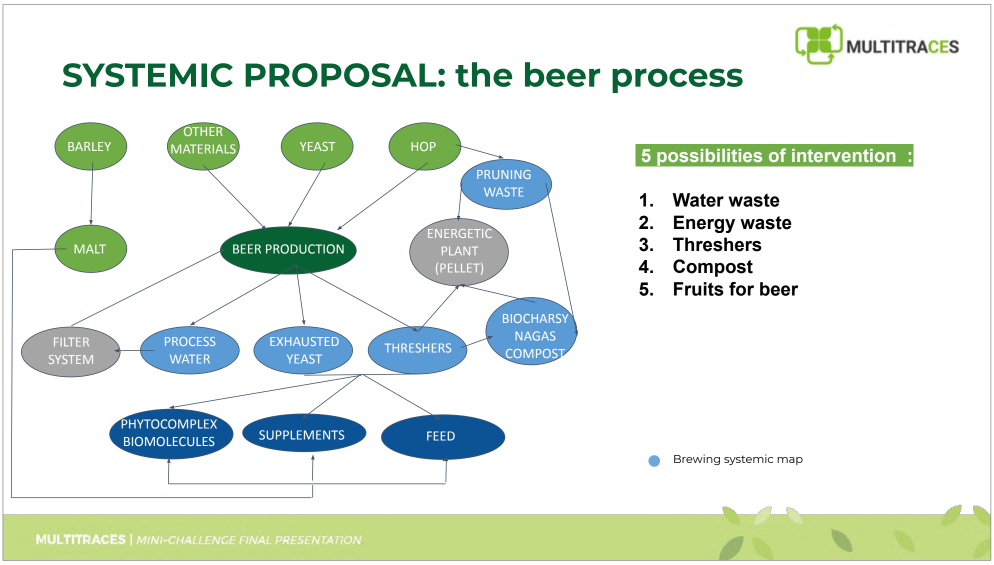
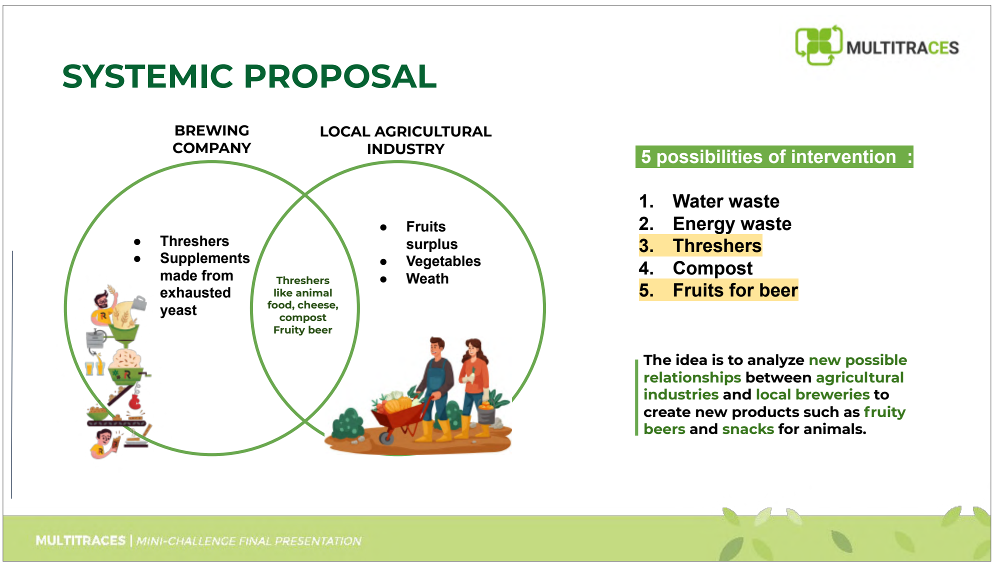
GROUP 8 – BREWING SECTOR





INTELLECTUAL OUTPUT 5

MULTITRACES

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