Transitions Hub

EIT Climate-KIC

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Challenge-led System Mapping

A knowledge management approach

Handbook for the design and implementation of participatory system mapping processes addressing system innovation

Climate-KIC is supported by the EIT, a body of the European Union

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The activities leading to this guide were carried out as part of a collection of projects and actions that received funding from the EIT Climate-KIC Innovation Framework..

A slow revolution is underway in how we think about and act upon the challenges of climate change and environmental sustainability. From a past preoccupation with promoting specific supply-side technologies, a new research and policy focus is instead on transforming end-use socio-technical systems. The International Energy Agency sees three urban systems – mobility, buildings, and energy – as the key to a low carbon transition. The European Environment Agency highlights food as a fourth critical system for a sustainability transition.

Enabling transitions in this core set of socio-technical systems requires radically novel advances in practice-based knowledge to underpin a new type of transformative innovation policy. EIT Climate-KIC, in its recent strategy 'Transformation in Time', expresses exactly this ambition - to develop knowledge and innovation capabilities to enable systems innovation. Practice-based knowledge requires a synthesis of actor-oriented practices such as 'learning by doing' with analytical frameworks to understand 'the properties of systems'.

This handbook is an impressive contribution to the fulfilment of such aspirations. It combines knowhow in practical participatory methods with insights and methods of knowledge management and social network analysis. The result is a powerful handbook for transition practitioners. It offers an original and useful mix of insights on system mapping process and tools. Utility for the user has been the overarching principle in its design.

The genesis of this guidebook lies in activities supported by EIT Climate-KIC, including the Transition Cities project in which I was privileged to be a participant. Further projects and programmes implemented in the northwest, south and east of Europe followed the same approach of bringing together local officials with transition specialists to promote transformation of their urban and regional systems of mobility, buildings, energy and circular economy. The challenge was to situate the diversity of ongoing climate actions in a socio-technical systemic perspective to facilitate more effective strategic transition management by stakeholders, regional and local authorities.

The EIT Climate-KIC Transitions Hub team has done an impressive job in transforming the insights and innovations of a portfolio of projects supported by EIT Climate-KIC into a coherent and accessible handbook. It deserves a wide audience.

Fred Steward
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Member of the Scientific Committee, European Environment Agency

Background

The scale and urgency of the challenge of climate change requires a new model of innovation. The commitment of the European Union and member states to ambitious targets for greenhouse emission reductions and a transition to a low-carbon society has been accompanied by an increasing recognition that these targets must be implemented at the regional and local level.

New practices based on increasing the participation of multiple stakeholders and promoting bottom-up initiatives are thus emerging. They focus on the co-creation of local solutions for systemic transformation. As a result, there is increasing demand among local challenge-owners for flexible tools that are adaptable to address local challenges.

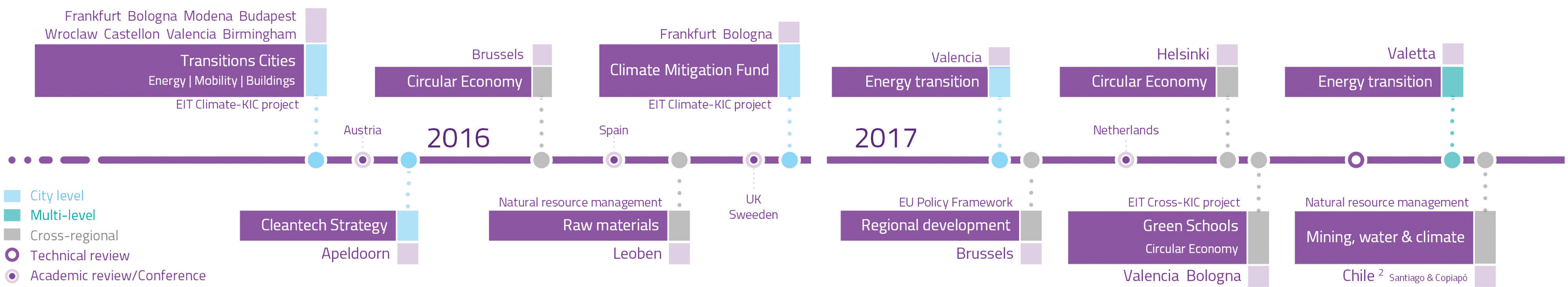
Adopting a system perspective means analysing the relationships between projects and their contexts to determine whether projects can go beyond their experimental status and become mainstream. However, there are barriers to understanding complex systems. Participatory processes can be considered a reliable source of information with controlled biases.

Knowledge management can help significantly improve the participatory processes by harvesting the information and transforming it into systematised knowledge. That knowledge, often describing system components and network mapping, can help to better understand complex systems and, thereby, contribute to decision-making and planning.

System mapping enables the engagement of people who recognise knowledge as an asset. These are communities with shared practices and motivated by collective learning experiences. EIT Climate-KIC and its partners have worked hand-in-hand with challenge owners who seek to better understand the challenge of fostering transformative change in a low carbon economy.

> **Communities of practice** are groups of people who share a concern, a set of problems or a passion for a certain topic and who deepen their knowledge and expertise in this area by interacting on an ongoing basis.

Figure 1: System mapping processes implemented 2015-2020

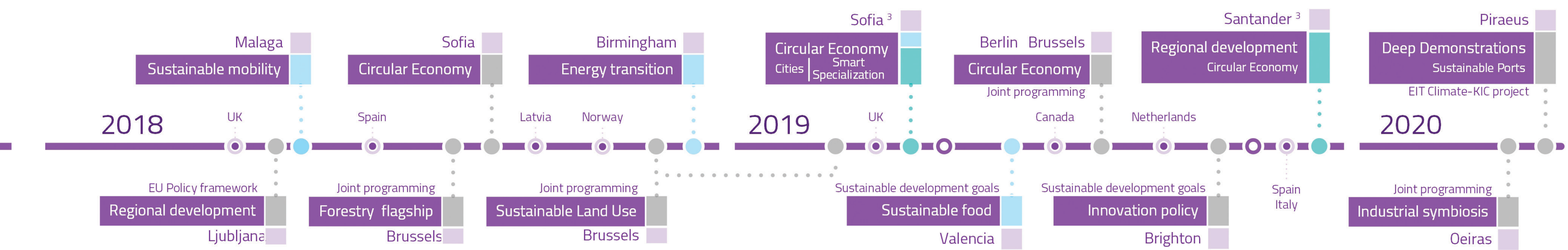


An evolving methodology

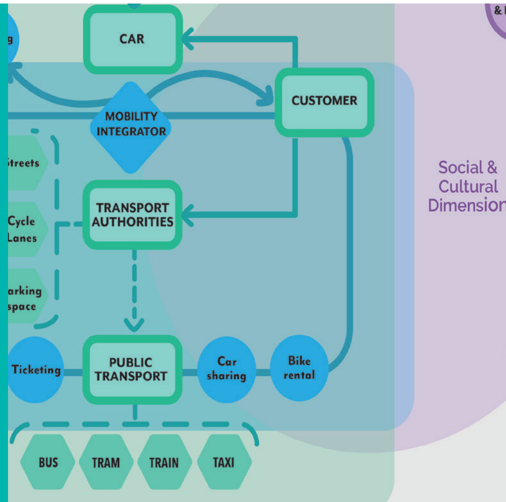
The challenge-led system mapping approach has been developed through the implementation of different EIT Climate-KIC activities since 2015. Key insights originated as part of learning processes from 2012 embedded in several EIT Climate-KIC projects, such as Pioneer Cities (2012-2014), Transition Cities (2014-2017) and Circular Cities (2018-2019), as well as the EIT RIS Programme. The approach was tested in over 40 initiatives in European and Latin American cities, realised in collaboration with EIT Climate-KIC and both policy and scientific actors.

This methodology is in constant evolution and should not be considered an exact formula. Indeed, it is precisely its adaptability to new environments that has been fundamental to its success. The first experiment with socio-technical mapping by city challenge-owners was introduced by the Pioneer Cities project in 2012 when multiple stakeholders were able to identify solutions on the ground, while the Transition Cities project (2014-2017) entailed a major investment in multi-city collaboration built on these results. It explored a mechanism to facilitate the development of practice-based knowledge to help cities facing climate change challenges to focus on a systemic innovation approach.

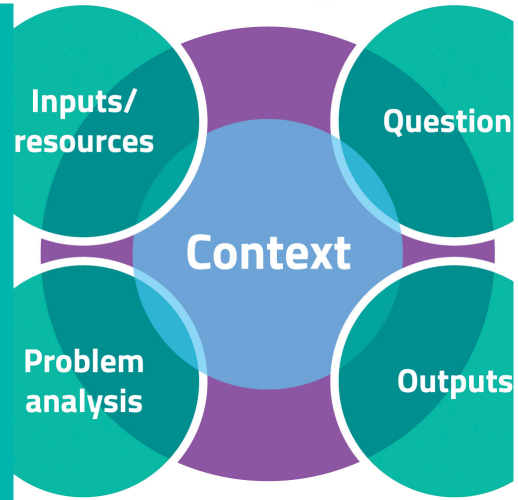
Since 2015 the EIT Climate-KIC Transitions Hub has contributed to these actions with new insights into participatory methods, knowledge management and visualisation. More recently, new areas of action include multilevel and cross-regional policy-driven processes as well as co-creation spaces for joint programming. Throughout the co-creation and learning process, empirical and methodological aspects were simultaneously presented and discussed in a variety of academic and policy forums. The resulting methodology included in this handbook harvests the lessons learnt from what we have achieved. It is aimed to foster "learning by doing" practices to encourage practitioners to improve and move forward together.



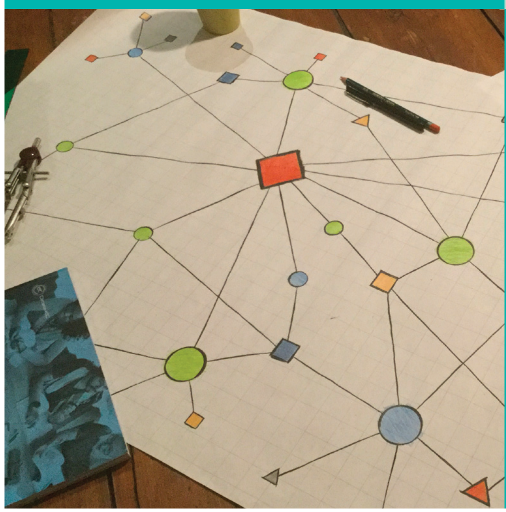
Content



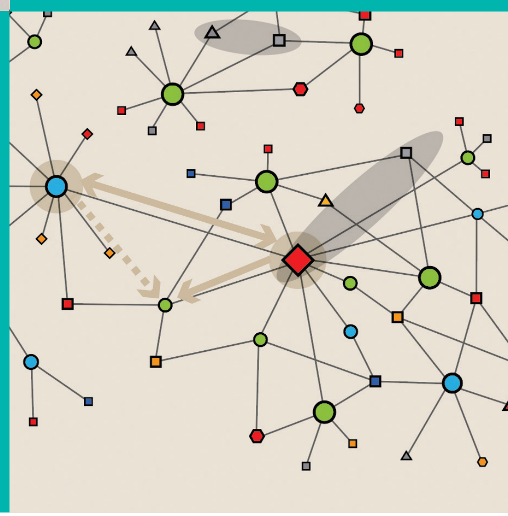
CAR
CUSTOMER
MOBILITY INTEGRATOR
TRANSPORT AUTHORITIES
Cycle Lanes
Social & Cultural Dimension
Ticketing
PUBLIC TRANSPORT
Car sharing
Bike rental
BUS
TRAM
TRAIN
TAXI



Inputs/ resources
Question
Context
Problem analysis
Outputs




WHO



Why this handbook?

This handbook summarises what we have learnt. It was designed to be simple for practitioners to use as a complementary tool for participatory processes based on visual tools. It makes a good companion to **The Visual Toolbox for System Innovation**, a handbook of ready-to-use visual tools for system analysis and network mapping. These tools, along with other tools designed by organisations such as the Joint Research Centre, have been applied throughout the development of this handbook in defining challenges, analysing and visualising systems, and, by extension, exploring opportunities for system Innovation.

The handbook follows a co-design logic in terms of process, principles and practical tools to support practitioners in the design and implementation of system mapping processes by highlighting the knowledge management component. The **Challenge-led system mapping approach** responds to the need to improve the practitioner's capacity to move towards transformational system change by providing horizontal mechanisms to work with challenge owners and other actors (PROCESS).

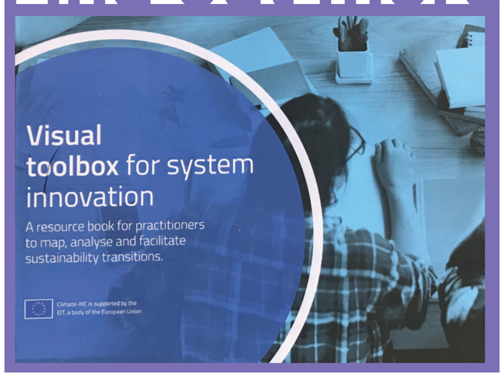
Knowledge management a good practices for analysis and communication responds to the increasing needs to use participatory methods to co-produce practice-based knowledge and make them accessible for practitioners (PRINCIPLES).

Additionally, networks as analytical tools are included based on lessons learnt from different projects (TOOLS).

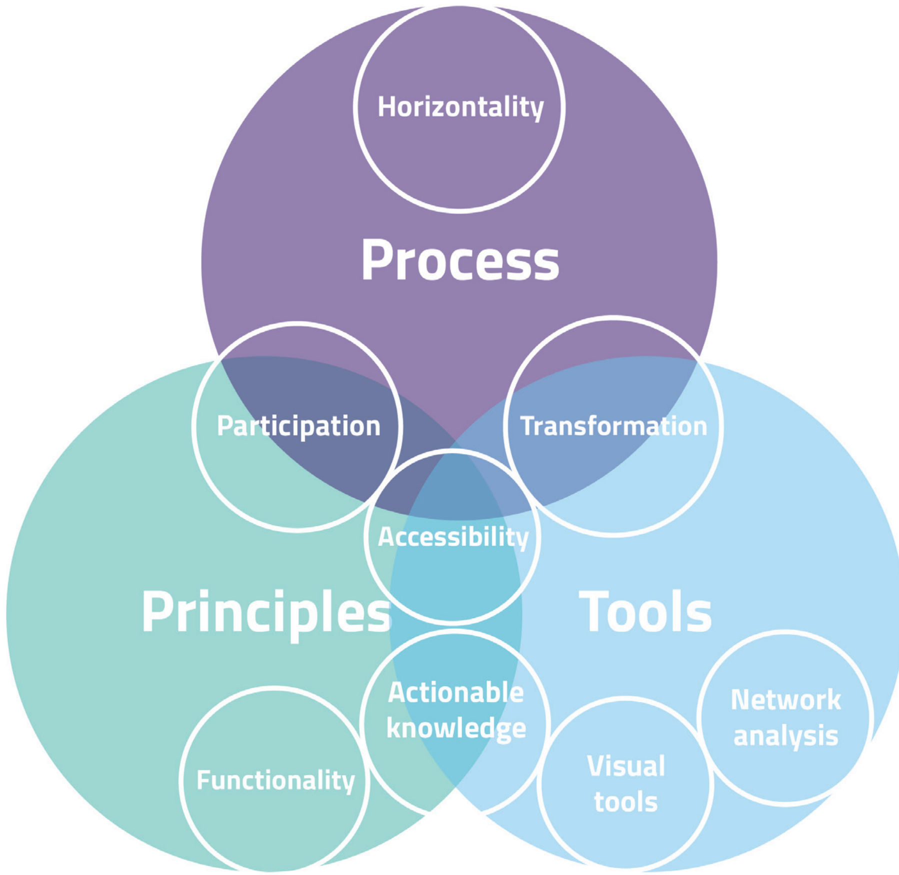
As a practitioner you might wish to:

- visualise the diversity of projects as a manageable set of clusters;
- mediate and facilitate a dialogue on priority setting and opportunities for innovation amongst multiple stakeholders;
- identify priorities for financial and political support;
- replicate projects in new contexts or connect them with other innovation initiatives;
- embed projects in a wider system to then scale up and foster transformation;
- create a space protected from external pressure and early failure.

Find out more



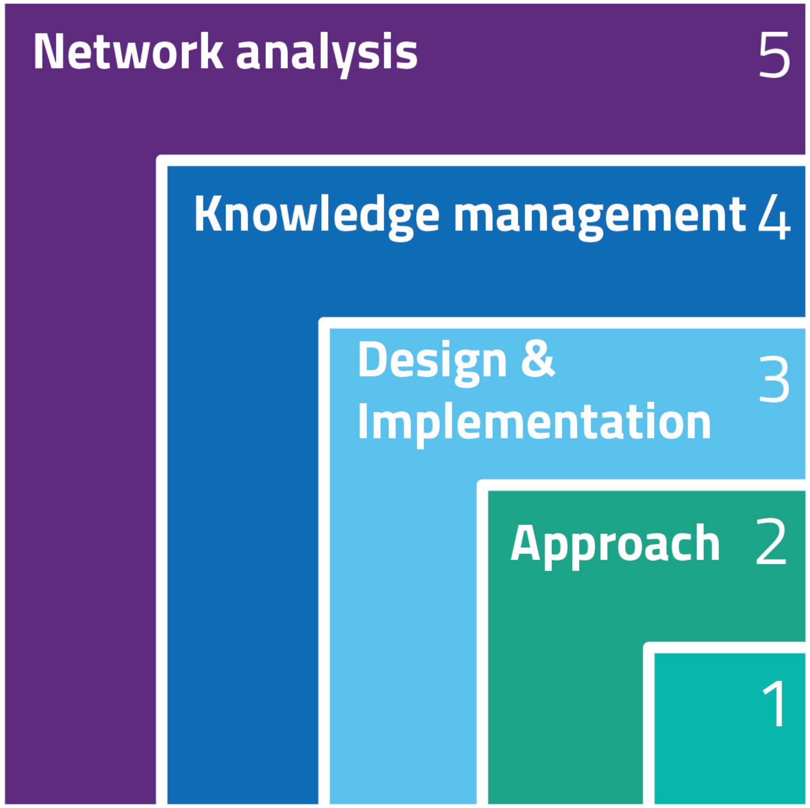
Practitioners are users of practice-based knowledge who are active in SMEs, applied research projects, NGOs and local or regional governments.



How to read the handbook

This handbook offers a step-by-step process to guide practitioners, from simple concepts and examples to key elements for practical application.

Chapter 1 focuses on defining key elements and creating a framework of common understanding. Practitioners without facilitation experience are highly encouraged to dive into the different examples and concepts.



Chapter 2 captures the essence of the challenge-led system mapping process by providing an explanation of the overall approach and a practitioner-oriented narrative.

Chapter 3 focuses on the practical aspects of the system mapping process and the narrative regarding the modular format and specific components.

Chapter 4 covers the knowledge management process, from the fundamentals of knowledge management to the step-by-step explanation of data management, analysis and knowledge visualization and communication.

Chapter 5 consists of an in-depth look at network analysis and its application in visualisation. This chapter includes practical knowledge regarding network maps and how to interpret them.

This handbook comes with complementary material, including around 200 slides with detailed step-by-step explanations of visual tools and examples. Posters and different knowledge visualisations are also available in the online knowledge repository of EIT Climate-KIC Transitions Hub.

A system can be described, broadly speaking, as anything that is not chaos. A structure formed by several elements and the relationships established between them. These structures can change according to the influence and evolution of individual elements. Consequently, there is a need to develop a coherent framework, as well as methods of analysis, to establish existing internal and external processes.

Chapter 1

Socio-technical systems

In this chapter:

- System innovation
- Regions and cities as socio-technical systems
- A transition example for mobility system

System innovation

Technological innovation is an important driving force in addressing the problems of our societies today. However, technology does not change social structures and human attitudes by itself. Understanding socio-technical systems is thus fundamental to pursuing the goal of transformative change.

Socio-technical systems are complex because they combine two different system types: social and technical. Social and technical systems complement and shape each other. Interactions within social structures need technical infrastructure, while the creation of new technologies serves to mobilise social systems.

Social systems do not have structures, but they do exhibit structural properties as a result of emergent social and behavioural changes. The development of their characteristics cannot be planned and controlled with respect to the outcome; the changes within socio-technical systems are a matter of contingency and can only be understood retrospectively and not in advance. Social systems mainly serve their own needs.

Technical systems are produced and continuously adapted to provide a reliable, predictable relationship between user input and the system's output. This relationship is engineered and preplanned to serve the needs of users.

System innovation is defined as a transition from one socio-technical system to another. System innovation requires active learning and continuous evolution, but innovation and learning are two sides of the same coin; when leveraged together they are the most effective means to catalyse transformation.

Some historical examples are the transition from sailing to steam ships, the transition from horse and carriage to automobiles, and the transition from piston engine aircrafts to jetliners in American aviation. Much more profound examples of system innovation are the agricultural and the industrial revolutions, both of which fundamentally changed how societies operate.

We are currently experiencing another profound system innovation determined by the rapid development and dissemination of information and communication technologies. Throughout this transition, product and innovation processes are affected, but changes also occur in user practices, markets, policy, regulations, culture, infrastructure, lifestyle, and corporate management.

Transformative changes are complex, long-term and messy processes in which dominant practices become replaced. Complex socio-technical systems such as cities normally do not change by themselves. Actors play a key role in shaping desirable transitions through transformative activities.

Transformative activities can be defined as a collection of related innovation capacities and actions, extracted from existing structures and oriented toward a certain direction of change. They are intended to bring a demand-led logic through a portfolio of deliberate, connected innovation experiments that address the socio-technical system across multiple value chains.

A **portfolio approach** can be designed to generate viable pathways to change and rapid learning while reducing the risks that come with a system innovation approach.

Transformation in time, EIT Climate-KIC defines system(s) innovation as integrated and coordinated interventions across whole value chains in economic, political and social systems, based on a portfolio of deliberate and connected innovation experiments.

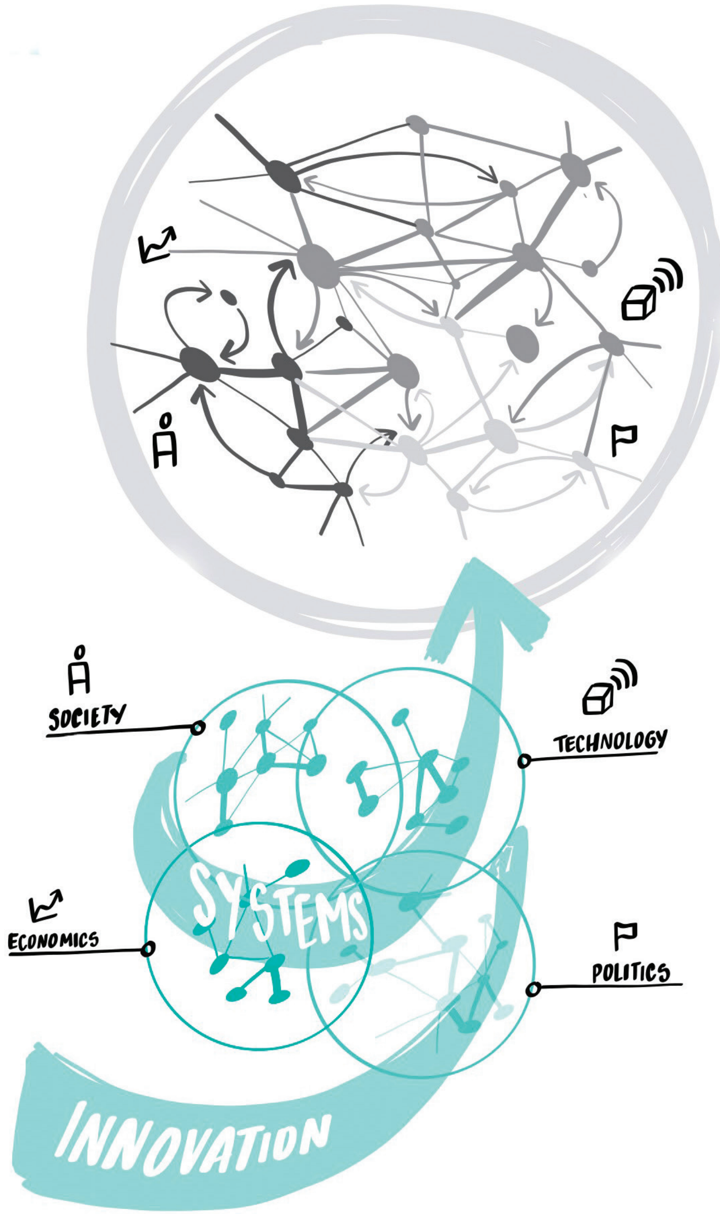


Figure 2: Systems innovation as integrated and coordinated interventions.
Source: Transformation in time (EIT Climate-KIC, 2019)

The learning process and a collective understanding of the system are both critical in identifying options, social and behavioural inflexion points, and in scaling transformative solutions as part of system-embedded knowledge processes.

Innovative practices for the co-production of knowledge include:

- A multi-actor process that involves a range of different actors with varying interest;
- An open-ended logic to address a multi-dimensional perspective in which different elements of the socio-technical system, such as technologies, markets, policies and behaviours co-evolving together;
- Facilitative, practice-based learning mechanisms that support the design of portfolios of transformative activities.

The **system mapping** process facilitates learning by enabling a collective understanding of societal problems as part of the combined system assessment and co-design process for a portfolio of transformative activities. System mapping uses the collective intelligence and credibility of a community, emphasising the role of individual and collective agency. In this critical first step, intermediary roles, leadership and brokering relations can emerge, catalysing transformative change in complex systems.

Regions and cities as complex socio-technical systems

Regions and cities are complex socio-technical systems that are critical contributors to greenhouse gas emissions. In cities, there is often a combination of different sub-systems:

- Physical: buildings, infrastructures such as energy, waste, transport and water;
- Social: human behaviour, interaction and activity;
- Economic and political: value chains and regional strategies
- Natural: vegetation, water, animals and landscape.

Complexity can be considered the effect of multiple connections, i.e. the interconnectivity of interactions between the different subsystems and their broader environment. Two questions very often arise when we try to understand this complex interrelationship:

- The relations within a subsystem: how complexity at one level or in one set of interrelated elements becomes elementary at the next level.
- The dynamics of the broader system: how systems with different internal dynamics interact with each other (e.g. relations between mobility infrastructure, energy network and human behaviour) and evolve or adapt in a changing environment.

The notion of socio-technical systems can help to explore and analyse that complexity by looking at the different elements and the complexity embedded in those multiple relations as well as their own emergent dynamics – independent of the complex processes that created them.

Those dynamics involve changes in technology, knowledge, economic and physical structures as well as cultural and social aspects, such as habits, preferences and needs. System innovation seeks transformative change involving all the elements and structure of socio-technical systems as part of interrelated multi-actor processes.

Socio-technical systems often focus on a specific technology. From a system innovation perspective, relations across economic sectors and technologies need to be considered in order to achieve transformatives changes.

Networks can be used as a metaphor to shape a socio-technical system. In the context of innovation, a network can be defined as the linkages between companies and other organisations to enable actors to benefit from information about opportunities and threats, to acquire technical and market knowledge and to gain better access to different inputs. In practice, networks can be defined within a geographic area (a city or region) and/or relate to a specific sector (e.g., energy). See Chapter 5 for more information about network analysis.

Community engagement for energy access
PROSPECTUS project
Birmingham, December 2018

Socio-technical systems in Mining
Cross-KIT EIT Climate-KIC & EIT Raw Materials
Leoben, May 2016

Scenario building on Climate mitigation
Climate Mitigation Fund project
Bologna, March 2017

Intent Workshop
Maritime Hubs Deep Demonstration
Piraeus, February 2020

Sustainable food systems
Community workshop
Valencia, May 2019

A transition example for mobility system

"Will cities ever have sustainable mobility systems? Well, technology will be ready for this in 20 years – but, it's way too expensive for the market!"

This is something we often hear people saying, when we talk about the future of mobility. But is this really true? Let's take the ownership of individual cars as the starting point for our example. According to the German mobility study, the overall distance covered by a car per day is around 40 km amounting to 84 minutes net travel time per day. This means that cars are parked for more than 22 hours per day! How expensive is this for each car owner, compared to an electric vehicle that is shared by different users throughout the day?

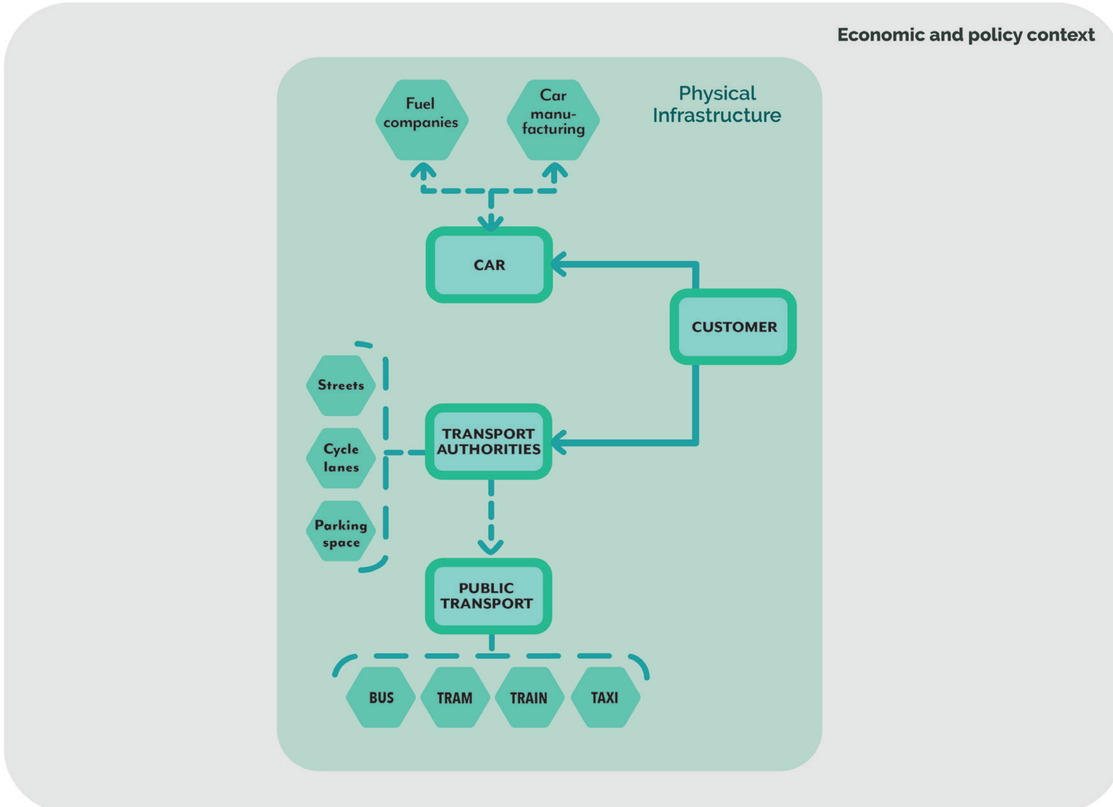


Figure 3: Mobility system example (I)

What does this socio-technical mobility system look like?

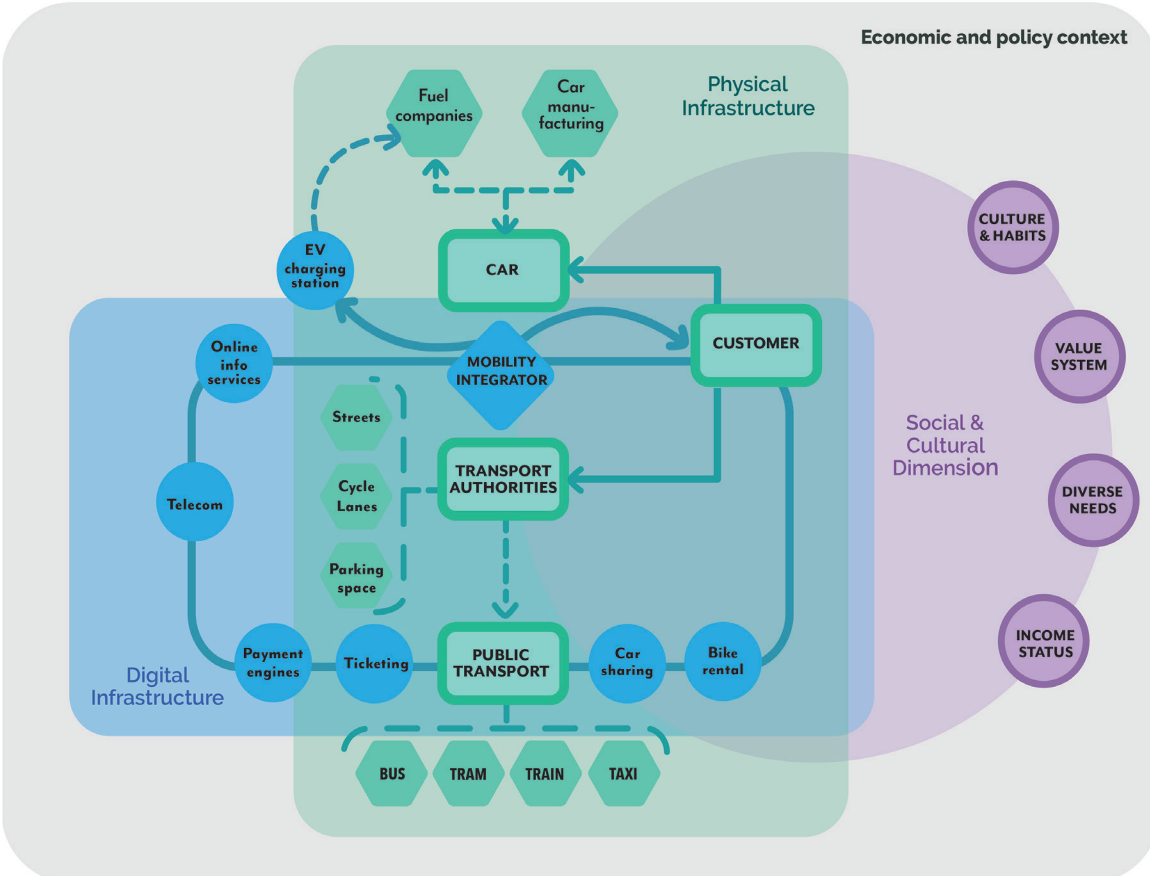
Economic and policy context. Variables such as policy frameworks, economic growth, geography and demography affect demand as well as related technology and energy alternatives. These variables are embedded in a broad socio-technical system where economic and political aspects shape the general rules of society, markets and the allocation of resources.

Physical infrastructure. If we look at public transportation, it is possible to identify the technological components and infrastructures that are part of the service. Physical infrastructure supports terrestrial networks and terminals, and also provides interconnectivity between them (multimodal terminals).

There are cars that can run on electricity, renewable natural gas and fuel cells. But what if we changed all fossil-fueled cars to electric ones? Our cities would still be full of traffic jams. Moreover, if the electricity is still generated from burning fossil fuels, emissions are only shifted out of the cities to where the power is generated. From a global perspective, the overall amount of emissions is not reduced.

Thus, a real transition is only feasible if sufficient electricity from low-carbon-renewal energy technologies is available to charge the vehicles. Therefore, fuel companies in the future will most

Figure 4:
Mobility system example (II)



likely be very different from what we are used to nowadays. Furthermore, car manufacturing is currently undergoing substantial change to meet the requirements of making cars drive with different engines. These changes in turn influence the way customers refuel (recharge) their vehicles, while also giving rise to the need for novel service infrastructure for recharging.

Social & Cultural Dimension. Ultimately, we are all subject to deeply rooted habits, which delineate our individual comfort zone, when it comes to many aspects of our daily lives. These are determined by many factors, such as culture, status, routines and belief systems.

For some, their personal vehicle feels almost like a second home, always at their disposal. As such, they fear that by abandoning it they stand to lose out on comfort and convenience. However, with fewer cars, one can only imagine how much urban space we would gain for green areas, safe bike lanes, pedestrian areas and food production. In this way it is worth looking at what we stand to gain, rather than what we stand to lose, in order to encourage behavioural change.

Digital infrastructure. This is where digitalisation comes in and adds an additional piece of the socio-technical transition puzzle.

If car-sharing systems would meet the variety of user's needs, there would be less C02 intensive mobility practices whilst allowing people and goods to be transported in a cost and time efficient way.

Digitalisation will allow for the provision of much more convenient services than we know today. For example, using a mobility integrator (see image), one would be able to use their smartphone to summon a vehicle that would take both them and their bike home.

Regional innovation and low carbon economy
EIT Climate-KIC & Joint Research Centre
Ljubljana, March 2018

System mapping is an interactive, participatory approach whereby multiple actors use visual tools as well as open, facilitated and dynamic discussions to collectively create a common understanding of the socio-technical system in which they are embedded.

Chapter 2

Challenge-led system mapping

In this chapter :

- The approach
- System mapping process
- Collective construction of socio-technical systems
- A system mapping story

The approach

The challenge-led system mapping process is intended to help tackle design sustainability challenges and support the creation of a proactive and interactive environment for a wide range of participants, in which different actors – such as managers, researchers, civil servants, business and civil society representatives – explore a common understanding of the system in which they are embedded. These actors have a variety of interests and hold differing levels of influence in the system.

The overall approach takes as its starting point an existing or new, collectively created challenge, often defined using input from an entire community as part of an open and inclusive process. This approach seeks to aid the representation of communities and their common goals by bringing their local knowledge and perspectives to the attention of governmental authorities and decision-makers.

It adopts practitioner-oriented visual tools for use by non-expert participants, avoiding the use of jargon or technical language. The materialisation of that learning process into **practice-based knowledge** is facilitated by co-created 'concept maps' where concepts and elements regarding specific topics can be written down – usually in one word – and connections drawn between them. Knowledge management is thus an essential aspect in the process, since any single piece of information can be used to contribute to a collectively created notion of the socio-technical system.

The value proposition of this approach is the creation of a **knowledge-based process as a service** for challenge owners and the broader community aimed at enabling them to better understand their system and recognise opportunities for innovation. These **knowledge services** take the form of mechanisms that contribute to the collective understanding of societal problems as part of the combined process of system assessment and co-design for creating transformative activities.

Practice-based knowledge is the knowledge developed and learning acquired by practitioners from designing and implementing diverse actions in a variety of contexts, including new shared understandings gained from exchanges and direct experiences.

Circular economy, cities and utilities
Circular Cities project
Sofia, February 2019

The system mapping process combines expert advice, technical assistance and participatory processes to bring 'analysts' and community 'actors' together to co-produce a shared 'system map' around a certain challenge.

Expert advice is provided through different mechanisms and conceptual frameworks, thus integrating and combining specialised knowledge from local and international communities. In this way, expertise from different policy areas and topics can be drawn upon, ensuring a broader scope. It is essential to direct the dialogue in a specific direction when the challenge is defined together with the challenge owner. This becomes more relevant during intensive exchanges of contextual information.

Technical assistance is defined by the combination of tailored design tools and thematic experts that facilitate the engagement of different stakeholders, operationalise conceptual frameworks and orchestrate the whole system mapping process. It also introduces innovative practices grounded in translational and applied research to enable learning processes with regard to institutional capacity development.

The **participatory process** is a collective process in which knowledge is created through executive workshops, exchange of information and facilitated dialogue between different stakeholders. It is managed by the experts' team, together with the challenge owner. A mix of techniques and visual tools are used to facilitate the dialogue and harvest valuable information to address the challenge and explore opportunities for transformative change

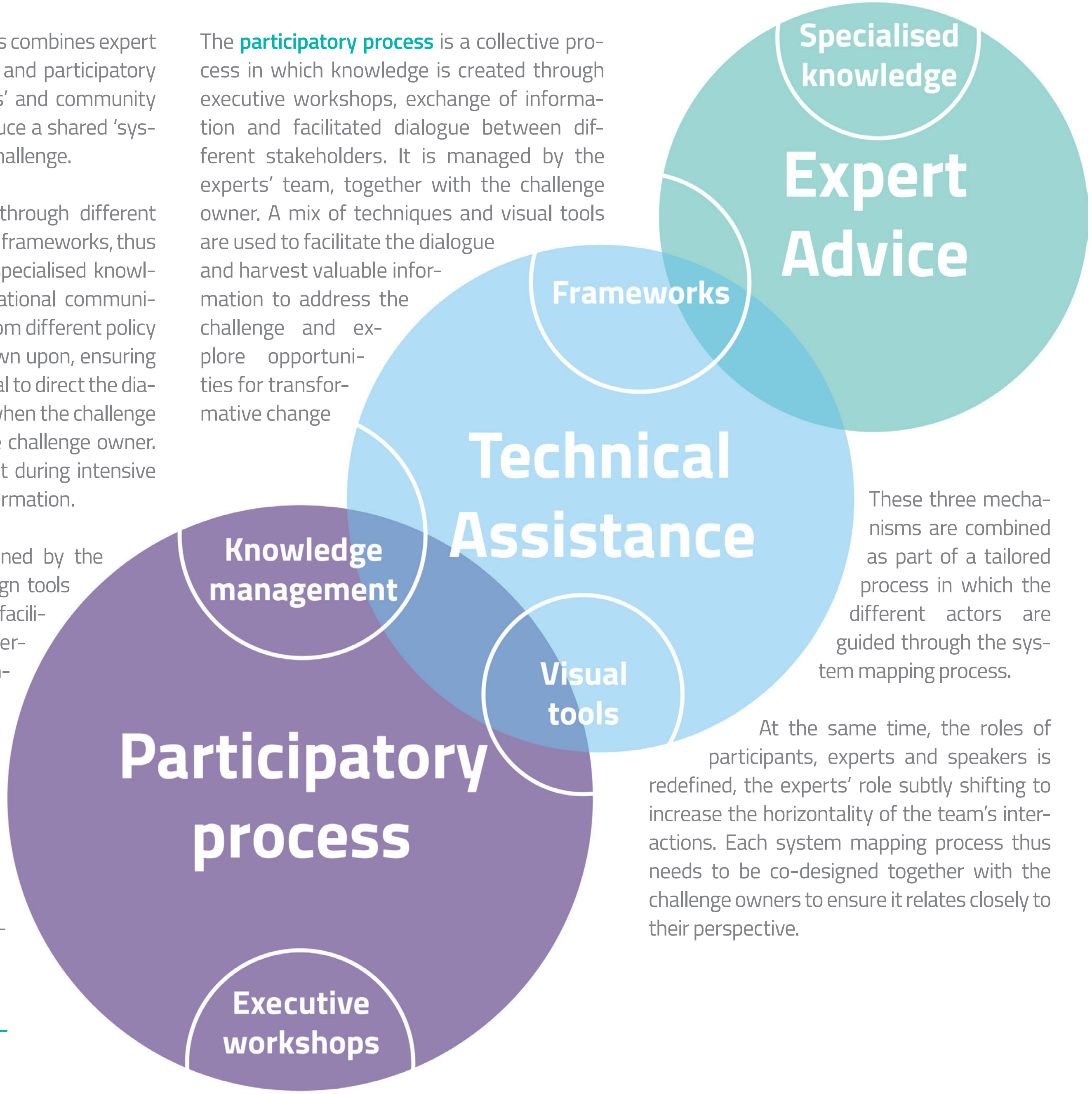


Figure 5: Challenge-led approach

These three mechanisms are combined as part of a tailored process in which the different actors are guided through the system mapping process.

At the same time, the roles of participants, experts and speakers is redefined, the experts' role subtly shifting to increase the horizontality of the team's interactions. Each system mapping process thus needs to be co-designed together with the challenge owners to ensure it relates closely to their perspective.

Blueprint for the system mapping process

Challenge definition is about understanding the context and, in doing so, it is important to align with the challenge owners on some critical elements:

- Problem analysis. A good understanding of the context for system mapping and the maturity of the challenge is fundamental.
- Input and resources. Input needs to be made available regarding the context and the challenges in question, as well as resources such as time, access to relevant actors and funding.
- Good challenges start with simple questions; the search for answers will drive the system mapping process.
- Challenge definitions, resources and questions should help to set expectations and direct output with regard to new information, common understanding and the expected system map.

The design of the system mapping process should rely on a framework with basic principles to better guide the overall process:

- Involving different stakeholders is highly beneficial for a systemic approach as the outcomes tend to be more accepted and sustainable when the process is inclusive.
- Specific policy contexts (e.g. Smart Specialisation, Covenant of Mayors) can contribute to some directionality in terms of output, expectations, available resources and long-term vision.
- The challenge is addressed through framing questions by using the information and indicators (measurements or variables) gathered in the mapping process.
- Prototyping contributes to select and adapt tools and methods for the mapping based on the defined challenge and according to the potential to provide information in answer to the framing questions.

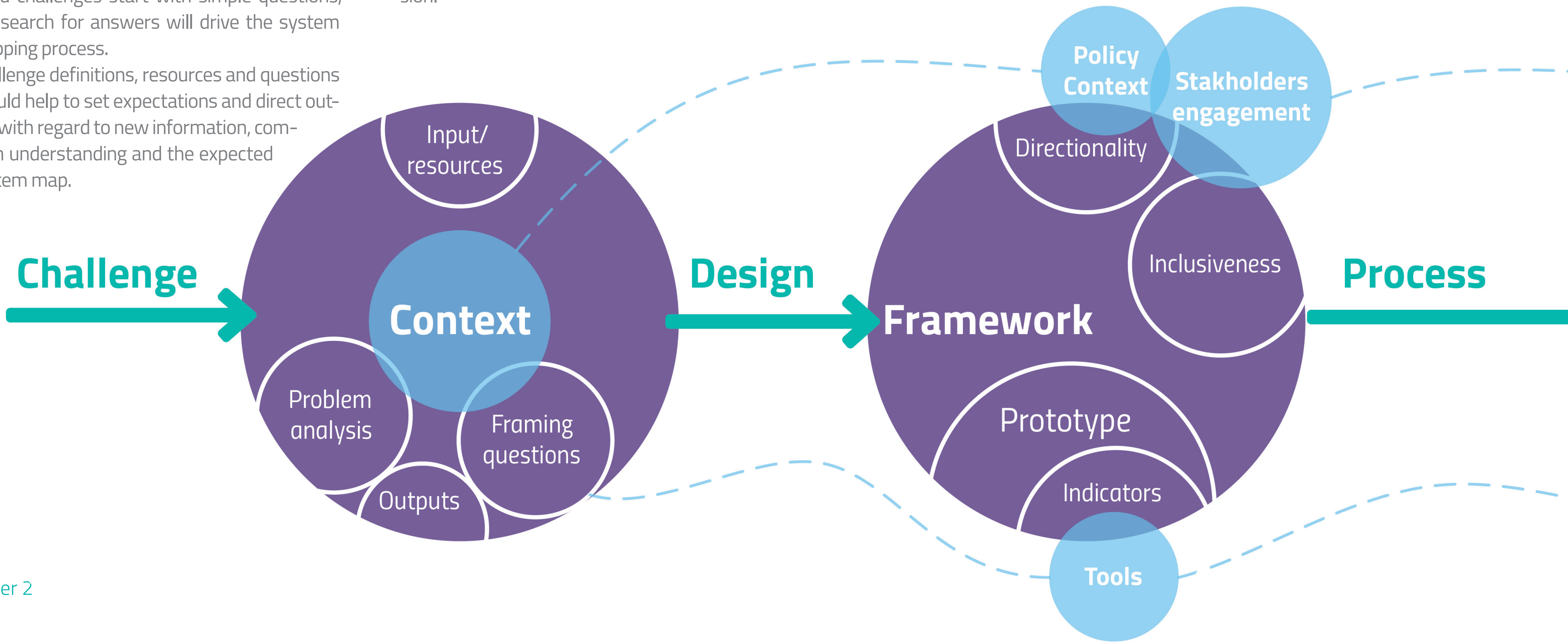


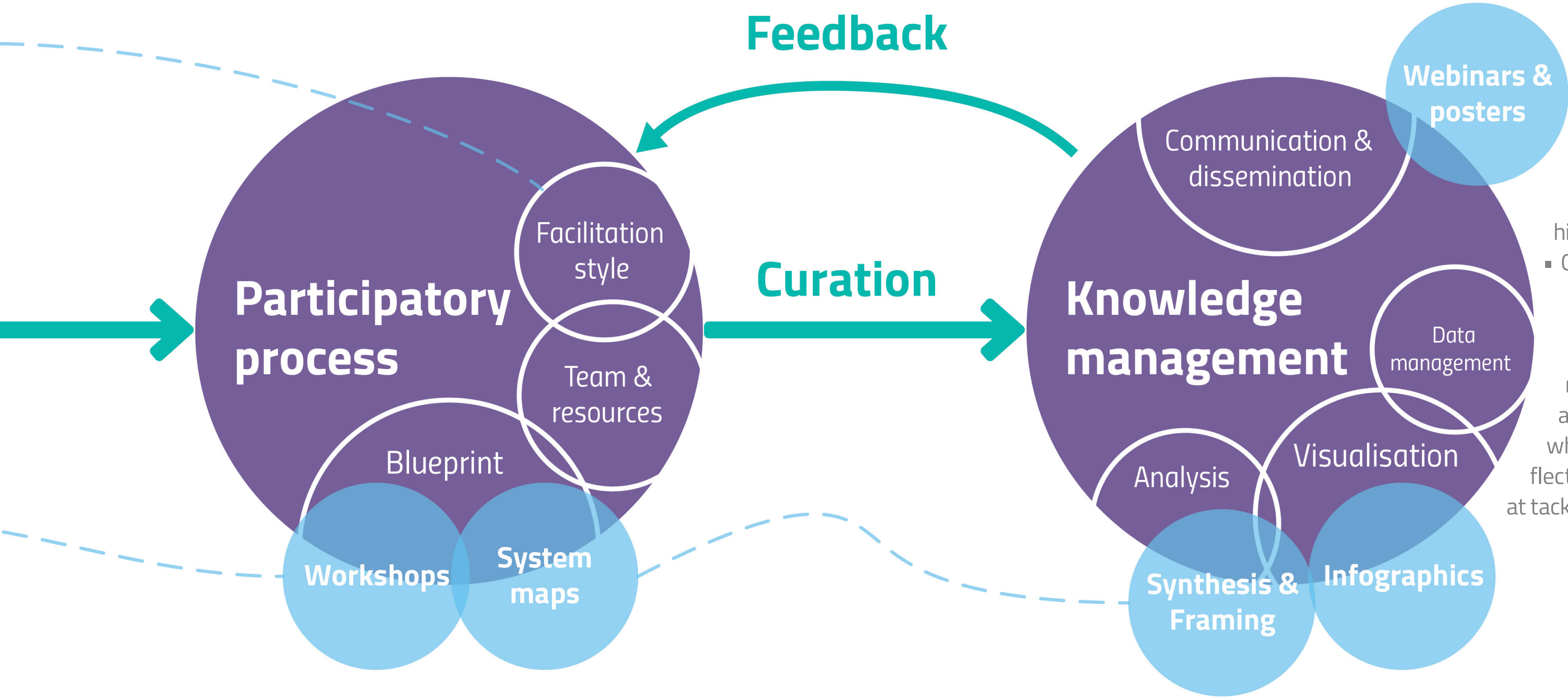
Figure 6: Blueprint for the system mapping process

The participatory process is the backbone of the challenge-led approach to system mapping. At this point, all stakeholders gain a collective understanding of their system:

- Blueprints integrate workshops, team design and resource allocation (tools, materials, physical space) for guiding the implementation of the system mapping process.
- The facilitation style depends on the maturity of the challenge. Early stages are more exploratory than advanced ones, which require more directionality and coordination.
- Policy-driven processes tend to be more guided. They require more attention to establishing the right mindset, managing expectations.
- The core activity is the workshop, but the process includes preparation, implementation and follow-up, as well as managing relations with challenge owners and participants.
- The system maps are the initial output of the workshops, but the knowledge management process serves to improve these results.

The **knowledge management** process involves the curation of the output from workshops based in the data gathered using the tools:

- Data management facilitates harvesting and documentation to transform data inputs into information.
- Analysis is guided by the framing questions while intermediate visualisation and feedback loops activate deeper discussion with practitioners.
- Synthesis and framing seek to improve the understanding of information through data that can be measured (indicators) and patterns of logical relations between elements (networks).
- Visualisation enables simplification and a new visual narrative while allowing the discovery of new insights and hidden structures.
- Communication involves guiding conversations around a map with stakeholders. They are supported by multiple communication formats such as posters and reports as well as webinars where feedback loops enable reflections on plans or actions aimed at tackling the challenge.



Collective construction of socio-technical systems

The **challenge-led system mapping approach** combines bottom-up exercises with a top-down approach to achieve a broad-ranging system analysis. Focusing on territorial sustainability challenges – sustainable mobility, energy efficiency, circular economy, etc. – activities are designed to highlight critical aspects of governance and complementary relations between different stakeholders and innovation opportunities. Tools and methods should facilitate a dialogue on the opportunities and constraints with regard to pre-identified challenges. The approach improves system analysis skills, placing an emphasis on upgrading certain professional competences.

Bottom-up exercises are useful to facilitate open discussion and a dynamic that promotes definite conclusions through a combination of science and practice in skill-building processes. The horizontality of actions is key in all stages of the roadmap (preparation, workshop, reporting, analysis, follow-up) and prevents hierarchies and specific roles from forming. In this way, basic elements of system innovation are introduced through the adaptation of visual tools to the needs of the organisers and participants.

Climate finance
Climate Mitigation Fund project
Frankfurt, October 2016

The top-down perspective is based on the sum of the actions and projects implemented at local level as well as different elements stemming from the broader policy and regulatory framework. To summarise:

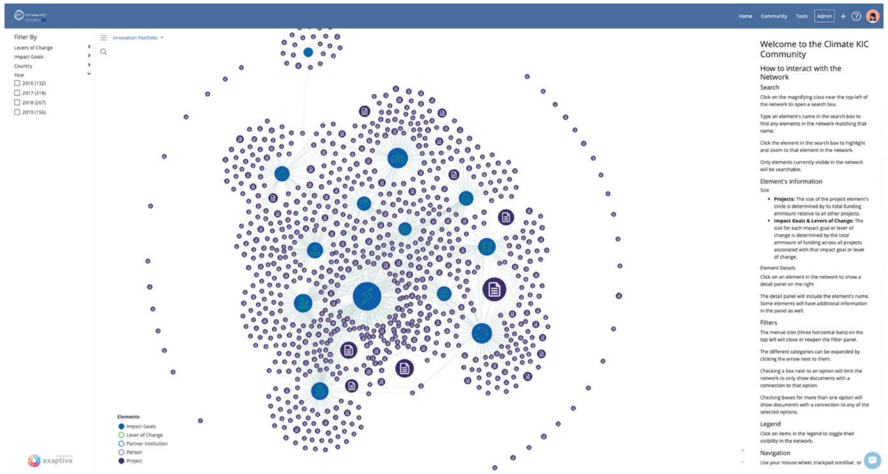
- The **portfolio perspective** allows for the exploration of strengths and patterns of connection in the existing system. Tools such as Exaptive (see figure 7) can help to map existing connections and, by doing so, help the challenge owner to identify gaps in existing projects, funding, and alignment of further actions centred on important projects and ongoing work.
- The **multilevel policy framework** should be analysed to enable practitioners to better understand the conditions enabling change in the specific context of processes driven by the European Union. More specifically, in the context of member states, the challenge owner and participants should be able to allocate the defined challenge and available resources as part of an ongoing process that relates to high-level commitments as well as complex interrelations between different policy-processes, priority settings and the context of application (see figure 8).

Establishing an understanding of socio-technical systems

The overall system mapping process allows participants to assess the results using the bottom-up exercises, the top-down elements and the co-created system maps. The stakeholders can collectively establish their own understanding of the socio-technical system as part of the combined system assessment and the exploration of opportunities based on available local assets.

The materialisation of that learning process into practice-based knowledge is primarily enabled by the conceptual framework provided by the visual tools. The tools' visualisations help participants to better understand and express what they already know by writing down concepts and aspects of a given topic in a few words.

In transition projects, outcomes have to be linked to the societal challenge; they are shared and communicated with the network of stakeholders both inside and outside the project.



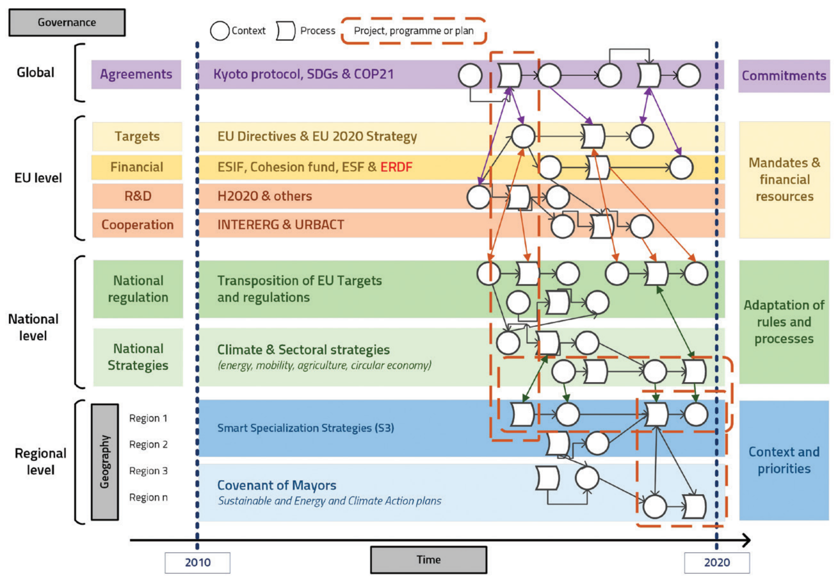


Figure 7: Portfolio Visualisation - Exaptive (Top)

Figure 8: EU's multilevel policy framework (Bottom)
Source: Matti et. al. (2020)

A system mapping story

The workshop choreography

A three-hour workshop was organised in Modena with the goal of identifying gaps within the local mobility cluster and exploring opportunities for action, which could then receive targeted support through seed funding.

The event was designed as a participatory workshop based on three major activities:

- Engaging participants in a visioning exercise;
- Presenting the network map created over the course of previous project activities;
- Analysing its gaps and highlighting possible opportunities with the participants.

The Municipality of Modena had already established a consultation table with quite a large number of local stakeholders, the so-called Tavolo per la Mobilità Sostenibile, gathering civil society representatives, third sector associations and citizens' committees, as well as trade and industrial associations, the Chamber of Commerce, universities and others.

From an operational point of view, it involved three facilitators. Two from AESS (Agenzia per l'Energia e lo Sviluppo Sostenibile) and one from the Transitions Hub, with the support of the Municipal government to run a workshop with fourteen participants, divided in two groups.`

Visioning exercise

The first exercise aimed to get participants involved in depicting current mobility problems and building a shared vision of the future. This collective portrait was defined by different indicators and possible trajectories to achieve the vision. A simple canvas was used, with concentric circular timelines going from the present (the outermost circle) to the future (the innermost circle) through a set of intermediate actions (in-between circles). Those intermediate actions were a key output of the activity, as they represented the directions of intervention agreed upon by participants. It is from that selection that the priorities for funding were finally chosen.

Network analysis

The second activity consisted in presenting the network map related to the local transport cluster. As the maps were built on a limited set of data (sourced mainly from public information and interviews), the workshop offered a chance to validate the overall structure of the cluster. Hence, the first part of the activity consisted of exploring the map all together. The map includes a code reference with a code where stakeholders are distinguished by type, projects, financial value and geographical pertinence. All this information must be interpreted and shared.

The final activity consisted of a validation exercise: participants were asked to integrate into the network map missing actors and/or actions that they found relevant to the cluster. The integration was done directly on a poster-size printed map. Participants were keen to integrate specific projects and stakeholders into the map using sticky notes.

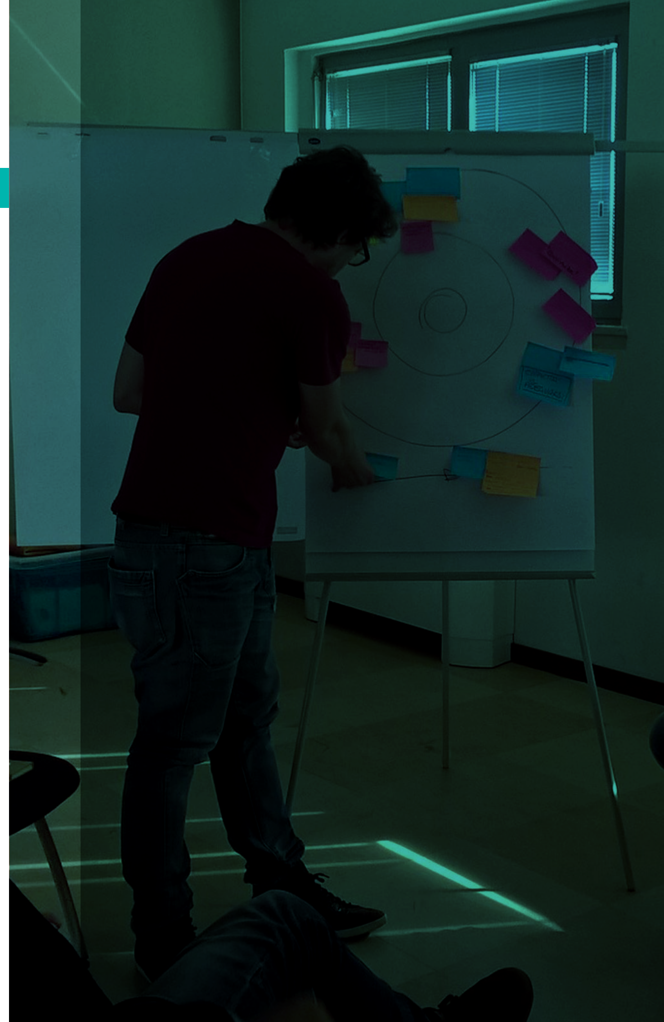
Gaps and opportunities

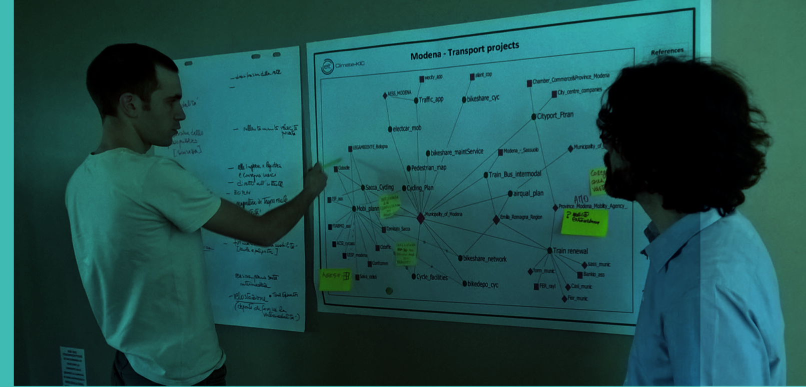
As a final experiment, participants were invited to add two possible future actions ("Education at Schools" and "Velostazione") to the network map and to connect them to all existing stakeholders and projects. In this way, the network map was used as an unconventional "planning tool".

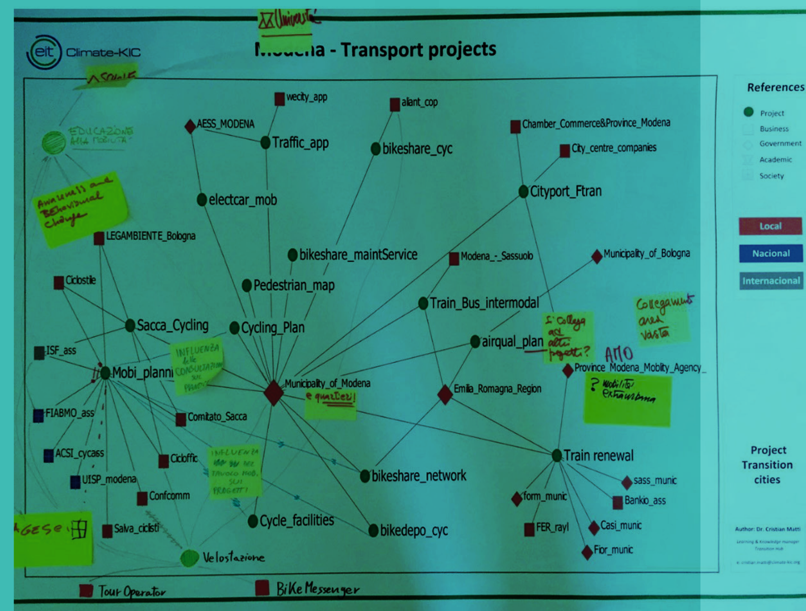
Workshop activities were able to involve and engage participants in a proactive manner. They left with the feeling of having contributed to defining the priorities for funding.

After the workshop a report was sent to all participants, including their three selected priorities around which the call for ideas would need to be developed:

- Promotion of innovative products/services for bike mobility, in order to make it more secure, accessible and affordable;
- Promotion of products / services for sustainable mobility of tourists;
- Development of ICT systems to plan and promote intermodality.







Mobility Cluster
Transition Cities
Modena, April 2017

Energy Transitions in Malta
EIT RIS Programme
Valetta, December 2017

Co-creation is an essential process at the core of challenge-led system mapping. Each co-creation process is a unique participatory meeting that pools the value of the knowledge and perceptions held by a diverse group of actors.

Chapter 3

Design and implementation of the participatory process

In this chapter 3:

- Design prototypes and blueprints
- Implementation process & the workshop
- Team and complementary materials

Design of the system mapping process

Tailor-made process

The challenge-led system mapping can be implemented gradually as part of a process of learning-by-doing. From a knowledge service perspective, the design of the components of the system mapping process should include the identification of the challenge, priorities and available resources.

Depending on the needs and context with respect to the challenge, the participatory process will have different learning goals, formats and outcomes. The outcome of the process can also lead to further steps as part of a flexible and modular format.

The modular format

The blueprint of the system mapping process can be seen as a flexible combination of three possibilities: teaser, pilot and roadmap, each with its own particularities (see Figure 9). The process follows a building block logic formed by stand-alone modules that can be incrementally assembled to construct the full learning pathway: the roadmap.

The modularity of this approach is integral to its adaptability to various environments. However, this chapter captures the basic elements that are relevant for the design and implementation of any system mapping process.

As indicated in Chapter 2, the potential outcomes are to be mutually agreed upon in advance by the experts and the challenge owners. The dialogue and decision-making process regarding the visualisation or type of outcome (e.g. a webinar) is part of the knowledge service.

A snapshot can be made of a system during a preliminary workshop. Thereafter, the information is processed and the knowledge is shared through a visualisation. The level of complexity can vary from descriptive to analytical data based on the maturity of the challenge and the openness of the setting.

In follow-up workshops, the participants will learn more about the socio-technical system by interacting with the maps in a more efficient way. Ideally, the roadmap format will result in a potential portfolio of prototyped actions in the short and the medium term.

Figure 9: Challenge-led System Mapping – Modular format

Teaser

Learning goals
Overall understanding of system innovation and socio-technical transitions by using own cases and examples

Format
One (1) workshop and follow-up activities. The workshop content is tailored to practitioner context and problems

Outcome
Dashboard of bottom-up indicators created during the workshop

Pilot

Learning goals
Analytical view on the local socio-technical system by focusing on cluster of projects and actors around main innovation areas

Format
Two (2) workshops and follow-up activities. A preliminary network map is developed as part of the process

Outcome
System map

Roadmap

Learning goals
Overall understanding of System Innovation and socio-technical transitions by focusing on selected specific policy challenges

Format
Full participatory process consisting of three (3) workshops, one (1) dissemination event and in-between activities

Outcome
System map, validated list of innovation areas and potential actions aligned to the policy challenge.

Urban transitions
EIT RIS Programme
Brussels, June 2016

The process should be designed to meet participants' expectations without getting lost in an endless series of workshops, discussions and useless conclusions.

System mapping processes driven by a system innovation logic are conceived to address complex situations where uncertainty and ambiguity shape the overall context. Simple **framing questions** can help to address that complexity by laying down the boundaries for the system mapping process itself, as well as clear rules for decision-making.

In most of the cases, the mapping process is designed to contribute to an existing process or action plan. Thus, it can be explained as a strategic input or an intervention that contributes to the understanding of the socio-technical system and the present innovation opportunities.

Framing questions

These are essential in facilitating dialogue with challenge owners throughout the roadmap process. Some examples:

Challenge definition and current system

- Is there any strategic plan or policy framework in this area?
- Are there alternatives to the current practices?
- Who are the right actors to address this? Why?
- What do we need (e.g. resources, funding, knowledge, skills) to resolve it?

Future action

- What could be done differently next time?
- What can be the relevant leverage points or intervention points.?
- How can we introduce change and transformation? When?
- What needs to be achieved in the short and long term?

Design of the system mapping process

Challenge definition as starting point

The challenge definition illustrates the need for change in the form of a statement on the willingness to transform the system surrounding a problem. Challenge definition can be facilitated by some key elements from the overall system context:

Inputs and resources. Elements for understanding the context and further supporting the system mapping process:

- Background indicators and general information regarding the context.
- Access to experts in terms of knowledge, strategic support and allocation of time during the whole process.
- Challenge ownership that may rely on a government, a project consortium or community. A lack of ownership can lead to excessive complexity.

Problem analysis. A challenge can be analysed from various different or combined perspectives:

- Top-down. This may be policy-driven or target-driven and may follow high-level mandates with established and validated objectives.
- Bottom-up. This may be community-driven that can follow an unstructured governance logic (no hierarchies) or follows the structure of a project or programme with an structured action plan.

Questions. Simple framing questions can help to address the dynamic elements behind the challenge. Common question topics include (1) system components and relations, (2) existing process, actions and resources, (3) conflicts, confronting ideas, interests and co-existing narratives and (4) innovation opportunities and potential priority areas.

Output. Agreements on the overall expected results of system mapping process are fundamental success factors for its design and implementation. Common outputs can be:

- New intermediation and orchestration roles and mechanisms.
- Participation to enable multi-actor dialogue and community building.

Managing expectations on the use of co-produced knowledge is a required step to highlight the value of system mapping as a tool.

If the challenge cannot be defined in advance due to the lack of ownership or unclear vision/targets/narratives, it can be defined during the first workshop. It should be clearly communicated as a goal. Tools such as the 'pentagonal problem' can facilitate the discussion.

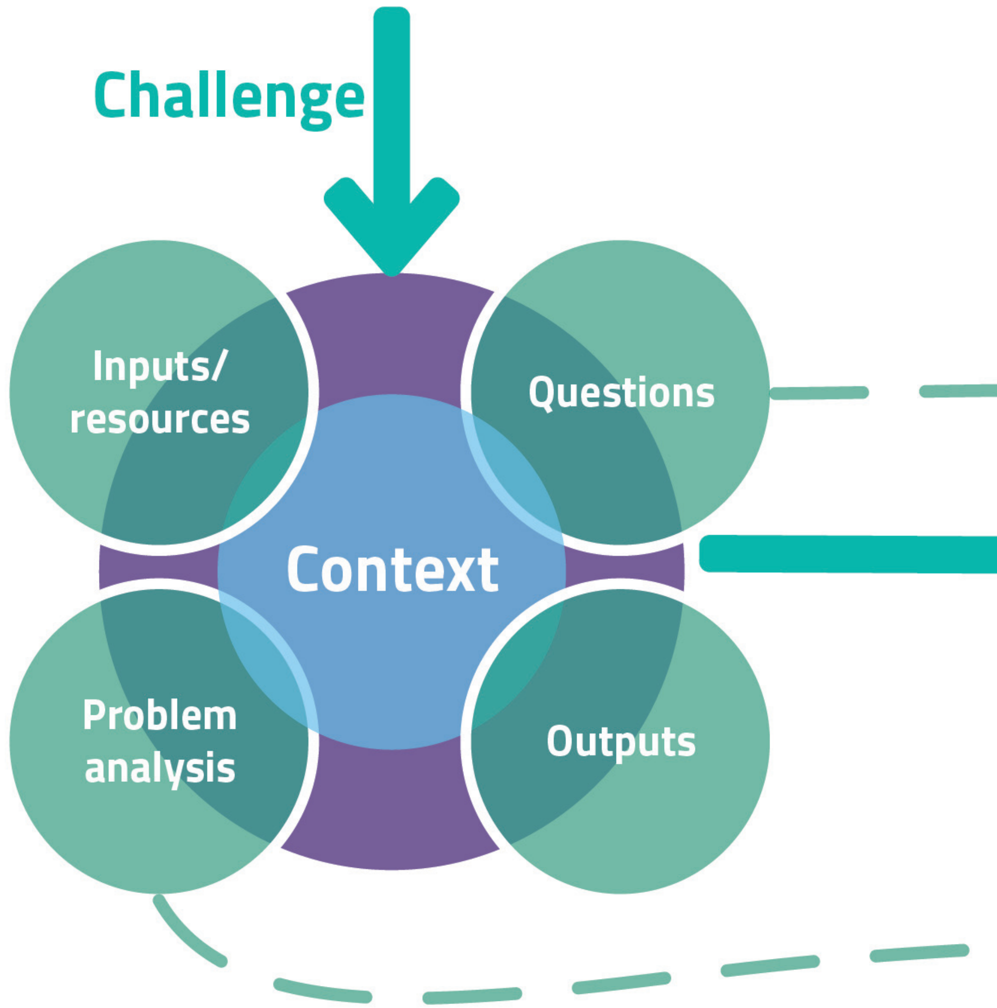
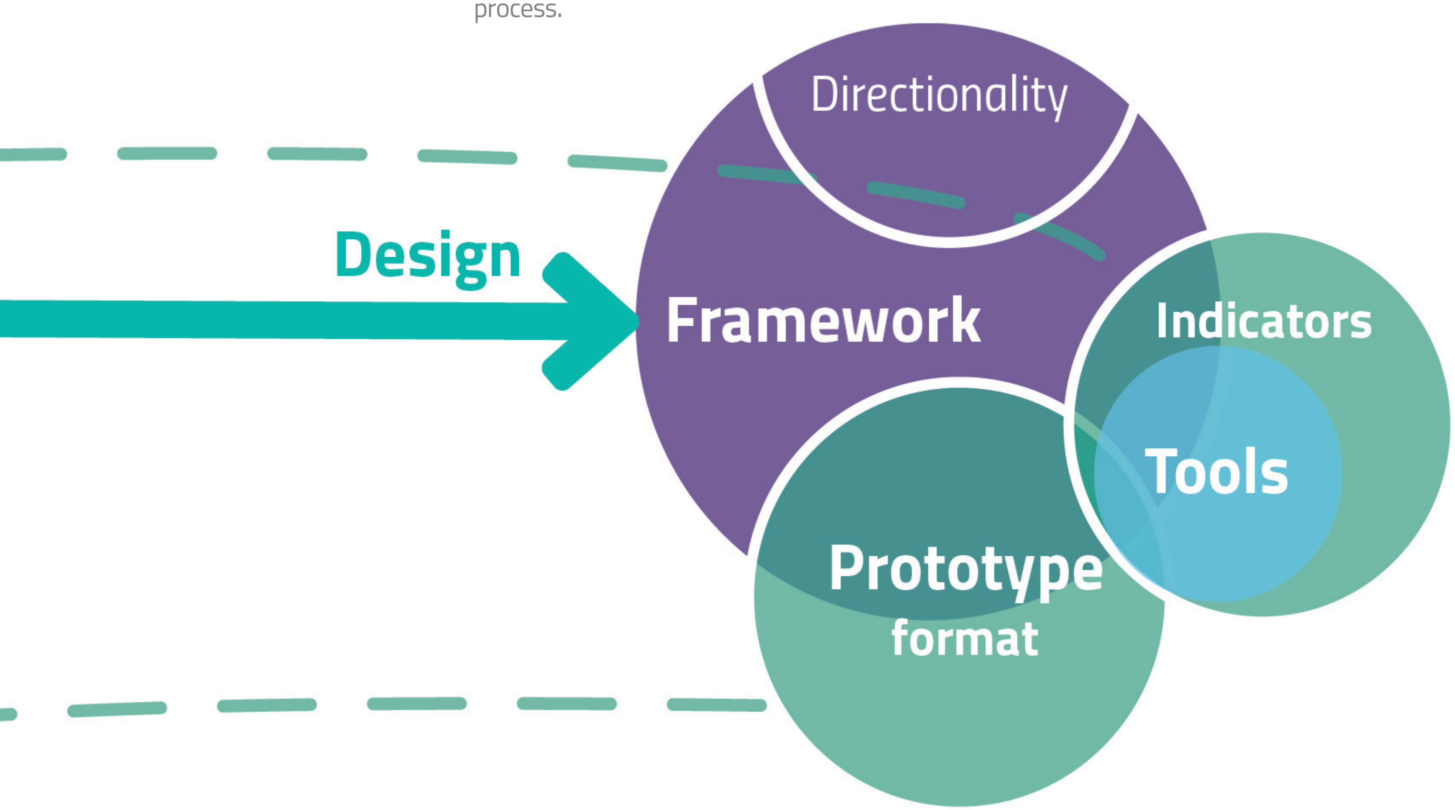


Figure 10: Challenge definition and prototyping

Prototyping as a design principle

Understanding the context of the challenge definition as well as the policy background is fundamental for the system mapping process. The framework should help to give some direction in terms of the emerging questions and the potential indicators to be harvested through tools during the activities. Together these elements will form the prototype for the system mapping process.



Framing and mindsetting. The overall concepts and ideas driving the process should be defined as pillars for the full process. For example, system(s) innovation is the overarching concept used by EIT Climate-KIC when setting the values, causal relations and when mindsetting with the stakeholders. Framing then helps to provide a basic understanding of innovation and transformative mechanisms as part of the mapping process.

Directionality and challenge context. System mapping is part of the decision-making process and takes place in a specific policy background; the strategic direction of the dialogue and the expectations should thus be set accordingly. The output in terms of consensus, the level of stakeholder involvement over time and the potential impact on the policy-making process are critical elements in defining the tools, indicators and the mechanism for interaction while considering the types of stakeholders involved.

Tools as process enablers. The decision to use (adapted) existing tools or new tools will depend on different questions and framings, and will be influenced by the competences of the delivery team and the time considerations for each workshop as well as the overall process.

Prototyping is defined as the simulation of a system mapping process. Such simulations can range from informal ideas sketches to more detailed concept maps with initial sets of questions, tools, team composition, resources and timelines..

Design of the system mapping process

Framing through blueprints

Prototypes facilitate the space for bringing all the pieces together from an open ideation perspective. Moving to a detailed process design for running a pilot requires a full-scale re-creation including fewer variables, team responsibilities, clear outcomes and a detailed timeline.

For doing so, a **blueprint** such as a protocol or a choreography needs to be developed to frame and integrate the challenge incrementally. A blueprint is a guide that can be followed to ensure that the course material is on point by displaying the image of the process in its entirety.

It serves as a course guide to convey all the critical information (specifications) of the project and to assess required interventions at stages with problems. This can be done by elucidating the interrelations between framing questions, tools, workshops, and knowledge flows across the entire system mapping process.

Framing questions help to breakdown the challenge into the elements of the system to be addressed during the mapping process.

Interrelated sessions and tools based on the framing questions are adapted to maximise the learning process, the effectiveness of the results and the knowledge flows (inputs) between them.

Interrelated workshops follow the logic of the flexible modular roadmap of the tailored made process along a proposed timeline.

Knowledge management (See chapter 4) contributes to making those interrelations effective through data and knowledge flows. Inflows involve documenting and harvesting data while outflows focus on conceptualisation and analysing including visualisations and developing bottom up indicators.

Interrelation is presented as the natural flow by which the output of one action contributes to the development of the others.

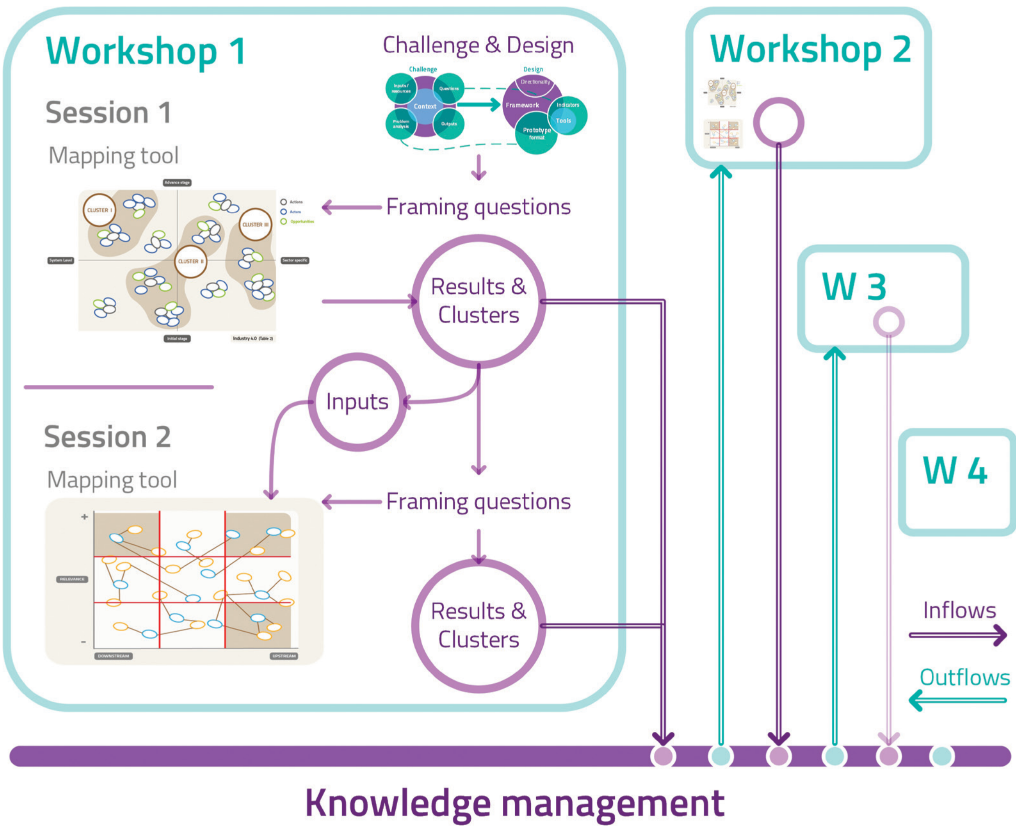


Figure 11: System mapping blueprint as interconnected tools, session and workshops

Learning by doing

The challenge-led mapping approach has been designed based on the lessons learnt from several experiences in a variety of contexts, involving a diversity of topics and challenges.

Practitioners applying this approach should consider it as a point of departure when developing their own practice-based knowledge through experimentation and a 'learn-by-doing' approach. Each challenge, each process and each workshop will be different but, at the same time, each of them will be an opportunity to experiment and learn.

Through the continuous adaptation of ideas, tools and practices, practitioners will test and experiment their way to their own collection of consolidated blueprints for system mapping processes.

Prototyping, piloting and learning loops

The adaptation process involves transforming existing tools and methods for new system mapping processes. It can take different pathways depending on the topic of the exercise and expertise and composition of the team.

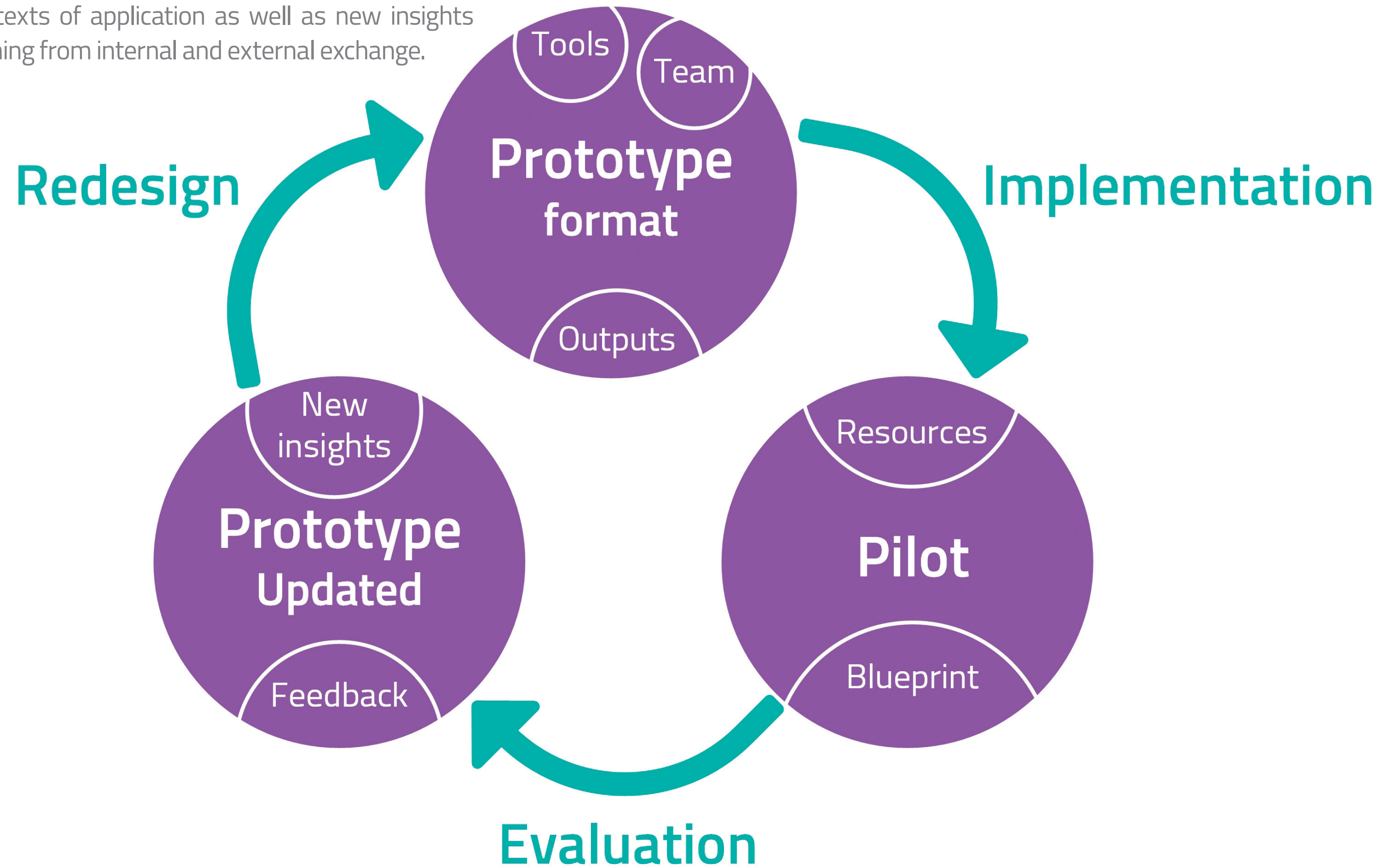
The consolidation of lessons learnt arises from the iterative process by which the teams co-create, test and implement the blueprints in pilots. Throughout the continuous redesign, implementation, evaluation and follow-up of the system mapping processes, the dialogue amongst different members of the team facilitates learning at the individual and group level. The modularity and flexibility of the methodology favour learning; each iterative process is thus a learning loop.

These learning loops are fed by the feedback and evaluation of the experiences in the different contexts of application as well as new insights coming from internal and external exchange.

Primary loops concern the use and implementation of the original framework by considering goals, challenge definitions and decision-making practices. Secondary or double loops are intended to analyse how a given framework might be reconsidered.

Upon repetition, cumulative experience and reflection, the process becomes simpler and can reach its full potential.

Figure 12: Learning loops between prototypes and pilots



Implementation of the mapping process

The roadmap narrative

The roadmap logic guides the phases of the system mapping. The process needs to be adapted to different situations irrespective of the context and the challenge in question by ensuring that practitioners have a guide through the unexplored territory of their own system. Design elements provide direction and logic towards the defined challenge, allowing practitioners to know where they are in the system mapping process at any point in time. Technical assistance, expert advice and knowledge management are essential elements to build that process.

The **roadmap's basic structure** follows the logic described in the blueprint for challenge-led system mapping. The process consists of three stages:

- The **design** stage establishes the basic context in which the team will co-create, before identifying the existing tools and desired outcomes.
- The **system mapping** stage comprises the core activity, in which visual tools are used to facilitate the dialogue between participants and bottom-up data is gathered.
- The **roadmapping** stage is when participants get to analyse the first system mapping results and go from planning actions to implementing actions.

The roadmap format has four main objectives:

- To facilitate a guided dialogue with the aim of building a shared vision of common problems or priorities through a challenge-led system mapping approach.
- To spot and set out trajectories of change, inspired by different potential scenarios and a portfolio of related prototyped actions as part of existing strategies (e.g. Smart Specialisation, Sustainable Energy and Climate Action Plans).
- To aid in developing transition competences linked to objectives for skills development set out by project managers and governmental officials, among other participants.
- Finally, a roadmap format allows participants from the same context to recognise themselves as a system of stakeholders, building up the sense of a community of shared practices, while facing their inner conflicts of interest.

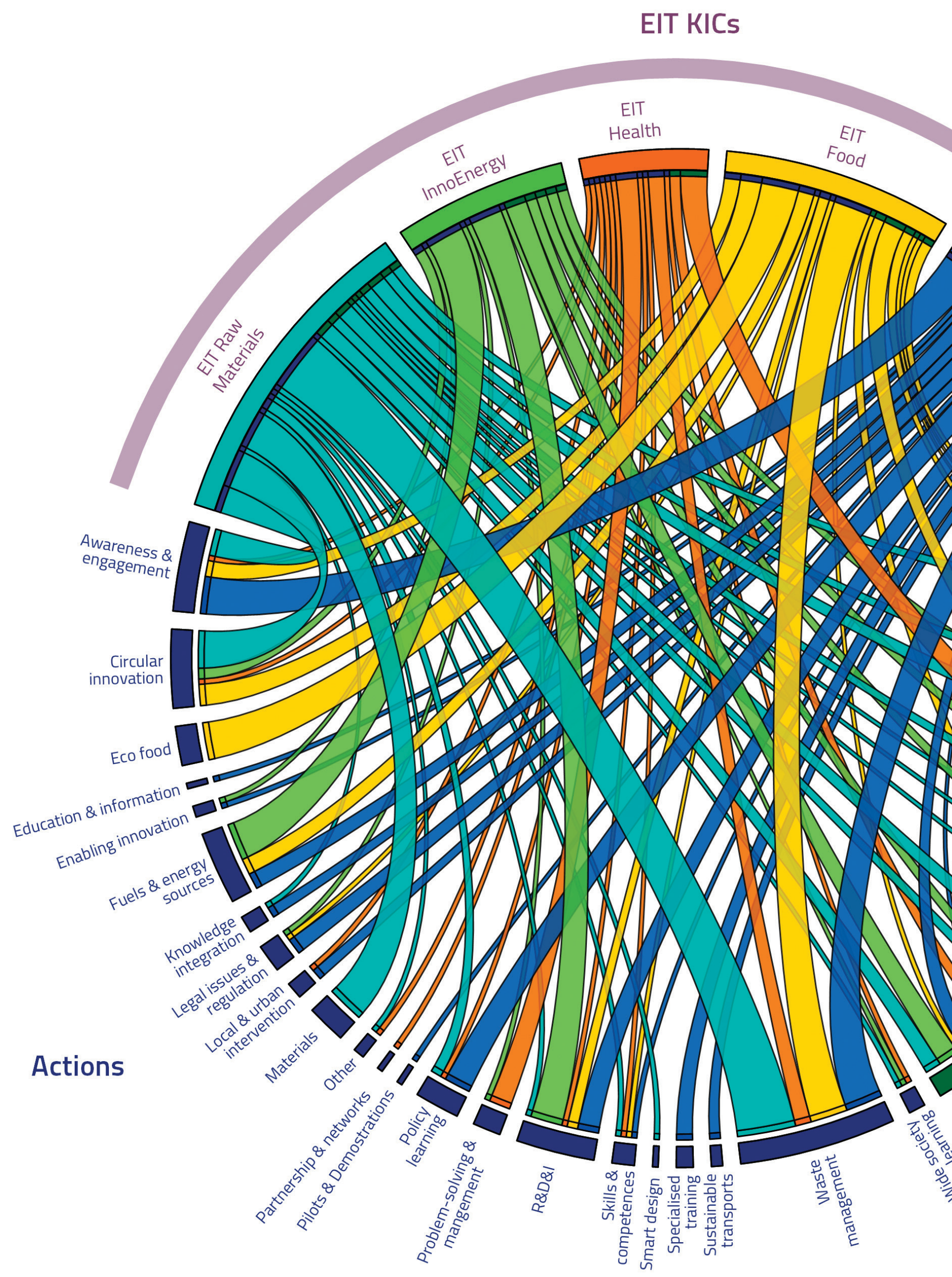
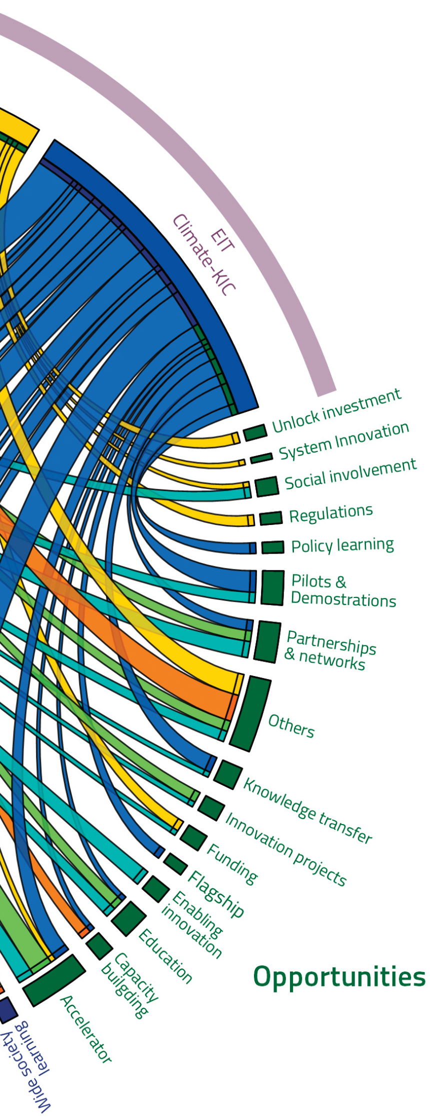


Figure 13: Knowledge visualisation of actions and opportunities in Circular Economy.
Source: Cross-KIC Workshop, Sofia, 2018



Design

The design phase involves in-depth interaction with the challenge owner and the stakeholders. The aim behind this exchange is to identify the needs of local practitioners and to co-create the blueprint of the full process according to the maturity of the challenge. As it was explained in the last section, the blueprint is obtained through framing the interrelation between the inputs, mapping steps, and outputs of each activity by considering the knowledge management elements.

Managing expectations and facilitating the path to the right mindset is critical in nurturing a dialogue on systemic transformation that includes differing perspectives. Resources, including human resources, time, information and funding will provide the scaffolding for the blueprint.

Mindsetting is the process for enabling a set of values, behaviours and perspectives that guide the way to a collective process that is put in place to address the defined challenge and adopt a deeper understanding of a systemic perspective.

System mapping

This stage seeks to initiate the mapping process through a system assessment guided by the defined challenge, specific tools and expert advice. The co-produced 'system map' is developed as part of a sensemaking exercise with the purpose of giving meaning to a collection of ongoing processes and actions and, thereby, achieving a common understanding of the components and relations of the socio-technical system in which they are embedded.

The collective construction is navigated through simple notions of system innovation by applying participatory tools, such as the ones included in the *Visual Toolbox for System Innovation*, to work on the defined challenge.

Sensemaking is the interplay between giving meaning to a notion of the system – and its ongoing actions – and achieving a common understanding as a springboard to action.

Roadmapping

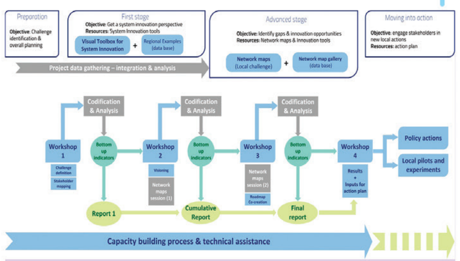
In this more advanced stage, the participants gain a deeper understanding of the socio-technical system by analysing its various elements. They do so based on their co-created understanding of the socio-technical system and the opportunities for innovation. The aim is to explore what further action could be taken in terms of identifying resources, capacities and ongoing mechanisms at different levels. The short, medium and long term are all considered. A combined project and strategic management perspective should be adopted, taking into account social commitment and political willingness as key enabling factors.

Strategic management is the process of setting priorities, allocating resources and ensuring that stakeholders are working toward common goals. This is done by establishing agreements regarding the intended outcomes.

Implementation of the mapping process

The roadmap stages

Design — **System mapping**



Framework

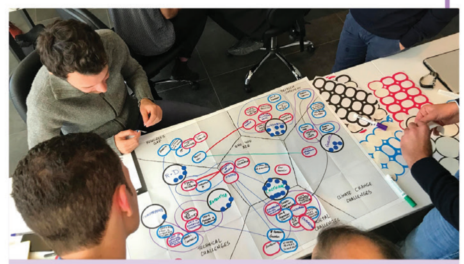
Objectives. Challenge definition & resource allocation

Resources. Challenge-owner existing data

Output. System mapping blueprint

Knowledge management

Tailored made process and tools



Workshop 1

Objectives. Priority setting

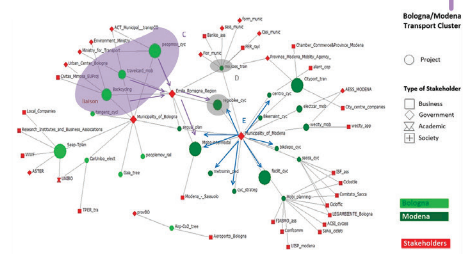
Resources. Tools and expert team

Output. System map 1

Knowledge management.

Data harvesting, data structure

Intermediate visualisation & Webinar



Workshop 2

Objectives. Identification of innovation opportunities

Resources. System maps, infographics and tools

Output. Long term vision

Knowledge management.

Data analysis, Infographics & Webinar

Data harvesting second workshop

Figure 14: The roadmap stages

In this stage the blueprint is developed for the system mapping process, considering (1) the context, challenge definitions and expected outputs, (2) the framework, including tools and indicators, (3) the participatory process, including team, activities and resources and, (4) a knowledge-management proposition.

Participants create an initial system analysis and seek to achieve consensus on common priorities. Information is gathered, analysed and transformed into infographics and reshaped into system maps (e.g. networks). Follow-up webinars are held to share the information gathered.

The results of the first workshop are analysed, as well as any follow-up webinars regarding system configuration and priority areas for potential change. Future-oriented exercises can be carried out to co-create a long-term perspective. The information is again codified and shared.

Road mapping

Workshop 3

Objectives. Matching resources with potential actions

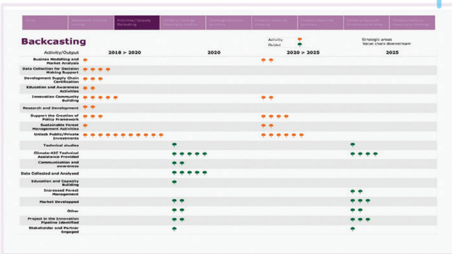
Resources. Validated priorities and vision

Output. Set of transformative activities

Knowledge management

Infographic on consolidated system map

Data harvesting third workshop



Dissemination event

Objectives. Aligments formoving into action

Resources. Portfolio of proposed actions

Output. Roadmap

Knowledge management

Validated collection of actions and output

The broad socio-technical roadmap is co-created with relevant actors by using the available resources, allowing a specific timeframe for an action. Prototyped actions can be sketched by applying project and innovation management tools while matching the vision, identified priorities and existing resources

Specific inputs are presented, such as targets, outputs and related activities for action plans. Dialogue sessions are organised to explore how the various elements can be reshaped and integrated into existing policy mixes and strategies, as well as into proposals for local pilots and experiments.

Moving into action

Towards the end of the process: synthesis, strategy and leadership are important factors in directing the participants' mindsets towards concrete actions. Challenge owners should:

- acknowledge the value of what was collectively created, such as practice-based knowledge and and a portfolio of prototyped actions;
- reflect on what was learnt from the mapping experience and the opportunities for collaboration;
- encourage participants to communicate and articulate what they intend to do next. For example, following steps that can be accomplished in the short term plus bigger steps that may take many years;
- reflect on potential local pilot schemes and experiments based on the linkages between the defined challenge, the proposed portfolio of prototyped actions and the existing strategy, the ongoing policy prototyped and existing projects and initiatives;
- evaluate how proposed actions can be reshaped into project proposals using the available resources identified during the road mapping stage;
- think about society engagement actions such as an "ideas competition" as a simple mechanism to stimulate innovation at the local level.

The workshop

Each workshop is different; its design depends on the conditions and the stage of the process when it is implemented. However, there is a general logic in organising and running them. There are considerations to be made before, during and after the workshop.

Starting up

Workshops are an essential part of the system mapping, but they are only one part of a broader process comprising many actions. The following preparatory steps are common to most situations:

Initialising. It helps to come to an agreement with the challenge owner regarding the overall goal and expectations for the workshop, as well as for the application of the system maps as an output.

Framing. A more technical discussion where the architecture of the workshop is formulated to address the needs of the overall challenge.

Mindsetting and detailed planning. This is an iterative, design-oriented stage, where the workshop team and challenge owner co-produce the workshop plan and tailor-made content. They must prepare the team and set the conditions with participants.

Setting the scene. Just before the workshop starts, actions are implemented to get the participants and the team ready for the workshop implementation.

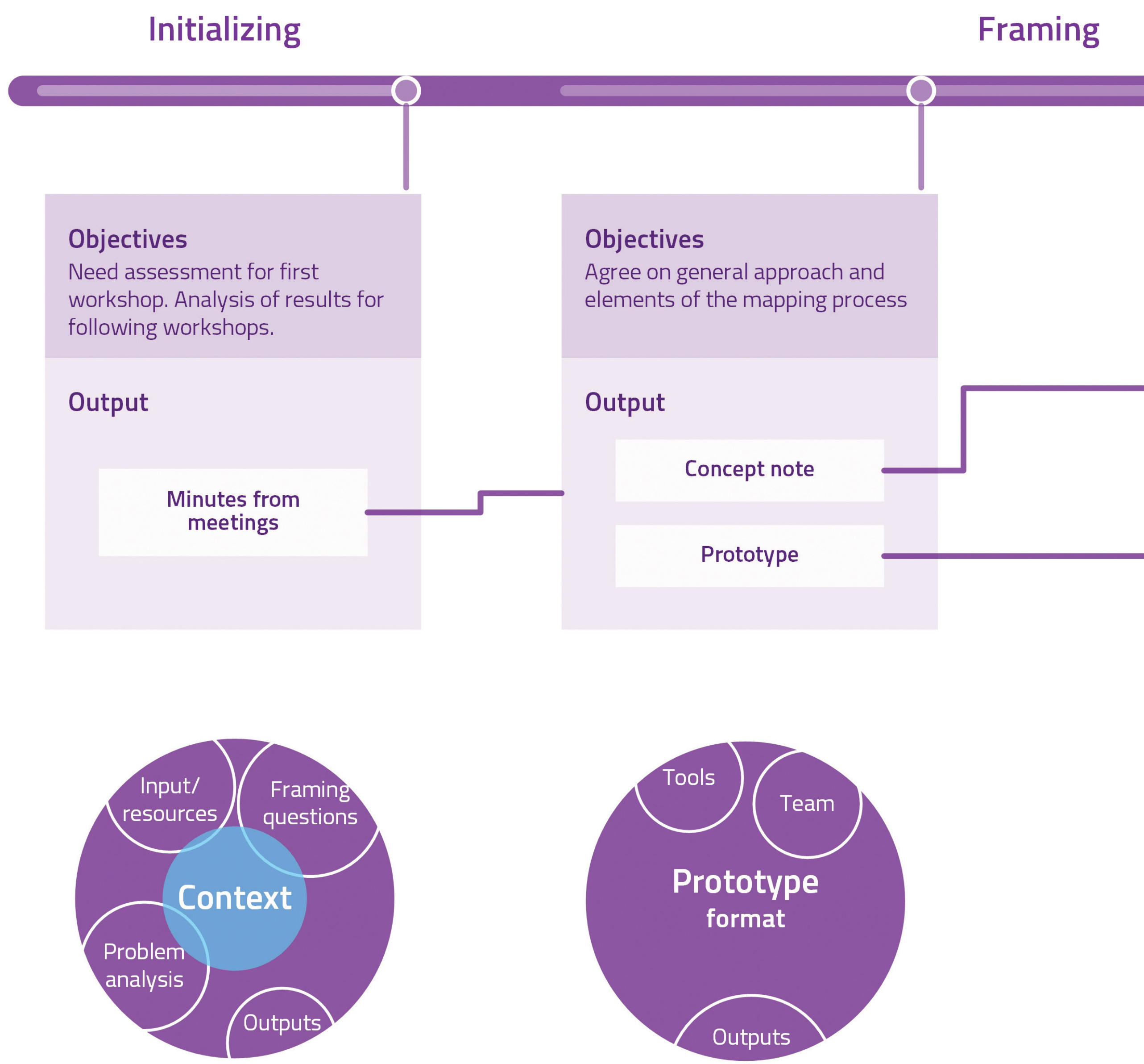
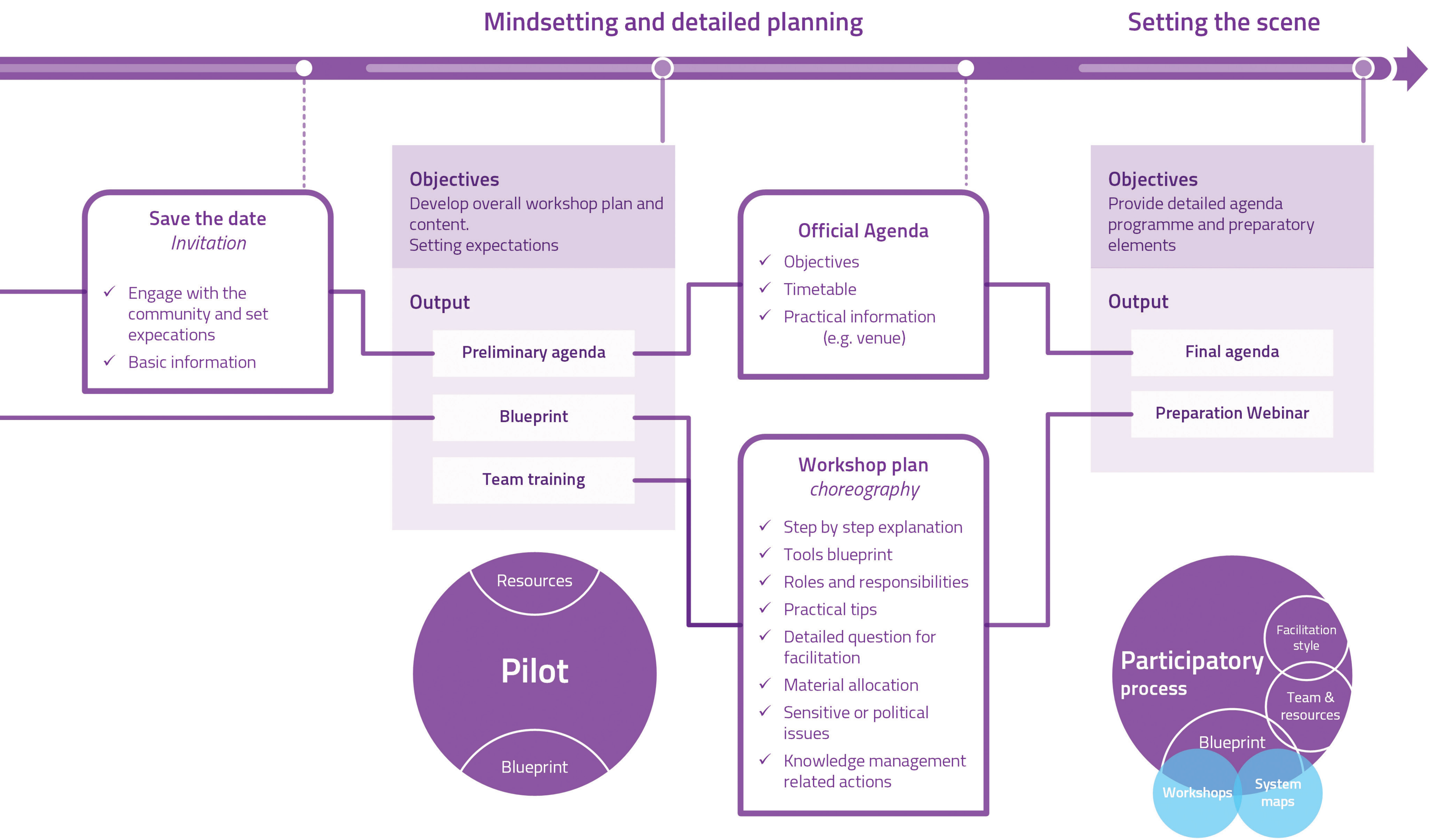


Figure 15: The workshop implementation process



Mindsetting and detailed planning
Setting the scene
Save the date
Invitation
✓ Engage with the community and set expecations
✓ Basic information
Objectives
Develop overall workshop plan and content.
Setting expectations
Output
Preliminary agenda
Blueprint
Team training
Resources
Pilot
Blueprint
Official Agenda
✓ Objectives
✓ Timetable
✓ Practical information (e.g. venue)
Workshop plan
choreography
✓ Step by step explanation
✓ Tools blueprint
✓ Roles and responsibilities
✓ Practical tips
✓ Detailed question for facilitation
✓ Material allocation
✓ Sensitive or political issues
✓ Knowledge management related actions
Objectives
Provide detailed agenda programme and preparatory elements
Output
Final agenda
Preparation Webinar
Participatory process
Facilitation style
Team & resources
Blueprint
Workshops
System maps

During the workshop

Introduction

- Facilitate informed consent. Explain verbally or with a leaflet:
  - why you are running the session;
  - how the maps and recordings will be used;
  - that participants are free to leave the session at any time.
- Negotiate consent to record the session.
- Explain how the session will work and how the information produced with be gathered and analysed and shared.
- Introduce each participant (ice breaker activity).

Mapping sessions

- The aim of the mapping sessions is not just to produce a series of maps, but to use them as a tool to encourage discussion.
- Map experiences or ideas about the topic in a visual fashion.
- Ask each group to present their maps to the rest of the groups or ask each participant to offer a final comment.
- Wrap up the session with a positive note and give thank to the participants.
- Reporters should take notes during the mapping session to support the further interpretation and analysis of results.

Facilitation

Facilitation style may differ depending on the workshop framework, early stages being more exploratory and more advanced stages requiring more direction. However, there are some general aspects to consider:

- Enough facilitators should be available to make the session run smoothly. There is no fixed numerical ratio, but one facilitator for each group of 6 to 10 participants maximum usually leads to fluid dynamics.
- Help participants to define the problem. Asking them open questions can be a good strategy. Sometimes, using examples is also useful. The strategy to use depends on the behaviour of each group.
- The facilitator's role is to manage the process, not direct the content.
- Get individuals to talk about what they are mapping and why.
- Ask questions that enable participants to ask the right questions or to challenge assumptions.
- Ensure participants follow through with their own emergent ideas; remind them that they are not looking for consensus, but for the expression of their diversity.
- Explore implications of connections that are mentioned to create clusters.
- Ensure the essence of conversations is recorded or noted down.

Visual tools to guide conversation

The participatory process takes the form of guided conversations, where science-based visual tools facilitate the process for transforming participants' contributions to shared understandings. System mapping relies on the use of visual tools in co-creating new knowledge based on individual input and other layers of information.

- Visual tools facilitate individual contributions and the sharing and exchange of knowledge in a horizontal and open space.
- As individuals or in pairs, each participant fully expresses their thinking and individual view as part of the group setting. Each individual input should be noted down.
- Repetition of items is good, it means consensus. Encourage it!
- System mapping is an interactive and inclusive process that constantly shifts between individual, paired, group and whole workshop discussion.
- Any similarity or difference between individual narratives is an opportunity to reflect from multiple perspectives on the connections drawn.
- The evolving conversation contributes to the collective understanding of the challenges, the questions and the mapped system itself.

A simple, three-step process can be used to implement these guided conversations by combining the value of the interactive dialogue from the workshop and any harvested data relevant to the continued knowledge management process.

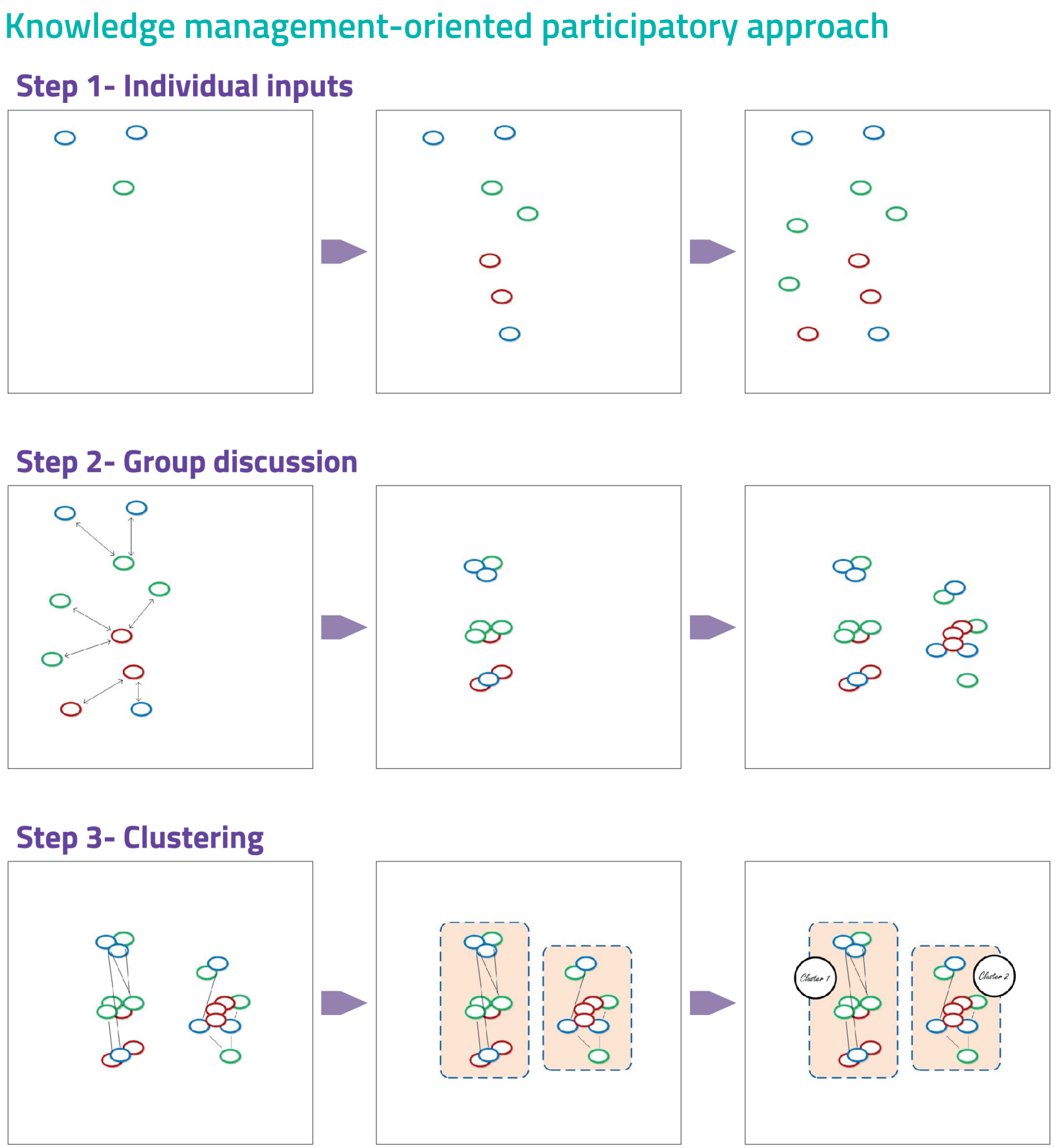


Figure 16: 3-steps for a guided conversation for participatory process

Step 1 – Individual inputs. Participants should write down at least three ideas for each question, elements or steps suggested by the tool. Different shapes and colours help to highlight the variety of elements and become highly valuable for knowledge management. Pre-printed cards and stickers can also be used.

Step 2 – Group discussion. Group dialogue is facilitated to identify differences & common elements in the whole picture. Participants regroup the elements based on affinity relations.

Step 3 – Clustering. Participants analyse relations between elements and agree on new groups containing clusters of different elements where concepts and ideas are thematically grouped. They decide on new broad labels that better represent the aggregation and layers. Large Post-it notes or stickers can be used for visual representation.

Different **layers of information** – from individual input to clusters – enable participants, experts and analysts to gain a deeper understanding and arrive at valuable conclusions regarding the participants' input during workshops and during the continued knowledge management process. In practice:

- Layers help in negotiating meaning and setting priorities.
- Layers facilitate the ranking of elements by type.
- Marco layers (Clusters) can be used as key inputs for the next step or tool in the mapping process.

After the workshop

Debriefing session

- Save a reasonable amount of time (an hour or two) after the mapping session to type up notes and record your reflections.
- Hold a group analysis session with the team members who took part in the mapping session.
- Analyse the produced maps, the content of conversations and the field notes or reflections produced by all the facilitators.
- Be sure that each canvas has been labelled.

Follow-up

A variety of actions can be implemented depending on the stage of the participatory process. The most common and recommended actions are:

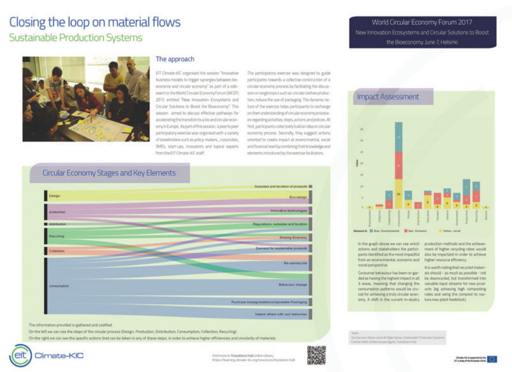
- Facilitate conversations between experts and challenge owners to better contextualise and consolidate the results of the workshop.
- Organise executive meetings with challenge owners to define potential next steps.
- In the most advanced stages of a participatory process, specific actions can be designed and implemented.

Knowledge management and visualisation

Curation of the data harvested during a participatory process is fundamental for system mapping. The questions defined by the challenge can be addressed through co-created bottom-up indicators based on the information generated during the workshops. Chapter 4 will explore this process, where a variety of actions including data gathering, analysis, knowledge visualisation and communication process will be explained. To achieve success at this stage:

- All the outputs of the mapping session should be managed properly to guarantee the best possible conditions for the knowledge management process.
- Be sure that visual tools (canvas) are properly labelled and organised by group, table, session, topic and workshop.
- Guarantee that you have enough complementary materials, such as reporting notes and team reflections.
- Take pictures of each canvas, even when you can keep them.

Figure 17: Example knowledge visualisation. Helsinki (2017)



Practical tips

- Invite enough participants and ensure diversity.
- Have a gender-balanced team or panel (if any).
- Invest time and resources on marketing and communication for the event.
- Consider developing a selection process criteria for participants.
- Send invitations through multiple channels.
- Book a room large enough to allow people to walk around freely.
- Order enough materials in advance (stickers, pens, markers, paper and so on).
- Organise the disposition of the room during the workshop planning stage.
- Secure a camera to record the session or to take pictures.
- Consider making audio recordings of the speeches, session wrap-up and individual group presentations.
- Think about branding: roll-up banners, flyers and posters.
- Keep a good track of participation and representation with additional considerations, such as a signature list and name cards.

Team

From the beginning of the process, different types of roles can be identified. This does not mean that each of the roles below must be assumed by an individual, but that they must be filled either individually or by multiple persons for the process to work.

Project manager. Responsible for the overall organisation of the activity and the logistics of the entire process.

Facilitator. Responsibilities may include the design of the roadmap, interactions with the challenge owner and the implementation of the workshop. They are most likely to be the methodological expert in the team.

Coach. They are of central importance to the roadmap, being responsible for guiding participants through the workshops activities, structuring and facilitating the learning.

Data analyst. Responsible for systematisation of results by gathering, codifying and analysing the data coming from the different system mapping exercises. They are also responsible for producing infographics and network maps as main inputs for workshops and reports.

Local expert/Liaison. Responsible for enabling the linkages with local context and contributing to the adaption of the tools.

Thematic experts. They are responsible for providing the input needed on specific topics such as transition management, sustainable mobility or green business models. They can also directly participate during the delivery, encouraging the debate and answering the questions raised by participants.

Reporter. Responsible for collecting data and information developed during the workshops and for gathering feedback or lessons learned. This role is usually filled by the team's communications person.

Communication officer. They work closely with the project managers, facilitator and data analyst to understand and prepare the communication that can be shared with external audiences

Materials and IT. Materials to run the workshops include this handbook, as well as a complementary set of learning materials covering all the stages of the roadmap format. For knowledge visualisation, a variety of statistical tools and visualisation software can be used, including freeware for network analysis or online dashboard platforms for managing significant amounts of data and the complex decision-making process. The decision of which software to use should take into account the overall goals and expectations of the team with respect to the roadmap process.

Cross-functional team

Members from different organisations should be part of the delivery team, including the challenge owner's organisation. Their input will be important to the challenge's definition and implementation as well as the analysis of the results and communications.

Roles and responsibilities can be combined interchangeably throughout the roadmap process, taking into account content and logistical elements as well as the specific setup of the team and the available resources. This setup depends on the framework designed for the system mapping process, the available resources and the participation of the challenge owner's staff in the implementation process.

A combination of local and international experts is strongly recommended to ensure a broad scope of approaches is addressed during the roadmap process.

Regarding knowledge visualisation, competencies in data management, applied research and statistics are essential and may be outsourced to a specialist. It is also highly recommended to involve challenge owners in the analysis of results since it guarantees better interpretation and inclusiveness over the whole process.

Complementary materials

To supplement this handbook, support materials are included, such as detailed explanations of aspects of sustainable transitions and walk-throughs for the visual tools. This more practical material can be used to build capacities in system mapping, team training for a mapping process or in-situ explanations for workshop participants.

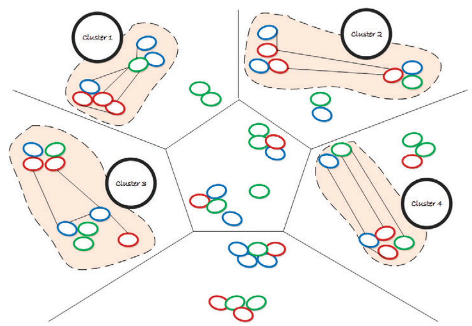
Below you'll find a summary of the most frequently used tools, following the roadmap narrative and focusing on key aspects of the design and implementation processes:

- **Application (A):** indicates the stage of the process: system mapping or road mapping
- **Difficulty (D):** low, medium or high
- **What you get (W1):** relates to challenge questions, type of data and indicators
- **What you need (W2):** Inputs and resources
- **What is next (W3):** Knowledge management (KM), relations between steps, related tools and actions

KM refers to Knowledge management, visualisation, exchange and dissemination with practitioners and challenge owners.

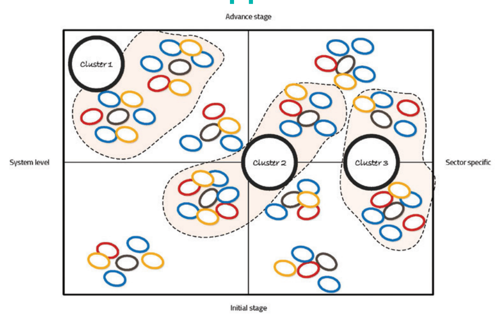
The complementary materials also include references to and examples of different tools from EIT Climate-KIC partners and the Joint Research Centre applied during the system mapping process.

Pentagonal problem



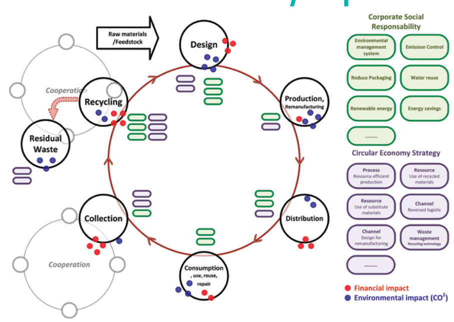
A: Challenge definition – System mapping, Workshop 1
D: Low
W1: Systemic components of the problem
W2: Inputs on challenge status from challenge owners
W3: KM + system mapping session. Two versions are included: standard and policy-oriented sections.

Ocean of opportunities



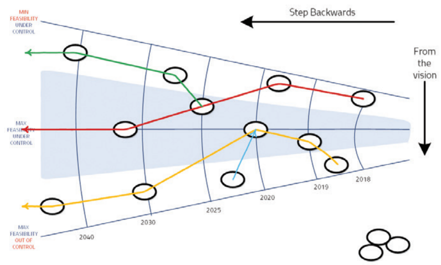
A: System mapping, Workshop 1
D: Medium
W1: Ranked priority areas and key system elements
W2: List of existing actions by area or topic
W3: KM + Visioning exercise. Two versions are included: standard and policy-oriented sections.

Circular economy explorer



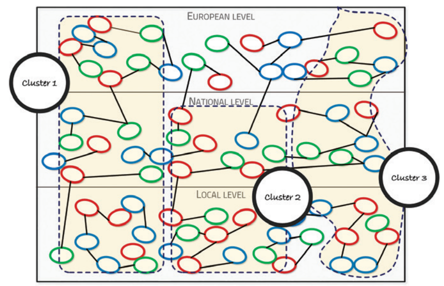
A: System mapping, Workshop 1-2
D: Medium-high
W1: List of potential actions, driving forces and trends
W2: Selected cases and sectors as priority areas
W3: Prototyping business model and actions
Two complementary tools: system simulation and driving forces and trends exploration

Future radar



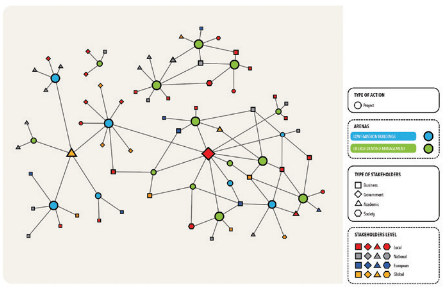
A: System mapping, Workshop 2
D: Medium-high
W1: List of potential actors and driving forces
W2: Selected cases and sectors as priority areas
W3: Prototyping business model and actions. Two versions with different layout are included

Socio-technical roadmap



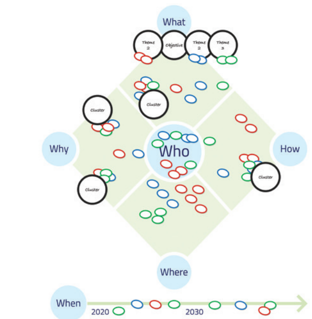
A: Road mapping
D: Medium-high
W1: Resource mapping and prioritisation of innovation areas
W2: Existing system map and info about local available assets
W3: KM and action/project prototyping session
Two versions are included: Standard and multi-level governance setting

Network Analysis



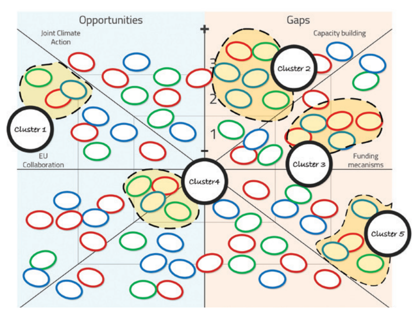
A: System mapping, Workshop 2
D: Medium-high
W1: List of potential actors and driving forces
W2: Selected cases and sectors as priority areas
W3: Prototyping business model and actions
Network elements and illustrative cases are provided

Program prototyping



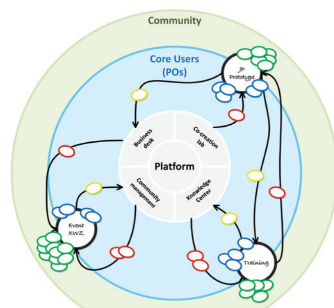
A: Road mapping with focus on value proposition
D: Medium-high
W1: List of key elements for action/programme prototyping
W2: Selected cases and sectors as priority areas
W3: Prototyping business model and resource allocation

Gap analysis



A: System mapping, Workshop 2 or beginning of road mapping
D: Medium-high
W1: List of potential actors and driving forces
W2: Selected cases and sectors as priority areas
W3: Prototyping business model and actions
Network elements and illustrative cases are provided

Platform prototyping



A: Road mapping with focus on portfolio of actions
D: High
W1: List of potential actors and driving forces
W2: Selected cases and sectors as priority areas
W3: Prototyping business model and systemic relations between actions

Sustainable Land use
Forestry Flagship
Brussels, January 2018

Knowledge management is the systematic management of knowledge assets for the purpose of creating value and meeting tactical and strategic requirements. It is the process of creating, sharing, using and managing the knowledge and information of an organisation.

Chapter 4

Knowledge management, analysis and dissemination

In this chapter:

- Management as learning
- Science-based visual tools
- The journey to create a shared understanding
- Step-by-step process

Knowledge services

The system mapping process can be defined as a knowledge service where a team of facilitators, experts and practitioners facilitate a guided conversation, enable the exchange of information and support an iterative curation process. Driven by a problem-solving process based on specific tools and methods, practitioners move from traditional "learning to manage" practices to "management as learning" while "recycling what is already known".

System maps work then as "artefacts" to provide information and to focus the conversation on the specific areas around the defined challenge and related decision-making process. Knowledge is incorporated as an input for productive use, which can be adapted and transformed as part of the system mapping process.

From data curation to knowledge co-production

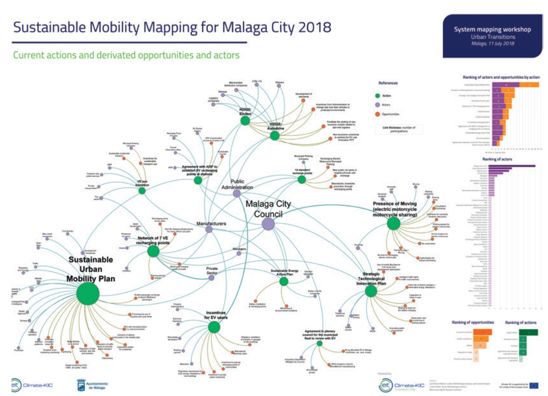
Data curation combines expert advice and technical assistance to ensure the knowledge management process maintains a focus on the stakeholder's challenges. It is guided by the system mapping framework (see Chapter 2) and the output from the interaction with various actors over time.

Chapters 2 and 3 have introduced the rationale regarding the connection of the defined challenge with simple questions supported by an overall framework.

The participatory process and the application of visual tools allow new data to be harvested towards a better understanding of the overall system. This chapter introduces knowledge management to facilitate the curation of the data gathered during the system mapping sessions through the practices of documentation and subsequent knowledge co-production.

This horizontal learning process integrates links between interpretation, cognitive transformation and analysis to introduce practitioners to simple iterative mechanisms for creating practice-based knowledge or enabling a shared understanding of the system in which they are embedded. The process facilitates the identification of new patterns and connections while seeking to visualise hidden insights, recurrent loops and unexpected elements. In doing so, common data science practices are applied.

Data science. is an interdisciplinary field that uses science-based methods to extract knowledge and insights from both structured and unstructured data. Data science is related to data mining and big data but can be applied to any data source, e.g. to harvest data from the visual tools used during the mapping process.



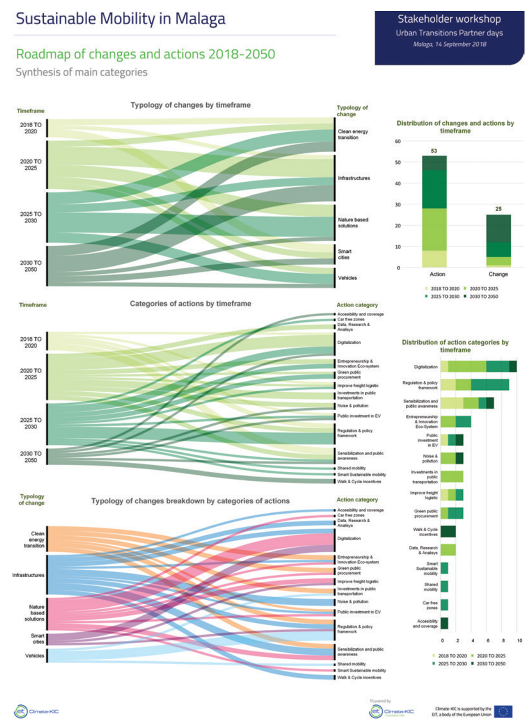


Figure 18: Example of knowledge visualisation: System map (left) and Infographics (Right)

Creating practice-based knowledge through visual tools

System mapping processes rely on science-based visual thinking techniques. Visual tools help to simplify a variety of components and concepts of the socio-technical system through metaphors while facilitating an interactive dialogue process to enable the design of co-created maps.

The science-based visual tools provide (1) guiding principles to allow the interplay of different elements, such as the attributes and variables of the socio-technical system in the spaces and sections defined by the visual tools and (2) the possibility to introduce layers of information through affinity and clustering. To facilitate these possibilities, layers can be classified by colour, shape and size, using Post-it notes, stickers or any other input device.

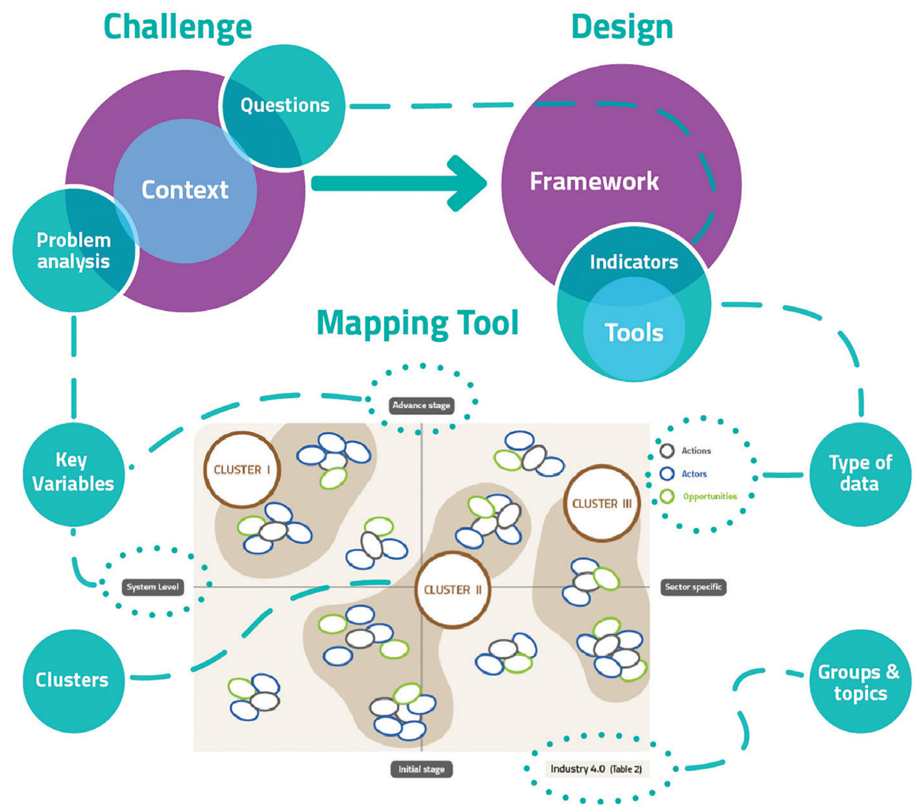


Figure 19: Relations between the challenge, the framework, and the visual tools

By following the principles suggested in Chapter 2 and 3, tools can be chosen and adapted to perform a systemic process for capturing and systematising system elements. That adaptation should be done by following the questions coming from the challenge definition.

The choice of visual tools is an essential step in the design framework. Tools introduce key variables and data types through different forms of visual communication. They also help to identify the indicators needed to answer the main question and support the decision-making process for the challenge at hand.

Relational information is essential to transform data into relevant knowledge on system composition and relations. Knowledge management contributes to the analysis of the layers of information and the different levels of aggregations and patterns of relations gathered through system maps.

Science-based visual tools grounded in translational and applied research facilitate the interpretation and analysis of data gathered by following a question-driven process and indicator-based decision-making process.

The journey to create a shared understanding

The knowledge management process proposed for the challenge-led system mapping approach is inspired by the Knowledge Management Cognitive Pyramid (DIKW). It is aimed to improve the structure and understanding of the knowledge developed throughout the system mapping process.

Structure ranges from the analogue structure produced with participants during the mapping exercise to more complex data sets and indicators based on the framework provided by the science-based visuals tools.

Understanding involves a learning process driven by the challenge and includes system components and relations, as well as more complex linkages coming from the analysis driven by the mapping framework.

Knowledge management depends on the capacity and willingness of the audience to absorb, exchange and internalise information. Two stages are proposed to enable a pluralistic understanding: (1) harvesting and documentation and (2) conceptualisation and analysis.

Intermediate outputs are provided based on the iterative feedback loops, which enables a pluralistic understanding of the system and a broader perspective in terms of conceptualisation. At the same time, the examination of connections between small elements introduces basic practices for co-producing practice-based knowledge with and for practitioners.

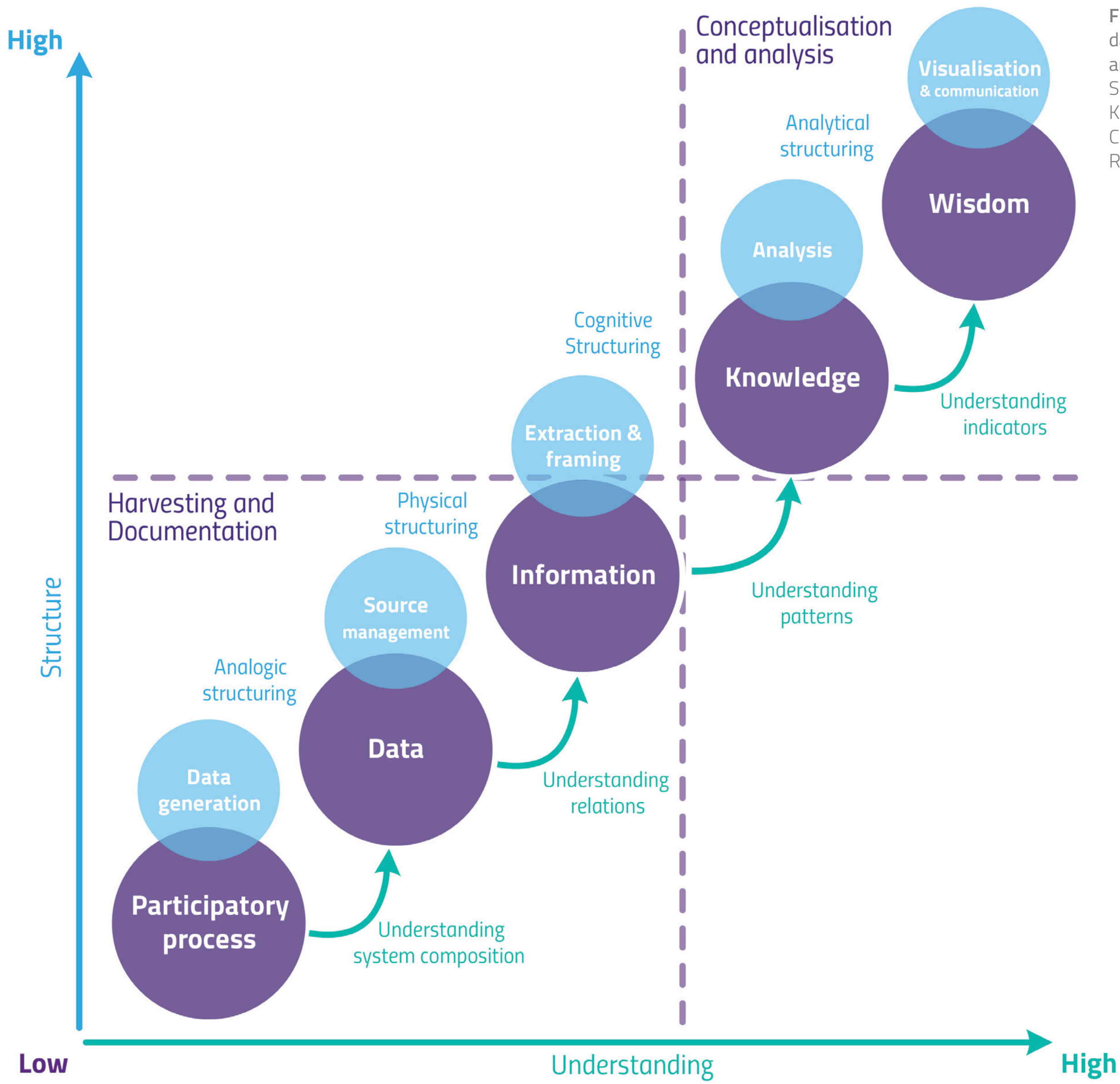


Figure 20: Participatory process, data, information, knowledge and wisdom.
Source: own elaboration Knowledge Management Cognitive Pyramid based in Rowley (2007)

Harvesting and documentation

This stage goes from material results (canvas/ analogue structures) to physical data structuring by starting right after the participatory process.

It compounds two steps: STEP 1 Source management (DATA) and STEP 2 Extracting and framing (INFORMATION). It includes a series of techniques coming from data science such as data mining and data processing.

It focuses on transforming data into information from which intermediate structured data visualisations are generated to activate discussion on the connections with the questions and indicators introduced by the framework (e.g. tools). It helps to draw reflections with challenge owners and participants and to identify focus areas for further analytical steps.

Conceptualisation and analysis

This stage seeks to provide a more analytical perspective by navigating from cognitive to analytical structuring and, by doing so, enabling knowledge co-production with practitioners.

It starts with STEP 3 Analysis and coding (KNOWLEDGE) whereby interactions are made between coding categories to reveal hidden INSIGHTS, recurrent loops and unexpected elements by addressing the questions and indicators introduced in the framework.

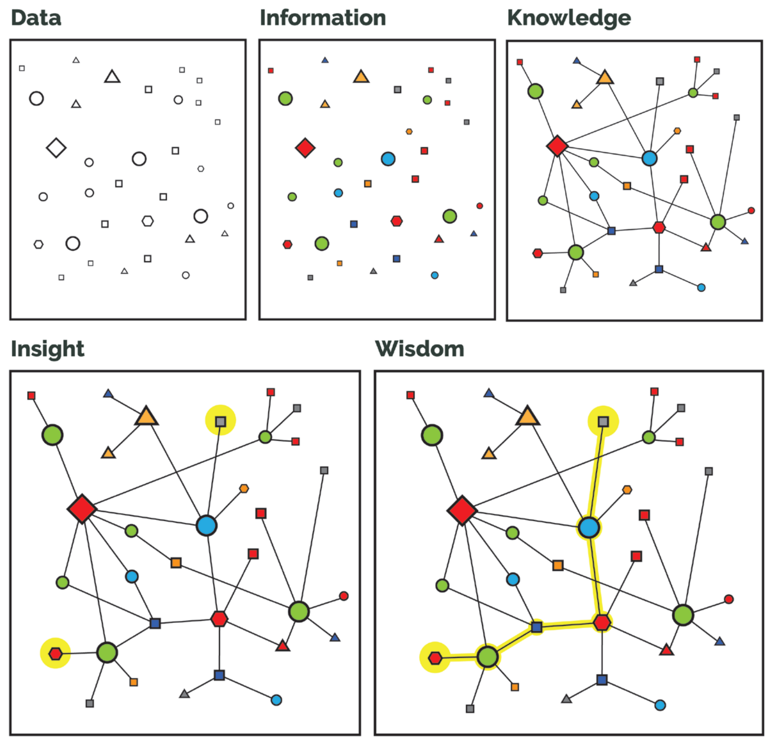


Figure 21: Mental model for knowledge development stages
Source: own elaboration based in Figueroa (2019)

STEP 4 applies visualisation and communication tools to help identify nuances, trigger reflections and, most importantly, incorporate different views into the co-created narratives into a SHARED UNDERSTANDING or collective WISDOM

Collective intelligence. The whole process is implemented through an active exchange with challenge owners and participants. By doing so, different elements and layers of information are transformed to build up narratives based on collective intelligence. Therefore, the final co-created result is much more than the sum of all the single elements.

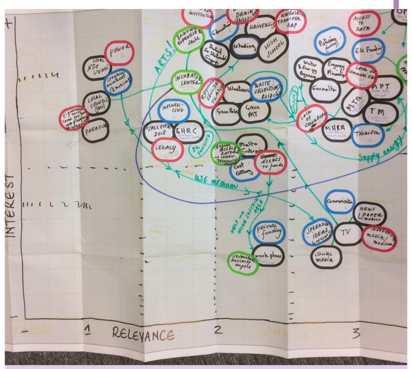
Trust. The purpose of curation is to enable better knowledge flows for challenge owners and participants. The system mapping process, broadly speaking, involves managing expectations and problems such as conflicts of interest. Intermediate steps for data curation and knowledge co-production contribute to achieving transparency and creating trust.

Step-by-step process for knowledge management

Figure 22: Four-steps knowledge management process

Harvesting and documentation

Conceptualisation and analysis



STEP 1
Source management

Data

Multiple sources are organised by considering workshops,topics, tools and canvas

Analogic structuring

Sorted list of groups, topics and clusters

D	Worksho	Canva	Quadrar	
103	Sofia CE	E1 Climate	2	Digitalisatio
104	Sofia CE	E1 Climate	2	Digitalisatio
105	Sofia CE	E1 Climate	2	Digitalisatio
106	Sofia CE	E1 Climate	2	Digitalisatio
116	Sofia CE	E1 Climate	3	Education
117	Sofia CE	E1 Climate	3	Education
118	Sofia CE	E1 Climate	3	Education
119	Sofia CE	E1 Climate	3	Education
127	Sofia CE	E2 Climate	2	Green busin
128	Sofia CE	E2 Climate	2	Green busin
131	Sofia CE	E2 Climate	3	Green Policy
132	Sofia CE	E2 Climate	3	Green Policy
133	Sofia CE	E2 Climate	3	Green Policy
146	Sofia CE	E2 Climate	1	Inno + tech +
147	Sofia CE	E2 Climate	1	Inno + tech +

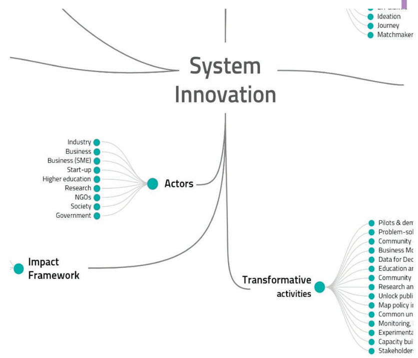
STEP 2
Extracting & framing

Information

Data is digitalised, translated and structured in a data set

Physical structuring

Panel data format & data structure visualization



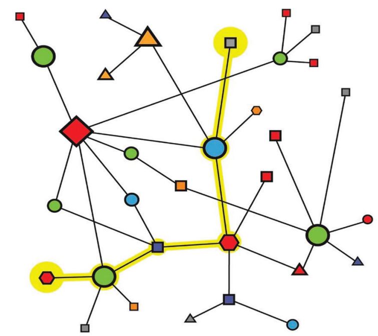
STEP 3
Analysis & coding

Knowledge

Knowledge systematization is implemented based in framework indicators and coding categories

Cognitive structuring

Multi-level & multi-layer relations



STEP 4
Visualisation & communication

Shared understanding

Indicators are presented through a visualisation framework and communication formats

Analytical structuring

Infographics, Dashboards and Webinars

Urban Cleantech strategy
Apeldoorn, June 2016

Source organisation

The organisation of sources coming from the system mapping process will follow the logic of the activities designed for the participatory process.

- A single **workshop** is organised in several **mapping sessions** based on selected **tools**.
- Each session may include several groups organised by simple numerical division or topics such as energy, mobility and water as part of the defined challenge.
- **Canvases** are the materials on which **tools** are drawn or printed for producing and capturing data from participants' inputs during workshop sessions.

In practice, each workshop can be designed by including one or more sessions. Each group is assigned one canvas for the mapping session. What follows is a simple example based on the roadmap narrative. Workshop 1 can include two sessions (S1: stakeholder analysis, S2: visioning) and 25 participants divided equally into 5 groups. This yields 10 canvases (2 X 5) at the end of the workshop.

Scale. Three workshops following the same structure will then account for a total of 30 canvasses, from which data will be harvested and organised for the knowledge management process.

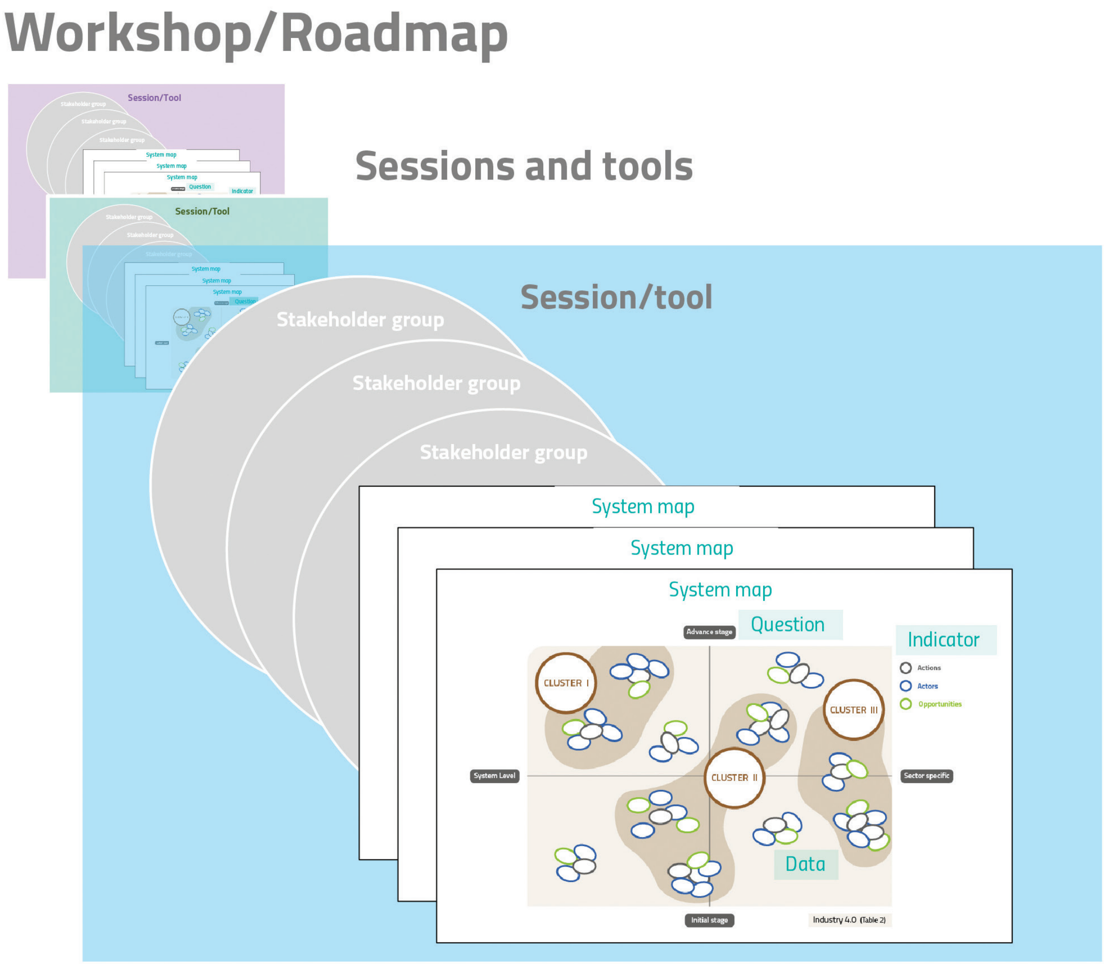


Figure 23: Workshop, session, tool scales for system mapping

Data inputs gathered. Each tool/canvas can harvest an average of 60 inputs divided into 2 or 3 variables. In total, the example described could produce 600 inputs per workshop, which is a medium size data set.

Labelling. Name and/or number the canvases before the workshop. Clear tagging is essential to a valid data management process.

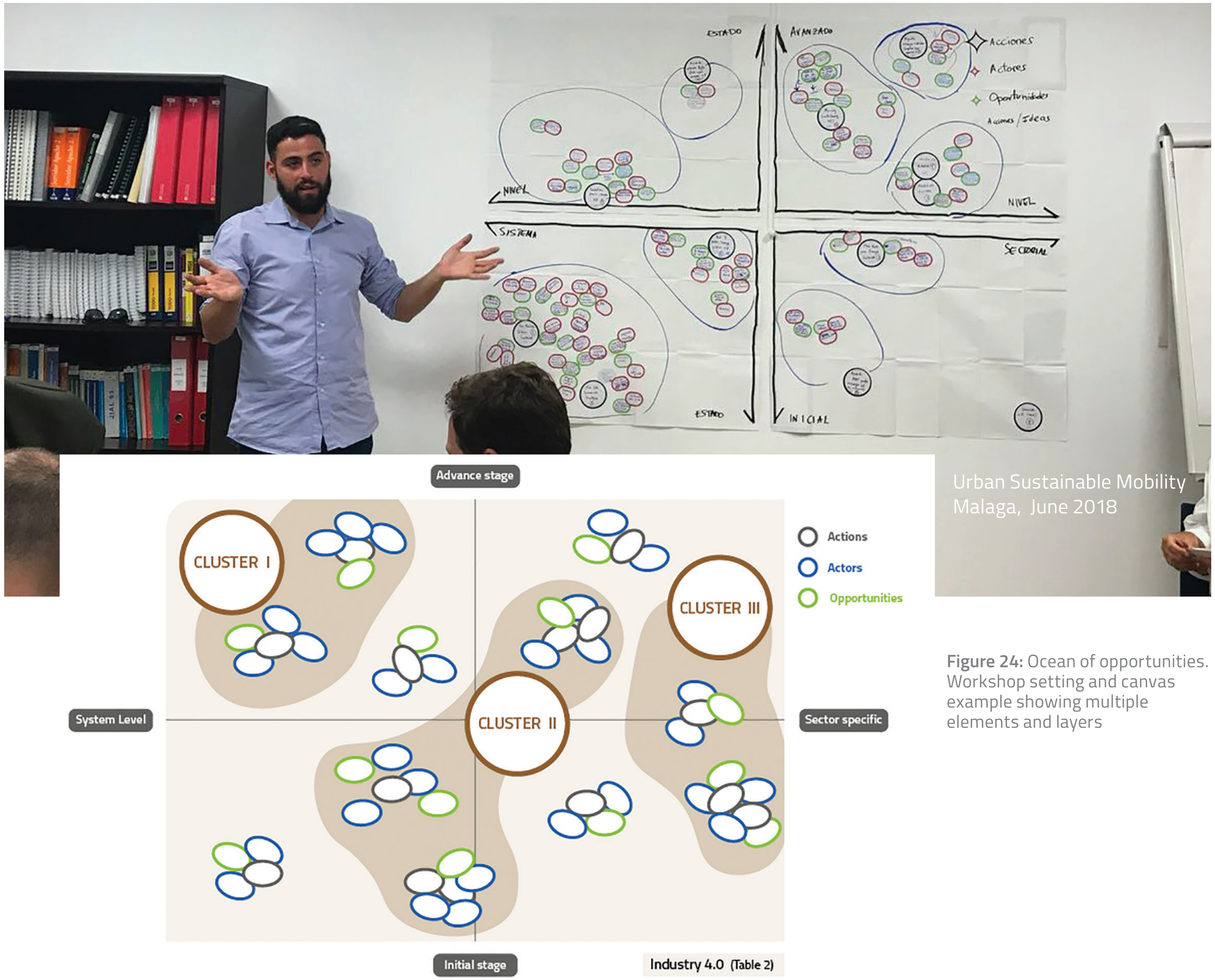
Source preparation

The data and relations harvested can be understood in terms of the guiding principles provided by the science-based visual tools, such as those of the different elements of the socio-technical system, as well as layers of information based on clustering and coding (e.g. colour coding, shapes and sizes).

Tools then enable challenge questions to be explored though bottom-up created indicators based on the type of data gathered. Chapter 5 presents insights into the application of network analysis techniques in sociotechnical systems. Figure 24 presents an example of the 'ocean of opportunities' tool, which applies three guiding principles for the exploration of on-going actions:

1 Cross shape: two axes (V, initial vs advanced stage, and H, system vs sector level);
2 Different colour-coded elements (actions, actors and opportunities) and
3 Layers of information created through groups and clusters (in the example, big stickers represent clusters of ideas).

This logic is part of the overall workshop framing. The team should organise meetings before and right after the participatory process to check implementation issues. The clearer the elements (e.g. colour coding) are, the better the knowledge management process will be.



Urban Sustainable Mobility
Malaga, June 2018

Figure 24: Ocean of opportunities. Workshop setting and canvas example showing multiple elements and layers

Step 2: extracting and framing

The primary information identified using the science-based visual tools should be gathered and collected by extracting any single data input following the tool's logic. This step involves the digitisation of the results to create data sets.

The data set

The extraction and management of all that data will produce a data set from each workshop that could be integrated into existing data. Data units such as Post-it notes and stickers are converted into text entries, maintaining the sectional structure of the tool/canvas.

- The process requires management of the feedback loops between the extraction and interpretation of inputs as well as exchange between experts, facilitators and challenge owners.
- The coding process at this stage is limited to the indication of general tags such as colour and size, action, opportunity, resource, etc.
- Various scales, such as workshop and canvas, already described in the last section, should be considered in the structure of the data.

Data structuring through panel data

The panel data format is used to better organise all these levels and components and to guarantee optimal use of the data for statistical analysis.

Panel data contains observations and attributes of multiple phenomena obtained over multiple repetitions.

This data set format is suitable for gathering data from mapping exercises since science-based visual tools include multiple elements that can be organised in different sections and levels.

The figure below shows an example of the panel data format with data gathered from the 'ocean of opportunities' tool implemented in Sofia. The panel comprises the basic data set structure, raw data and the coding process results in the last column.

Figure 25: Panel data example based in Ocean of opportunities tool

ID	Workshop	Canvas	Quadrant	Cluster	Colour	Text	Coding/category
142	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Action	-video shooting - creative campaigns	Awareness and engagement
138	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Action	renewable energy from wast water	fuels and energy sources
139	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Action	renewable energy from food waste	fuels and energy sources
140	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Action	zero carbon emissions in cities	local and urban intervention
144	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Action	zero food waste	waste management
145	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Action	turn food waste into fertilizer	waste management
146	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	business	Business
150	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	business	Business
156	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	Business	Business
151	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	Municipalities	Local government
153	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	Municipalities	Local government
147	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	mass media	Media

Basic elements for the analysis

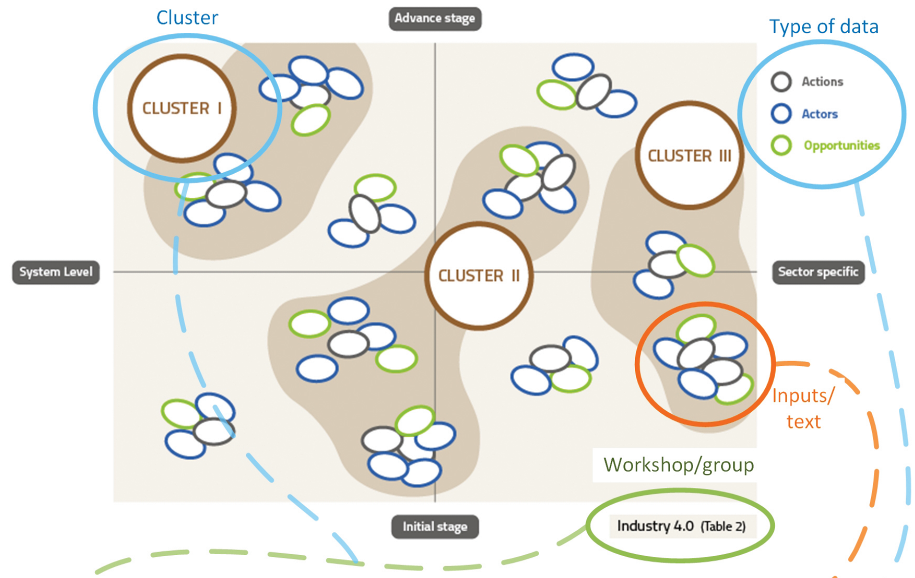
The science-based visual tools are designed to address guiding questions based on a variety of variables. The panel data format allows to structure and organise the data in the canvases by following the framework of those tools.

Panel data helps to group data in different scales (see page 56) such as tools, sections, clusters and workshops while allowing further statistical analysis, from simple counting to more complex network analysis. The figure to the right shows how the different components of a canvas ('Ocean of Opportunities' tool) are covered in an excel sheet designed with the panel data format. The standard format for a worksheet is as follows::

Data set structure

- **ID:** a unique identifying number for each element, used to avoid duplications and to manipulate relations, run statistical processes and clustering.
- **Workshop name:** used to organise different origins. The formula *Location + Topic* is mostly applied.
- **Canvas:** refers to the analogue artifact, such as a flipchart or printed canvas, used by a group of participants during a mapping session based on a specific tool, and indicates the grouping logic (e.g. topic, city, sector).

Figure 26: Transposition from visual tool to panel data structure



ID	Workshop	Canvas	Quadrant	Cluster	Colour	Text	Coding/category
142	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Action	-video shooting - creative campaigns	Awareness and engagement
138	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Action	renewable energy from wast water	fuels and energy sources
139	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Action	renewable energy from food waste	fuels and energy sources
140	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Action	zero carbon emissions in cities	local and urban intervention
144	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Action	zero food waste	waste management
145	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Action	turn food waste into fertilizer	waste management
146	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	business	Business
150	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	business	Business
156	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	Business	Business
151	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	Municipalities	Local government
153	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	Municipalities	Local government
147	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	mass media	Media
159	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	Media incl social	Media
148	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	NGOs	NGOs
152	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	Universities	Universities
154	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	Universities	Universities
160	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Opportunities	Accelerator	Accelerator
161	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Opportunities	Pathfinder	Pilots & Demostrations OP

Dataset structure — Tool framework & layers — Inputs and indicators

Step 3: analysis and coding

Tools framework and layers of data

- **Quadrant** or **Section**: indicates the different spaces represented by the visual tool, which serves as a guiding principle for the expected indicators. Generally these are scales and sub-sections based on the main concepts provided by the visual tool.
- **Cluster**: indicates a collection of elements grouped under a meta-category by following affinity relations referring to thematic or geographical proximity (see Chapter 5, p. 84). Isolated elements can be categorised as 'non-clustered', guaranteeing further analysis.
- **Type of element:** expresses as an attribute the kind of information on the Post-it note or sticker, such as action, actor, resource or output.

Inputs and indicators

- **Text:** the most accurate translation of the written input/unit of data such as a Post-it note or sticker. Data entry involves an iterative translation process requiring data cleaning, merging and the consolidation of inputs and elements.
- **Coding/category:** the codes assigned to written input through the coding or tagging process.

Bottom-up indicators are measurements taken by means of the simultaneous conceptualisation of data given by a cognitive framework (codes) and the quantification of these codes into comparative quantitative magnitudes. Conceptualisation also helps to make a connection between data and to create relational indicators that could be used for stakeholder analysis and the relations between them.

Data entry. Any member of the team can be assigned to enter data, i.e. to extract and digitise it into a data set. Several iterations and review processes can be made based on additional materials produced by coaches, reporters and experts before the analytical stage.

Data harvesting from canvas

Intermediate data visualisations

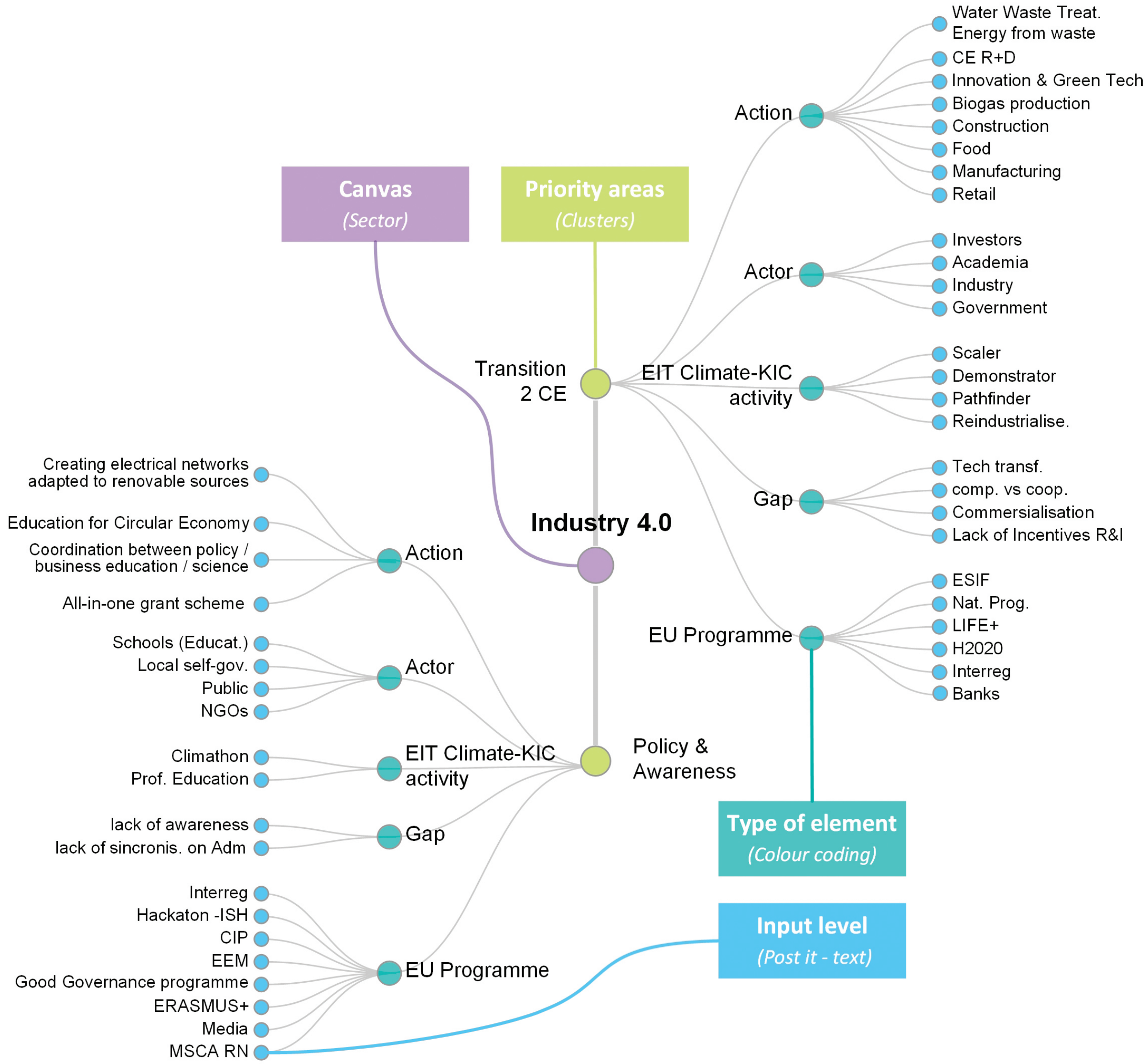
Once the data set has been organised in the panel data format, intermediate visualisations can be produced to explore -together with the practitioners- reflections on the workshop results.

Simple visualisations using a cluster logic help to organise exchanges with challenge owners and experts about early results.

- The intermediate structured data visualisation allows the discussion and overall priorities to be revisited.
- Visualisations help to get an idea of the amount and complexity of the data, so that decisions can be made regarding focus areas or emerging topics.
- Visualisations enables focus and exploration of patterns and new insights.
- It is helpful to compare overlay data (canvas, cluster, element type, inputs) and the framing questions and indicators driving the mapping exercise.
- Structured data visualisation is an intermediate output of the system mapping and, and in some cases could match the challenge owner's expectations.
- At this stage, the data set itself is an output of the system mapping process..

The figure to the right shows and example of visualisation of a single topic, comprising two clusters and five different types of element.

Figure 27: Intermediate structured data visualization



Step 3: analysis and coding

Once the data extracted from the workshop has been organised in the panel data format, the next step is data analysis. To this end, each input is reviewed in terms of the conceptual definitions and attributes by following the guiding principles of the workshop framework and the science-based visual tools. Conceptual values are then assigned through a simple coding or 'tagging' process based on content analysis techniques to produce bottom-up indicators for further analysis.

The coding process seeks to unpack the information included in the data set into a more comprehensive and simple set of elements to be analysed. Data analysts, practitioners and thematic experts regroup the inputs from the workshop by relying on a cognitive framework such as a lexicon-based set of categories (i.e. a structured family of words). Two actions are important in this step: (1) synthesis and framing and (2) establishing bottom-up indicators.

Synthesis and framing through coding process

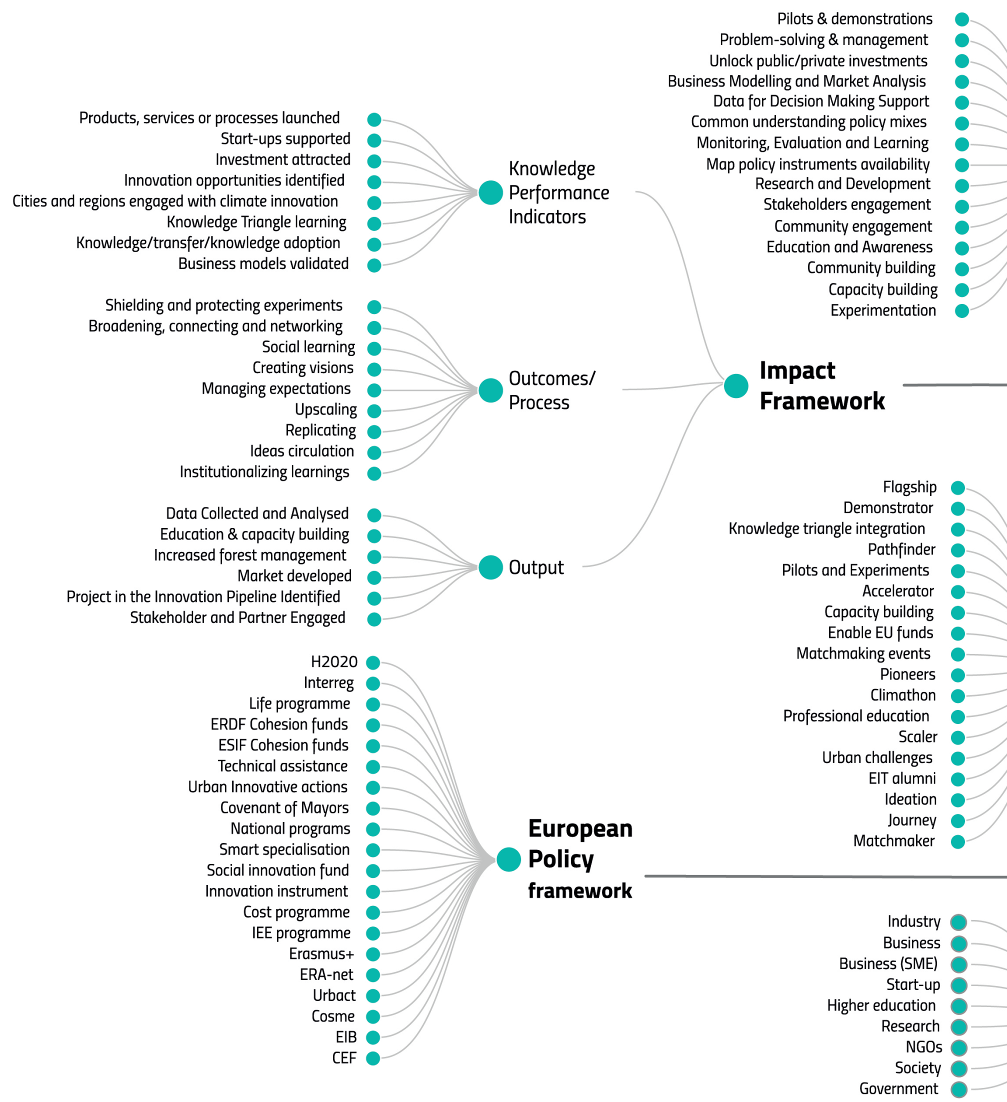
Coding helps to conceptualise and synthesise information by structuring it into categories based on cognitive frameworks. It helps to improve the understanding of information through the identification of patterns between different elements now represented and conceptualised by categories. Cognitive frameworks can include elements with different levels of difficulty, from a simple list of categories such as actor type (business, university, local government) to broader elements such as actions and opportunities (see figure 28). The workshop topics can help to anchor the analysis in specific fields (e.g. energy efficiency, circular economy).

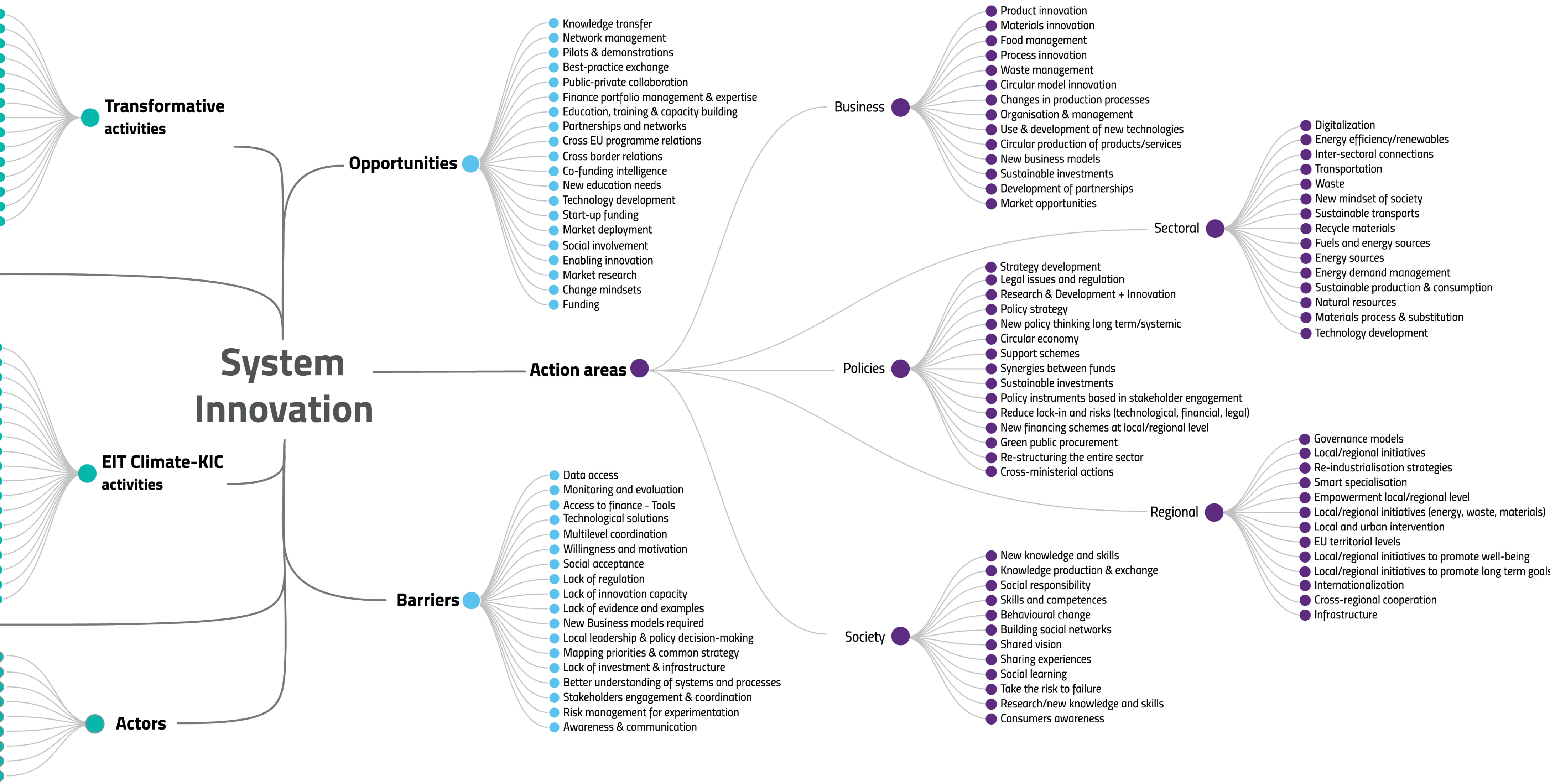
Cognitive frameworks are very often co-designed by challenge owners, thematic experts and the analyst in charge of the knowledge management process. They evolve through the addition of new categories describing elements of new subsystem, processes and innovation fields. In practice, this family of words enables the systematisation of information into practice-based knowledge. To be useful for practitioners, cognitive frameworks should be:

- systemic by including system elements and their common process;
- accessible to different contexts and needs (policy makers, researchers, business); and
- grounded in terms commonly used in the field in question.

> **Coding** is the process of assigning words or short phrases (CODES or CATEGORIES) to short texts formats such as words or sentences with the aim of transforming text data into practice-based knowledge.

Figure 28: Cognitive framework on System Innovation




System Innovation
Transformative activities
EIT Climate-KIC activities
Actors
Opportunities
Knowledge transfer
Network management
Pilots & demonstrations
Best-practice exchange
Public-private collaboration
Finance portfolio management & expertise
Education, training & capacity building
Partnerships and networks
Cross EU programme relations
Cross border relations
Co-funding intelligence
New education needs
Technology development
Start-up funding
Market deployment
Social involvement
Enabling innovation
Market research
Change mindsets
Funding
Action areas
Barriers
Data access
Monitoring and evaluation
Access to finance - Tools
Technological solutions
Multilevel coordination
Willingness and motivation
Social acceptance
Lack of regulation
Lack of innovation capacity
Lack of evidence and examples
New Business models required
Local leadership & policy decision-making
Mapping priorities & common strategy
Lack of investment & infrastructure
Better understanding of systems and processes
Stakeholders engagement & coordination
Risk management for experimentation
Awareness & communication
Business
Product innovation
Materials innovation
Food management
Process innovation
Waste management
Circular model innovation
Changes in production processes
Organisation & management
Use & development of new technologies
Circular production of products/services
New business models
Sustainable investments
Development of partnerships
Market opportunities
Policies
Strategy development
Legal issues and regulation
Research & Development + Innovation
Policy strategy
New policy thinking long term/systemic
Circular economy
Support schemes
Synergies between funds
Sustainable investments
Policy instruments based in stakeholder engagement
Reduce lock-in and risks (technological, financial, legal)
New financing schemes at local/regional level
Green public procurement
Re-structuring the entire sector
Cross-ministerial actions
Society
New knowledge and skills
Knowledge production & exchange
Social responsibility
Skills and competences
Behavioural change
Building social networks
Shared vision
Sharing experiences
Social learning
Take the risk to failure
Research/new knowledge and skills
Consumers awareness
Sectoral
Digitalization
Energy efficiency/renewables
Inter-sectoral connections
Transportation
Waste
New mindset of society
Sustainable transports
Recycle materials
Fuels and energy sources
Energy sources
Energy demand management
Sustainable production & consumption
Natural resources
Materials process & substitution
Technology development
Regional
Governance models
Local/regional initiatives
Re-industrialisation strategies
Smart specialisation
Empowerment local/regional level
Local/regional initiatives (energy, waste, materials)
Local and urban intervention
EU territorial levels
Local/regional initiatives to promote well-being
Local/regional initiatives to promote long term goals
Internationalization
Cross-regional cooperation
Infrastructure

Establishing bottom-up indicators

The coding process enables the systematisation of information by following the combination of content analysis and affinity relations between different elements contained in the data set.

Quantification. The use of simple mechanisms to count the number of elements per category as a simple frequency distribution is the first step in the data representation. That distribution (see figure 29) provides an overall estimation of variety and balance of elements gathered with the mapping tool.

Elements can be counted by means of simple steps like pivot tables in Excel, which allows the results to be sorted and compared. The example on the right shows two tables, with the distribution of actors mapped using the 'ocean of opportunities' tool.

Table 1 in Figure 29 shows the distribution of actors found in one working group. Row labels show the data input provided by participants. Table 2 in Figure 29 shows the distribution of actions found in the same exercise after an initial coding iteration to reduce the number of elements.

In practice, taking the mapping exercise as a starting point, the counting of elements can provide an indication of the relevance or irrelevance of some elements. It can facilitate the estimation of rankings and comparative shares as bottom-up indicators to measure the importance of actors, actions and other elements in the data set.

These measures should be considered with precaution since – depending on the tool applied, the repetition and the amount of information – they might not have statistical significance. However, they are essential inputs when it comes to providing insights in further knowledge visualisations.

Table 1

Type of element:	Actors	
Row Labels	**Count of ID**	**Share**
IT companies	1	2%
Ministries /Nac Gov	1	2%
Recycling/recovery companies	1	2%
Transport operator	1	2%
Young people	1	2%
Citizens/Consumers	2	4%
EU organisations	2	4%
Local community	2	4%
Government/Policy makers	3	5%
Media	3	5%
Regional Government	3	5%
Schools	3	5%
Start-ups/New Business	3	5%
Local government	5	9%
NGOs	5	9%
Business	7	13%
Universities	12	22%
Grand Total	**55**	**100%**

Table 2

Type of element:	Actions	
Row Labels	**Count of ID**	**Share**
education and information	1	2%
Enabling innovation	1	2%
Pilots & Demostrations	1	2%
Skills and competences	1	2%
Knowledge integration	2	5%
local and urban intervention	2	5%
sustainable transports	2	5%
fuels and energy sources	3	7%
legal issues and regulation	3	7%
Specialised training	3	7%
R&D&I	4	10%
Policy learning	5	12%
Awareness and engagement	7	17%
waste management	7	17%
Grand Total	**42**	**100%**

Figure 29: Screenshot of summary tables (quantification) based in coding process

Segmentation is the process of dividing a population into groups or segments, based on different characteristics.

In practice, counting elements allows for the aggregation of multiple elements into common categories, subgroups or segments, which can be applied to describe more complex relations and multiple levels of system elements, such as actors or policy instruments. The example shows the distribution of elements in a cluster where the actions (A) and actors (B & C) are re-categorised into simple categories.

Segmentation is possible where a cognitive framework is applied to the data produced during the mapping exercise. Technical assistance is critical at this stage as the process can include several iterations to get to the final coding categories based on the feedback loops between experts, the technical team, challenge owners and other people included in the mapping process. Those iterations provide higher value by enabling links between interpretation and cognitive transformation into a simpler and reduced list of elements.

An encoded data set is a collection of translated, organised and conceptualised data, ready to use in a statistical or qualitative analysis. It is an intermediate output of the knowledge management process.

ID	W	Cluster	Colour	Text	Coding/category	
142	Sof	Inno + tech + i	Action	-video shooting - creative c	Awareness and engagement	
143	Sof	Inno + tech + i	Action	change the perception "It d	Awareness and engagement	
138	Sof	Inno + tech + i	Action	renewable energy from wa	fuels and energy sources	A
139	Sof	Inno + tech + i	Action	renewable energy from foo	fuels and energy sources	
140	Sof	Inno + tech + i	Action	zero carbon emissions in ci	local and urban intervention	
141	Sof	Inno + tech + i	Action	create the relevant softwar	R&D&I	
144	Sof	Inno + tech + i	Action	zero food waste	waste management	
145	Sof	Inno + tech + i	Action	turn food waste into fertili	waste management	
146	Sof	Inno + tech + i	Actors	business	Business	
150	Sof	Inno + tech + i	Actors	business	Business	
156	Sof	Inno + tech + i	Actors	Business	Business	
151	Sof	Inno + tech + i	Actors	Municipalities	Local government	B
153	Sof	Inno + tech + i	Actors	Municipalities	Local government	
147	Sof	Inno + tech + i	Actors	mass media	Media	
159	Sof	Inno + tech + i	Actors	Media incl social	Media	
148	Sof	Inno + tech + i	Actors	NGOs	NGOs	
149	Sof	Inno + tech + i	Actors	Packaging recovery organis	Reclying/recovery companies	
155	Sof	Inno + tech + i	Actors	Start-ups	Start-ups/New Business	
152	Sof	Inno + tech + i	Actors	Universities	Universities	
154	Sof	Inno + tech + i	Actors	Universities	Universities	
157	Sof	Inno + tech + i	Actors	academic institutions	Universities	C
158	Sof	Inno + tech + i	Actors	Universities	Universities	
160	Sof	Inno + tech + i	Opportunities	Accelerator	Accelerator	
161	Sof	Inno + tech + i	Opportunities	Pathfinder	Pilots & Demostrations OP	

Figure 30: Example of coding and segmentation as part of cluster composition

Industrial Symbiosis-Regional mapping
H2020 SCALER
Oeiras January 2020

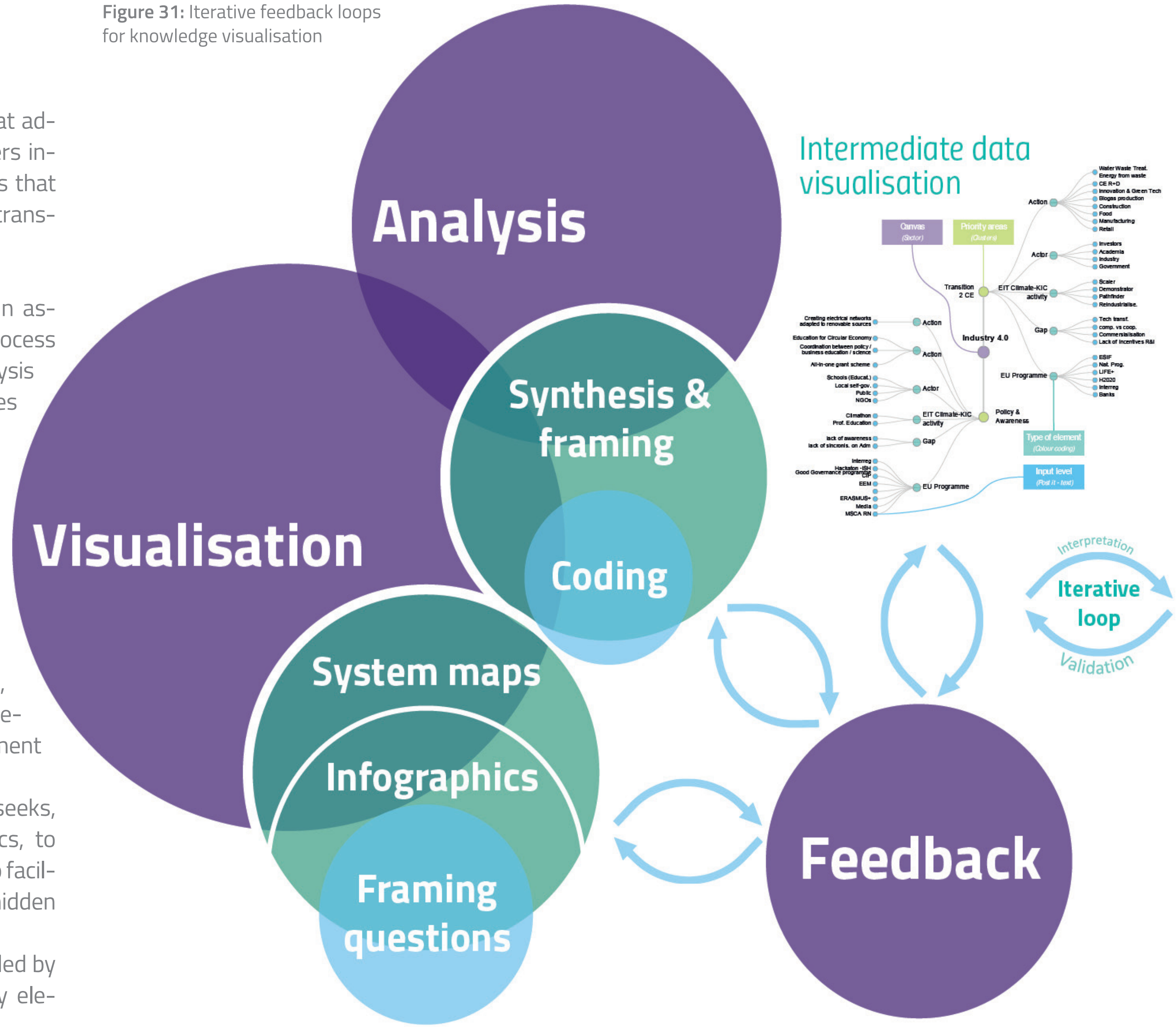
Designing information for decision-making

The process for designing information that addresses the needs of the challenge owners involves a series of iterative feedback loops that integrates interpretation and cognitive transformation.

These feedback loops represent the main aspect of the knowledge co-development process since they validate the results of the analysis and help to translate data and narratives into visual forms to aid in communication.

- **Intermediate structured data visualisation** (STEP 3, page 61) and **Synthesis and framing** through the coding process (page 62) introduce the first two **feedback loops**, which help to reconnect practitioners and the system mapping team with the framing questions, the mapping tool and the workshop results as part of the knowledge management process.
- The **Visualisation** process (STEP 4) seeks, through system maps and infographics, to simplify and develop a visual narrative to facilitate the discovery of new insights and hidden structures.
- **System maps and Infographics** are guided by a visualisation framework, drawing key elements from all the previous steps.

Figure 31: Iterative feedback loops for knowledge visualisation



Step 4: Visualisation and communication

Visualisation framework

The visualisation framework for presenting data on system maps relies on three components:

- The **science-based visual tools** that provide the guiding principles which allow the interplay of the framing questions with different elements of the socio-technical system.
- **Analysis and coding** through the coding process, which helps to address the questions and indicators introduced in the framework.
- The **workshop narrative** is the third component through which different levels of analysis are possible, such as canvas, sessions and workshop (see STEP1).

The visualisation of system maps and related infographics can take different forms, either considering the whole system or the components and elements that help to understand a single aspect or a collection of them. Small portions of the system map can illustrate different aspects in the form of submaps, nested maps or complementary infographics.

- **Submap** by tool and theme: 1 canvas = 1 group. It helps to focus on very specific insights at the level of framing questions.
- **Nested maps** through the whole session/tool: multiple canvasses = multiple groups (and Themes). Suitable for illustrating patterns of relations across different themes.
- **System map** for the macro-level workshop narrative, made by combining all sessions and tools. It is based on the other maps and is intended to contribute to a more comprehensive understanding at the system level.
- **Thematic submap.** If the workshop is organised by thematic group, narratives can be created by combining all the canvases or tools for a given topic.

Data science methods generally suggest five overall categories for data visualisation: (1) categorical, (2) hierarchical, (3) relational, (4) temporal and (5) spatial. Each category can help illustrate different components of the system map. Special attention is paid to relational data. See Chapter 5 for a full explanation of the use of network maps for mapping systems.

Technical assistance provided by a workshop team is fundamental to understanding the possible breakdown of the system map into a narrative and components for creating stories with data, as well as managing time for absorbing new insights and making reflections based on the exchange with practitioners. Being able to consider the variety of digital resources for displaying the information, a team with strong technical capacities will open up a wide range of possibilities from simple charts to complex infographics.

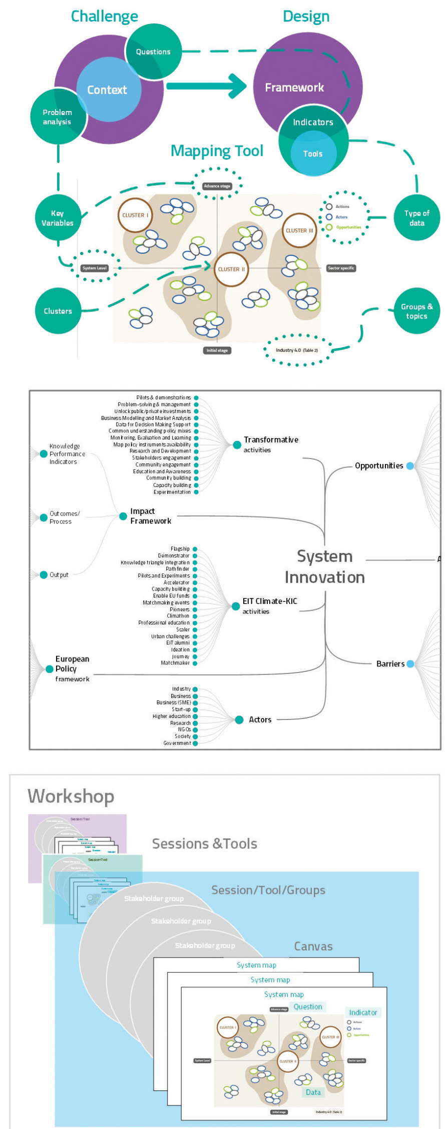
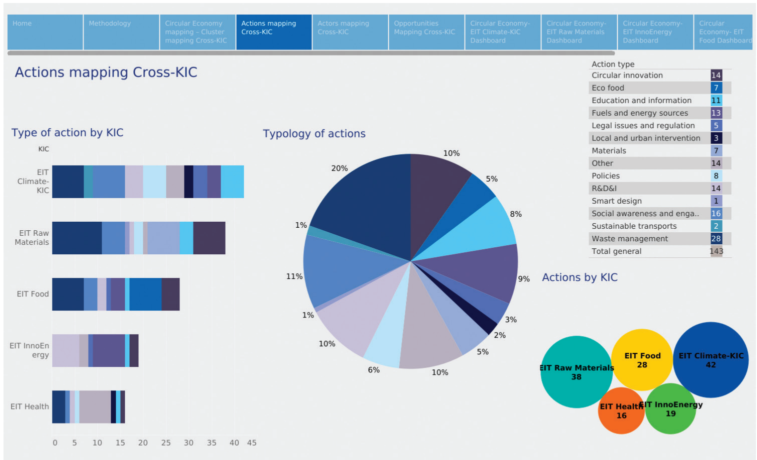


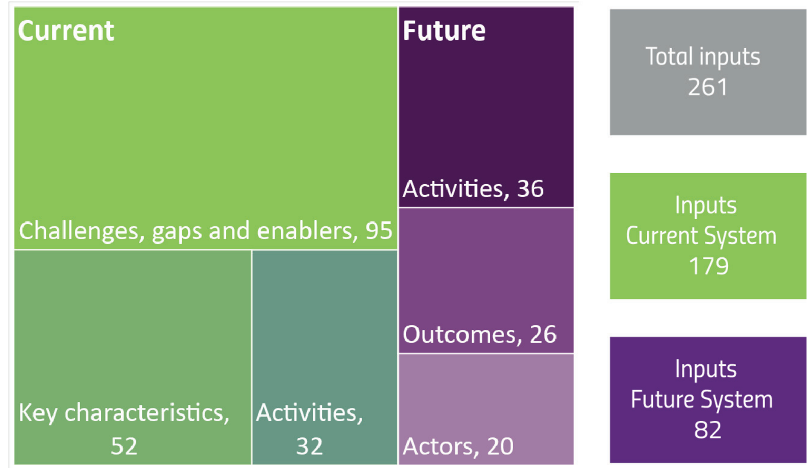
Figure 32: Three components of the visualisation framework

Types of data visualisation

Figure 33 (left): Action mapping presented in dashboard of knowledge visualisation (Tableau).
Source: own elaboration based in cross-KIC workshop Forum Circular Economy, Sofia (2018)

Figure 34 (right): : Tree map comparing system.
Source: Intent workshop Maritime Hubs (2020)





Categorical

Application: comparing categories and the distribution of quantitative values.

Different groups of data (e.g. divisions of actors, actions and opportunities) can be further divided to reflect the ranking within each group using **simple bar charts.**

Framing questions:

What are the components and elements of the system?
Which are the predominant thematic areas?
How is data thematically grouped?

Bottom-up indicators:

Distribution of different elements (actors, actions, opportunities, gaps).

Hierarchical

Application: charting part-to-whole relationships and hierarchies.

Proportions and distributions as a measure of balance and composition in an organisation or system. Can be represented using **pie charts** or **cumulative bar charts** to express aggregated values. **Tree maps** and **sunburst charts** can also be used, with layers representing different hierarchical levels.

Framing questions:

What is the relative weight between elements?
Which are the main conditioners within the system?
What hierarchies can we find within the elements of a system?

Bottom-up indicators:

Rankings of typology of elements and composition of groups at different levels (clusters, categories, subcategories).

Step 4: Visualisation and communication

Relational

Application: graphing relationships to explore correlation and connections.

The layout of the network maps draws on techniques from social network analysis to place more prominent actors at the centre of the map and to place more closely linked actors nearer to each other. This approach is intended to reveal interrelationships and the role of different actors in the process of change.

Social network analysis can be used to visualise the socio-technical systems in the form of network maps, which can show the relationships between actions and stakeholders involved in each action within a city. The socio-technical mapping method is not only about specific network actors but also their attributes, relationships and social exchanges between them, while considering their links, proximity, ties, etc. Additionally, matrices, scatter plots, chord diagram and Sankey graphs are good alternatives for showing the relationship patterns.

Framing questions:

How are the elements within the system interconnected?

What are the relevant structures and positions according to the interrelations among different elements?

Bottom-up indicators:

Number of connections and nodes, more complex measures relating to connectivity and diversity.

Figure 35: Network map Sustainable Mobility in Malaga.
Source: own elaboration - adapted from the original map.

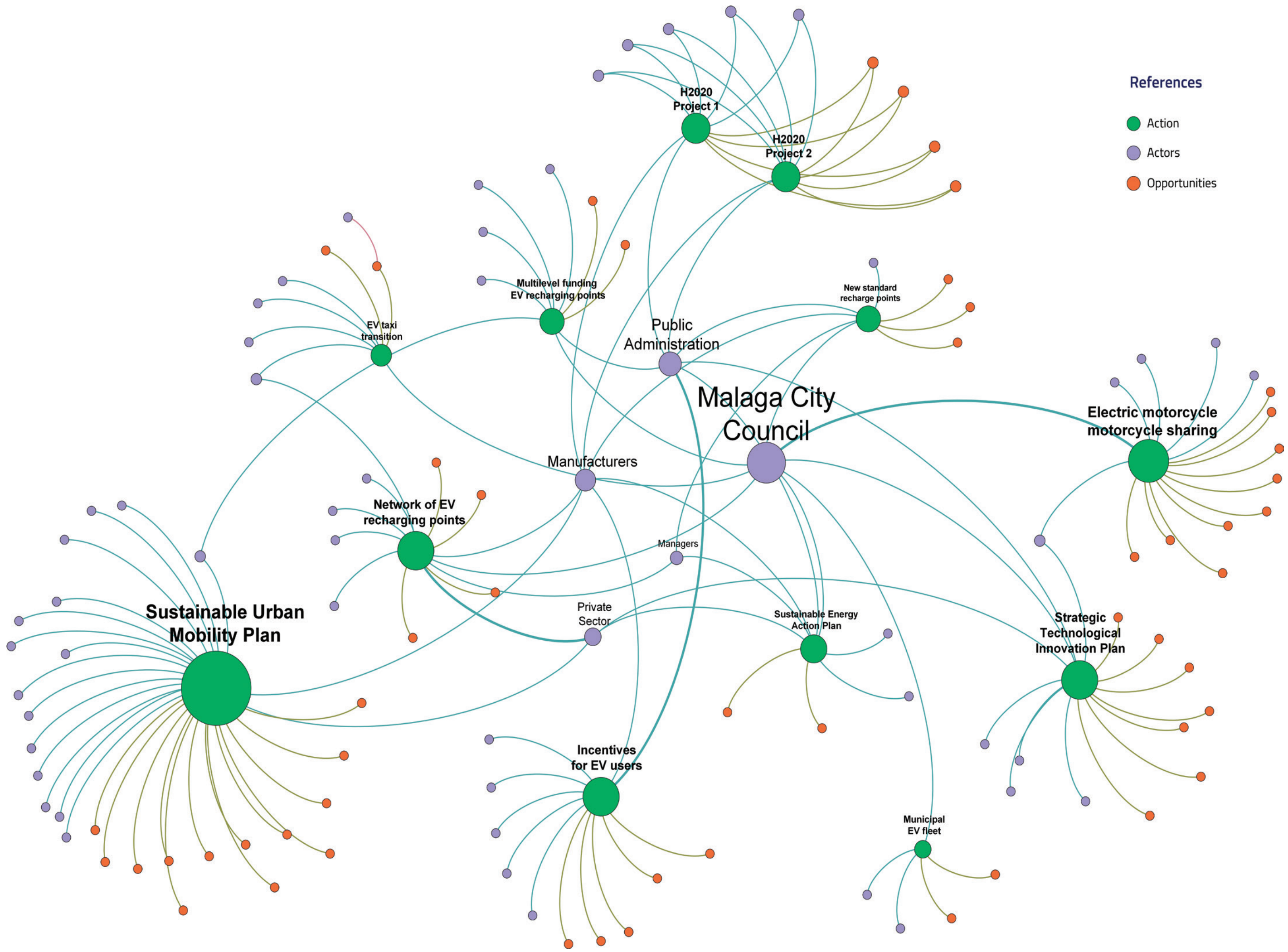
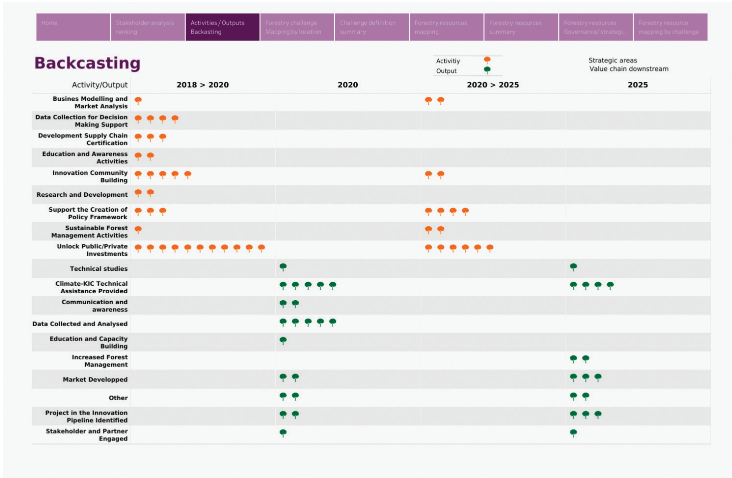
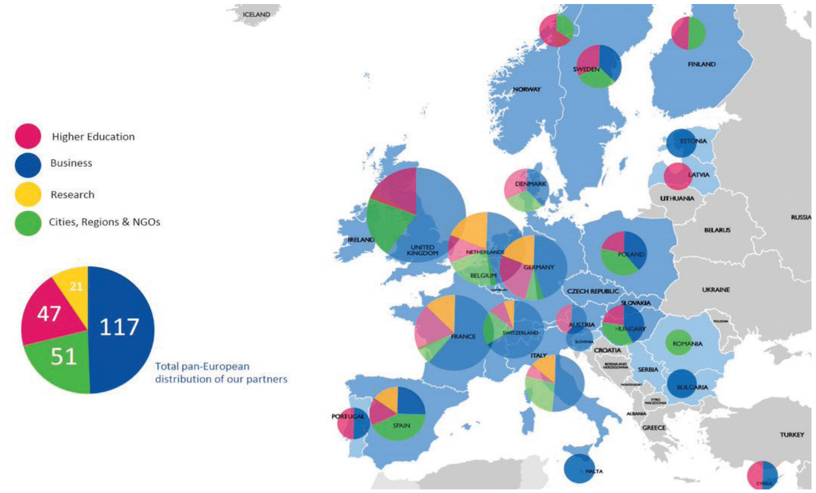


Figure 36 (left): Backcasting presented in dashboard of knowledge visualisation (Tableau).
Source: own elaboration based in Forestry flagship workshop (2018)

Figure 37 (right): : Distribution of EIT Climate-KIC partners by sector map in 2018.
Source: EIT Climate-KIC





Temporal

Application: showing trends and activities over time.

The distribution of data over time can be expressed using line and area charts, while **Sankey diagrams** are suitable for showing data over broad timeframes. Pathways and collections of activities can also be represented with **arc diagrams**, where the time is often reflected with a line, showing the distribution of events that were punctual or part of larger processes.

Framing questions:

How have activities and outputs been distributed over time?
What are the connections between elements over time?
What is the amount and distribution of actions or changes yet to come?

Bottom-up indicators:

Timeframes with an evolving number of elements, such as actions, resources and outputs.

Spatial

Application: mapping spatial patterns and geographical elements through the use of overlays and distributions.

Maps are the most common charts where patterns can be explored in terms of location and agglomerations. Geographical categories and locations can also be compared in terms of distribution of multiple elements by using simple **XY charts (scatter)**, displaying plot points along an XY grid.

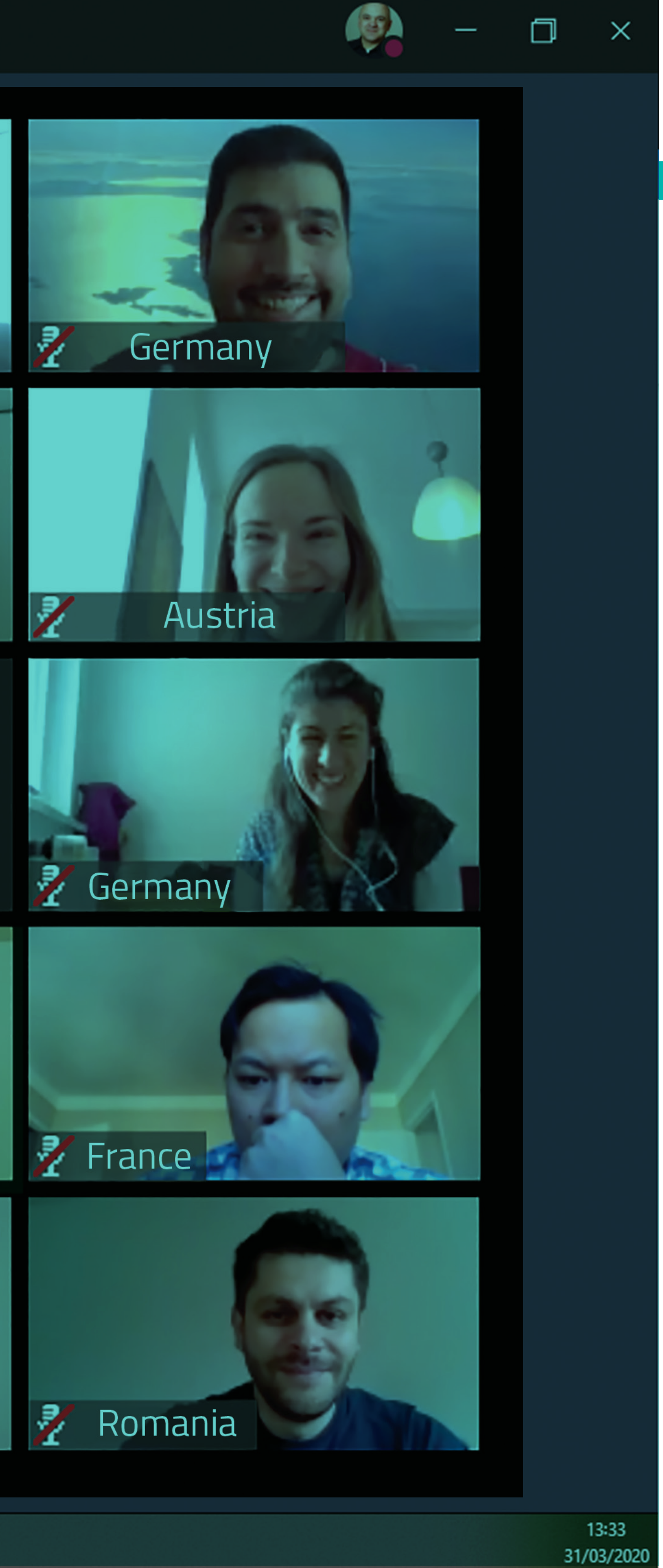
Framing questions:

How are actions and changes distributed geographically?
Which is the location with more ongoing projects, relevant actors and opportunities?
Which common elements appear or influence different locations?

Bottom-up indicators:

Distribution of variables and shares across geographical locations.

Screen capture Policy mix webinar
EIT RIS Programme (2020)



Step 4: Visualisation and communication

Communication and dissemination

The communication surrounding system mapping involves guiding conversations around a map and infographics that work as artefacts to allow some direction in the conversation. In this way, new ideas can be discussed, interpretations exchanged, collaborations enabled and an action plan proposed.

The system mapping process involves interconnected sessions and tools. Tracking these relations is critical for guiding communication, for which a complete set of resources is needed beyond the visualisations.

The communication team

The roles and responsibilities of the team (Chapter 3) are reinforced in this stage by the provision of a strategic direction to the conversation at any stage of the system mapping process.

Those in the leading roles of project manager, facilitator or coach provide the backbone of the communication process by giving the system maps and infographics a facilitating role in the exchange. Furthermore, leaders guarantee the appropriate alignment between the challenge owners and the broader context of the system mapping process. The thematic experts, the data analyst and reporters provide the specific content-related elements and highlight any insights coming from the system maps.

The whole team works in a coordinated fashion to perform communication as a tailor-made process based on the challenge owner's needs. They utilise system mapping as a knowledge service in different types and levels of communication throughout the process. Goals, content, formats and audience will determine the type of communication.

Communication as part of knowledge co-production. Intermediate outputs of the knowledge management process are exchanged between different actors as part of the facilitated dialogue and feedback loops (see Step 4). These internal reports include the encoded data set, preliminary visualisations as well as some course of actions for further analysis.

Communication to support challenge-related processes. Simultaneous construction and negotiation of meaning are important in such conversations where direction and flows of information may go back and forth between different stakeholders or groups. Information should help to identify alternative actions, support effective planning based on the overall defined challenge and framing questions.

Communication for dissemination. The results of the system mapping process are consolidated, adapted and disseminated to the target audience: citizens, policymakers, experts, etc. In this way, further dialogue and the exchange of knowledge is enabled across different communities.

Step 4: Visualisation and communication

Some simple principles can facilitate conversations:

- Challenge is the anchor of the system mapping process. It is a reference to guide the conversation throughout the process.
- Highlighting the stage in the system mapping process (e.g. intermediate inputs) helps to manage expectations.
- The use of the framing questions and indicators helps to stimulate the conversation.
- Unpacking the system map into different types of information contributes to create a storyline behind the data.
- Information is relevant around a context. Explaining the context will help to communicate more effectively.
- Vocabulary simplification helps to eliminate potential divergent interpretations and guarantees effective communication.
- Consistency in the use of indicators and visualisation for similar questions and exercises can add value through the understanding of multiple stories created from similar data, variables and measures.
- Horizontal interactions through interactive formats support the construction of a shared understanding.
- Feedback loops and interactions contribute to the creation of an evolving narrative throughout the process.
- Keeping track of that narrative facilitates the anchoring and consolidation of the main result.
- Information regarding next steps for both the system mapping process and the broad action plans supports the challenge-based narrative of the communication.

Content of communication

Among other things, they can include:

- a summary of the tools used
- a description of the knowledge management process
- the cognitive framework
- a description of results
- bottom-up indicators
- an analysis and synthesis of results
- if agreed, the data set*

*Check GDPR requirements first

Communication formats

Managing the communication surrounding system maps requires consideration of the type of communication, the maturity of the challenge and the particular moment in the system mapping process. This last refers to the communication of intermediate outputs, the facilitation of feedback loops or a more advanced decision-making stage.

Intuitive and interactive elements make visual formats more effective at triggering essential conversations on new action plans or project proposals. Software and online resources can provide several options to foster exchange and interaction but also provide a practical mechanism to analyse indicators and facilitate decision making.


For this, it is understood that there must be a transition in the transport model (towards a more sustainable system, mainly of shared mobility) as well as a greater programmatic importance on the part of non-profit community organizations.

6. The Faith sector must continue to be important in the field of clean energy, as well as a node for the standardisation of sustainable mobility in the municipality. Together with the education sector, it is perceived as the main source of awareness and normalisation of the energy transition in the city of Birmingham.

2. Variety of actors and impact sectors

In the municipality of Birmingham there is a great contrast between the public or non-profit sector and the private or business model-based sector. The former accounts for 72% of the current presence in the energy sector - 75% if we add the education sector to the equation - having a strong potential impact (as we have seen in the previous section) on the development of future policies in the field.

Distribution of actors identified by sector

Although the distribution of actors in the energy environment of the city of Birmingham is highly led by the public sector - which implies a high dispersion of its agents, not a shortage of weight of the private sector - not all areas are open to high degrees of democratisation. This means that there are areas within the energy sphere that are not open to the influence of interest groups.

Distribution of impact sector according to the variety of actors

According to the data collected, the sectors of public policy design, the transition towards a sustainable transport model and the fight against the difficulty of access to fuel are parcels of a high degree of democratisation, in which community associations can exert a greater degree of pressure to modify their dynamics. On the contrary, water management is scarcely democratised as long as there is not a high degree of variety of influential actors, as well as with regard to sources of financing and modification of economic patterns (from a linear model to a circular model).

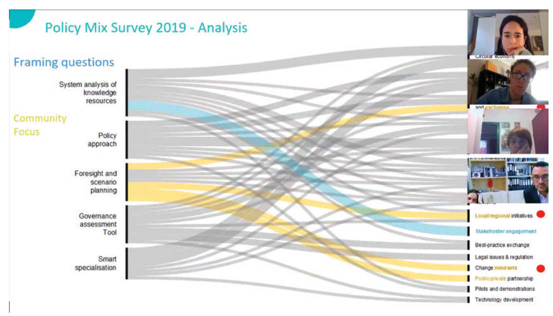
3. Analysis of potential opportunities by sector

Based on the thematic distribution of the actions currently present in the municipality of Birmingham and the opportunities detected from the relationship between actors, we have prepared a sectoral description that offers a vision of the most consolidated sectors - from

Figure 38 (top): Example of report for stakeholders. Prospectus project (2018)

Figure 39 (bottom): Screen capture Policy mix webinar EIT RIS Programme (2020)

Reports provide a detailed description of the full process for system mapping to be used in the monitoring and learning process.

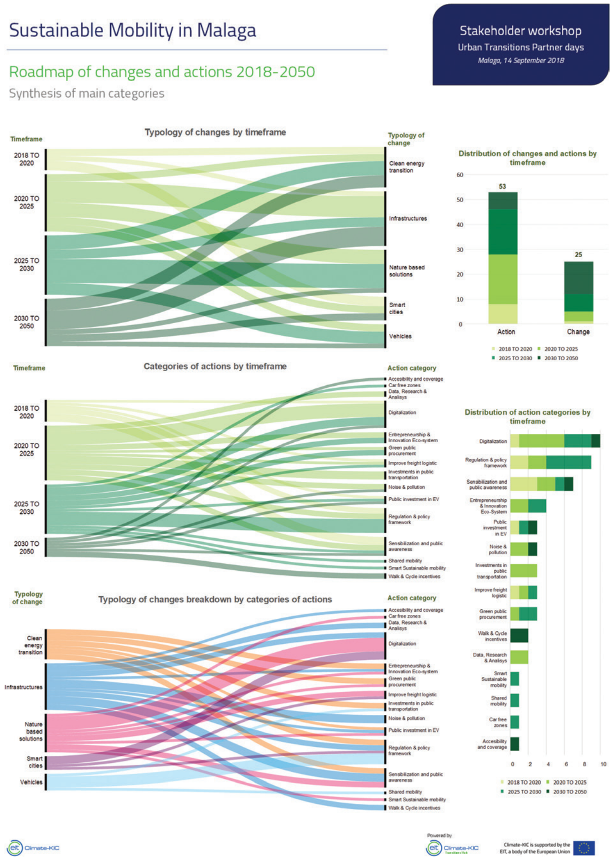


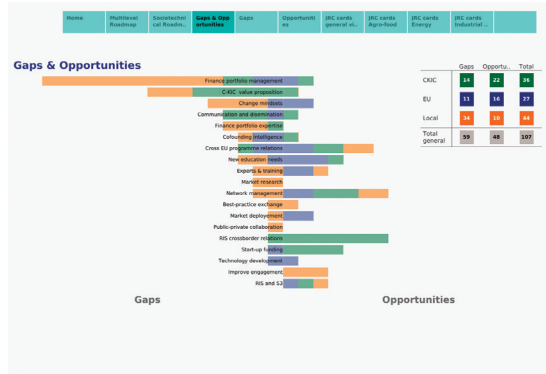
Webinars serve as an interactive mechanism for sharing data representations and full narratives through knowledge visualisation.

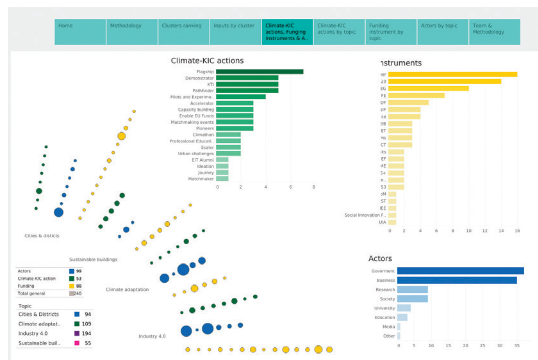
Figure 40 (left): Posters Sustainable mobility in Malaga (2018)

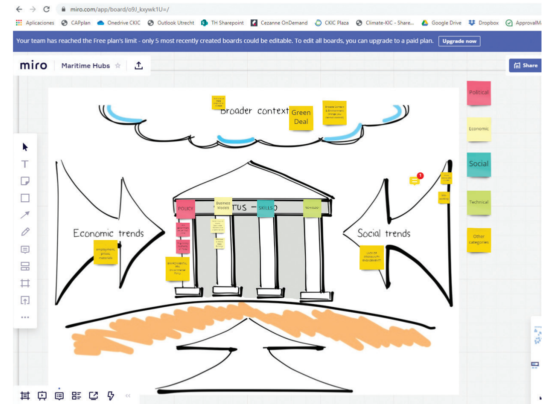
Figure 41 (center): Dashboards of knowledge visualisation (Tableau). Top: RIS Partners days (2017). Bottom: EIT Climate-KIC JRC workshop Ljubljana (2018)

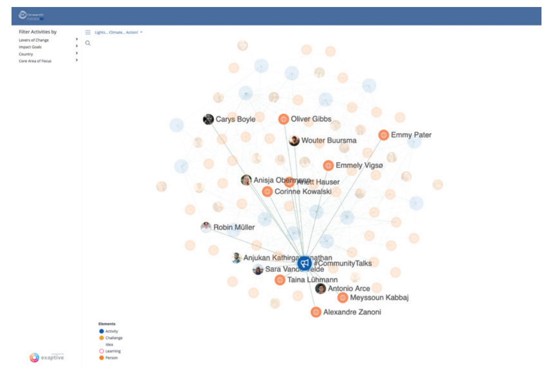
Figure 42 (Right): Top: Miro board – Maritime Hubs (2020), Bottom: EIT Climate-KIC Exaptive capture (2019)







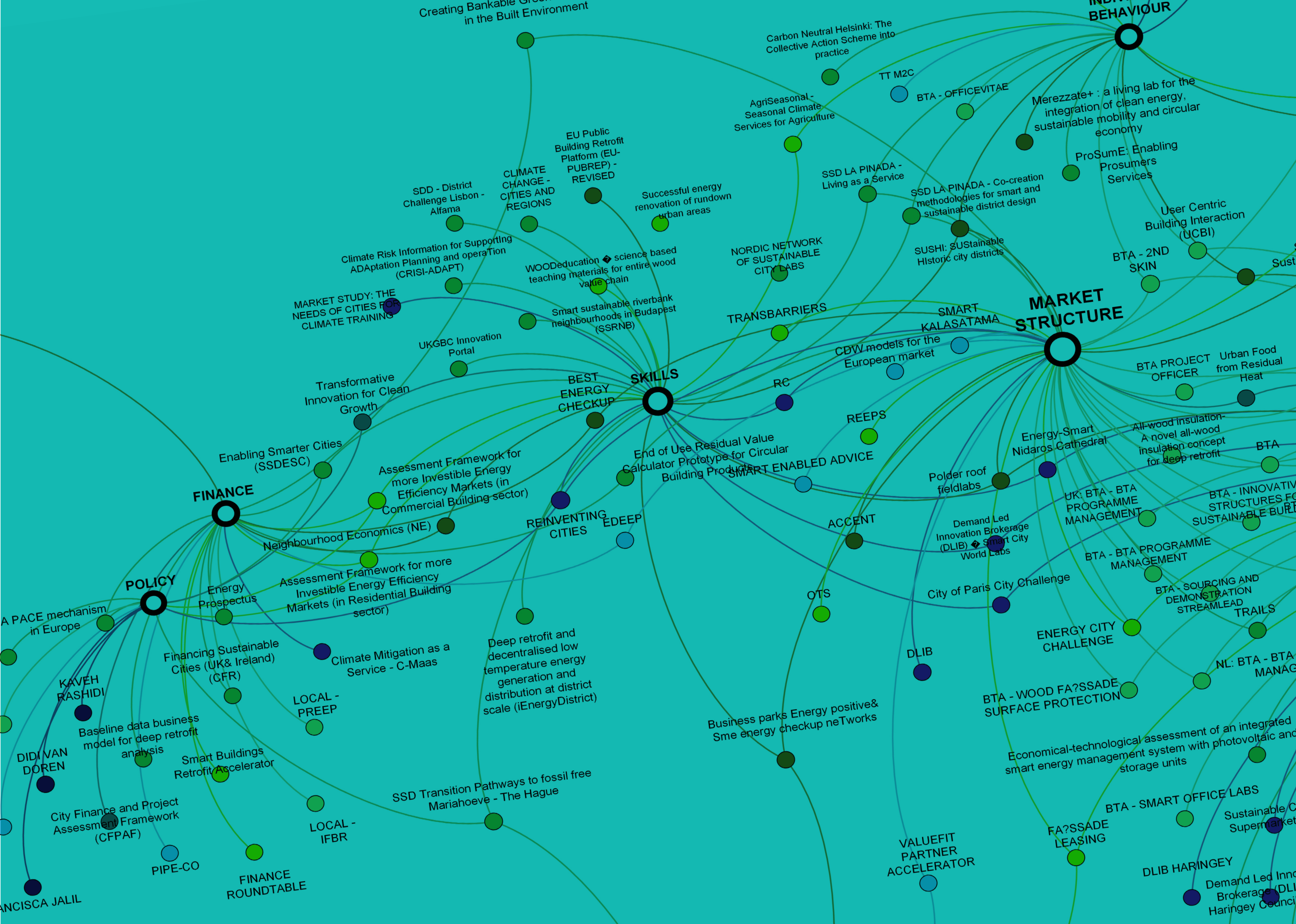




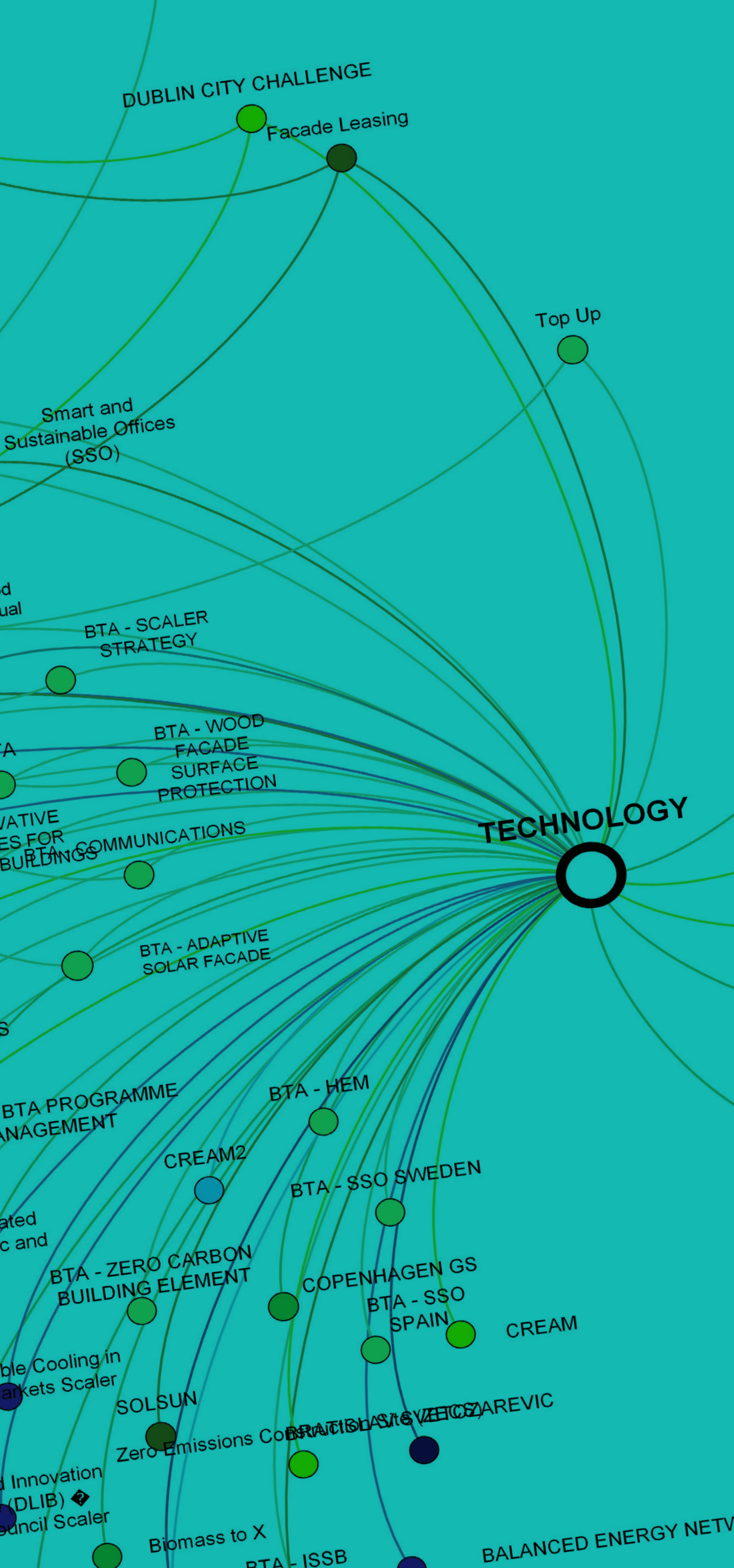
Posters illustrate a single infographic or two to showcase overall results or complex elaborations for systems such as socio-technical network maps.

Dashboards allow users to explore dynamic analyses of multiple variables as part of a series of inquiries, representations of a collection of different tools and dimensions of system elements, timeframes and rankings.

Online platforms such as Miro, Kumu or EIT Climate-KIC Exaptive facilitate the interactive dialogue as part of a community of practice narrative. They could be used to participate autonomously or as part of group-coached sessions in which team facilitation skills are critical.



Creating Bankable Gr... in the Built Environment
INDIV... BEHAVIOUR
Carbon Neutral Helsinki: The Collective Action Scheme into practice
TT M2C
BTA - OFFICEVITAE
AgriSeasonal - Seasonal Climate Services for Agriculture
Merezzate+ : a living lab for the integration of clean energy, sustainable mobility and circular economy
ProSumE: Enabling Prosumers Services
EU Public Building Retrofit Platform (EU-PUBREP) - REVISED
CLIMATE CHANGE - CITIES AND REGIONS
SDD - District Challenge Lisbon - Alfama
Successful energy renovation of rundown urban areas
SSD LA PINADA - Living as a Service
SSD LA PINADA - Co-creation methodologies for smart and sustainable district design
User Centric Building Interaction (UCBI)
Climate Risk Information for Supporting ADAptation Planning and operaTion (CRISI-ADAPT)
WOODeducation � science based teaching materials for entire wood value chain
NORDIC NETWORK OF SUSTAINABLE CITY LABS
SUSHI: SUStainable HIstoric city districts
BTA - 2ND SKIN
MARKET STUDY: THE NEEDS OF CITIES FOR CLIMATE TRAINING
Smart sustainable riverbank neighbourhoods in Budapest (SSRNB)
TRANSBARRIERS
SMART KALASATAMA
MARKET STRUCTURE
UKGBC Innovation Portal
CDW models for the European market
Transformative Innovation for Clean Growth
BEST ENERGY CHECKUP
SKILLS
RC
BTA PROJECT OFFICER
Urban Food from Residual Heat
REEPS
All-wood insulation-A novel all-wood insulation concept for deep retrofit
Enabling Smarter Cities (SSDESC)
End of Use Residual Value Calculator Prototype for Circular Building Products
SMART ENABLED ADVICE
Energy-Smart Nidaros Cathedral
BTA
Assessment Framework for more Investible Energy Efficiency Markets (in Commercial Building sector)
Polder roof fieldlabs
FINANCE
UK: BTA - BTA PROGRAMME MANAGEMENT
BTA - INNOVATIV... STRUCTURES FO... SUSTAINABLE BUIL...
REINVENTING CITIES
EDEEP
ACCENT
Demand Led Innovation Brokerage (DLIB) � Smart City World Labs
Neighbourhood Economics (NE)
BTA - BTA PROGRAMME MANAGEMENT
Assessment Framework for more Investible Energy Efficiency Markets (in Residential Building sector)
BTA - SOURCING AND DEMONSTRATION STREAMLEAD
POLICY
Energy Prospectus
City of Paris City Challenge
OTS
TRAILS
A PACE mechanism in Europe
ENERGY CITY CHALLENGE
Financing Sustainable Cities (UK& Ireland) (CFR)
Climate Mitigation as a Service - C-MaaS
Deep retrofit and decentralised low temperature energy generation and distribution at district scale (iEnergyDistrict)
DLIB
NL: BTA - BTA MANAG...
KAVEH RASHIDI
LOCAL - PREEP
BTA - WOOD FA?SSADE SURFACE PROTECTION
Business parks Energy positive& Sme energy checkup neTworks
Baseline data business model for deep retrofit analysis
DIDI VAN DOREN
Smart Buildings Retrofit Accelerator
Economical-technological assessment of an integrated smart energy management system with photovoltaic and storage units
SSD Transition Pathways to fossil free Mariahoeve - The Hague
City Finance and Project Assessment Framework (CFPAF)
LOCAL - IFBR
BTA - SMART OFFICE LABS
Sustainable C... Supermarket...
FA?SSADE LEASING
VALUEFIT PARTNER ACCELERATOR
PIPE-CO
FINANCE ROUNDTABLE
DLIB HARINGEY
Demand Led Inno... Brokerage (DLI... Haringey Counci...
...ANCISCA JALIL



Chapter 5

Network Analysis as a participatory visualisation method

Network maps can be tools for practitioners to better understand their socio-technical systems. Social network analysis (SNA) is the process of investigating socio-technical structures by using networks and graph theory. The application of social network analysis as a participatory visualisation method seeks to bring analysts and actors together to co-produce a system map.

In this chapter :

- Networks maps as analytical tools
- Key elements of network maps
- Network analysis and interpretation

Network maps as analytical tools

Social network analysis (SNA) can provide a new framework for understanding systems by highlighting interrelationships and the role of different actors.

Network maps can be used to visualise the socio-technical systems by representing the relationships between actions and stakeholders embedded in the system. Interactions between different actors (i.e. business, academic, society etc.) around a collection of projects related to a knowledge area or subsystem (i.e. low emission buildings, energy demand, mobility etc.) can be analysed as clusters.

Network maps applied to socio-technical systems can help to analyse change and system dynamics over time (see figure), as well as comparable elements of subsystems within and between cities or regions.

Starting with the basic information about a project and related organisations, the system mapping process can capture key systemic dimensions, such as:

- the engagement level of different actors;
- brokering relations and governance configurations;
- the systemic business model;
- sectoral and knowledge specialisation;
- financial and procurement models; and
- active policy and regulatory frameworks.

System mapping through network maps can be an iterative learning process that evolves over time through combining processes of harvesting data and understanding the pattern of relations between different elements. Interactions with stakeholders and feedback loops also bring new insights and redirect conversations to focus on the local challenge (See Chapter 4 Step 4 Visualisation and communication).

Figure 43 illustrates the learning-by-doing journey among several interactions during a system mapping process for mobility system in Bologna and Modena during 2015: January (1), April (2), May (3) and October (4). The sequence shows the variations in the visualisation formats coming from feedbacks, reinterpretations and highlights of a variety of network aspects such as structure, scales and clusters.

This chapter aims to provide a simple visual explanation of the set of concepts and key elements of networks maps that can help practitioners to apply and easily manage network analysis as a participatory visualisation method.

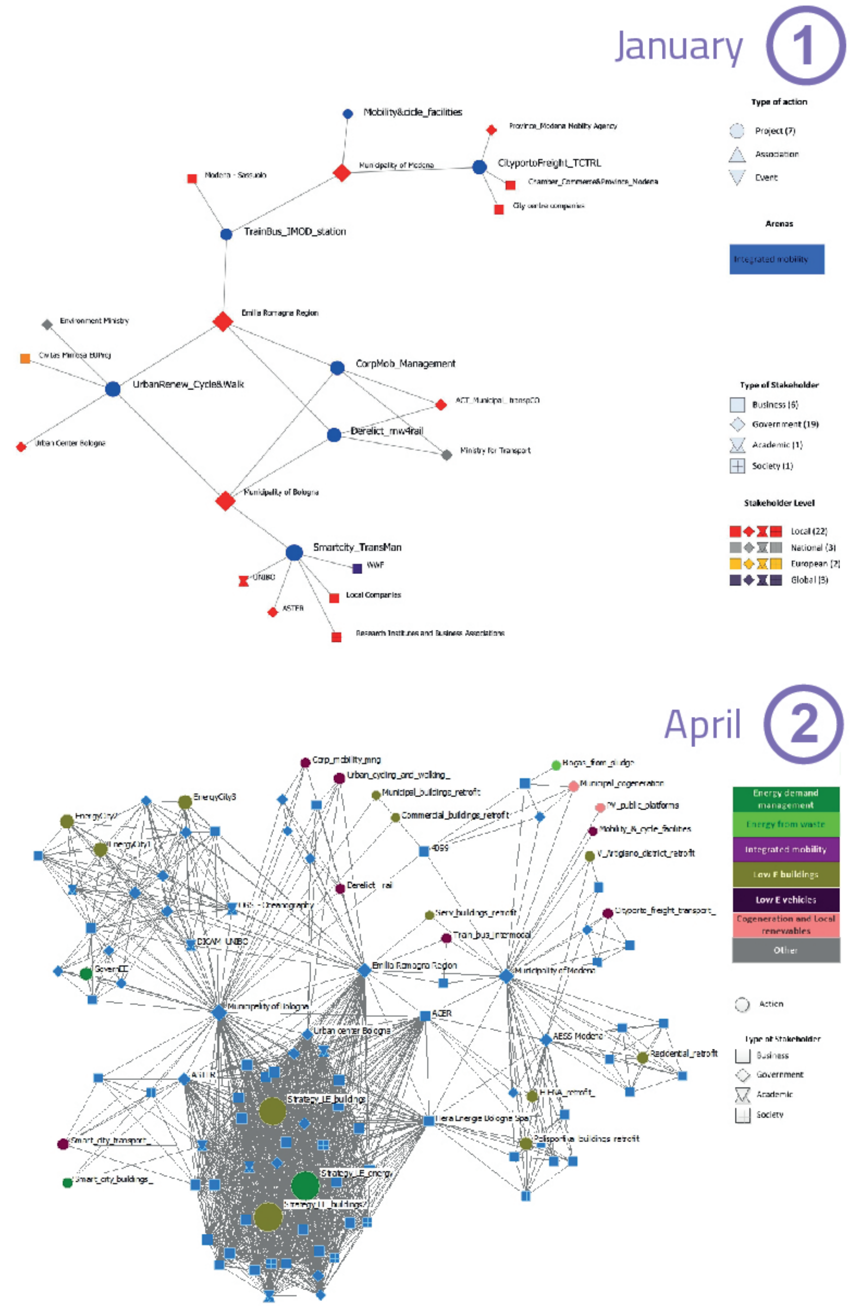
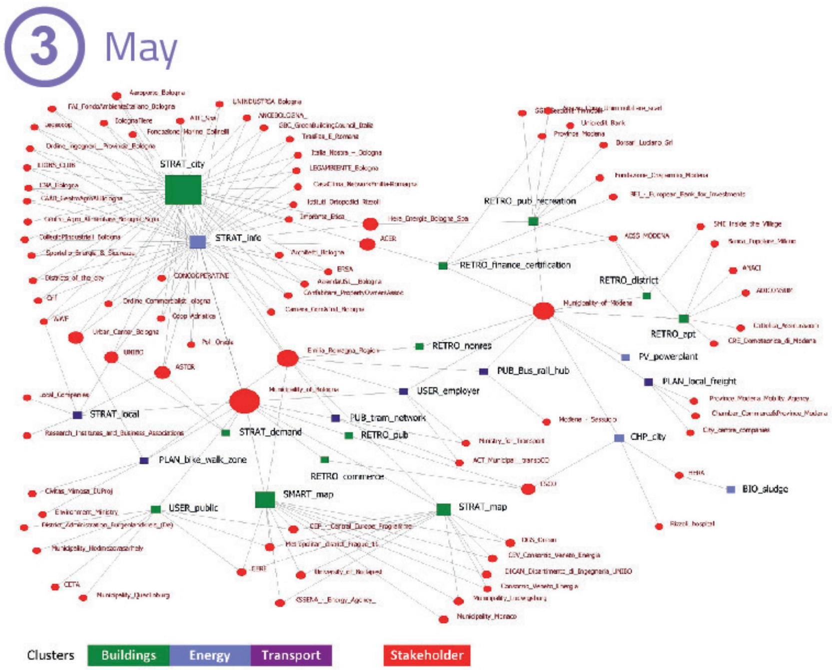
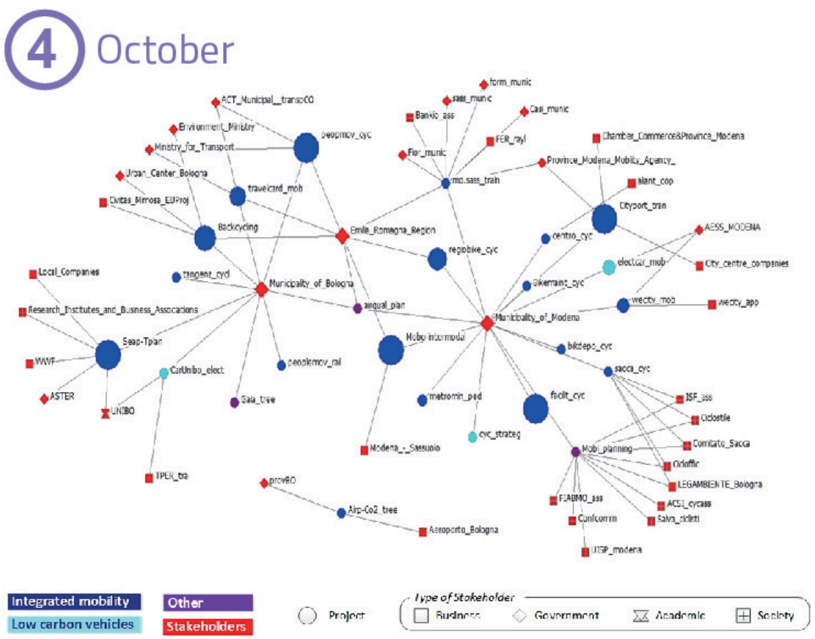


Figure 43: Several Rounds of Network Mapping – Bologna/Modena Mobility Cluster 2015





Network maps can facilitate the understanding of socio-technical systems in cities and regions, applying a system innovation approach to aid interaction between different thematic clusters, such as buildings, mobility, circular economy, sustainable land use and energy networks.

Challenge-led system mapping offers a participatory approach, enabling a learning process that unites local actors and experts. Together they can co-create network maps of socio-technical subsystems, which take the form of thematic clusters. Critical concepts from the sociology of innovation, such as diversity and relationship brokering, can also be considered in the analysis of the system configuration.

This methodology seeks to be different to the traditional cluster approach, which is focused on technological distinctiveness. Instead it looks at subsystem configurations, enabling comparison between them and thus providing analytical elements by which to identify the actors who can facilitate pathways for system transition.

The participatory process entails a combination of bottom-up exercises (stakeholder mapping) and the application of social network analysis as a top-down complement. The latter draws on information gathered from workshops as well as and secondary information from projects, actions and other activities implemented at the system level (e.g. city or region).

System mapping seeks to provide an analytical space for understanding the role of network actors and their attributes and relationships. It also seeks to understand levers of change, such as policy, skills, technology and market elements. In this section, science-based explanations regarding network maps and clusters are provided in simple language. This is intended to aid practitioners in challenge-solving situations. Some key elements to understanding network maps and clusters are:

- nodes and attributes;
- links and ties;
- structural holes and brokers;
- density and proximity.

The following definitions have been reinterpreted and adapted from their original technical and academic background with the purpose of providing practice-based knowledge and facilitating its application.

Network maps: **key elements**

Nodes & attributes

In socio-technical mapping, **nodes** are the elements of a network represented by polygons. They can depict stakeholders (of different types and levels) or projects and actions (as illustrated by the circles in the figure). Most networks comprise different structures in which a central actor is working as a main or central node to connect all of them. Stakeholders or projects connecting the network with nearby actors can draw new ideas and resources to the network.

Attributes are the characteristics which describe the stakeholders and the actions (different shapes and colours). Projects can take place in specific sectors or arenas in which they seek to innovate, e.g. low-emission buildings and energy demand management (blue and green, respectively).

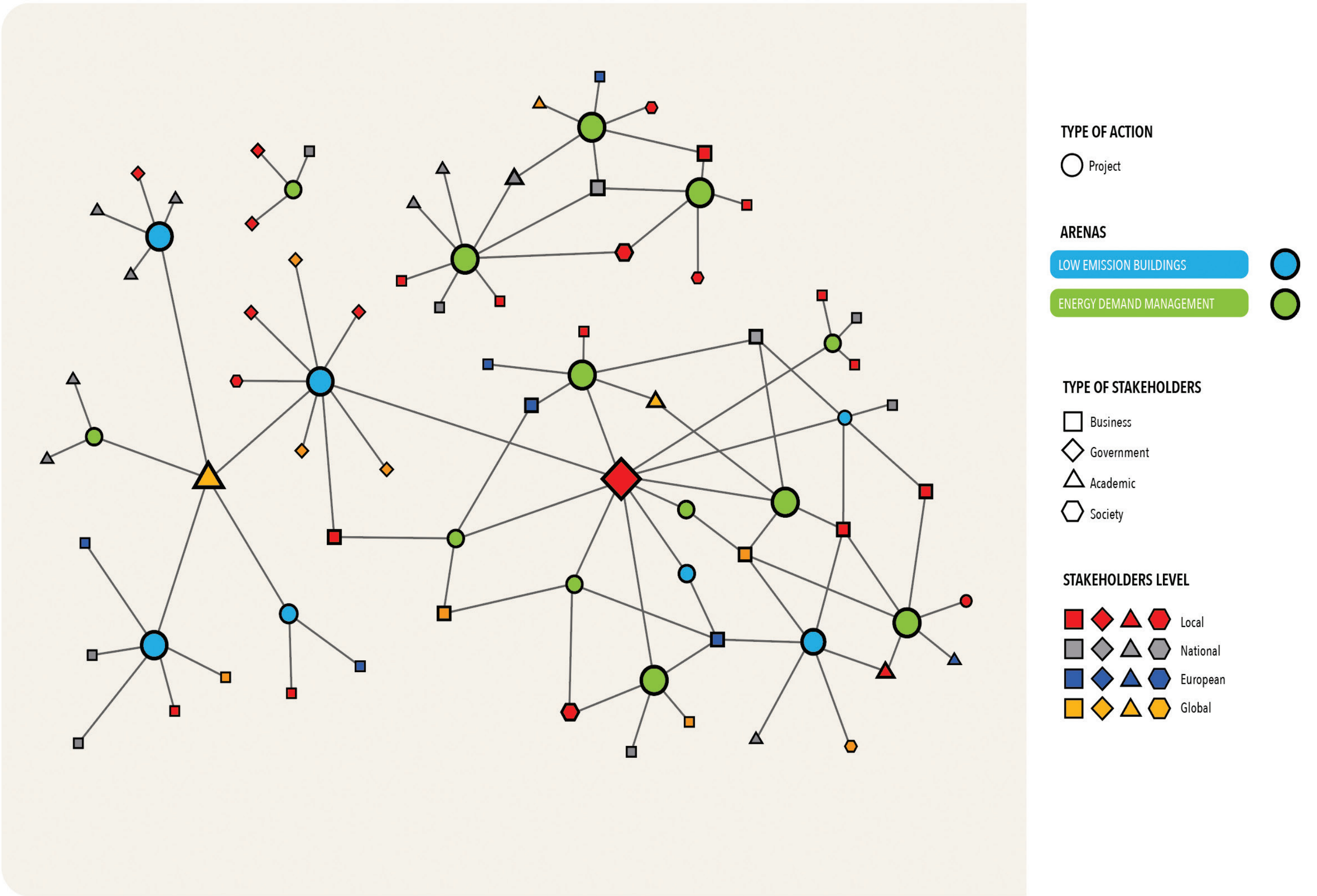


Figure 44: Network maps elements

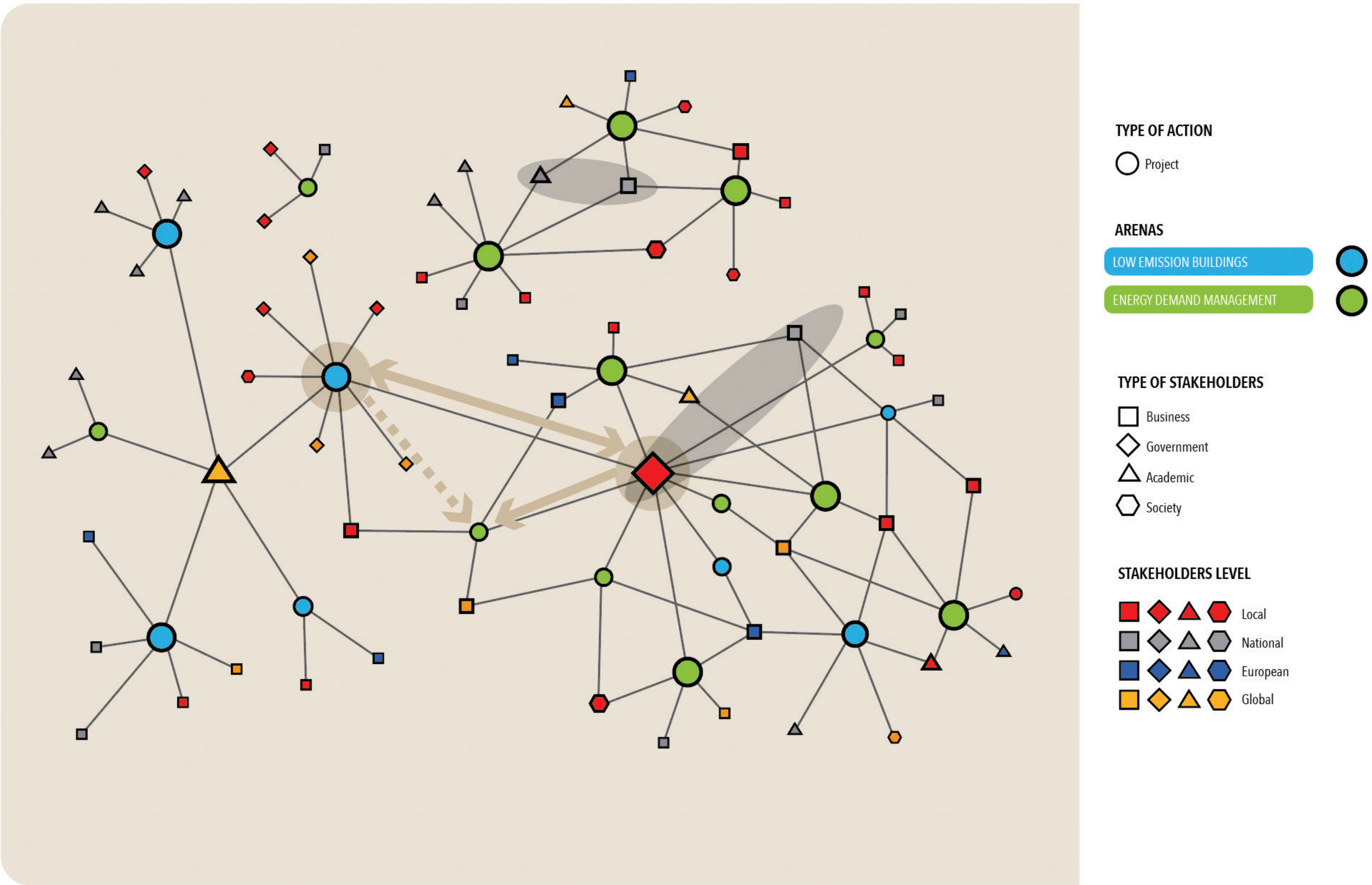


Figure 45: Network map link and tie

Links and ties

Links describe flows between nodes, representing information or financial resources, for example. The flow direction can be unilateral (emitter and recipient) or bidirectional if relationships are reciprocal. The strength of the link can be represented according to some magnitude or index. For instance, social capital or financial means. In visual representations, the number of links of a node is also represented by node size: the more links a node has, the bigger it is.

Ties have the function of bringing together actors through links. They can vary in direction or strength. Actors who have multiple ties are more representative of the resources within the network, while those considered weak, i.e. with fewer representations in a network, are useful for connecting the network to other groups. This is because they are able to span more than one sphere of relations without their presence within the network affecting certain inter-group relations with regard to resources or attributes (see structural holes).

Ties can be classified as direct or indirect, reflecting whether actors can be linked to others through third parties.

Structural holes & brokers

Structural holes refer to a lack of links in a network. Without that connection the network is disarticulated/divided. If we simulate a connection (see Brokers) we can identify potential links.

Brokerage is a means of allowing isolated or unconnected actors or groups of actors to share information and resources. This promotes greater economical, political and social interaction between these actors and the rest of the network.

The broker may connect isolated areas of a network and is therefore the only one to access information and resources (attributes) from different areas.

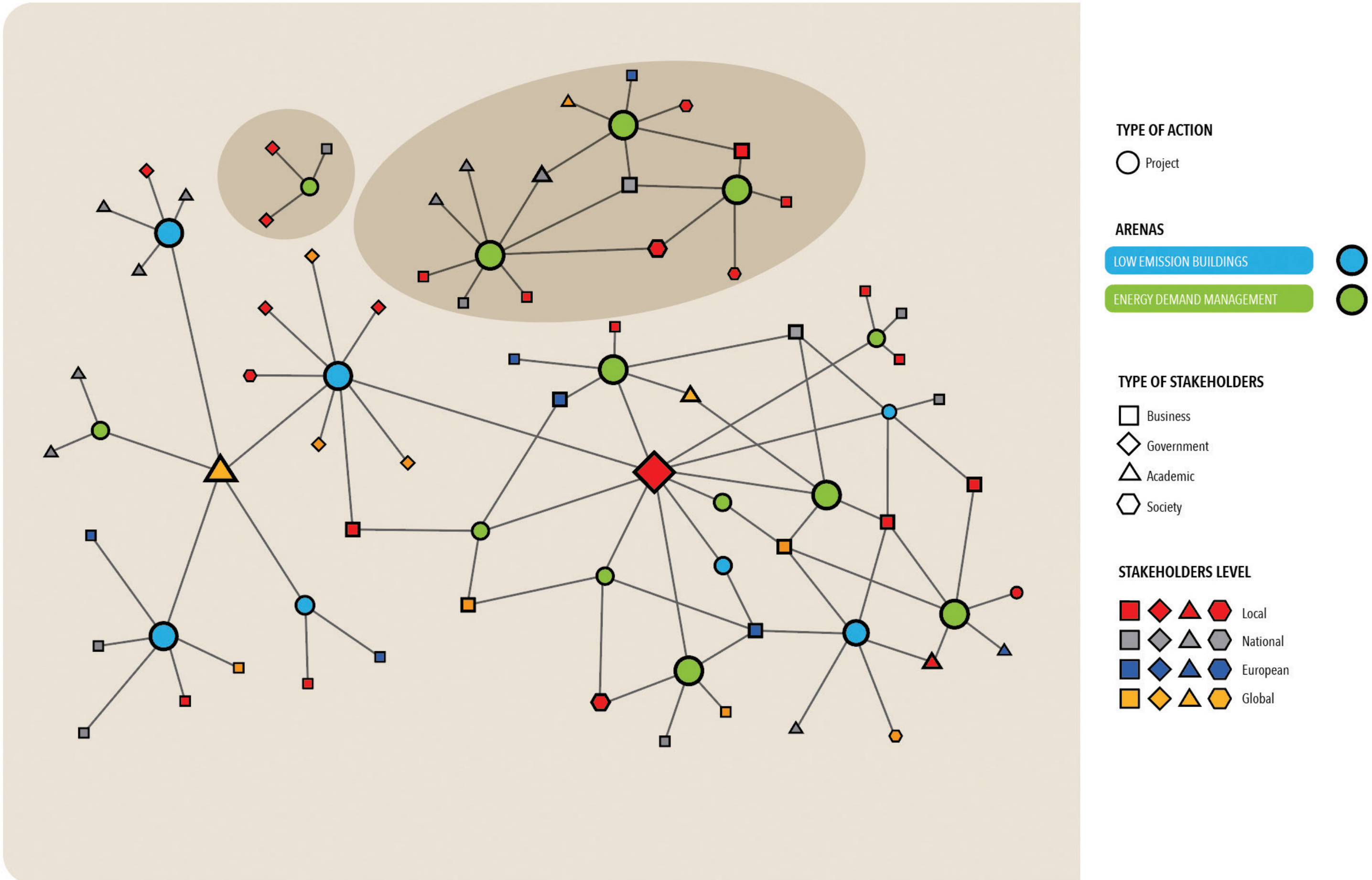
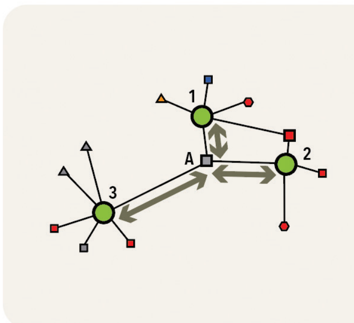


Figure 46: Network maps structural holes

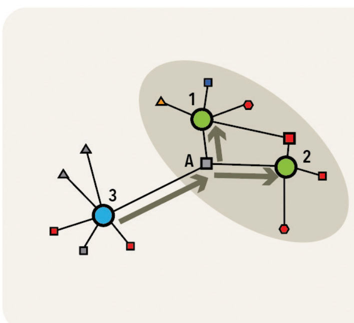
Brokerage typology

Stakeholders can develop brokerage relations not only in their own projects but also in different arenas or knowledge areas. They can affect the variety of resources they manage between these arenas.

Figure 47:
Network maps
brokerage typology



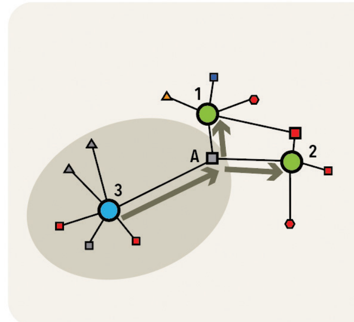
COORDINATION



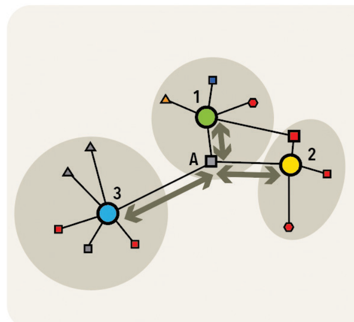
GATEKEEPER

Coordinator. This type of broker plays the role of connector between projects or groups of projects belonging to the same arena. The coordinator manages bilateral flows equally among all projects. In the figure, Broker A connects three projects (1, 2 and 3).

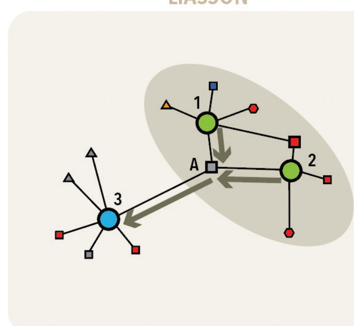
Gatekeeper. This broker controls the information or resources entering the groups it is a part of. It decides whether the unconnected actors in the groups have access to information or resources from the outside. In the figure, Stakeholder A is part of the projects of multiple groups. Project 3 (blue arena) offers resources to Stakeholder A, who is also part of a different group (green arena, projects 1 and 2). In this case, Stakeholder A acts as gatekeeper of the green arena.



ITINERANT BROKER/CONSULTANT



LIASSON



REPRESENTATIVE

Itinerant. This broker facilitates the connection between different groups of projects. The broker belongs to both groups and manages the communication between them. In the figure, Stakeholder A is part of Projects 1 and 2 (green arena) as well as Project 3 (blue arena). Stakeholder A act as an itinerant by connecting the blue arena (from which it receives resources) with Projects 1 and 2 of the green arena (which it provides resources).

Liaison. This broker serves as a hub, enabling ties between projects from different groups to which the stakeholder does not belong. In the figure, Stakeholder A connects three different groups.

Representative. This type of broker is a stakeholder belonging to different groups of projects but representing only one of them in the case of an exchange between them. In the figure, Stakeholder A is part of the green group (Projects 1 and 2). Project 3 receives resources or information from Stakeholder A and is part of a different group (blue). In this case, Stakeholder A acts as a representative of the green group when dealing with Project 3.

Network maps: **key elements**

Density and proximity

Density represents the degree to which the network is populated, i.e. the number of relations within it. The connectedness of a socio-technical system – the proportion of links in relation to the total possible number of connections – reflects the quality and health of the whole system. If there are 20 people participating in a group, each person could potentially connect to 19 others. A density of 100% (19/19) is the greatest density possible in the system. By contrast, a density of 5% would indicate that only 1 out of 19 possible connections has been made.

Proximity. The concept of proximity usually refers to geographical proximity. However, in socio-technical networks we find other forms of proximity: institutional, organisational, cultural, social or technical. Different actors can gain access to resources – knowledge or interactions – through each other. In social networks, proximity is determined by how 'close' nodes are to each other in terms of their relations and project attributes. In socio-technical systems, a group of actors working on a common project within the same arena indicates a high level of proximity, which is represented visually by the length of the link.

Based on these definitions, a cluster in a socio-technical system can be described in terms of the density of actors and projects positioned closely (proximity).

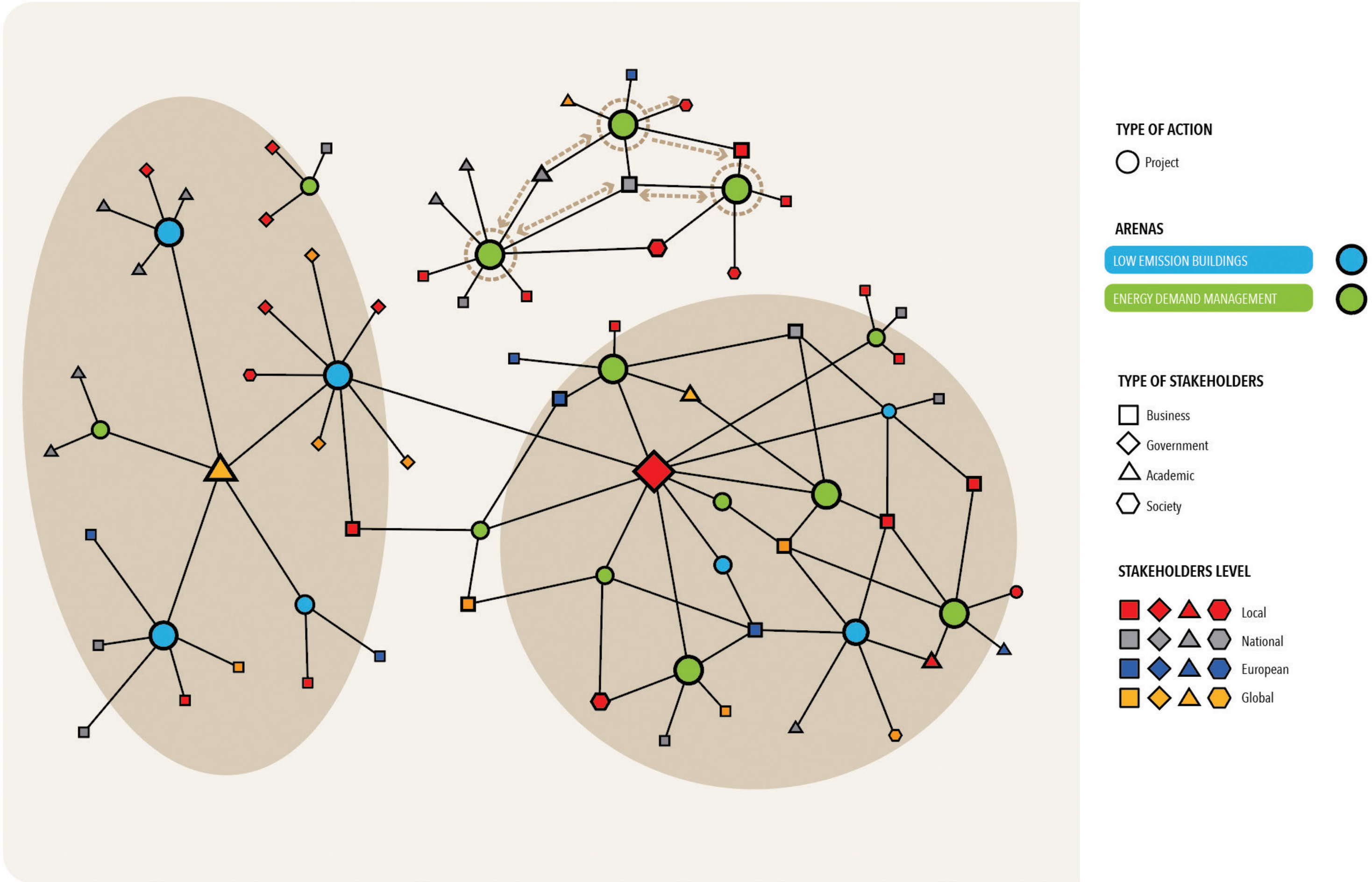


Figure 48: Network map, density, proximity and clusters

Deepening on social network analysis

Network modes

Social networks are representations of systems in which the elements (nodes) are connected by links. Most networks are defined as one-node networks (Fig. A) with sets of nodes that are like each other.

However, some networks are in fact two-mode networks (Fig. B). These networks are a particular kind, with two different sets of nodes, and links which can exist between nodes with different attributes.

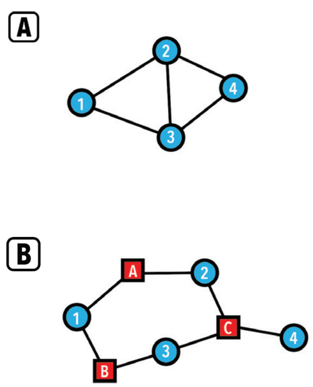


Figure 49: One-mode network (A) and two-mode-network (B)

Network centrality

Network analysis uses the concept of centrality to describe the way that an actor is embedded in a relational network. In other words, to describe the related constraints and opportunities of its structural position. Actors in a favourable position can achieve better bargains in exchanges, exert greater influence and receive greater deference from less favourably positioned actors. The three simple systems below illustrate how a given structural location can be advantageous or disadvantageous to actors.

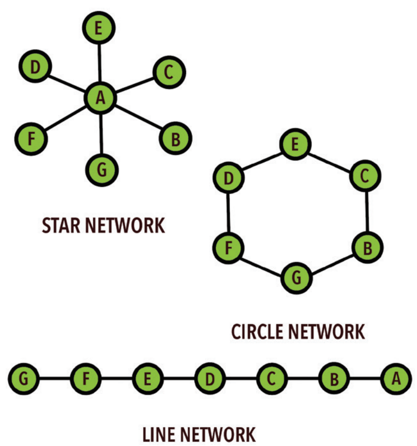


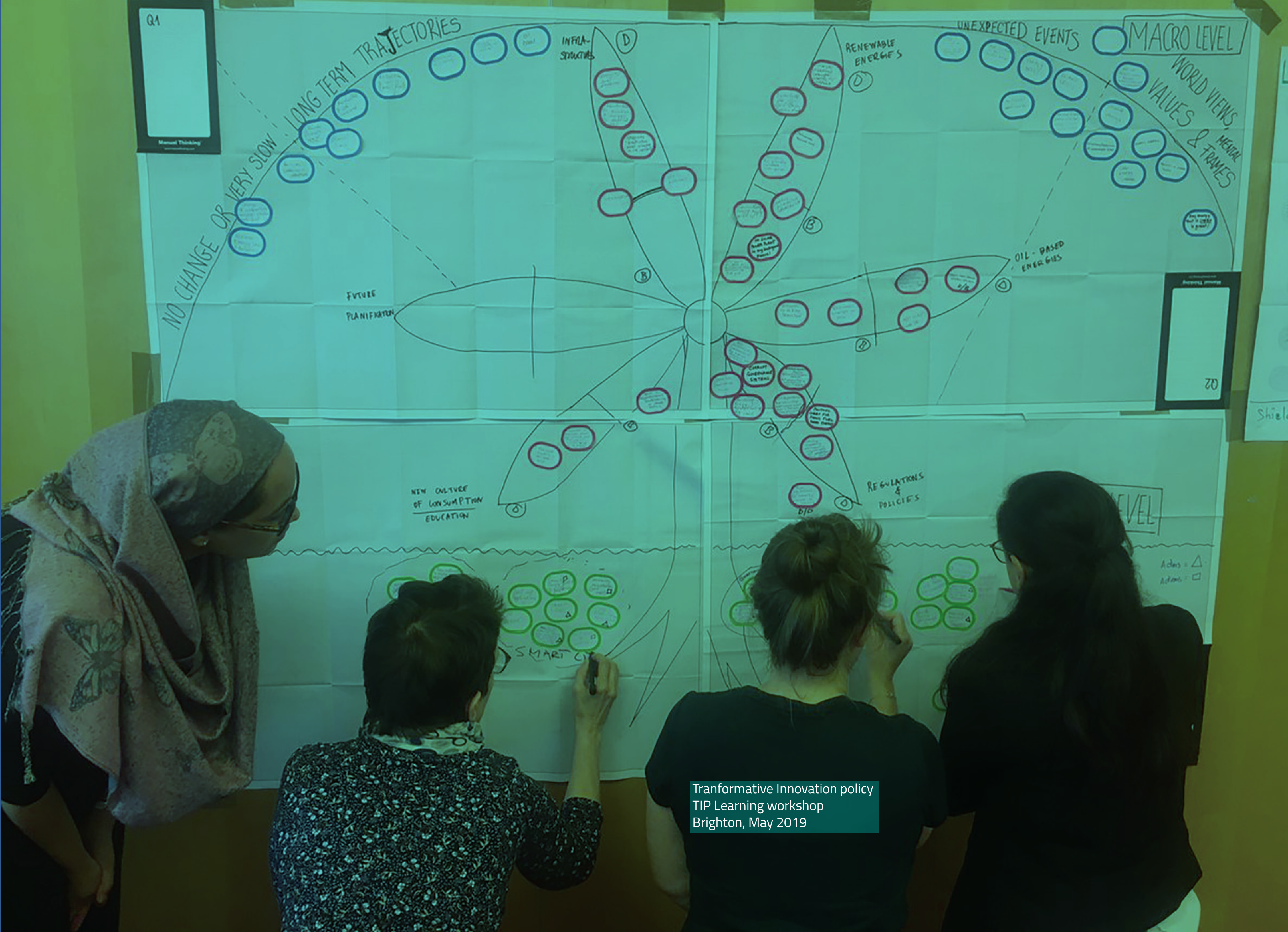
Figure 50: Network centrality examples

How can we measure centrality?

Closeness centrality: this relates to the average length of the path between one node and another. Actors who can reach others at shorter proximity, or who are more reachable by other actors at a shorter proximity, have favoured positions. In the star network, Actor A is more powerful than the others as it is closer to more actors than any other.

Degree centrality: this refers to the number of links that one node has with the others. The more links an actor has, the more power they (may) have. In the star network, Actor A has more opportunities and alternatives than other actors and is thus at a clear advantage in the star network. In the circle network, each actor has the same number of alternative trading partners (or node degrees), so all positions are equally advantaged or disadvantaged. In line networks, the actors at the end of the line (A and G in this example) are at a structural disadvantage, while the others are apparently equal.

Betweenness centrality: this relates to the structurally advantaged position of being between other actors and acting as a bridge. In the star network, Actor A is advantaged as it lies between all other pairs of actors in the network. As such, there are no actors between A and any other. In the circle network, each actor lies between each other pair of actors, such that all actors are equally advantaged or disadvantaged. In the line network, the end points (A and G) do not lie between any pairs and thus have no brokering power. Actors closer to the middle of the chain lie on more pathways among pairs and are thus at an advantage.



Tranformative Innovation policy
TIP Learning workshop
Brighton, May 2019

Network analysis is a statistical technique used to understand how nodes (e.g., actors and projects in socio-technical maps) can be grouped together according to the pattern of relation between them or their shared characteristics (attributes). It is an exploratory means of data analysis that aims to sort nodes into groups such that nodes of the same group have a high degree of centrality.

Network composition

When analysing clusters, we look at the composition of the network (diversity) and the overall pattern of relations between the different elements (connectivity).

Diversity is defined as the balance, variety and degree of difference between the nodes of a network. Diversity can increase through combinations of increased variety, balance and/or degree of difference with regard to node attributes and size.

- **Variety** describes an increased number of nodes with different attributes. In a network, diversity increases along with the increase in the number of nodes with different attributes.

- **Balance** refers to the distribution of nodes in terms of their amount/proportion within the network. Diversity increases along with the increase in balance between node size distribution.

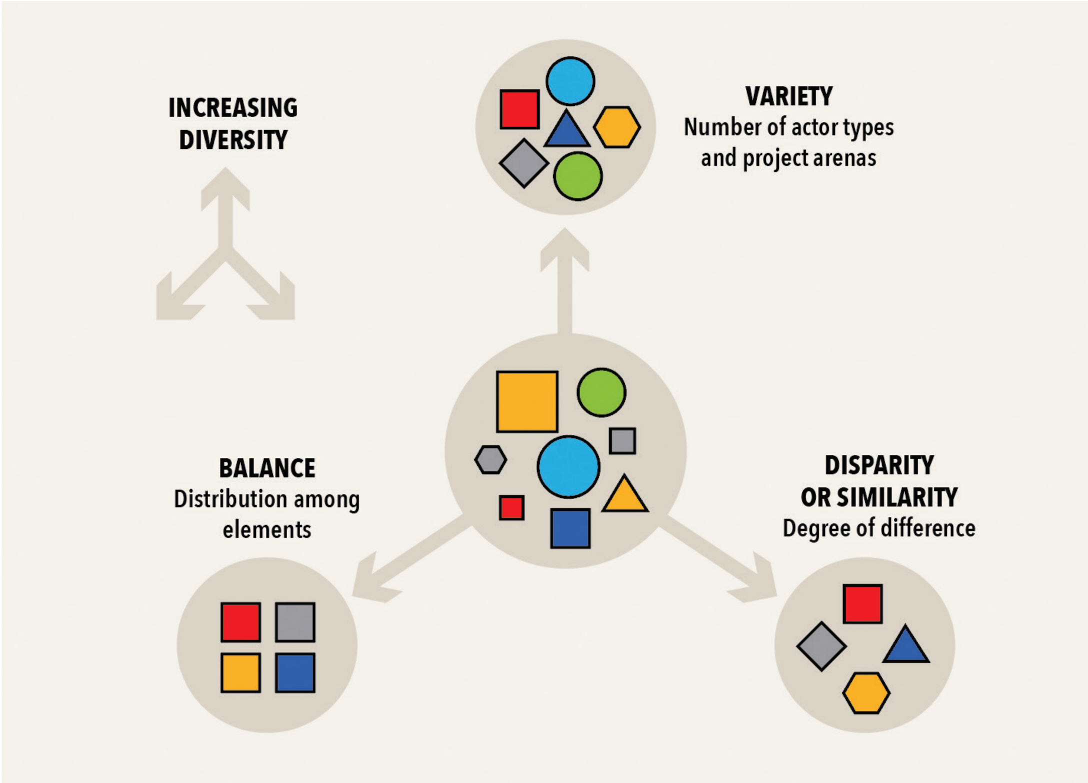


Figure 51: Diversity defined by balance, variety and disparity
Source: own elaboration based in Rafols and Meyer (2010) and Stirling (2018)

- The **degree of difference** refers to how different nodes are within a cluster in terms of attributes and size.

Connectivity indicates the intensity of similarity relations between nodes in a network, where similarity can be built upon the attributes and brokerage relations. In the socio-technical system, this can indicate the extent to which actors and projects are articulated and integrated to the benefit of system functionality.

Network analysis and interpretation

Understanding network formats

A network can be interpreted and analysed by combining diversity and connectivity to track network integration in the form of clusters within social-technical systems.

The concept of connectivity can aid in the analysis of the level of integration in a cluster: one can identify how compact a configuration is based on the level of density in the general structure. Integration in a socio-technical system can be a dynamic process driven by the diversity of elements in terms of different actors, such as government, industry, business, academic and civil society working together on projects, combining multiple capacities and areas of knowledge. As a dynamic process, a cluster could experiment with a process to increase diversity and/or connectivity and thus arrive at a new network format. By following this logic, the combination of different levels (i.e. low and high) of connectivity and diversity can produce four different scenarios. The figure on the right of this page provides a schematic representation of this perspective.

Knowledge integration is a dynamic process characterised by diversity and increases in connectivity. In other words, it is a process in which previously different and disconnected nodes become related.

Given these constraints, combining network diversity (top-down) and network connectivity (bottom-up) offers perspective with regard to the tracking of knowledge integration.

Diversity facilitates the understanding of the full range of existing activities, stakeholders and thematic areas in the socio-technical system.

Connectivity indicates the degree to which individual initiatives link together following a coherent underlying system.

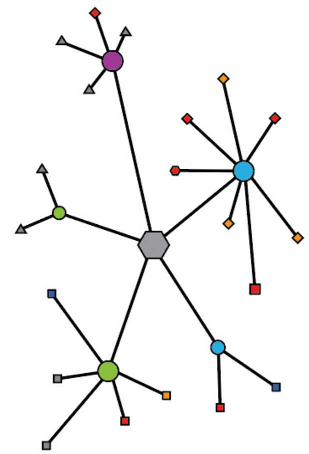
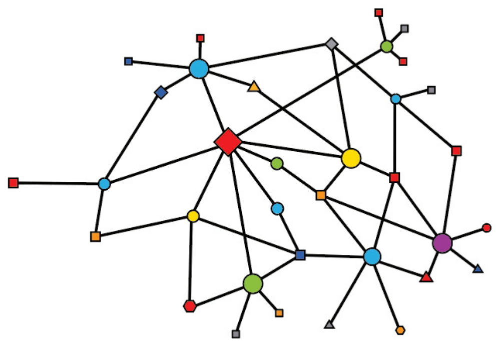


Figure 52: Typology of networks based on diversity and connectivity

Low connectivity and high diversity

The network above is composed of a high diversity of actors with different characteristics (attributes), stakeholders and projects, all of which contribute to enabling and shaping the relations in the socio-technical system and the clusters.

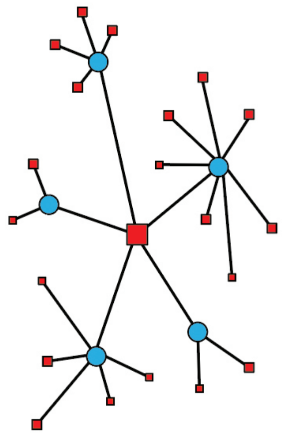
Here, a broker with a potentially high degree of centrality is the main link for all the projects. For example, this might be a national NGO acting as a coordinator of multiple projects. However, connectivity is very low given the lack of relations between projects, indicating potential structural holes.



High connectivity and high diversity

This network shows significant diversity in terms of the characteristics (attributes) of its actors and projects. It describes a socio-technical system that integrates multiple sectors working in multiple knowledge areas, technologies and actions.

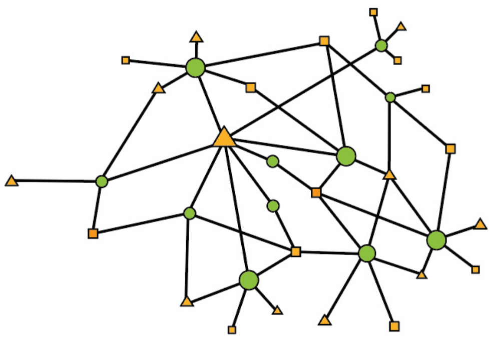
Connectivity is also high, here: nodes are highly interconnected, creating a high-density network. For example, this might relate to an urban innovation agency that participates in multiple projects and whose partners form a consolidated network.



Low connectivity and low diversity

This network features very similar elements, such as actors with similar characteristics (attributes) and projects belonging to the same area of knowledge or technology.

Connectivity is low here; potential structural holes can be found. For example, this might relate to a local company running specific projects with providers and customers who form a local network. The company plays the role of coordinator but could also serve as a gatekeeper for managing the resources of its own projects.



High connectivity and low diversity

This network presents a configuration with very similar elements and a high level of connectivity, which can indicate a good level of density and proximity. This format could describe a specific industrial sector or network whose relations and resource flows (e.g., knowledge, technologies) are very homogeneous and specialised.

This configuration might relate to an EU R&D network specialised in a particular sector, such as graphene, with companies and academic/research centres actively collaborating to share similar resources.

A practical example of network interpretation

The challenge-led system mapping approach suggests a socio-technical system as the starting point, where nodes are actions and stakeholders. Analysis and interpretation may vary significantly from case to case due to the variety of inputs (i.e. the amount and type of available data and categories).

The following example concerns the Sustainable Mobility Cluster in Bologna/Modena. Network maps have three attributes: knowledge proximity (technology and sectors), geographical proximity (cities where they are implemented) and governance configuration (governmental levels). The size of the action nodes indicates the financial scale. Some simple interpretations concerning brokerage relations are presented to provide a concrete example of the type of analysis that can be made based on this setup.

The initial overview of a network map should focus on the amount and distribution of elements. Figure 53 presents several actions categorised into three knowledge areas (integrated mobility, low carbon vehicles, others). It shows a medium level of connectivity, with some central nodes having multiple connections. In terms of distribution, most of the actions are categorised under integrated mobility, while the stakeholders are mostly categorised as business and government.

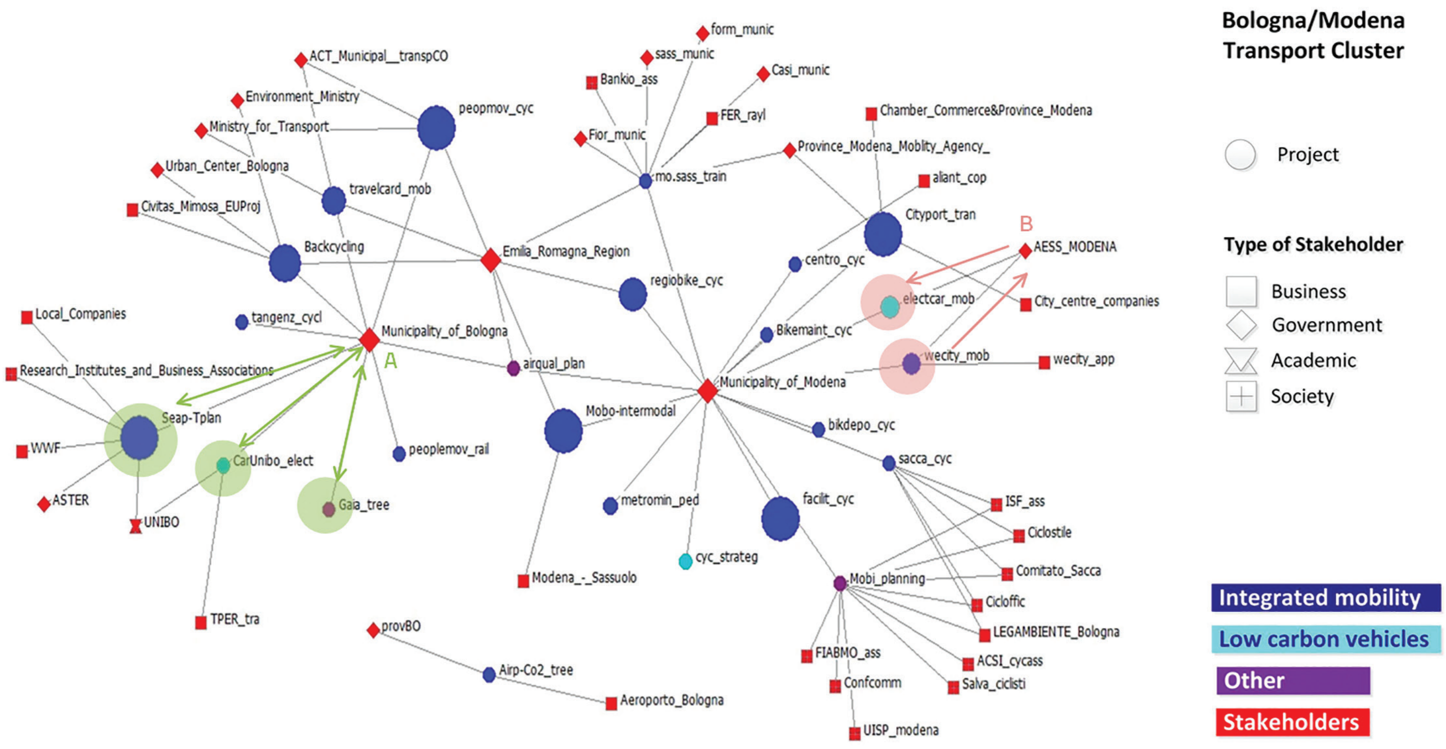


Figure 53: Socio-technical network of Bologna/Modena transport cluster by knowledge area (2015)

Brokerage relations can be interpreted by taking one node as the starting point and from there analysing its potential relation with other notes. For example:

- The Municipality of Bologna plays the role of liaison with three projects, connecting knowledge and relation sources from three different areas (A). It thus serves as a hub.
- The agency AESS Modena plays the role of itinerant by facilitating the connection between stakeholders from two different knowledge areas (B).

Figure 54 shows the same actions categorised by city of implementation. Certain roles can be identified:

- The Emilia Romagna Region (regional government) plays the role of representative of its projects (C) in relation to projects implemented in Modena. It connects projects from different groups. The regional government can also play the role of gatekeeper in relation to projects that are not connected to other stakeholders in Bologna (D), controlling incoming information and resources. This can also be seen as a structural hole, which could decouple the network into separated areas.

- The municipality of Modena can play a major role in the coordination of actions implemented in the city (E).

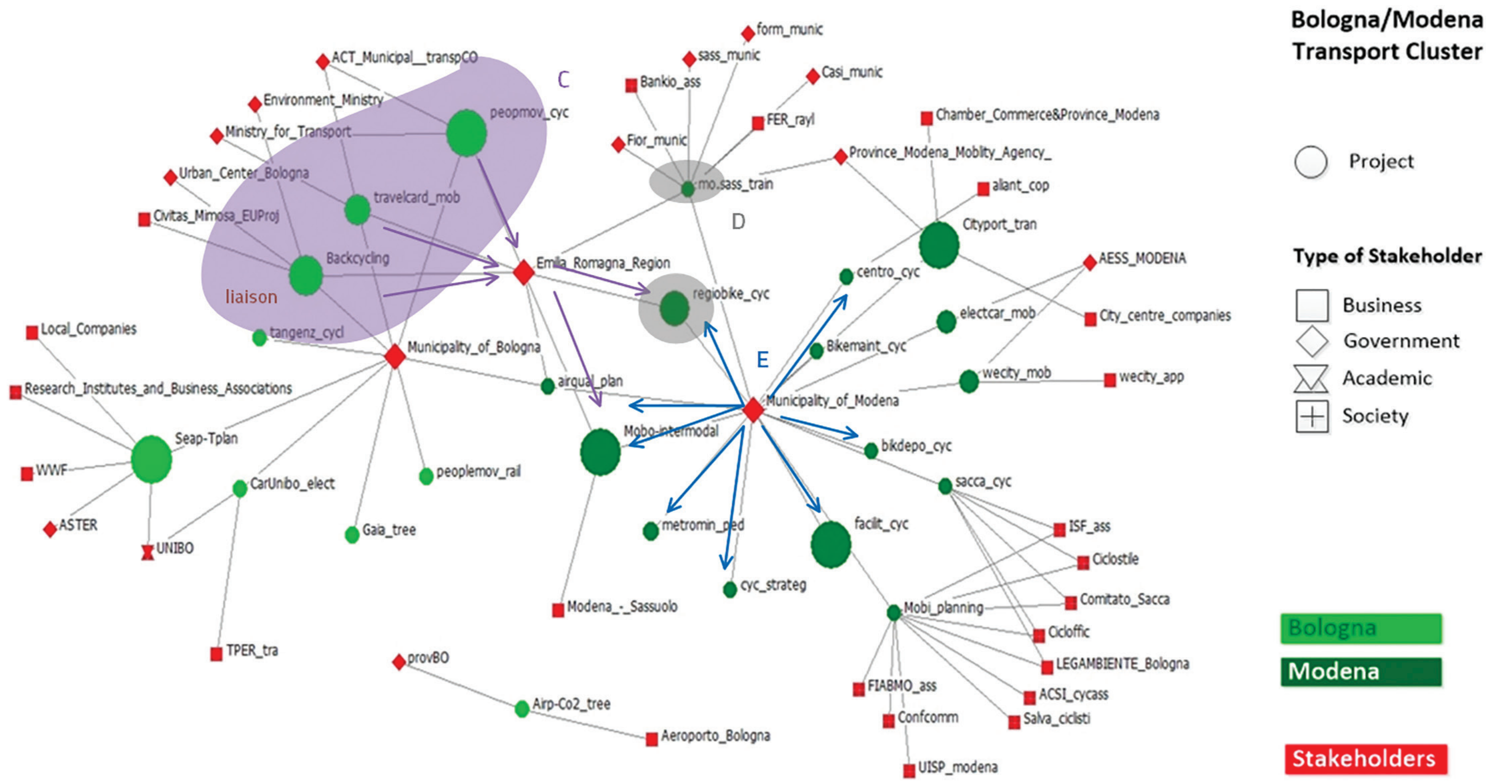


Figure 54: Socio-technical network of Bologna/Modena transport cluster by project location (2015)

Practical tips

Supporting questions

Results and elements from the different workshops can be used to facilitate a conversation around the network maps. The following questions can serve as triggers for that conversation:

- Are there any stakeholders missing?
- Can we integrate a new actor into an existing activity?
- Which actions could be combined to move forward with a technology or project?
- Can we use existing actions to design a new pilot or experiment?
- Are these actions already connected to regional priorities or strategic action plans?
- How can a connection be made (e.g. a new project, pilot or experiment)?
- Which are the clear areas of specialisation?
- Are there any missing resources, such as knowledge and technology, required for a system perspective (e.g. IT elements for Smart cities strategy)? Which ones?
- Can we bring that knowledge from an existing local stakeholder?
- Is there a system integrator that plays a major role in the system? If not, do we need one?

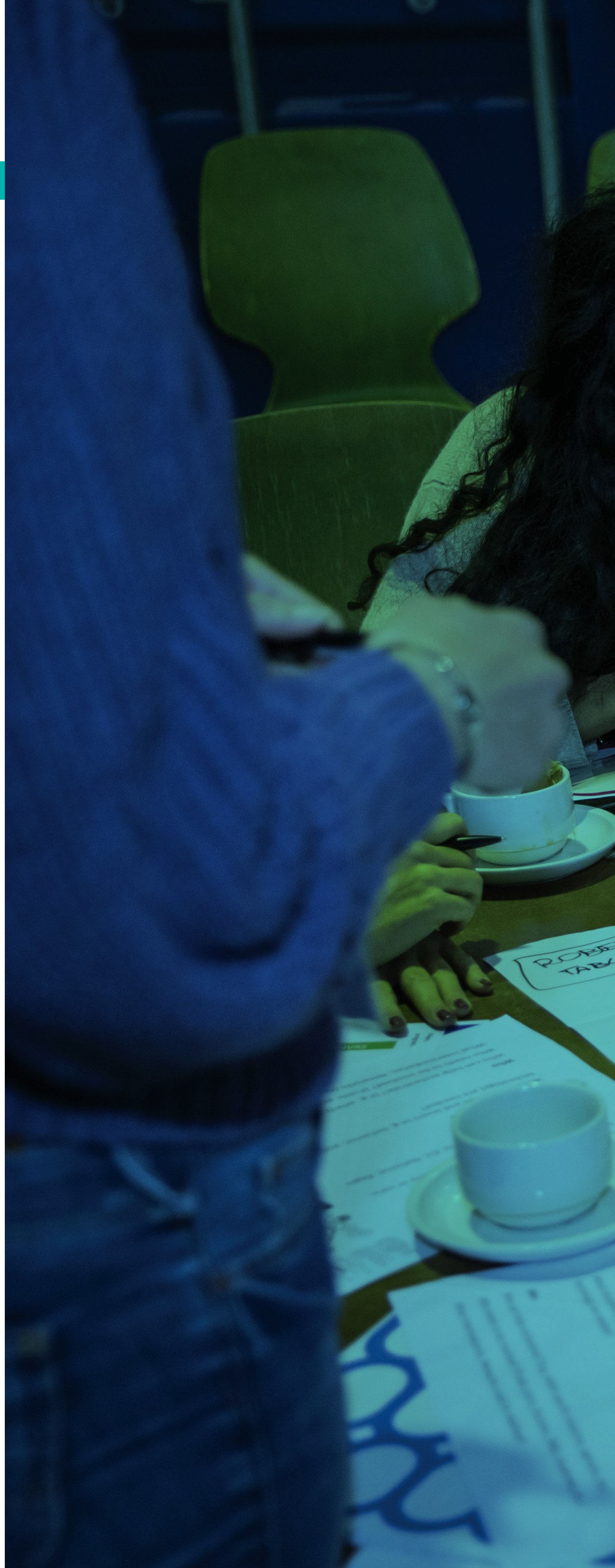
Bias and contextual factors

Network analysis is a powerful method to describe and analyse sets of units by focusing on their interrelationships.

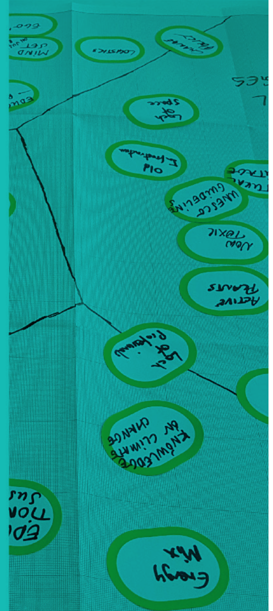
The risk of bias is significant in terms of the scope and coverage of the system analysis and it can not be fully mitigated through feedback loops with practitioners and challenge owners.

Some contextual factors may influence mapping networks and should therefore be considered to avoid or mitigate bias.

- Language is a common barrier while mapping actions in terms of perspectives coming from a variety of actors, such as business, academia or government.
- Regional loyalties are relevant to the definition of centrality and brokerage relationships.
- Shared ideologies and experiences can affect sets of actions or entire sectors resulting in a map with biases.
- Common or differing interests can serve to create conflicting views with regard to innovation actions and the roles of different actors.



Circular economy - Joint programming
H2020 CICERONE
Berlin, November 2019



Epilogue

The challenge ahead

We have reached the final compilation of lessons learnt on system mapping. You have navigated the system mapping process from challenge definition to blueprints and knowledge visualisation techniques. Now, we will bring the last reflections from a service-oriented perspective to help the reader to move it forward with their own learning-by-doing experience.

Knowledge as a service

Contributing to the understanding of complex socio-technical systems has been the main motivation throughout the years of work that have led to the birth of this handbook. There are an abundance of current and future events that challenge the sustainability of our modus vivendi. The large amount and variety of these events make, now more than ever, collective mapping and analysis a critical step to explore transformative mechanisms towards system innovation.

There is a risk that cities and regions seeking to understand, combat and adapt to these multiple challenges will not capture the relevant knowledge. Efforts to understand the complexity of those systems can be paradoxically superficial in a world where there is a real abundance of databases and peer facilitation assistance. Meaningful conversations may not be translated into knowledge, or that knowledge could be lost or decontextualised.

Therefore, there is a growing need to capitalise on lessons learnt through easy and ready-to-use methods that facilitate the exchange and adaptation of existing knowledge while co-creating practice-based knowledge with the aim of being able to apply it in new contexts. This handbook has been built upon the curation of lessons learnt extracted through multiple experiences in system mapping. The whole learning process was driven by the motivation to create new interfaces between applied science, policy and practice.

In doing so, a knowledge service logic has been introduced as a response to the challenges faced by multiple practitioners such as professionals, business managers and civil servants. This logic can be used to combine technical assistance with expert advice and horizontal interactions to achieve a collective understanding of socio-technical systems.

Challenge definition as a starting point and co-design/prototyping as guiding principles emphasise the importance of reconnecting with practitioners needs, policy context and assets that are already available in the society. Participation as a mechanism helps to get a grip on a common understanding of the society needs and defines actions of change.

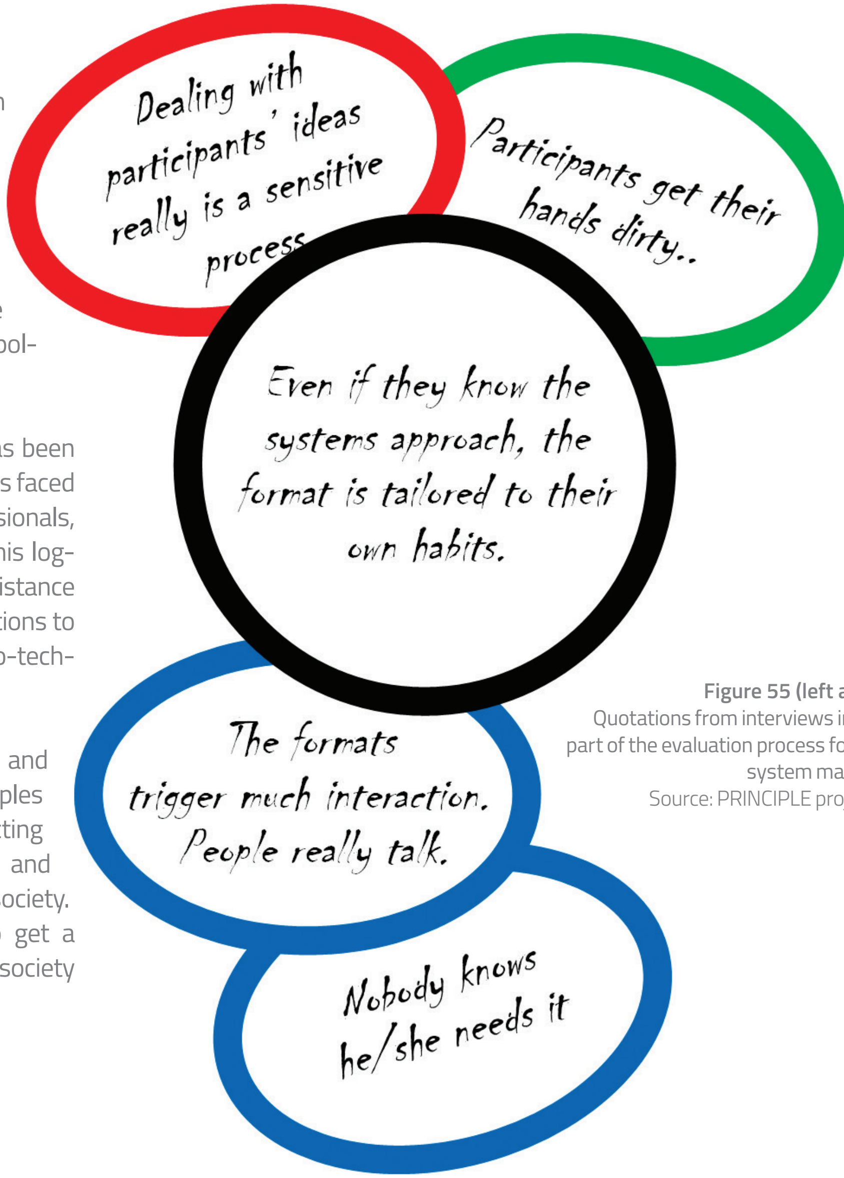


Figure 55 (left and next page):
Quotations from interviews implemented as part of the evaluation process for Challenge-led system mapping approach
Source: PRINCIPLE project, Vito (2019)

Towards a practitioner centred perspective

Practitioners' needs have been the main input to understand how we can better systematise and elucidate some essential issues such as interactions with challenge owners by taking into account the mistakes made, the lessons learned, the feedback and advice received as part of tailored-made knowledge services.

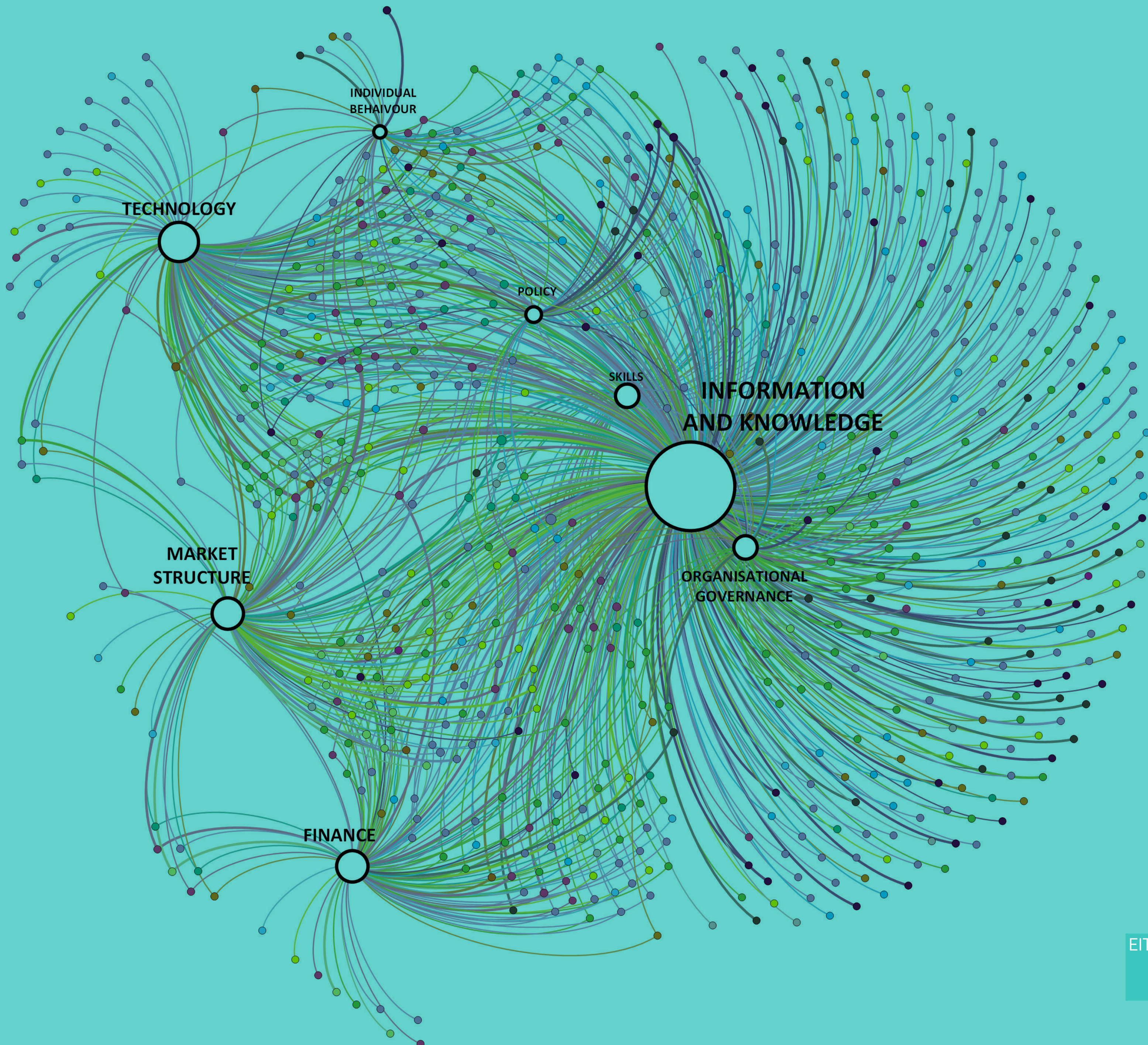
With all this, we have gained practical experience on providing effective guidance on system mapping that has allowed us to move forward co-creating successfully practice-based knowledge with communities seeking to initiate actions and steer towards set targets as part of their own policy plans.

Communities of practice that may show interest in the experiential content systematised in this handbook will do so precisely because of the potential for integration and combination with their own background in specific areas of applied knowledge. It is precisely the content of this handbook combined with their expertise that should increase their own transformative potential. This will hopefully strengthen the delivery of services in their environment, and encourage the strengthening of close links between participants from these communities of practice.

Moreover, a key part of these services is the implicit skillset of practitioners who face these challenges, such as "service delivery", including project and community management as well as service interactions to enable the best customer experience.

We hope that the reader will engage with the lessons learned and concepts from this new material, continuing this loop of knowledge exchange and, thereby, the promotion of the required transformation to address the growing impact of climate change on their environment.

Figure list



EIT Climate-KIC Portfolio map - Interrelated impact goals-
Project sample 2016-2018
Portfolio week, Amsterdam 2018

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Challenge-led System Mapping. A knowledge management approach

Handbook for the design and implementation of participatory system mapping processes addressing system innovation

Edited by EIT Climate-KIC Transitions Hub

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Transition Cities project

This handbook is an updated version of the first guidelines co-produced by the Transitions Hub and the Transition Cities project (2014-2017):

> Matti, C., Stamate, E., Juan Agulló, B., Bauer, A., & Avella, G. (2017). Participatory socio-technical mapping. Guideline for practitioners to design and implement a community-based process for system mapping and analysis. Version 1.0. Brussels: EIT Climate-KIC.

That original material was updated based on lessons learnt over implementation of new actions during 2018-2020, a brand-new chapter on knowledge management, complementary materials and new peer review processes..

Summary

EIT Climate KIC's Transition Cities programme worked with the cities to consider the challenge of climate change through a new challenge-led mode of innovation rather than a technology-driven one. It involved eight cities drawn from across Western, Eastern and Southern Europe in activities run from 2014 to 2017. Alongside the development of a mapping approach drawing on insights from transition management thinking, the program's stakeholders explored the limitations of existing activities and tried to develop pilot schemes and experiments that address some key gaps and holes in their current low-carbon activity.

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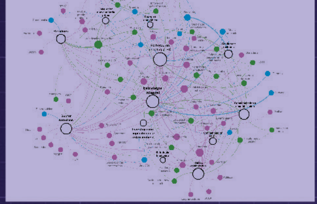
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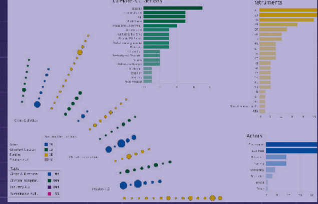
Modena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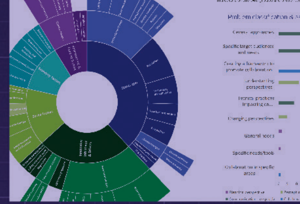
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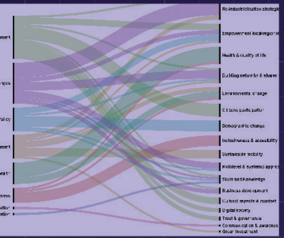
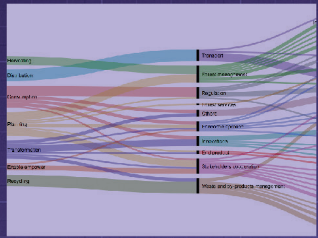
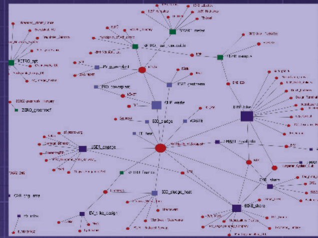
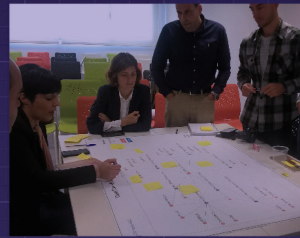

Mondragon


Brighton

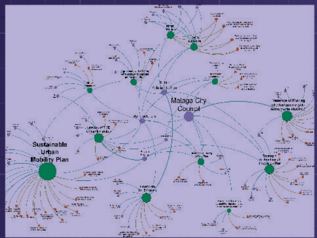

Helsinki


Atacama

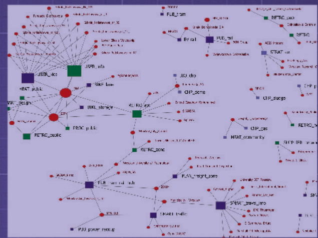

Budapest


Castellon

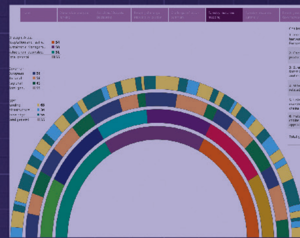

Birminghan


Malaga


Berlin


Wroclaw


Valetta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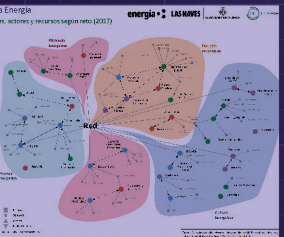
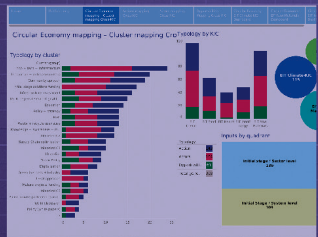

Valencia


Oeiras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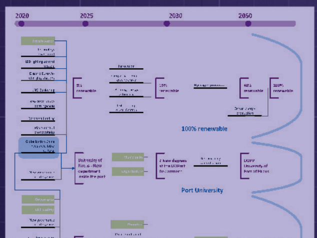
Bologna


Piraeus


Buenos Aires

“This handbook is an illustrative example of our commitment to better understand what we do, to harvest what we learn and to share our insights with the community”

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