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The Paradigm Shift of Living Labs in Service Co-Creation for Smart Cities: SynchroniCity Validation

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Abstract. In the literature there are many definitions of co-creation and several disciplines are involved within this approach, especially co-design, participatory design and open innovation. Co-creation has been linked with many tools and platforms, without a coherent framework and specific guiding principles to follow, especially within the smart cities' context for developing new services. For this reason, it is required to clearly define which are the methods and digital tools that cities should pursue to fully exploit the potential of these platforms in terms of enhancing global collaborations. Starting from the review of the literature on participatory design, co-creation and open innovation, the paper aims to discuss the role of Living Labs in supporting service design for smart cities, by providing an effective approach for involving stakeholders in real life experimentation through digital platforms. The evaluation has taken into account the current use of co-creation approaches by eight smart cities involved in the SynchroniCity project, and considered as the current best practices in Europe. The analysis focused on timing, stakeholders, activities for involving citizens, rewarding systems, tools and metrics used to investigate the success of their implementation. Ten methods and twelve tools have been selected as the one best supporting smart cities in service design and their real application has been investigated through an online questionnaire and in depth interviews to the cities. As a result of the study, Living Lab has resulted as the most used and effective method for the smart cities in the EU for service design.

Keywords: Smart Cities, Internet of Things, Co-Creation, Participatory Design, Living Labs, Service Design

1 Definition of Central Concepts

1.1 Co-creation for the Smart Cities

Originally, co-creation has been defined as the participation of end-users in the process of developing a product or a service [1]. Co-creation has been linked with many applications, without a coherent framework to follow [2] [3]. De Koning et al. [4] have provided an analysis of 50 co-creation methods and definitions, presenting a first comprehensive framework. According to the authors, in literature the co-creation term has been approached by following four different models, which are: the co-creation

spectrum, the co-creation types, the co-creation steps and the joint space of co-creation. The types of co-creation define the process by identifying three criteria: when the co-creation happens, the amount of direct benefit or change produced, and the level of collaboration among the parties. What is clear and commonly agreed upon in the analysis of the literature, is that co-creation tends to refer to the active involvement of end-users sharing ideas with firms at various stages of the production process [5]. The core principle of co-creation is engaging people to create valuable experiences together, while enhancing network economics [6]. A central element of the transition to co-creation is the ability to effectively develop and manage two-way communications and information systems [7]. In the literature, authors have been provided three different definitions of the co-creation term according to the perspective of involving citizens in the process [8]: citizens as co-implementers of public services, they only perform some implementation tasks; citizens as co-designers, they decide how a service should be designed; and citizens as initiators, they trigger themselves an initiative and the government follows their approach. Within the context of smart cities and IoT projects, we support that these definitions are not representing the active role assigned to the citizens and the complex set of stakeholders usually involved. Hence, we prefer to apply the definition provided by Leading Cities [9], which sees co-creation as: *“an active flow of information and ideas among five sectors of society: government, academia, business, non-profits and citizens - the Quintuple Helix - which allows for participation, engagement, and empowerment in, developing policy, creating programs, improving services and tackling systemic change with each dimension of society represented from the beginning”*.

By taking into account these approaches and the specificities of smart cities activities, the following steps have been here defined as complementary for the effective implementation of co-creation practices in smart cities:

- *Step 1: Co-Analysis*: defines the objectives to be achieved, including the approach to select the group that should be involved in co-creation and also the tools to put in place, considering stakeholders' needs.
- *Step 2: Co-design*: citizens generate new ideas to reshape or improve existing services. Within smart cities, co-design can be horizontal, engaging different municipalities in a city and in different regions; or vertical, when stakeholders are involved in both ways from up and down the service chain.
- *Step 4: Co-evaluation*: it aims to assess the efficacy and effectiveness of the proposed solutions by evaluating its potential socio-economic impacts. This phase includes also testing with stakeholders.
- *Step 5: Co-implementation*: the project takes its final shape and real results are occurring. By co-evaluating the products/services with current stakeholders, it is necessary to ensure the real usage and impact of the solutions.

1.2 Participatory Design vs. Co-creation

Participatory design is a process focused on the definition of a service idea implemented together with stakeholders to provide a service ready to be used. In more traditional views on participatory design, stakeholders tend to be involved in the process

only as testers during the prototype phase. This process has been evolved since 80's, from customers to users in 90's, from participants to co-creators until today. The participatory design theory has then advanced thanks to the Scandinavian School, supporting the idea that through a participatory design approach we do not design things as objects, but socio-material assemblies, real things [10] [11] [12]. Co-creation has emerged for sure in connection with the participatory and human centred design approaches, where the attention was focused on empowering people for decision making processes and working practices. In participatory design, people contributes to the design processes, for this reason the connection with co-creation is strong and sometimes misleading. However, within the participatory design approach, co-creation is only seen as one of the strategies that can be applied to increase effectiveness, especially within social innovation contexts [13], rather than an autonomous process. Moreover, often in the participatory approach, co-creation is subordinated to co-design, to which a more relevant role is assigned, representing the collaboration process. By applying co-creative techniques, the focus should be on people as proactive citizens, rather than as consumers of services. The process is more related to the engagement of different communities, rather than only to some users in a group [9]. In this context, co-creation is seen as the only effective way to support governments to be more responsive to citizens' needs and to increase effectiveness and efficiency of cities [14]. In contrast, participatory design is managed by design experts acting as facilitators, rather than empowering citizens to make decisions for governments in the first place and be active contributors in the service development process [15].

1.3 Philosophy of Open Innovation in Smart Cities

Open innovation is a widely accepted concept both in academic and in business contexts. This is confirmed by the fact that searching the term in Google Scholar it shows 1.490.000 results. The topic has been one of the most discussed, especially in relation to economics, psychology, sociology and culture [16]. The first definition of open innovation has been provided by Chesbrough [17], however, the concept is not totally new, it is derived from the 70s' literature on customer and user-driven innovation, open systems and open paradigms [18] [19]. The open innovation concept has been applied to smart cities only recently to be closely linked to innovation systems at national and regional level [20], as an application to open innovation platforms and for public policies. From this first analysis, Open Innovation has been continuously investigated also referred to the capability of generating public policies for governments implementing open source software as a strategy to create socio-economic value for citizens. However, implementing open data policies requires to adopt also transparency and accountability. Indeed, according to the European Commission [21], within smart cities, open innovation can only be realised if the prerequisites of innovation are taken into account and if open knowledge, data, access and connectivity are implemented in the cities.

2 Social Transformation of Citizens in Adopting Co-Creation Platforms

The analysis of the basic concepts about co-creation and participatory design clears the need of changing the usual engagement perspective provided by governments in the past twenty years. Indeed, using digital tools to gather feedback from citizens requires specific actions to them. According to the survey submitted by the Intelligence Unit of The Economist [22] to 1,950 citizens and 615 business executives in 12 cities around the world, the majority of citizens (51%) requires a wider access to digital platforms enabling them to communicate with governments, but only a small part of them (32%) is actively providing feedback on local issues. Citizens and business both share the need to find new communication channels and processes to enable them to participate in Smart City initiatives. Transparency and trust are generally still considered to be the main concerns slowing the engagement process. Within the Smart City context, is clear that empowering citizens can contribute to concretely solve this issue, who should not be only seen as real time data providers; instead, they can really provide added value from data for improving decision making processes and governmental digital services. The concept of *Smart Citizenship* is also relevant to be analysed, as it assigns the capability of smart cities to support the citizens to recognise their position not only in a community (as in the traditional framework), but also in a network through digital platforms. This process requires the citizens to provide feedback and establish different connections in this complex context [23]. However, to enable them to activate this bidirectional approach and create new services, cities should yield them all the necessary tools. Within this framework, the smart citizenship approach focuses on the power of citizens, rather than on the impact of technologies, which are then seen only as an instrument for allowing them to shape new urban environments, defining policy and development processes, to take positive actions for an effective change of the society. According to the smart citizens' manifesto, the most relevant role of citizens is in supporting cities to improve their quality of life by refusing to be mere consumers or informers to decision makers [24]. The manifesto recognises the usual scepticism of citizens to implement collaborative and co-creation practices with municipalities. In contrast, the Director of the Waag Society, the first promoter of the manifesto, supports the need to implement this change. The manifesto upholds a previous study introducing the "*citizensourcing*" concept defined as a process originally performed by a public agent and now outsourced to large groups of people through open calls within the whole lifecycle of an initiative [25]. Citizens are acting as policy makers, often providing ideas that really improve the governmental policies. Citizensourcing has been also seen in the literature as a process called *e-participation* and enabled by the new technologies for improving deliberative democracy and increasing government transparency [26].

2.1 The Role of Living Labs in the Innovation Process for Smart Cities

The Living Lab term has emerged in the beginning of 2000 [27]. Originally the concept of Living Labs has been arisen in USA within the artificial lab context to describe a research facility implemented as a real home with the objective to provide observations of individuals [28]. In Europe, the concept is often connected to both open innovation and user innovation. The dynamics of the everyday life are part of the innovation experiment to co-create new products and services in a real life environment. Living Labs usually exploit a four steps approach based on contextualisation, concretisation, implementation and feedback gathering. The first phase aims to describe the framework and identify the group of users to involve in the analysis. The concretisation step is defined by the users' perception and their behaviour. During the implementation phase, the users are involved in the co-creation process. In the last step, users are requested to provide their opinions on the experience, in order to evaluate the change of attitudes and perceptions in relation to the products and services developed. Within smart cities and IoT projects, Living Lab strategies can be implemented to enable users to deploy real-life experiments involving large scale panels, including both the public and private sector. This approach has a huge impact in terms of acceptance and adoption of the solutions proposed and consequently aims to stimulate a more accurate market potential by exploiting the full potential of local innovation opportunities. Five key principles guide Living Labs: continuity, openness, realism, empowerment of users and spontaneity [29]. Empowerment of users is confirmed to be one of the most relevant, together with realism, as the main objective of Living Labs is to involve its users to participate in a real process of adding value to existing technologies or exploiting new products and services. This is mostly important in the context of smart cities and it is strictly connected to participatory design.

3 The SynchroniCity project

SynchroniCity [30] represents the first attempt to deliver a Single Digital City Market for Europe by piloting its foundations at scale in reference zones across 8 European cities, involving also other cities globally. It addresses how to incentivise and build trust for companies and citizens to actively participate, in finding common co-created IoT solutions for cities that meet citizen needs and to create an environment of evidence-based solutions that can easily be replicated in other regions. The project moves from observing that the digital transformation of cities has been on the agenda of the R&I community and technology vendors for more than a decade. SynchroniCity aims to synchronize existing IoT-enabled smart city ecosystems in Europe by removing barriers of fragmentation and misalignment that currently sets them apart. It will pilot the necessary building blocks and drivers for change to foster an environment that will contribute towards technical, legal and socio-economic harmonization of the European smart city market. For *European citizens*, the resulting environment will create a richer choice of affordable citizen-centric services that meet their needs and expectations through increased market competition and co-creation opportunities. It will also provide them with new opportunities to participate in active policy-

making. Indeed, in cases where IoT interventions are expected to drive human behavior change or disrupts existing business practice, the right legal and policy framework must be in place to incentivise stakeholders' participation and/or buy-in. Current environments are too constrained and rigid to experiment with such new opportunities and SynchroniCity in this sense aims to overcome this issue.

4 Co-Creation Methods and Tools in Smart Cities

Starting from a systematic review of the literature, including the analysis of 89 papers on co-creation and on participatory design in Living Labs, smart cities and in contexts applying Open Innovation (both used as specific keywords for the search), ten methods and twelve tools have been identified to be specifically applied to smart cities, since the analysis of this particular environment is still scarce in the literature. This study has been developed taking into account the characteristics of the services and products that can be generated by implementing IoT infrastructures, considering also the specificities of the SynchroniCity project. A series of 'factsheets' have been provided to the reader to identify the approach implemented by each method, the context, reasons to apply it and the process to follow. The guiding principles have been selected and presented to the cities involved in SynchroniCity through an online questionnaire and in depth interviews, to support them to implement the methods and tools best supporting the cities to achieve their objectives. It is relevant to clearly define what is a method and what is a tool in the co-creation process. Indeed, a *method* is the systematic and theoretical framework guiding the whole co-creation approach. A *tool* is the instrument used to practically exploit the co-creation process within different phases. The methods and tools for co-creation in smart cities have been chosen by taking into account the specific needs of the cities involved in SynchroniCity and they are currently used in the whole co-creation process (as explained in section 1.1). The following tables provide a brief description of each method and tool selected. The application of each tool has then been linked to the different co-creation methods to support the smart cities to identify which ones have been effectively put in place for service design.

Table 1. Methods for co-creation in smart cities

Method	Description
Personas	A method using the everyday experiences and needs of representations of the users to identify their perspectives in all aspects of the design process
Lego serious Play™	A method for positioning a service offer in a team and to dialogue on the potential exploitation of a service at early stages of development
Gamification	A process of enhancing a service through gameful experiences supporting users' value creation, by bringing implicit knowledge and

	maintaining engagement over time
Bodystorming	A technique to physically experience a situation and deriving new ideas. It requires setting up an experience and physically implementing it, by providing feedback
Appraisal interviews	A method to evaluate past performances of an activity developed within a group and identify areas of further improvement
Basis SWOT workshops	A method used in bottom-up strategy development with different and heterogeneous stakeholder groups, to collect and visualise data describing the actual situation of a group
Strategic roadmaps	A method to gather insights on knowledge management processes and on indicators to increase benefits
Social network analysis	A method to support knowledge sharing in social networks, providing suggestions to influence relationships among network actors
Role play	A method to involve customers to perform a hypothetic service experience and build a potential journey on functionalities
Living lab	A method to implement real-life experimentation processes where stakeholders co-design innovative products and services

Table 2. Tools for co-creation in smart cities

Tool	Description
Social media	A set of online tools for gathering feedback during to generate public values about services entering the market
Mobile contribution (apps)	A mobile tool to collaboratively share open data and create innovative products/services, by incubating innovation capacity
Visual collaboration maps and mindmaps	A set of maps to visualise information during brainstorming processes with large groups of actors, and quickly exploit a topic
Toolkits (sensors, pictures and sharing results, etc.)	A set of instruments for providing data, presenting images and concepts relevant for the brainstorming process in co-design
Crowdmapping	A map for crowd-generated contents in a social media platform. It is useful to provide information on real-time data and connections
Rating and voting	A system to evaluate actual or potential services/products designed in the co-analysis and co-design phase
Mock-ups	A replica of a product/service, providing mainly information on its structure, used for instructional or experimental purposes
Issue cards	A physical instrument to show a picture of the current situation and to express users' differ-

	ent viewpoints and provide solutions
Affinity diagram	A brainstorming tool presenting a series of facts on a general theme and organizing it into clusters by natural relationship or affinity
Character profiles	An instrument for describing the personality of a potential user of the services and listing activities and fears in adopting such services
Storyboard	A graphic representation of the final product, to share the user's vision behind the result of co-design
Motivation matrix	A tool to focus on the motivations of the users when making a purchasing decision. It requires a clear understanding of the market

5 Results from the Questionnaire and Interviews

The questionnaire has been available online for the smart cities involved in the SynchroniCity project at the following link <https://www.surveymonkey.com/r/5D2T3V3> from May 2, 2017 until June 6, 2017 and it has been sent to eight cities' leads (Antwerp, Carouge, Eindhoven, Helsinki, Manchester, Milan, Porto and Santander). The questionnaire has been based on eleven open and close questions. The theoretical implications of this study are derived from the literature review and the main objective of the questionnaire was first to provide an understanding of the cities on previous experiences with co-creation; then to investigate the effective application and relevance of the methods and tools proposed within the SynchroniCity project. This approach has helped us to better refine the co-creation methodology for the cities, and to identify the relevant topics to further investigate within the in-depth interviews. All the cities have replied to the questionnaire, by providing relevant information in terms of previous involvement in co-creation practices and methods. The results from the online questionnaire have been useful for better understanding at what stage of the project cities are using co-creation and what methods are already in place, their objectives, the tools and the rewarding systems used, and the current phases of development. However, several cities have declared to use some methods that in the literature do not apply to a specific phase (e.g. appraisal interviews during co-analysis, which indeed should be applied during co-evaluation and co-implementation) or have not considered other ones that can best serve their co-creation needs. Through these in depth interviews, we have discussed with the cities the replies to the questionnaire and proposed them to apply other methods. The results from the questionnaire have clearly shown a *medium to high level* of experience on co-creation. All the cities have already put in place at least one co-creation activity. Indeed, cities have very different experiences and knowledge about co-creation and this should be carefully taken into account to provide the right support to everyone. Specifically, Antwerpen, Eindhoven, Porto, Milan and Santander use co-creation often, not only for involving the citizens, but also all the stakeholders involved in the process, such as public and private companies, academia, suppliers, utilities, service providers and so on. Helsinki implements co-creation approaches all the time for developing digital services and for ur-

ban planning. Carouge and Manchester have less experience, but are both very interested in exploiting more co-creation methods for their use cases within the SynchroniCity project. All the cities have declared to use co-creation mainly to *engage their stakeholders*, including not only citizens but also public and private companies, startups and academia to develop innovative action plans and solutions. This result confirms the theoretical implication included in our definition of co-creation, that the cities are concretely implementing a “*quintuple helix approach*”. Seven out of the eight cities have declared co-creation is important also for *creating new services and increasing the efficiency* of already existing products. Co-creation is mostly implemented in the *co-design* phase and this reflects their need to implement such processes for digital service development. *Citizens* and *industry* are always engaged in co-creation activities organised by the cities, but also **utilities** are often the main stakeholders, especially in terms of urban planning, and this is an interesting result, as from the review of the literature there is no reference on the involvement of this actor for co-creating smart cities. All the cities use co-creation for *brainstorming processes*, and six out of the eight cities, implement these approaches to generate ideas on novel solutions, evaluate new concepts and improve the governance framework within their municipalities. It is then clear that even if the cities do not recognise it, co-creation is used by them mostly within the *co-analysis* phase; hence, the activities declared to be implemented by them are mainly used in the first stages of co-creation. As emerged from the analysis of the literature, more work has to be put in place to fully support smart cities around Europe to include co-creation activities within the co-evaluation and co-implementation phases. It is therefore very important to have all the stakeholders on board to assess the potential impact of the services developed on the market and to efficiently deploy the “*smart citizenship*” concept. Currently, the definitions provided by the authors on the role of the citizens on co-creation, represents only them as co-initiators and co-designers, but not as *co-implementers*. In terms of rewarding systems, by analysing the results from the questionnaire, it is evident that cities favour *community recognition* to reward their stakeholders to participate in co-creation activities, together with *virtual prizes*. This result clearly confirms the need of the cities to engage real communities of stakeholders bounded around the co-creation process to increase *e-participation* for improving deliberative democracy and increasing government transparency. This scope can only be achieved by using the a single digital effective platform. Offering new jobs or providing monetary prizes are not very applied as rewarding systems, as the real value for the stakeholders relies on sharing good practices in the community and stand out on the activities developed among the different users for each city. With reference to the co-creation methods used, it is impressive to detect that all the cities are currently exploiting **Living lab** as the main method. Five cities are also implementing Personas, Gamification, Appraisal interviews, Basis SWOT workshops and Strategic roadmaps. This result reflects the need of the cities to benefit from a method that can be applied both in co-analysis, co-design and co-evaluation phases, especially for implementing brainstorming processes, and this is a theoretical implication confirmed both by the questionnaire and by the interviews with the cities. In this sense, Living lab is a more effective holistic approach in considering the whole value chain and to mix in a rational way all the in-

redients needed for service design, provide a succeeding story and build the smart cities' ecosystem. With reference to Bodystorming, it has not been applied by the cities involved in the study, even if it is usually implemented in the co-analysis phase, which is relevant for mostly of them, but it requires a lot of efforts from governments to physically engage the stakeholders to experience and implement service processes. Moreover, the stakeholders involved are mainly using virtual communities and it would be very difficult to involve them in real word activities. On the contrary, it has been detected the importance of **Hackathons**, already used by Helsinki, to be implemented later on by Manchester, which are more successful for enabling service development based on actual technologies and they require less psychological and personal involvement in the co-creation process. In terms of tools applied, even if Social Network Analysis as a co-creation method is only used by one city, seven out of eight cities have declared to use *social media* as a main tool for co-creating with their users. *Apps* and specific *toolkits* implemented by the cities (including sensors) are also put in place. This result confirm the theoretical implication related to the need of the smart cities to work alongside with their stakeholders in virtual communities through digital platforms. The main metrics to evaluate the success of co-creation activities are related to *increase the number of people participating* in these processes (mostly achievable thanks to the use of online communities) and *improve innovation capabilities*. Six cities have also declared to assess the impacts of co-creation approaches against *improving sustainability* of products and services, by confirming that co-creation is relevant for improving the co-implementation phase and should be further exploited in all smart cities around the world.

6 Conclusions and next steps

The online questionnaire and the in-depth interviews have shown the ten methods presented in this document have been effectively used by the cities to implement co-creation processes in close collaboration with their stakeholders. Indeed, as a result of the study, the *main challenges* for the cities in terms of co-creation, are related to engage the stakeholders in the first place and organise co-creation activities with new actors around virtual communities, to effectively deliver what is designed or agreed with them. To have a digital platform which can really incentivise the third parties to be involved in the co-creation activities, it is the most urgent issue to enable the smart cities to select the right tools to be used by the different categories of stakeholders involved every time in a co-creation approach. This platform can also be relevant for building a co-creation community and constantly engaging the actors in the process, within the whole co-creation lifecycle, thus providing the right methods to keep the stakeholders interested over time and to address their needs. Finally, the platform should make clear to the different stakeholders what is in it for them, considering the different level of knowledge provided by them.

Therefore, as a result of the study, **Living Labs** can play a relevant role in the smart cities framework. However, to achieve this goal, legal requirements should be clear and shared with all the stakeholders, open data should be automatically collected

and available online for all the citizens through the digital platform. Online community building methods should further be exploited, taking into account the relevance of such communities to develop services, which are useful for them. In terms of infrastructure development, this should be interoperable and value-added services should be implemented. In order to generate concrete innovation outcomes, the target market has to be specified and IPR principles should be established. SMEs potentially relevant for the co-creation process should also be engaged and business models have to be identified. As Living Labs are predominant for the smart cities' service design process, SynchroniCity should connect possible users and co-creators involved in each cities' activities through them. The next steps of the study will be to analyse the results and issues faced by the cities in applying co-creation methods proposed and to provide a final set to be used throughout the whole lifecycle of the project, by discussing these directly with the cities.

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