Transitions Hub

Make innovation happen

Challenge-led and participatory learning processes to facilitate urban strategies for innovation on low carbon futures

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Keywords

transitions, cities, socio-technical system, networks, innovation

1. Introduction

The urban contexts are potential scenarios for decisions making process to address sustainability issues (Frenken & Boschma, 2007; Raven, Schot, & Berkhout, 2012). In this paper we present a new sociotechnical and systemic approach to urban specialization with a policy focus on challenge-led clusters. Specialization patterns are explored through urban sociotechnical systems where networks and organisations act as "transition arenas" in a policy shift to the meso regime level as a new focus of transformative innovation. It is an alternative to the traditional macro/micro split more attuned to systemic rather than singular innovation, and offers a broader definition of innovation, which highlights social, organisational, and business model novelty.

It addresses the lack of capacity of different actors across domains to drive process of system analysis as well as problem structuring and envisioning. We argue that a more reflexive and inclusive approach of 'management as learning' can be applied to overcome this critical limitation in order to pursue local actions towards pathway creation in emergent environmentally sustainable sectors.

The study provides analytical evidence on inclusive approaches for urban low carbon strategies as a learning approach to transform the policy agenda in European cities. We carried out a participatory process to enable cities to articulate better their needs and challenges through the co-creation of multi-actor clusters in three mayor areas: energy networks, mobility and buildings. The approach focused in learning processes by which stakeholders, experts and local authorities share and shape different perspectives and expectations while facilitate different layers of learning regarding sustainability transitions in urban socio-technical systems.

For doing so, a co-creative collaboration between actors and researchers is performed to run several rounds of network analysis based in real projects data set, which are finally confronted with stakeholder's views as part of a process for defining specific socio-technical systems in cities. This exercise illustrates the application of participatory methods(Van de Kerkhof & Wieczorek, 2005; Wittmayer & Schäpke, 2014) by combining science and practice in the search of a model to help cities move towards a more sustainable, low carbon future and also signal a clearer and more coordinated intent to the market for innovative products and services that will be required to achieve it.

The paper is organized in four sections. We begin by bringing together key concepts sociotechnical networks and innovation policy with a view on the learning process

from transition management perspective along with a review of how policy instruments are tailored to the characteristics of regional knowledge. The third section introduces the key elements of the mix methods participatory approach based in Social network analysis (SNA). This is followed in the fourth section by the preliminary results of the three rounds of interactions developed as part of the on going project. Our analysis of these interactions is based on the experimentation of variations of the SNA applied to a broader understanding of the low carbon cluster addressed by the cities. Final reflections are aimed to capture changes in the understanding of regional know-how and the series of feedback loops between actors and researchers in the search of improvements for the participatory method.

2. Transition management and learning processes. Insights on new policy practices and sociotechnical networks

The concept of sociotechnical transitions as a new framework for the analysis of innovation for sustainability can be understood as a new synthesis of evolutionary and associational approaches in science, technology and innovation studies (Steward, 2012). The approach introduce new elements to understand long term changes and transformation (Geels, 2004) but also practical implications regarding conditions required to stimulate social innovation (Van de Kerkhof & Wieczorek, 2005) and concepts as sociotechnical networks and organisation of a multi-actor network "transition arena" which facilitate the policy agenda shifts from macro and micro level, to a new focus of transformation at the meso regime level (Steward, 2012).

In this context, the city level became a scenario for innovation processes aimed to facilitate change for integrated sustainability, in which a major amount of learning emerges through the exchange, combination and adaptation of different type of knowledge and best practices (Nevens, Frantzeskaki, Gorissen, & Loorbach, 2013). That learning process can be defined as collaborative constructed understanding in terms of expansion learning (Engeström, 2001, 2011) where the formation and change of concepts involves confrontation and contestation between a variety of actors as policy makers, scientists, and other local stakeholders provide.

In the urban transition arena, the confrontation of concepts such as system innovation, governance systems, urban cluster and policy intervention facilitates the constructed understanding of the urban socio technical system. That understanding takes the form of layers of leanings where the articulation of new conceptualization and new practices are motivated by a challenge led, demand oriented, systemic initiatives that move forward from a legacy of technology driven, supply side, singular approaches (Steward, 2012, 2014).

An emerging field of participatory visualization methods have taken the challenge of exploring the field of action research to facilitate change (Emmel, 2008; EWMP, 2015; Rambaldi et al., 2006; Schiffer & Hauck, 2010) by delivering in a co-creative collaboration between actors and researchers (transdisciplinary research). This studies claims that this participatory approaches of mapping sociotechnical systems can contribute to generate knowledge to build trust, enable consensus, and facilitate the dissemination of information (Scott, 2015) while engage the relevant city stakeholders into action (Nevens et al., 2013). This paper explore a mix method approach for sociotechnical network mapping with the purpose of facilitate new inclusive challenge-led approaches of management as a learning process for a wide range of stakeholders with the final purpose of fostering systemic transition through niche innovative solutions.

3. Social network analysis and participatory methods to visualize Socio-Technical systems at urban level

This paper use a mix methods approach for action research where the transition arena is proposed as a main tool to provide to local change-agents a context of discussion, interaction and exchange diverse perspectives on the different urban challenges. With that respect, the aim of this methodology is providing support to collaboratively construct an understanding of

urban socio-technical system with the purposes of creating linkages between the findings of low carbon projects implemented locally with wider European policy on climate change . Projects are implemented in 6 metropolitan areas – Birmingham, Bologna, Budapest, Frankfurt, Valencia and Wroclaw. The focus is on systemic aspects of buildings, energy networks and mobility on which pilots and experiments will be undertaken. We explore the use of participatory techniques and the environment of collaborative projects regarding urban issues as the general framework to facilitate a learning process and knowledge exchange among stakeholders. The research design includes two main components: 1) the definition of regional clusters and management of projects data and 2) the participatory Social Network Analysis. Both processes are implemented in several rounds of interactions where the results of each exercise provide new data and learning outputs regarding two main aspects 1) improvements in the methodological approach and 2) better understanding of urban socio-technical systems. These processes are briefly described below.

3.1. Cluster definition and open data management

The aim of this task is to develop the concept and content of challenge-led low carbon clusters. The study will explore this approach in six identified cluster areas based in the three core themes of buildings, energy and mobility. Each partner city will take a lead on one of the transition clusters but will twin with the other cluster within its core theme. By clustering projects, cities can deepen their understanding and gain a wider awareness of transition thinking.

The task includes gathering project data and knowledge systematization through open data management where stakeholders and researchers collaborate for the compilation and codification of information within a common resource. Relational data set and panel data format are used as instrumental tools by which stakeholder and research interact to define conceptual categories, relations and the different variables considered relevant for the defining the socio-technical system (e.g. type of actions, stakeholders attributes, financial issues, affiliation and role in the knowledge process). The final result is a relational data set as a main input for running Social Network analysis. Figure 1 shows the main stages in this process.

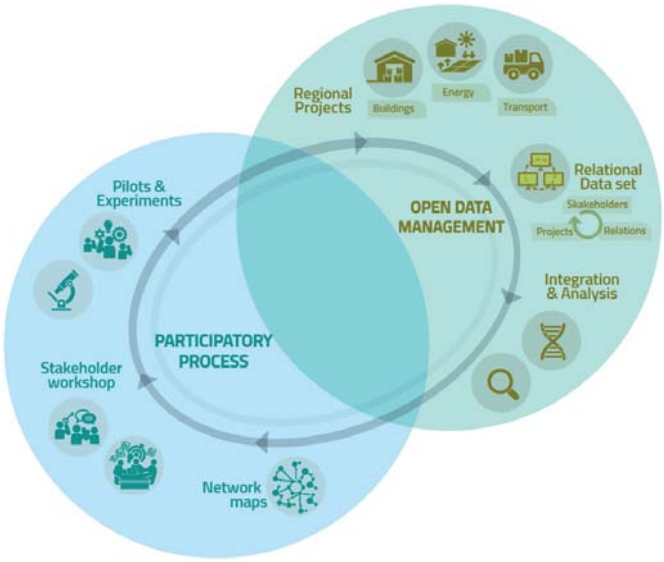


Figure 1 Mix method participatory approach

3.2. Social Network Analysis as a participatory visualization method.

The application of SNA as a participatory visualization methods seek to bring 'analysts' and 'actors' together to co-produce a shared 'map' of each transition cluster as a socio-technical system network. The layout of the network maps uses techniques from social network analysis to place more prominent actors at the centre of the map and to place closer linked actors nearer to each other. In doing so, the approach is aimed to stimulate the analysis and conceptualization of the socio-technical system by revealing interlinkages and the role of different actors in the process of change. It is argued that this offers a richer and realistic perspective for the radical pervasive changes needed for a better understanding of the transition to a low carbon society. The analysts use state of the art social network analy-

sis software (UCInet/NetDraw) to map out the pattern of social actors and low carbon innovation projects in a particular city. For each transition cluster this process will clarify the system configuration found in each partner city to enable comparison between them and also with leading global models of successful system transition. Starting with the basic information about projects and organisations this mapping process will also capture key dimensions of innovation and interaction such as:

- common barriers and governance issues
- integrative innovation models
- potential replication and extensions of the technology
- user and business engagement;
- new financial and procurement models;
- regulatory frameworks

The sociotechnical system is represented through Mode 2 networks by combining information on different activities such as projects, events and local association and the stakeholders involved. The first categorization of transition arenas includes: 1) Cogeneration & Local renewables, 2) Energy demand management, 3) Energy from waste, 4) Integrated mobility, 5) Low emission buildings and 6). Regarding stakeholders, the networks maps include information regarding type (Business, government, academic and society) and the governance level in which operate (Local, national, European and global).

The purpose of the network maps is to develop a new framework for understanding the patterns of system wide change. It uses a relational approach designed to reveal interlinkages and the role of different actors in the process of change. For doing so, the approach adapt and facilitate elements from different disciplines to the practical contexts of actors involved in the project. Critical concepts of sociology of innovation as relational orientation and communicative interactions (Rogers, Medina, Rivera, & Wiley, 2005) as well as homogeneity and heterogeneity (Granovetter, 1983) and informal 'social' links and boundary spanners (Conway & Steward, 1998) are considered.

Simultaneously, the variety and similarity of network participants is analysed regarding potential roles as gatekeepers, brokers, intermediaries through the challenge-led approach based in the local transition strategies on low-carbon initiatives. In doing so, the methodology seek to be different to conventional cluster approach focused on technological distinctiveness and, thereby, provide a mechanism to identify actors who can facilitate and define pathways for system transition (Steward, 2012).

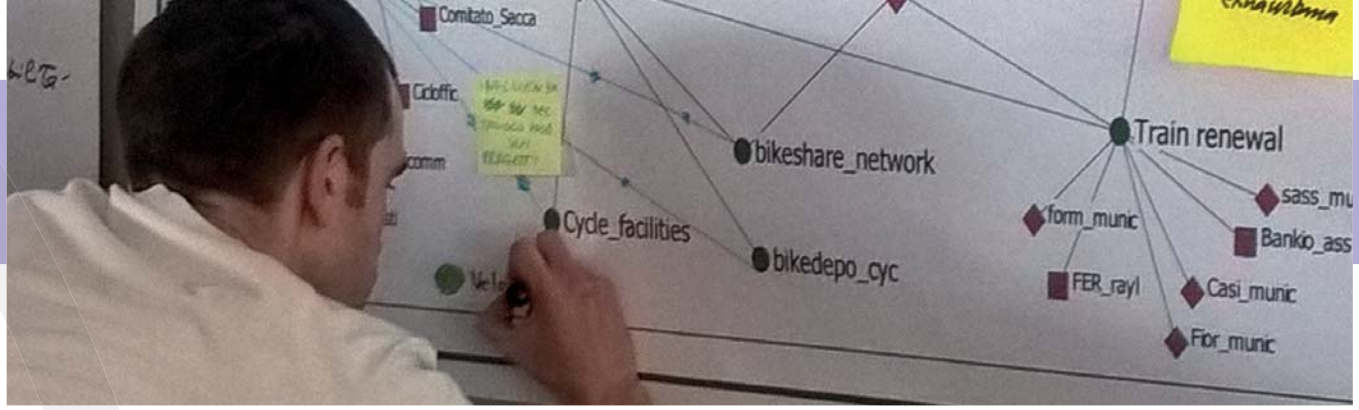
4. Low carbon innovation cluster analysis for sociotechnical network mapping.

In this section the results of the implementation of mix method approach for cluster analysis for sociotechnical network mapping are presented. At first, the brief description of the main variables included in the panel data are presented by focusing in the general distribution of actions and diversity of stakeholders in each city. Secondly, the results of the cluster analysis are presented by highlighting the key lessons learnt in term of methodological aspects and collective understanding of urban socio-technical systems.

Data gathering and integration

The process of data gathering and compilation has involved the design and creation of central data set. By doing so, the researchers specify fields and some specific data properties such as labels, typologies and classifications through interaction with project partners during participatory workshops. Project partners have introduced individually the data while the research team has followed further actions regarding data cleaning and integration. The current panel data includes information regarding actions and stakeholders and the corresponding relations. The panel includes 300 initiatives and 674 stakeholders distributed in the 6 cities/regions (see Annex Table 1-8).

Three types of actions are included (projects, events and associations) where projects are the main type of action (87%) across regions. Regarding the distribution of action across the transition arenas, low emission buildings is the most important arena, followed by co-



generation and local renewables and integrated mobility. The application of variety index reveals different balance across cities where Birmingham presents the higher variety index or the most balanced distribution of initiatives among arenas. Only 139 initiatives have currently accurate data regarding length, in this subgroup the mayor share of initiatives last one year (27%) and 50% of initiatives last between 2 and 4 years.

Regarding stakeholders distribution, they are categorised by type (Academia, Business, Government and Society) and level of operation (Local, National, European and Global). While Birmingham is the regions with mayor number of stakeholders, all the cities present a mayor number of Business stakeholders. Bologna/Modena and Wroclaw presents the most significant participation of stakeholders from government and, West midlands and Valencia presents the most significant participation of Academia. Regarding level of operation, Local stakeholders are around the half of the total but they are the most in Wroclaw, Frankfurt and Bologna/Modena. Budapest, Valencia region and Birmingham presents more balanced compositions, however, this last presents a significant share of European stakeholders.

System analysis and learning process

The exercise of cluster development through participatory methods is aimed to focus the analysis on the different processes of knowledge diffusion among cluster (e.g. type, scope and sector) by identifying the relevance of intra-cluster relations for knowledge exchange (i.e. type of collaboration) and the role played by individual actors involved in the transmission of knowledge. This exercise is critical to facilitate to local actors the development of a system perspective where local institutions can be identified as bridges connecting internal and external actors but also the coordination and facilitation mechanism are analysed in term of the use, combination and adaptation of existing knowledge bases to foster innovation emergent sectors related to low-carbon economies.

At the current stage of the Transition cities project, the full exercise has been carried out in three rounds of interactions by looking at different scopes and of socio-technical systems in term of cluster development. Interactions and new round of networks maps were designed by introducing the lesson learnt and demands of participants arising in the workshops.

4.1. Dynamics of learning process on urban sociotechnical systems implications

The collective construction of multi-actor clusters through participatory process with local stakeholders has been based in several rounds of interactions. Network maps has been used as tools to facilitate the identification of relations of knowledge exchange and the different role played by local actors in terms of innovation performance and strategic position in different clusters. The main goal of these interactions was at first, to promote a better common understanding of the urban socio-technical system in selected focus areas (i.e. the three clusters) and, by doing so, facilitate the identification of gap and opportunities to create linkages between actions and actors through new experiments and pilots.

Each round of interaction involved the experimentation with different representation of network maps in terms of scale, knowledge areas and categorization of activities with the purpose of contribute to the discussion on the conceptualization and explanations of the nature and logic of urban clusters from different perspectives. Each round of interaction includes new data gathered on both new actions and attributes of the existing actions (e.g. financial variables) and stakeholders (e.g. level and position in organizational structure). The lesson learnt from four interactions carry out during 2015 are briefly explained below:

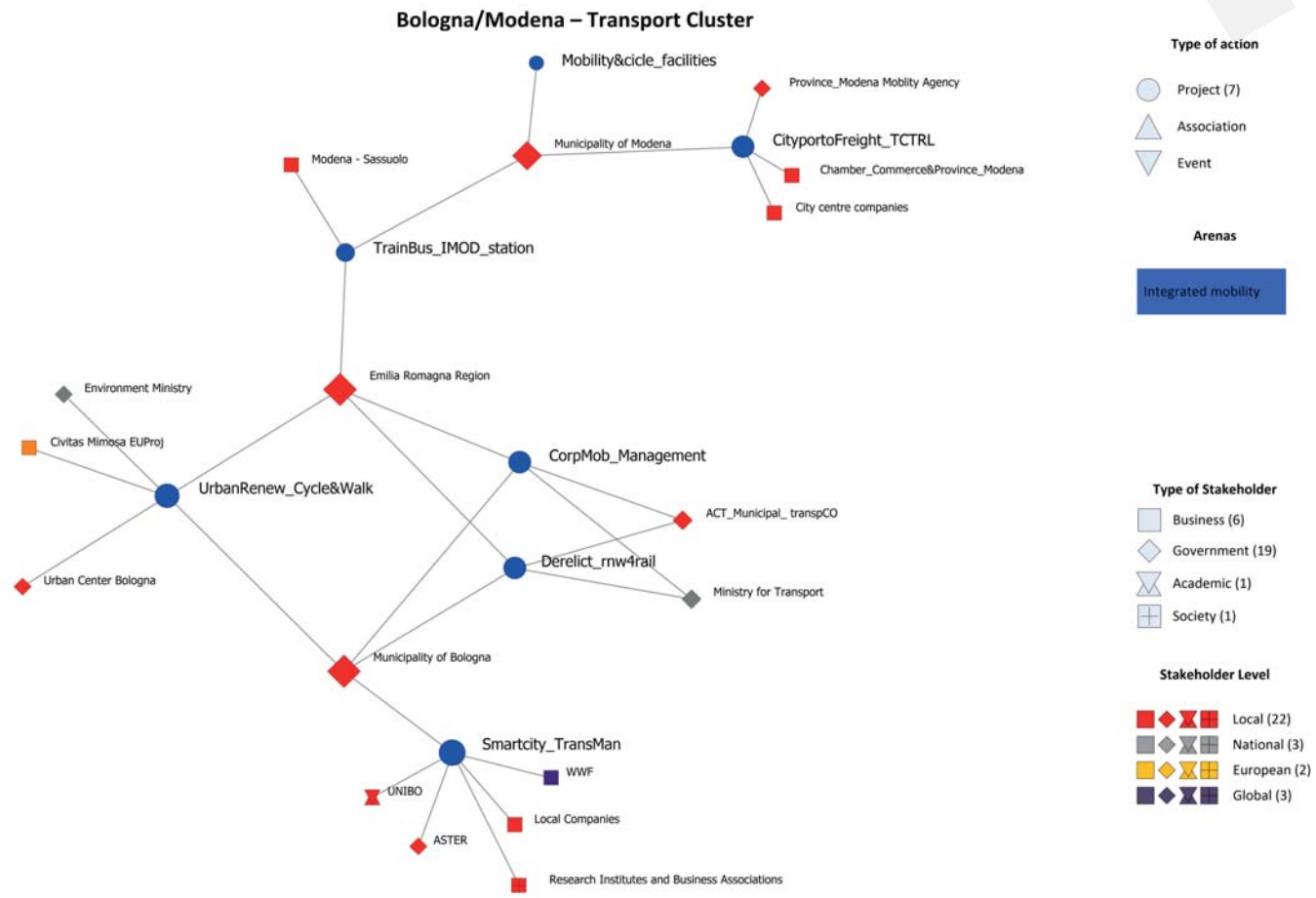


Figure 2 First Interaction: Individual cluster analysis – Modena/Bologna January 2015

First interaction: Individual cluster analysis at city level

The first round of cluster maps was created by the original set of 6 transition arenas defined in research design of the TC project. The objective was the identification of strengths and weakness in the different clusters in term of critical mass of projects, actors and knowledge bases locally available. The figure 2 shows the example of the transport cluster in Modena and Bologna where the distribution of actions is presented by identifying the different type of stakeholders involved according to the transitions arenas. The size of nodes represents the number of relations with other nodes.

The results of this first exercise have revealed the critical mass of projects in each cluster and city where most of the projects in the cities are concentrated in the building related arenas. The distribution among cities also has showed differences with respect to variety among arenas but with not particular pattern in term of type of city or cluster (see Table 2 in Annex)

From the analysis, some governance configurations were identified across cities and clusters by which the role of local governments has been more prominent in some cities such as Bologna and Wroclaw than others like Budapest, Valencia (see Table 4 in Annex). That distribution was also affected by the discussion on the nature of local project where the inclusions of international actions (e.g. EU projects such as H2020) were reviewed for further consideration.

More specifically on governance configuration, the discussion was centred in the volume of activities where the transport clusters present a significant amount of local stakeholders by comparing with the building cluster and the energy cluster. At the same time, the mayor cities as Birmingham, Frankfurt and Valencia region have clear governance configuration with specialized local government units in the different clusters. In the other cities, the simplification of activities and services in single units (sometime at regional level) underesti-

mate the role of municipality, the technological areas covered and the type of interactions with different actors. With that respect, the main lesson learnt for the exercise is related with the need of better explanations regions, cities and subunits in order to showing closeness and separateness in term of political action and knowledge assets.

Second interaction: City system – integrated cluster analysis

The second round of cluster maps was aimed to move forward to the analysis of networks configurations. This approach was motivated by the need of better defining the role of the supporting organizations (local institutions) and the individual actor positioning and implications in terms of innovation performance across multiple technological domains. Figure 3 shows the integrated cluster map where the three cluster and all the transition arenas are included.

This exercise has provided a better context for interaction between different cities to analyses the relations between local institutions and other stakeholders in term of the different area of knowledge under analysis. In particular, the exercise improves the information of roles of different local and national actors in order to set a debate on the existence of gaps such as structural holes in the networks maps but also enablers and gate keepers that facilitate linkages with different areas of knowledge in at system level.

As the size of the nodes indicates level of participations (i.e. number of partners involved in the case of projects and number of projects in the case of organizations), the networks layout confront different understandings regarding the importance of actors and projects in terms of other variables as budget scale for the project or political relevance for the actors. The level of aggregation for both government and academic units also was considered a barrier as stakeholder recognise dif-

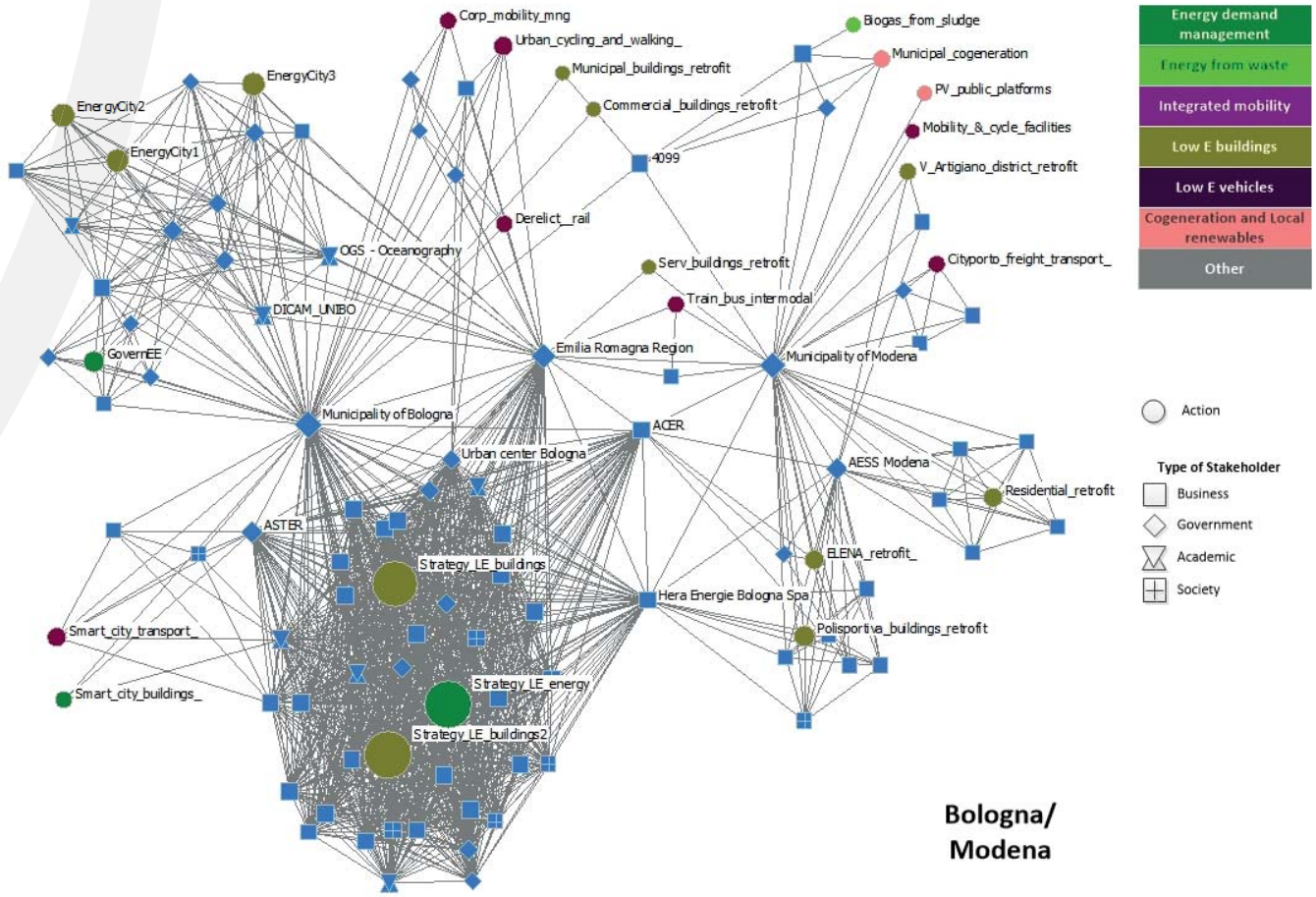


Figure 3 Second interaction: Cluster analysis at city level – Modena/Bologna April 2015

ferent patterns of knowledge flows and specializations in subunits not indicated in the network maps.
Additionally, the use of the simplify name of projects as labels, has been revealed as a barrier for comparison between cities in term of deeper understanding of the innovation process and regarding knowledge process (i.e. knowledge developer, knowledge user, funding organization) and governance configuration in term of the analysis on potential replication of some actions in different context.

Third interaction: application of innovation categories (City level)

The third round of interactions was developed by considering the lack of understanding of the relations between identified actions and broader aspect of the socio-technical system in of type of innovation process and areas developed in each cluster. Thus, a new classification scheme and attributes were assigned to the different actions by considering the type of technology, the social actors involved, the policy action, the system focus and the type of activity developed through project (see table 9 in the annex). The distribution of actions according to the new classification has revealed that a significant share of actors is involved in some categories as user oriented, smart strategies, building retrofitting and supplier related actions (see Figure 5 in the Annex).
This exercise has provided stronger connections of the actions with the different elements that define the socio-technical system. At the same time, the simplification of categories was an stimulus for emerging questions regarding level of specialization, expertise and variety of problem owners. More specifically, diverse understandings have been found in term of the knowledge and innovation management as well as the role of different actors (i.e. knowledge, producer, knowledge

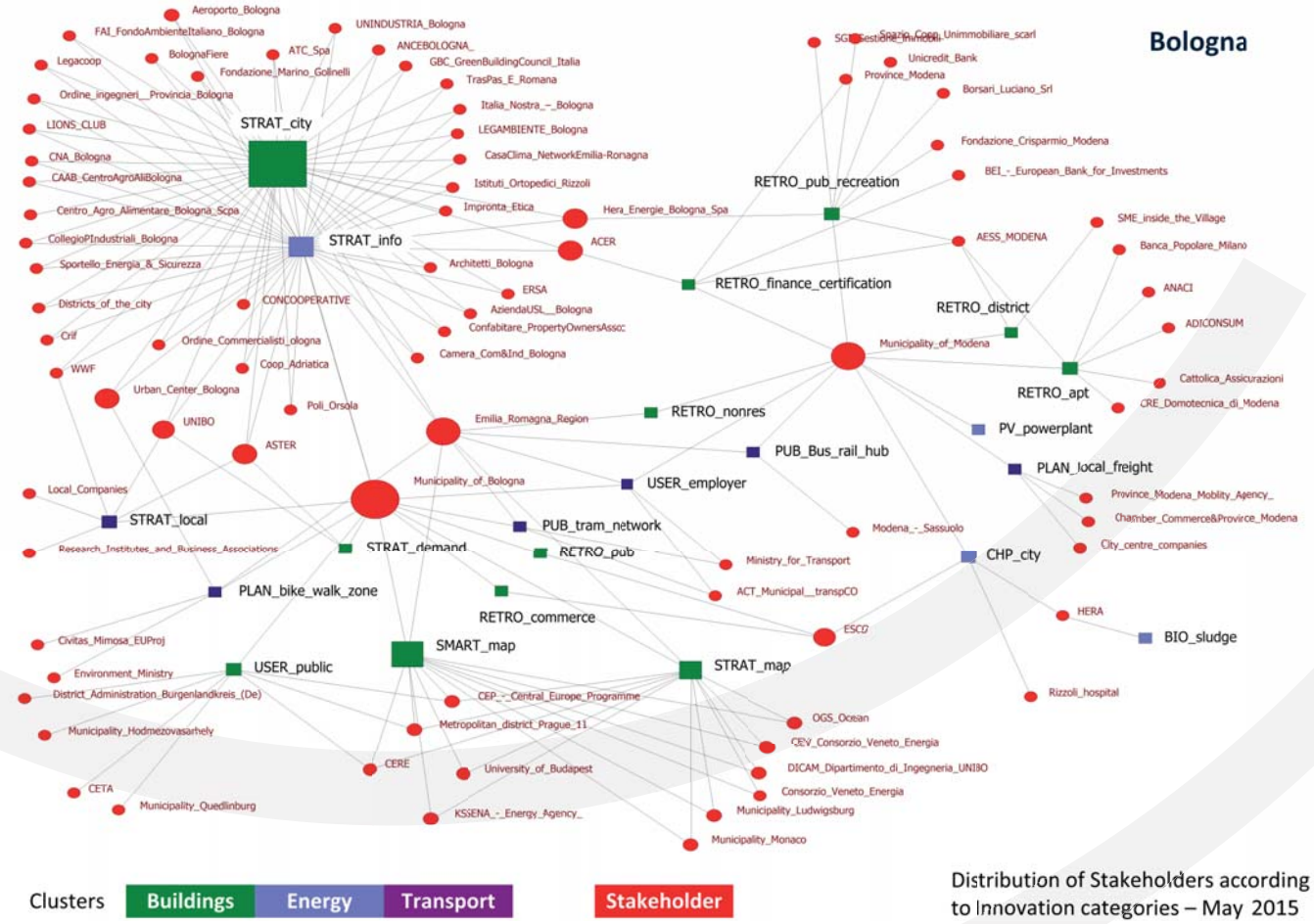


Figure 4 Third interactions: City level and innovation categories – Modena/Bologna June 2015

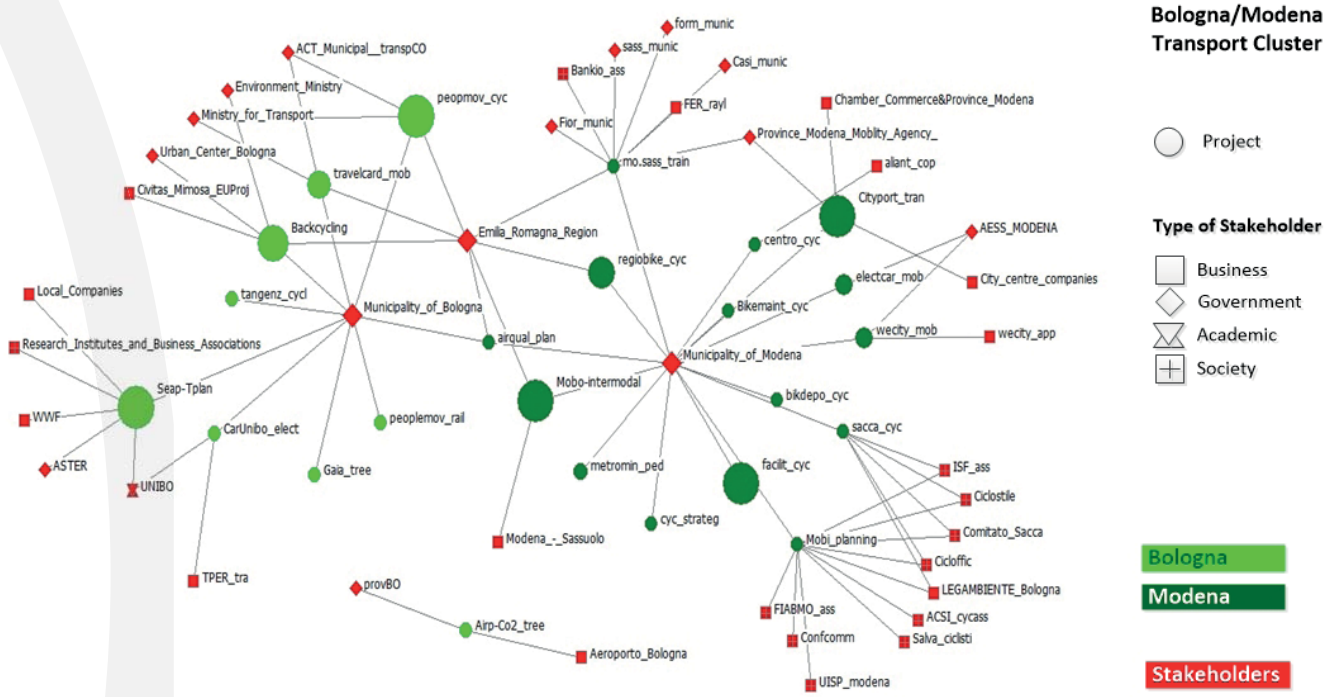


Figure 5 Fourth interaction: Individual clusters analysis and Innovation categories – Modena/Bologna 2015

user, facilitator) in term of the innovation process. Thus, the innovation focus has also facilitated the debate regarding knowledge transfer between cities on the different policy mechanism while revealing the need of governance configurations in term of public-private collaborations.

The figure 4 shows the system network map by applying the classification scheme for Bologna and Modena. The map shows the constellation of actors at city level by combining innovation areas with specific application regarding policy mode and type of technology.

These elements have provided a better understanding of political dimension in term of governance configuration and the role of some key local actors, however, there is a need for further simplification by going back to the analysis at individual cluster level in order to better understand the nature and implication of the policy practices in each cluster. At the same time, analysis of additional of the socio-technical system is required in order to better understand new financial and procurement models but also the impact of the action in the system in term of relevant economic and innovation variables such as employment, value chain value, and environmental impact.

Fourth interaction: searching for specialization patterns through the application of innovation categories to clusters at city level

The fourth interaction was aimed to simplify the overall analysis of the socio-technical system by looking at the cluster level but by considering critical dimension as the specialization pattern (innovation categories) and the scalability (financial variables). Thus, that information was improved in some pilot's cases, as Bologna and Modena in order to better understand the connections with the long-term local strategy. By doing so, the analysis also facilitate some question regarding path dependence related with the location of local investment and the linkages with local problems and needs

The analysis at cluster level was particular important for all the cities as they were able to betel align the Transition cities approach with the set of priorities defined locally in term of particular sector such as building or transport. In doing so, the conceptualization of the cluster itself was enriched by the narratives and patters of historical relation among local actors based in existing governance configurations. A relevant output of this exercise was generating by combining the network maps with a visioning exercise where missing actors

(e.g. universities not participating in Transport project in Bologna/Modena) and local strategies were confronted with the needs of brand new long term alliances in the search of new and complementary knowledge and capacities towards a transition to more sustainable clusters/sectors

The exercise was part of the a learning cycle where participants in the project explore different formats, variables and scales to analyse, better understand and explain to other stakeholders the diversity and specialization pattern in each of the urban clusters. Indeed, the rounds of interaction have contributed to the analysis of strengths, opportunities and gaps in the different clusters and by doing so deeper analysis on the actions to be supported.

4.2. Highlights of the learning process of collectively constructed urban clusters. Lessons learnt on tracking specialization patterns

The learning process have been characterised by two main dynamic processes, at first, the internal process at city level regarding the better understanding of the urban socio-technical systems and, second, the parallel discussion with other cities in term of the different approaches, practices, knowledge combination and governance configurations to support sustainability transitions in each of the analysed clusters. The combination of both processes can be described as several layers of learning where concepts and narratives were confronted and reformulated in order to pursue an exploration of innovation opportunities from a local practitioner perspective.

Regarding the collectively constructed understanding of urban sociotechnical systems, one the most critical lesson learnt is related to the conceptualization and reformulation "transition arenas" in term of the composition and categorization of the different elements included. The need for a better understanding of the urban innovation system has stimulated the exploration of different form or representation of the transitions cluster though network maps. These include different network maps layouts in terms of scale (i.e. City or cluster levels) and categorization of projects in terms of layers (i.e. by transition arena and project names, applying innovation categories).

Regarding the scale, the complexity and variety of stakeholders has confronted some critical dimensions of the urban governance configuration as the multiple political levels, the financial flows and the overall narrative of the innovation process. The confrontation of city level with cluster levels allows the identification of key actors as integrators, facilitators and coordinators (e.g. local government, universities, big companies). More specifically, the understanding of the process of knowledge creation was based in the confrontation of perspectives based in complex beliefs systems, which includes issues on leadership, expertise and even assessment on the performance of innovation activities.

With respect to the categorizations of projects and clusters presentations, the set of interactions has allowed a movement from aggregated categories and concepts as transition arenas to more specific elements of the urban socio-technical systems. These different approaches have facilitated different understanding on the patters of specialization among clusters and cities. Figures 6 to 9 shows the pattern of specialization in the different format applied for rounds of interaction with network maps through the application of Circos (Krzywinski et al., 2009) data graphics tool for structural studies. The exercise seeks to facilitate the analysis of specialization evidence from patterns in the data.

The sequence of figures shows an increasing level of complexity regarding the patter of specialization. Figures 6 (distribution by cluster) and Figure 7 (distribution by transition arenas) present clear distinction in the share of projects by category among cities. Transition arenas allows a better identification of the projects in terms of more specific technological areas but it lacks on further evidence on the nature or logic of the projects in a broad socio-technical context. With that respect, the application of innovation categories (Figures 8 and 9) has contributed to understand the patterns of action around different aspects of the innovation system regarding Technology, social actors, policy mode,

Patters of specialization in Transition Cities

Distribution of projects/actions for Network maps according to different levels and categories

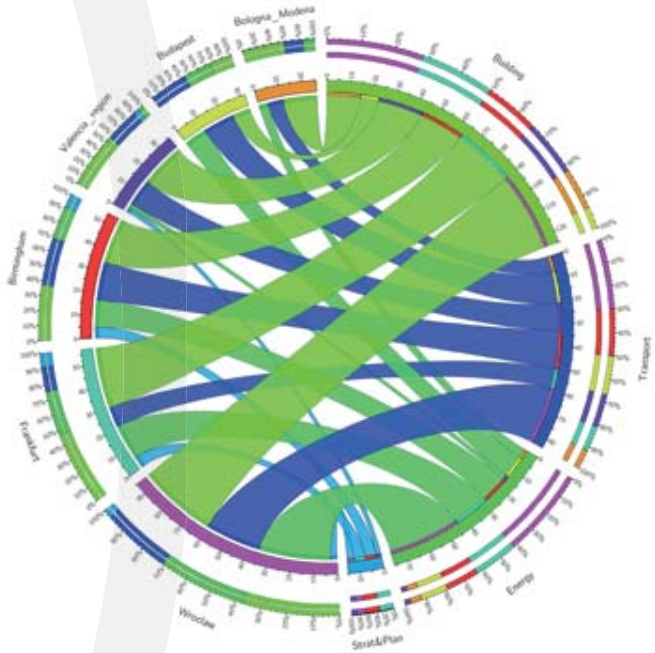


Figure 6 Pattern of specialization by transition clusters among cities

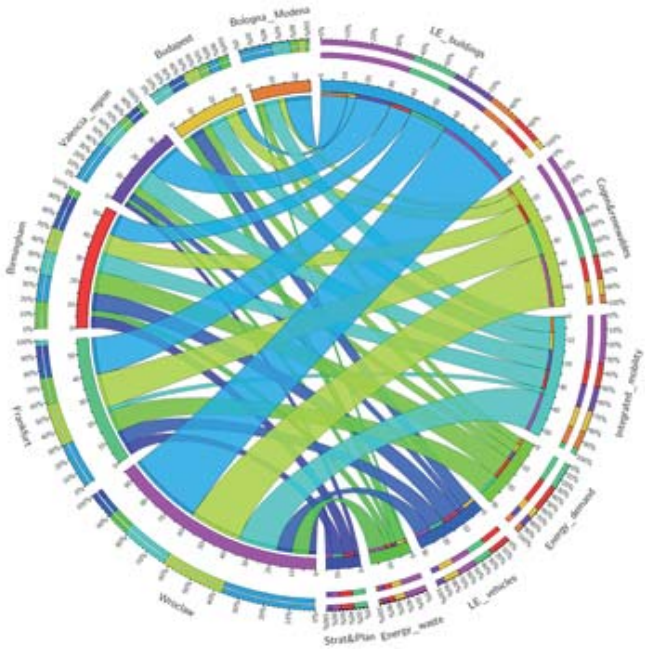


Figure 7 Pattern of specialization by Transition arenas among cities

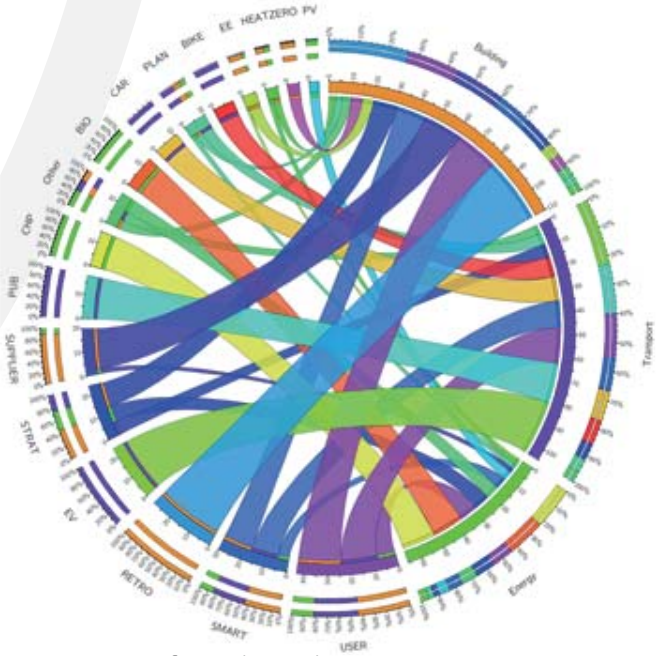


Figure 8 Pattern of specialization by innovation categories among

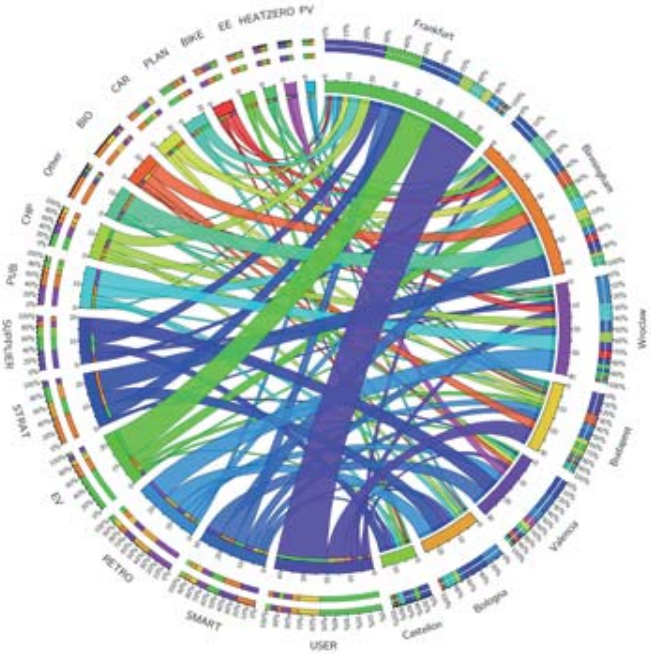


Figure 9 Pattern of specialization by innovation categories among cities

Source: own elaboration based in data from Transition Cities project (2016)

system component, and type of activity (see table 9 in the Annex) among cities and clusters.
The difference found among cities can help to confront the current priorities with strengths in term of knowledge capital and expertise based the logic behind the regional setting and industrial histories. Some particular cases to be highlighted are Frankfurt which shows a pattern of concentration in few categories such as USER and EV (electric vehicles), Wroclaw presents some specialization in RETRO (retrofitting) and PUB (Public transport) while Valencia indicates the highest concentration in SUPPLIER oriented projects. Birmingham as big city as well as Castellon, Budapest and Bologna have more balanced distribution among innovation categories.
These results has have a more clear connection with the design of initiatives as pilots and experiments in terms of the potential complementarities and gaps in each cluster in term of a more systemic perspective. With that respect, this last round of network maps with the application of innovation categories was the main input for facilitating broader stakeholder engagement regarding the priorities and gaps for pilots and experiments for the following year. That participatory process is briefly explained below.

Gap analysis and Stakeholder engagement through participatory processes

Stakeholder workshops were introduced in the working program as part of the methodological issues related to the Cluster – Network mapping method. The aim of this workshop is connect the analytical stages related to the analysis of the socio-technical systems and cluster with a broader set of stakeholder. By doing so, the interaction provides critical inputs for the identification of gaps and opportunities with potential for experiment, pilots and service innovation grants.
The general approach applied in the four cities follows two principles. First, the cities organise and design the workshop by considering a challenge-led approach in term of a regional priority and strategy related to one of the cluster to be analysed through the TC project. Second, complementary exercise on Visioning and Backasting or Stakeholder analysis are included as part of the workshop. These exercises have the double objective of engaging the stakeholder with the identified challenge and providing a general preliminary understating of system, cluster and stakeholders. On the other hand, the main expected outputs are related to new critical local inputs for the analysis of gaps and opportunities in the second part of the workshop: the analysis of the network maps.
The format of these workshops was preliminary discussed and agreed with the partner cities on the development of a common procedure for this year that includes the general structure of the workshops, the procedure for identifying opportunities at city level and the evaluation criteria. Two main aspects were important during the workshops, the lessons learnt on the potential improvements in the methodology and the identification of different narratives based in the challenge of the workshops.
Regarding the methodology, one of the main results comes from the confrontation of the visioning exercise and the network maps. On one hand, this allows the deep analysis of the underlying relation between actors, not only in terms of participation in the same actions but also in term of political, financial and knowledge aspects. On the other hand, the exercise of making fit the new ideas on the existing network map has facilitated reflections on the overlaps and performance of some action in the past.
Some cities as Frankfurt, Valencia and Castellon also perform an stakeholder analysis exercise where the participatory process was redirected to analysis current implementation and management issues. Whit that respect, there is a clear differentiation of how the cities much their needs and strategies in term of different stages where foresight, implementation, management and evaluation are confronted as part of feedback loops from the visioning and stakeholder exercise to the analysis of network maps.
Regarding the regional narrative, each city has based the challenge workshop in a topic connects to one to the three clusters: energy networks, buildings and transport. However, some of them were more interesting in supporting and emergent sector as green

buildings (e.g. Castellon) or specific geographic scales as districts (Frankfurt) while other cities have based a regional strategy such as sustainable mobility (Modena) or smart energy solutions (Valencia). The needs for increasing awareness and better understanding of the particular cluster were transversal elements. Specialised knowledge fro technicians and professionals as well as and practice-base knowledge for users and customers were critical elements in terms of the development of further actions.

Finally, the visioning exercise in confrontation with the network maps reveals different argument behind the type of actions and knowledge required to improve the operation and the specialization on each of the clusters. The participatory exercise facilitate differ elements to understand how the stakeholder perceive the strengths as knowledge assets and industrial development as well as the opportunities for further market exploitation. Those reflections are briefly explained below.

5.Conclusions

This exercise illustrates the application of participatory methods by combining science and practice to face coordinated actions to support low carbon futures. The method facilitates a learning process where stakeholder priorities and belief systems shape a collectively constructed notion of system innovation. Actions suggested as output of this exercise are aimed to support major pathway creation towards the identification of opportunities in emerging clusters and, thereby, support existing patterns of urban specialization. The transition arena is proposed as an instrumental learning environment for discussion, interaction and exchange where local change-agents can share, exchange, combine and adapt different types of knowledge and perspectives on urban challenges.

This paper has provided evidence on the application of a mix methods approach as part of new policy practices designed to facilitate transformative innovation at urban level. Early results provide some insights of different clusters configurations in each city though specializations patterns. At the same time the composition of urban socio-technical maps has induced the debate of morphology of networks regarding the organizational configuration and knowledge setting of different local institutions. Perspective on innovation process have been confronted by benchmarking the distribution of roles among different type of actors by type and level in each city where cluster configurations reveal different compatibilities with collaboration at national and European level.

Participatory exercises have facilitated a learning process for all the participants, where interactions between experts and local authorities have revealed different perspectives and expectations regarding the application of the method. In that sense, further exercises may analyse the use of the cluster analysis for different applications such as decision-making, policy evaluation and foresight by considering governance configurations as well as beliefs system, value setting and priorities

The quality of network interpretation depends on the understanding of knowledge flows and longitudinal perspective across policy domain. Any improvement in this area needs to consider the overlaps of knowledge process, collaboration mechanism and political dimension in order to separate network governance configuration and innovation networks. Finally, the conflict of interest regarding knowledge production process require that further steps should be made to facilitate more than one practitioner narrative about challenge and application of the method.

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7. Annex

Table 1 Distribution of projects in Transition cities(TC) by type of action

City/region	Association	Event	other	Project	Total	Share
Bologna / Modena				26	26	9%
Budapest		8		24	32	11%
Frankfurt	3	7	11	36	57	19%
Valencia region	1	2		33	36	12%
West midlands		1		53	54	18%
Wroclaw	2		4	89	95	32%
Total	6	18	15	261	300	100%

Source: own elaboration based in data from Transition Cities project (2016)

Table 2 Distribution of projects in TC by arena

Arena	Bologna / Modena	Budapest	Frankfurt	Valencia region	West midlands	Wroclaw	Total	Share
Cogeneration & Local renewables	3	6	16		9	24	58	19%
Energy demand management	3	4	10	4	10		31	10%
Energy from waste	1	4		2	3	8	18	6%
Integrated mobility	7	8	2	9	9	18	53	18%
Low emission buildings	12	4	17	16	10	35	94	31%
Low emission vehicles		6	7	3	8	7	31	10%
Planning & Strategy			5	2	5		12	4%
ND						3	3	1%
Total	26	32	57	36	54	95	300	100%
Variety Index*	1,92	2,53	2,32	2,13	2,72	2,22	2.59	

Source: own elaboration based in data from Transition Cities project (2016)

*Variety index
$\sum^{n}_{i} p_i \log_2(1/p_i)$
where pi stands for the share of each of initiatives in all the transition arenas

Table 3 Average duration of reported initiatives

City	Length of initiative											
	1	2	3	4	5	6	8	9	10	>10	Total	Average
Birmingham	14	5	2	8	1	1				1	32	3,1
Bologna / Modena	2		6	1					2	0	11	4,0
Budapest	5	1	5	3	1	1	1			3	20	5,3
Castellon	5	1	1	3			1	1		0	12	3,3
Valencia		1	3							0	4	2,8
Wroclaw	12	18	7	5	3	2		1		12	60	5,8
Total general	38	26	24	20	5	4	2	2	2	16	139	4,6
	27%	19%	17%	14%	4%	3%	1%	1%	1%	12%	100%	

Source: own elaboration based in data from Transition Cities project (2016)

Table 4 Distribution of stakeholders in TC by type

Type	Birmingham	Bologna/ Modena	Budapest	Castellon	Frankfurt	Valencia	Wroclaw	Total	Total Share
Academia	34	7	4	12	5	24	6	92	14%
Business	96	48	59	35	31	47	62	378	56%
Government	22	30	10	15	18	16	48	159	24%
Society	12	8	3	2	10	6	4	45	7%
Total	**164**	**93**	**76**	**64**	**64**	**93**	**120**	**674**	**1**

Source: own elaboration based in data from Transition Cities project (2016)

Table 5 distribution of stakeholders in TC by level

Level	West Midlands	Bologna/ Modena	Budapest	Castellon	Frankfurt	Valencia	Wroclaw	Total	Total Share
European	65	12	17	14	1	29	11	149	22%
Global	4	3	3	19	1	6	4	40	6%
Local	49	66	45	17	46	41	92	356	53%
National	46	12	11	14	16	17	13	129	19%
Total	**164**	**93**	**76**	**64**	**64**	**93**	**120**	**674**	**100%**

Source: own elaboration based in data from Transition Cities project (2016)

Table 6 Average number of stakeholder participating in TC projects by arena

Arena	Bologna / Modena	Budapest	Frankfurt	Valencia	West midlands	Wroclaw	Total
Cogeneration & Local renewables	2,0	2,7	3,1		9,1	1,0	3,1
Energy demand management	6,7	3,5	2,6	7,5	4,8		5,4
Energy from waste	1,0	2,5		5,0	7,3	1,5	3,1
Integrated mobility	3,9	4,4	1,5	4,8	3,0	2,2	3,3
Low emission buildings	11,4	3,8	3,2	5,7	3,0	1,7	4,1
Low emission vehicles		3,0	2,0	10,0	6,0	1,7	3,9
Planning & Strategy			2,8	5,5	4,8		4,1
Total	8,5	3,4	2,8	6,0	5,2	1,5	3,8

Source: own elaboration based in data from Transition Cities project (2016)

Table 7 Classification scheme and attributes

TECHNOLOGY		SOCIAL ACTORS		POLICY MODE		SYSTEM		ACTIVITY	
EV	Electric Vehicle	USER	End user, consumer citizen	PROC	Procurement	PUB	Accessible and used by the public	Design	Design
BIKE	Bicycle	SUPPLIER	Supplier company or business	FIN	Finance	INFRA	Infrastructure	Demo	Demonstration
		SME	Small and medium sized firms	STRAT	Strategy	ZONE	Designated spatial area or zone	Bizmod	Business model
FCV	Fuell cell vehicle			PLAN	Land use planning			Res	Research
CAR	Automobile			Engage	Engagement				
SMART	Information & Communication Technology			Behave	Behaviour				
RETRO	Retrofitting								
ZERO	Zero emission buildings								
EE	Energy Efficiency general								
DEMAND	End use demand management								
BIO	Bioenergy								
PV	Solar photovoltaic								
CHP	Combined heat and power, cogeneration, trigeneration								
HEAT	Heating systems								
WASTE	Waste treatment processes								
H20	Water management								

Source: own elaboration based in data from Transition Cities project (2016)

Figure 10 Distribution of innovation categories according to Classification scheme and attributes