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# Innovative Public-Private Partnership to support Smart City: the case of “Chaire REVES”

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## Abstract

**Purpose**-French universities can play a key role in generating Smart City approach through an innovative Public-Private Partnership dedicated to urban transformation.

**Methodology**-We led an action-research study for five years with several research and pedagogic projects including users or citizens.

**Findings**-The paper points out main factors of Smart City development. It also presents shared demonstrators' characteristics including industrial scale, sustainability and citizens' participation.

**Practical implications**-University of Lorraine diversification strategy through the “Chaire REVES” supported by public and private partners.

**Social implications**-At regional level, industrial-university-territorial partnerships could tackle both societal and economical issues “with”, “for”, and “by” citizens.

**Originality/value**-Based on the Living Lab concept our case study shows a concrete regional university strategy involving: user-centric design, collaborative processes, citizens' workshops and new financial and organizational answers enabling collaboration between private companies and public institutions. Our paper also argues that innovative public and private partnership involving users are necessary for developing smart cities.

**Keywords**- Smart City, Living Lab, Public-Private Partnership, Collaborative innovation, sustainable urban transformation, shared demonstrator, diversification strategy

**Paper type**- Case study

## 1.Introduction

Even if French universities are public, we can make an analogy with notion of market strategy. Indeed, universities are competitors for researches, teaching activities and resources (Delpierre & Verheyden, 2014). French public funds and subsidies reduction implies to diversify the origin of resources, especially with private funds. Thus, new constrains transform French universities (Gillot & Dupont, 2013), and stakeholders have to imagine new solutions, particularly at regional scale (Le Dehaut, 2013). However, societal changes and sustainable urban transformation generate opportunities for new kind of collaboration. Indeed, empirical evidences and state of art show isolated stakeholders cannot find sustainable answers (Batty et al., 2012). Furthermore, according to (McCormick et al., 2013) collaboration between universities and municipalities needs to be greatly diversified and expanded for urban sustainability. Other authors (Mauser et al., 2013) added global sustainability research questions “no longer emerge from science alone but in interaction with civil society, governments and other stakeholders”. Adopt a cross-border approach and connect companies and territories' challenges is not only relevant and necessary, but also expected. Indeed, since 2014, University of Lorraine (UL), Greater Nancy (urban area in North-East part of France) and two industrial companies – Electricité Réseaux Distribution France (ERDF) and Electricité de France (EDF) have led together a scientific

project about future of cities in a collaborative chair named “Chaire REVES” - Renaissance Ecologique des Villes or Ecological Renaissance of Cities in English. ERDF manages the public electricity distribution network and EDF generates and sales electricity. These very different partners have already had bilateral projects for several years. And they have made an alliance to reinforce their actions for sustainable urban transformation. This Public-Private Partnership (PPP) expects creation of multi-dimensional values on the regional territory such as economic, knowledge, ecology, and social. This paper presents how first step in making this innovative PPP was to enshrine Smart City (SC) approach in shared vision and strategy. Furthermore, in urban transformation context generates by social, ecological and economic crisis, cultural misunderstanding, territorial competition for the employment, digitalization, sustainability, new citizens aspirations, we adopt the Living Lab (LL) concept to co-create local smarter cities or urban area “for”, “with”, even “by” citizens, in the region studied: “La Lorraine” (North-East part of France). This project is a multi-case study to report on PPP initiatives on urban sustainability and suggest any concrete SC experiments through shared demonstrators. In this framework, we study a specific regional innovation system creates to support global societal challenges such as: global warming, inefficient urban mobility, and citizens’ health.

In this paper, we focus on the strategic dimension to generate such regional innovative process. We will show that both the “smart city” dynamic and the urban sustainability generate a new paradigm to make evolve territories and companies. In this new context, LL concept allows various stakeholders imagine and co-design new global solutions. After a literature review on main concepts in section 2, section 3 presents our experimental and multi-dimensional case study analyses through the Ansoff’s matrix. Section 4 describes the findings we obtained during the design of this specific diversification strategy. We also give the “Chaire collaborative REVES” characteristics in particular how shared demonstrators can support innovative PPP. Finally, in section 5 our proposal is discussed as well as implications for further developments are introduced.

## 2. Literature review

### 2.1 Smart city and users involvement

For more than a decade, SC concept generates new dynamics for sciences and researches, technologies, economic developments, and public policies. The concept is generated by the cross-fertilization of several trends like sustainable development, green growth and advances in ICT (Information and Communication Technologies). Tab. 1 gives some various and complementary current visions describing and analyzing the phenomenon. Furthermore, we are seeking to emphasize stakeholders’ role, in particular users and citizens, which can help local decision-makers (Elected representative, territorial engineers, companies, clusters, etc.) to make and adopt a strategy enhancing smartness of their territory.

**Tab. 1: strategy and management for SC: lessons from literature review**

References	Main disciplines or domains	Main method	Some findings in the domain	Key factors for SC development underlining stakeholders’ role
(Batty et al., 2012) <a href="http://www.futurict.eu">http://www.futurict.eu</a>	Complexity sciences	Complexity sciences focus on cities as spatial complex systems	Description of their research program Researchers expect a science of smart cities	A multidisciplinary international scientific endeavor with focus on techno-socio-economic-environmental systems with potential demonstrators in the future. These will be focused on specific problems types, specific model types and specific cities. ICT is the way of citizens’ interaction.
(Lazaroiu & Roscia, 2012)	Mathematic	Fuzzy logic for evaluating smart cities based on the (Giffinger et al., 2007)’s 74 indicators	A theoretical model for defining “smart cities”, considering the pre-chosen criteria, with different weights defined based	For researchers, a system which allows: -Combination of different opinions on various indicators, by means of different criteria and the translation of verbal expression in a numerical quantity. -To estimate the effects of decision makers

			on the fuzzy logic.	and citizens’ intervention, without yielding to competencies and personal subjectivity
(Lee et al., 2013)	Technological Forecasting and Social Change	Case studies: Interviews of several experts from Seoul and San Francisco	Proposed case framework for SC analysis	The study's empirical results suggest, inter alia, that: -Strategies vary from city to city, -Cities need to consider how best to balance centralized and decentralized coordination/control mechanisms -City's choice will be determined by its embedded ICT-based industrial competitiveness and dynamism of its likely PPP. Authors suggest how to transform behaviors of users
(Cosgrave et al., 2013)	Systems Engineering Research	Conceptual paper using LL and the Innovation District to support city leaders in navigating unknown territory	SC as an emerging information marketplace documented elsewhere, can provide the bond to integrate effectively tested innovation model	-Model not yet evaluated -Potential implementation framework of a SC as an information value chain -Theoretical interest to use the LL concept for territories -Authors imagine platforms to add value for users and citizens but they are not really involved
(Teller, 2014)	Urban Planning	State of art, Synthesis of the literature	A model based on: - Societal and technical evolutions - Networks of networks	SC comes from social and technological trends: citizens are key factors SC must relate to the physical reality of the urban structure and the rural social fabric
(Neirotti et al., 2014)	Management and Production Engineering	For 70 cities, coverage measurement for SC’s domains	Taxonomy of pertinent application domains: natural resources and energy, transport and mobility, buildings, living, government, and economy and people At least two SC models: one focused on technology vision and one that stresses soft aspects	Results reveal that: -The evolution patterns of a SC highly depend on its local context factors -The exportation of best practices may not occur easily - Many municipalities and their technology vendors mainly focus on technology, and not on people -Those cities that have planned a broader investments portfolio in smart initiatives are not necessarily better or more livable cities -Cities should enact “bottom-up” approaches that are not just based on the deployment of complex technological platforms, but rather on harnessing collective intelligence and creativity of their citizens
(Attour & Rallet, 2014)	Innovation management	Literature review on digital platform Case studies with smart grids and smart mobility project	A pragmatic vision of SC concept is preferred than definition based on expected positive effects or digitalization of its economic activities	(In France, at least) the “city” is the key place to generate collective innovation and spread innovation until end-users with digital platform communities
(Angelidou, 2014)	Urban and Regional Innovation Research Unit	SC literature comparison	A range strategies for SC development: -National versus local strategies -New versus existing cities -Hard versus soft infrastructure oriented strategies	-See what is already in place and how it can be improved -Select a few domains or areas that need to be improved urgently -Stakeholder engagement is crucial -Physical planning and social policy can and should underpin digital or ‘smart’ dimension of city -Approach smart cities and urban development through small- scale integrated projects -Digitization of citizen services could have splintering effects on the social cohesion of society

(Veeckman & Graaf, 2014)	Incubation & Entrepreneurship	A multiple case study analysis of four SC initiatives by development of mobile applications	LL concept as a possible facilitator of bottom-up innovations	-In a SC project, LL environment can play a central role as innovation intermediary in economic ecosystem -Facilitating co-creation processes between citizens and government entities could include some and exclude other citizens - Users are different (citizens, developers and SMEs were involved), specific processes need to be developed
(Coenen et al., 2014)	Digital research	A Smart City Living Lab Methodology operationalized and implemented: Two experiments	Authors claim SC as a meeting place where the public sector, private interest and citizens can come together to generate new value and innovate together	LL guideline for SC: 1. Idea generation 2. Idea selection 3. Co-design 4. 1st Implementation phase 5. Prototype testing 6. 2nd Implementation phase 7. Field trials 8. Evaluation by the stakeholders 9. Lessons learned and dissemination in the form of transferable knowledge. 10. Further market orientation Smart Users involvement depends on stage.
(Baccarne et al., 2014)	Digital research	Urban LL study: stimulate both citizens and professionals to work with open governmental datasets (hackathon)	Experiments allowing transitions on meso (facilitating infrastructures) and macro (policy and society) levels in the long run	Research shows: -Products and services can be ‘designed by’ citizens -Policy innovation and local governments are ‘designed for’ citizens -Infrastructures (e.g. sensor networks) can be ‘designed with’ citizens
(Mattoni et al., 2015)	Engineering sciences	SC concept analysis: definition, theoretical evolution and best practices	A model based on matrices of integration is developed for planning a SC	A first smart planning model for territorial engineers: -To work through territorial networks -To develop specific local strategies -To optimize actions and highlight links and connections among them
(Eskelinen et al., 2015) and (Hirvikoski & Laakkonen, 2014)	Multidisciplinary researches	Synthesis from a wide range of research articles and practical papers discussing in details the SC phenomenon from different points of view and in different contexts	-Guidebook to inspire to begin addressing city’s problems and issues through citizen-driven innovation -Examples from European Network of Living Labs (ENoLL)	-Essential technology paradigms for the SC model: Internet of Things, cloud computing, and open data. -Three families of methodologies for citizen engagement: idea generation, co-design, and service design. -Two types of policy initiative: facilities based on the Innovation hub model and approaches and policy instruments for demand-driven innovation

SC investigation based on literature review show a multi-disciplinary community of scientists exposes definitions, rankings, experiments to describe, support and spread this concept. Furthermore improve quality of life is a recurrent objective associate with SC concept. Nevertheless approaches are different for the authors and stakeholders are not the same involvement. Our literature review gives three major points of analysis: works that aim to propose methodologies or planning model for SC comparison or international policies, works that present the SC phenomenon origin or context of emergence, and works that try to analyze and characterize what main factors contribute to SCs development.

First studies (Giffinger et al., 2007; Lazaroiu & Roscia, 2012; Neirotti et al., 2014) present evaluations and measures allow to make national or international ranking tool of cities. For example, (Lazaroiu & Roscia, 2012) establishes a fuzzy logic to estimate the SC in accordance with established goals. Fuzzy method is used to determine the relative importance of indicators and sub-indicators. These approaches try to make cities comparable and develop prescriptive approaches. In this case, studies use “Citizen education” or “Communication between government and citizens” as indicators. These elements underline the role of “city” and local government, however process improvements are missing.

In the second group, (Teller, 2014) explains SC is a model based on two global changes, the worldwide social and technological transformations. Citizens’ involvement plays a central role in both. Indeed information in the third wave of societies (Toffler, 1980) and citizens are at the same

time producers and consumers, in particular for digital information. Furthermore, our literature review shows the model of the SC highly depend on its local context and civil society (Lee et al., 2013; Attour & Rallet, 2014; Angelidou, 2014; Mattoni et al., 2015). Indeed, SC is also a network of networks. Technical networks support mobility, energy (Smart Grids), material, light, and data. Social networks connect citizens and firms, firms and consumers, territories and citizens, citizens and citizens. Various stakeholders at different scales generate decisional networks. Collaboration between universities, research centers, companies and citizens create networks of innovation. Finally, networks of communication such as Internet, social media, smart phones, sensors, Internet of things support these previous networks. Nevertheless, (Angelidou, 2014; Neirotti et al., 2014) claim local strategies can give priority to technological infrastructures or soft approach. For example, according to (Lee et al., 2013) city’s industrial partnerships (PPP) reinforce ICT infrastructures and suggest how to transform behaviors of users.

Thirdly, new approaches and methodologies are suggested (Batty et al., 2012; Cosgrave et al., 2013; Mattoni et al., 2015) or experimented (Hirvikoski & Laakkonen, 2014) in various conditions. Experiments are very new, not widespread in real-word, and sometimes not yet made. Nevertheless, LL concept seems to be a potential interesting input to reach the SC purpose. Indeed, urban LL cases studies (Veeckman & Graaf, 2014; Coenen et al., 2014; Baccarne et al., 2014) show how researchers or engineers connect technological and soft approaches, where users play key role. Finally, (Eskelinen et al., 2015) present a practical methodology to generate citizen-driven innovation supporting territorial strategy. This method, involving users, could improve classical PPP for SC.

Democratization of open innovation, from economic field to societal field makes new modes of PPP. We focus therefore on specific networks: the university partnerships for co-designing and co-producing urban sustainability. Companies and local authorities use these specific PPP to develop urban sustainability (Lee et al., 2013). Nevertheless, an international study (Trencher et al., 2014) shows three elements: a relatively low exploitation of social innovation; techno-centric approaches for urban sustainability; a relatively low employment of technological transfer or economic development. In other words, urban sustainability needs efforts to enhance collaboratively human dimensions. It seems innovative sustainable solutions need innovation collaborations.

According to (Curley & Salmelin, 2013), LLs engage users in open regional innovation ecosystems where the innovation trials and scale-up can happen more successfully due to strong citizens’ engagement in the regions. The authors argue that this process follows the Quadruple Helix innovation model. Indeed, Arnkil et al. (2010) maintain that users, companies, public research organizations and public authorities are actively present in LLs, new networks are created. Thus, users expand the Triple Helix Systems of innovation (Ranga & Etzkowitz, 2013) generate by university-industry-government relationships.

## *2.2 our approach: LL concept to support SC strategy*

According to the literature review and our experience in urban planning and societal development a “smart city” is a city that should “listen” to citizens, take into account their evolving needs to enable a dialogue with them in a dynamic way. Furthermore, urban sustainability has to remain the key reference of implemented solutions. Urban transformations imply to imagine new collaborations between territorial stakeholders. Various stakeholders, particularly users, have to be mobilized and convinced to demonstrate how relevance the SC is. We make the hypothesis new university process involving users can support these multidisciplinary and multi-professional collaborations for SC. Indeed, we consider LL concept as an active network of local stakeholder for developing SCs. Moreover, this network is based on “shared demonstrators” allowing collaborative researches and actions for urban transformation. The next sessions show how universality conveyed by university is an opportunity to make territory smarter.

### 3. Research methodology: an empirical approach with a multi-dimension case study

#### 3.1 Our experimental strategy to support cities and territories’ smartness

Since 2008, adopting our SC vision, we have generated innovative processes and products to create sustainable values. We have chosen, imagined and designed a global research project with several levels of management. It is a “proactive” logic (Godet, 2007): to make the future we want. This means design and test new tools, methodologies, and processes with various stakeholders to make appropriate our experimental method. Following scientific rules, this approach must be explicable, assessable, adaptable or reproducible (partially or altogether).

According to the Ansoff’s Matrix (Ansoff, 1957), the first UL’s shared demonstrator should be the result of a diversification strategy (Fig.1): new product – shared demonstrator with the involvement of users and collaborative processes – and new market – urban transformation.

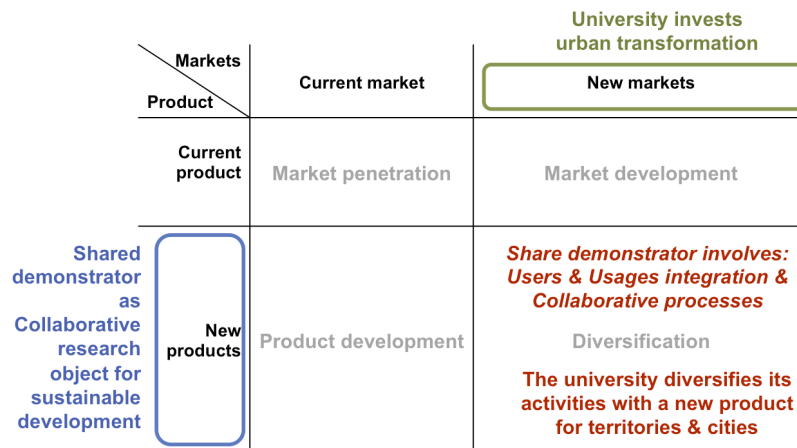


Fig. 1: University’s purpose with shared demonstrators, adapted from (ERPI, 2012; Ansoff, 1957)

As describe in the next sub-section, we have led action-research (Checkland, P. & Holwell, 2007) with several research and pedagogic projects for five years. In fact, we were interested not only in direct scientific or pedagogic outputs of each project, but also in their long-term impacts and connected outcomes. Since 2009, we have also developed specific spaces and an institution financed by private donations to aid research and societal project.

#### 3.2 Description of our multi-dimension case study

Tab. 2 merges and summarizes our different strategic actions. The first column indicates our projects’ names and our scientific references. The second column classifies the projects’ main activities. In the third one, we describe activities accomplished as a result. Then we underline main scientific outputs. Finally, we highlight our current key factors for SC strategy.

Tab. 2: Main lessons of our previous works

	Projects & references	Type of activity	Description	Scientific Outputs	Key factors for SC strategy
1	2006-2009 Dupont’s thesis (Dupont, 2009)	Research thesis in a public town-planning agency	Technological transfer: from industrial engineering to urban engineering	Distributed Collaborative Design ecosystem model	-First long term collaboration with local institutions (town planning agency and local authority) -Cities and territories are complex systems -Urban transformation needs to develop technologies (tools and methods) to manage front-end of urban project with users

2	Since 2009 Workshops on Urban Innovation (WUI)  (ENSGSI & ERPI, 2015)	Public Private Partnership for pedagogy	Multidisciplinary workshop with companies & territories managed by university Around 100 students, professionals, industrials, territorial engineers, experts, teachers involved each year	Training for master 2 students Exploratory studies for researchers Experimental collaborative methodology for learning	First long term urban studies with ERDF Better understanding of the territory, its stakeholders, and its societal issues and needs Efforts to promote user-driven innovation
3	Since 2009 Lorraine Smart Cities Living Lab (LSCLL)  (Guidat et al., 2011)	LL project dedicated to user-driven innovation and recognized by ENoLL in 2010	Collaboration between: - Business incubator - Laboratory (innovative process) - Resources platform for user-driven innovation	White paper on LL  Experimentation of a space dedicated to collaborative innovation	Recognized by external experts EU network Co-founder of France LL Financial resource for local projects (see n°6 below)
4	Since 2010 UL Foundation	Legacy structure	Institution supported by endowments that provides funds for research	Not concerned	Alliance of socioeconomic stakeholders for the sustainable development Financial opportunity for companies
5	Since 2010 Lorraine Fab Living Lab (LF2L)	University resources platform, supported by enterprises and local authorities	Collaborative space for communities of practices Global process dedicated to: co-creation; materialization; evaluation by users	Space dedicated to user-driven innovation	Platform of resources to incarnate PPP and support sharing and new economic development
6	Since 2011 La Fabrique Nancy Grand Coeur (NGC)  (ERPI, 2012; Dupont et al., 2014; Dupont et al., 2015)	Shared demonstrator between UL and Greater Nancy for the co-design of an Eco-neighborhood	Co-design of the NGC Eco-neighborhood with Citizens workshops and collaborative engineering (30 workshops / 200 participants)  Multidisciplinary approach: - Design and animation of a collaborative engineering - Human and social sciences diagnosis	Model of long term collaboration and urban LL mode  Strengthening of the methodology of citizens workshops  Scientific papers, Chapter of book	First long term experimentation with a local authority Emergence of a new product in new market (diversification)  Diagnosis of use of the eco-neighborhood Specifications for next developments and use tests
7	2011-2014 Skiba's thesis  (Skiba, 2014)	Research thesis in a laboratory	Theoretical research State of art Models	Operations to achieve “Living” dimension of LL project	Strengthening of the laboratory's LL skills and knowledge

#### 4. Findings:

##### 4.1 Strategic cross-fertilization between classical and new approaches

The “Chaire REVES” genesis and its first shared demonstrators use the four Ansoff's domains.

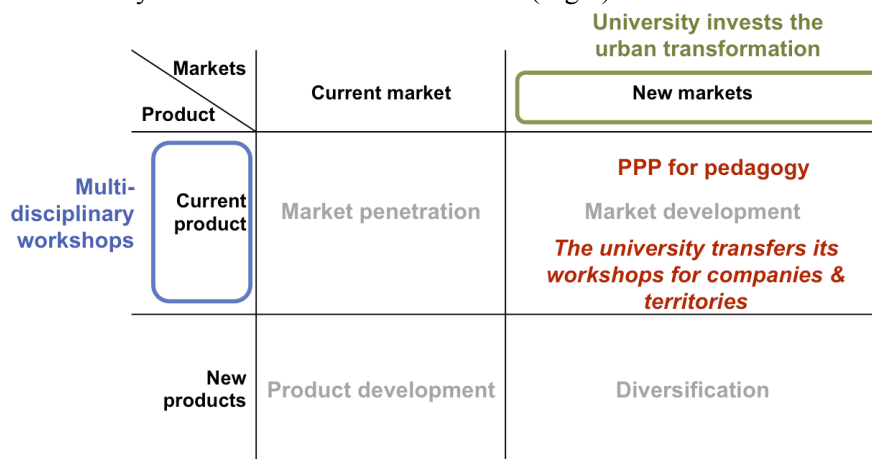
##### *a-Market penetration: research investigations with classical university tools*

A few years ago we sized opportunities to investigate urban transformation and LL concept with doctoral candidate. In 2009, the end of the first research project gives primary inputs to develop new approach for urban project including collaboration of end-users as experts. Furthermore, the theoretical “distributed collaborative ecosystem” model waited for test in real-life (Dupont, 2009). We have developed scientific projects to experiment this model (see below, b and c) and we have investigated the LL concept as potential renewal of practices in the urban design for SC (see d) since then. Since 2011, another thesis have allowed to strengthen laboratory's LL skills and knowledge, through the identification of potential operations to achieve project's “Living” dimension (Skiba, 2014).



*b-Market development: students workshops on urban transformation*

Since 2009, Workshops on Urban Innovation have been a joint collaborative endeavor of UL and ERDF. Each year, during five weeks, around 80 students from multidisciplinary Master 2 (Geography, Engineering, Architecture, Sport & well-being, History, Sociology, etc.) or professionals from lifelong training programs have to work together on a societal issue chosen by both partners. Furthermore, ERDF and UL involve one or several local authorities and other regional companies to select the annual topic. WUI will be widely described in an incoming scientific paper. Thus, in this section we present their key elements. WUI purpose is to produce competent professionals through combining education and practical experiences as close as possible to real-life situations. Based on the original pedagogy of the UL engineering school of innovation, a particular attention is paid to societal innovation, collaborative processes and user-driven approach. In the WUI, users’ experiences are used to co-create territorial development. WUI method encourages active pedagogy, cooperative learning, critical thinking and development of problem-solving skills. A multidisciplinary pedagogic team helps the students, which are also encouraged meeting the different partners. WUI project enables to teach complexity of territorial and/or sustainable projects, involve public and private partners in the challenge of the urban transformation, show it’s relevant to mobilize multidisciplinary to shed light on complex and often controversial issues. The six editions of the WUI show that the original skills and resources of the university can be used on a “new market” (Fig.2).



**Fig. 2: The university market development: Workshops on Urban Innovation, adapted from (Ansoff, 1957)**

With its collaborative engineering dynamic, knowledge and know-how dedicated to the urban transformation, WUI generate networks of shared knowledge and cross-sectorial collaboration including users expertise by students’ inquiries or simulations. WUI empower university-industry-government relationships and follow the “triple helix innovation” model, but citizens do not participate directly in workshops. For example, in 2012, the third edition of WUI ended with a virtual eco-mobility implementation in suburbs of Greater Nancy. Forty persons (industrials, elected, users, territorial engineers) participated in this serious-game; fifteen of them were directly mobilized by the eco-neighborhood project named “Nancy Grand Coeur” (NGC). According to (Brissel et al., 2013), this experience gives them an another way of thinking NGC’s mobility and allow to enhance the participatory process dedicated to this urban project. WUI are one of the tools UL uses that could support shared demonstrators. However, citizens’ involvement is also required for sustainable urban transformation. Concurrently to our market development, we have developed complementary product.

*c-Product development: “La Fabrique NGC” Citizens workshops*

Since 2011, our research team and Greater Nancy town-planning team have in charge the design of an eco-neighborhood located in city center. We design a collaborative engineering, named La Fabrique NGC. It allows to experiment and test the concept of “shared demonstrator” in a long term LL project (Dupont et al., 2014; ERPI, 2012; Dupont et al., 2015). We organize 30 workshops with citizens, territorial engineers, associations, experts, etc. Almost 200 persons participated directly to the process. La Fabrique’s workshops show the university’s approach can be defined by:

- Strategic framework: a research program, subject to an obligation of means.
- Tactical action: in “service delivery” mode, subject to an obligation of results. In this case, both territorial partners (decision-makers) and researchers wanted to obtain results.
- Experimental process: development of a shared demonstrator, experimented in real-life within an eco-neighborhood

Nevertheless, after the first year of experiment, 26 scientific interviews and our subjective and qualitative observations (ERPI, 2012) show La Fabrique was accepted as a “participatory device”. Territorial engineers and elected representative considered researchers action and development only as tools for citizens’ participation. In other words, after one year La Fabrique is viewed as an approach to involve citizens in the diagnosis of use for the eco-neighborhood, but not as a process to make work together eclectic stakeholders to co-design a new sustainable urban area. Indeed, our initial strategy was to help the local authority to develop the citizens’ participation in the urban project to support the recognition as eco-neighborhood. That explains the “product development” position in the Ansoff’s matrix (Fig. 2).

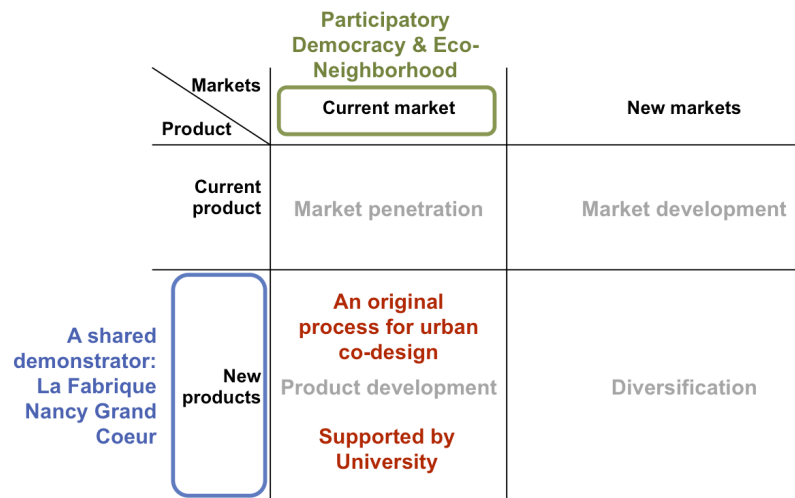


Fig. 3: in 2011, stakeholders perception on “La Fabrique” citizens workshops, adapted from(ERPI, 2012; Ansoff, 1957)

Within thirty years, our researches in innovation and experiences in complex systems have allowed to pursue our investigation and identify new ways of development. In this objective, we decided to transform the role of the university. The university has assigned itself the role of partner or facilitator rather than service provider.

In 2010 and 2011, during this first huge collaboration for urban sustainability between the university and Greater Nancy, the local authority provided material means (space, communication) and mobilized punctually some engineers or architects. In return, the university developed multi-disciplinary methodology and collaborative engineering. Academics also animated citizens’ workshops, made the links between technical, political and citizens’ knowledge and know-how. Finally researchers delivered results.

In fact, researchers followed a protocol in four stages:

- 1-Identification of the local authority’s needs in term of citizens’ participation to support urban sustainability
- 2- Reformulation of initial requirement: urban scale needed to manage spatial, temporal, cultural, and technical barriers. Due to the eco-neighborhood project complexity, we had to transform knowledge and know-how of stakeholders to generate a “distributed collaborative design” process (Dupont, 2009).
- 3-Cooperation with territorial engineers, urban planners and elected representative: build trust and confidence was necessary to support “La Fabrique NGC” workshops implementation and generate acceptable diagnosis of uses.

4-Capitalisation and continuation: feedbacks, learning from experience and outlooks. Researchers analyzed, strengthened, and added value to initial diagnosis. New objectives are: to switch from shared diagnosis to shared action. Indeed users’ expectations should be integrated in urban project design and users should be consolidated suggested solutions.

This first protocol and its outcomes gave the model to pursue the experimentation of eco-neighborhood co-design. Furthermore, these previous purposes give new framework for collaboration between academics and territorial engineers. Thus a three years contract (2012-2014) was made to implement further researches (Dupont et al., 2014) and let UL leading co-design process with citizens. Our findings suggest that continuing “La Fabrique” experimentation greatly enhances its chance to be a real shared demonstrator supported by all local stakeholders. Furthermore, territorial engineers could turn participatory process into process including use and users for sustainable solutions. This adoption would generate an innovative urban project design with a real shared demonstrator supported by all stakeholders.

*d-Basis for diversification: creation of financial, legal, technological instruments*

UL makes alliance with socioeconomic stakeholders for sustainable development. Together they created a foundation supported by private endowments that provides funds for research. UL foundation is a financial opportunity for companies, which take advantage of a tax deduction (66% of endowments). Since 2013, it has already supported WUI and theses projects dedicated to urban transformation. It is now the main UL financial tool and legal framework for generating PPP.

Furthermore, UL takes other technological initiatives with Lorraine Smart Cities Living Lab (LSCLL) and Lorraine Fab Living Lab (LF2L). LSCLL is the first and always unique LL project of Lorraine. The French government initially funded our first LSCLL experimentations such as “La Fabrique”. LF2L is a resources platform dedicated to prospective evaluation of uses. It gives material and logistic supports for LL projects.

*4.2 Strengthening of diversification: shared demonstrators*

Since we investigate urban transformation, we have developed researches, pedagogic projects, and experiments in real-life with citizens, and tools to support financial or technological needs. Each project (Tab.2) has a specific added value. Moreover, this multi-dimension case study gives the six main shared demonstrator characteristics for SC. For each characteristic, we identify four levels of achievement:

1. User-driven approach is qualified by end-users’ integration in the design process: from the strict delivery without integration (for) to end-user as product co-designer (with) or designer (by) (Kaulio, 1998).
2. Solution’s design process gives level of collaborative process (Dupont, 2009): stakeholder works alone on its project; several stakeholders work in parallel on different project’s parts project (distributed); stakeholders collaborate on long time project (collaborative); several collaborative group work in parallel on a complex project and interact regularly (distributed & collaborative).
3. Level of integrated solution depends on its sustainability and viability, i.e. the number of dimensions takes into account by a solution. According to circles of sustainability (James, 2015) we admit four dimensions for sustainable development (SD): Economics, Ecology, Politics, Culture. Furthermore, we add Governance as dimension connecting the four others (CUGN, 2011).
4. Industrial-scale level is defined by demonstrator proximity with final form (marketable or completely adopted by users)
5. Spatial scale level indicates number of concerned scales. A scale can be a product, an apartment, a building, a block, a neighborhood, a city, and a region.

6. PPPP (Public Private People Partnership) level shows how various stakeholders are involved in co-design. We can find university or academics, local authority or elected representatives and territorial engineers, company or industrials, and finally citizens.

Tab.3 describes the four levels for each shared demonstrator characteristics. This method enables a harmonization and a relative comparison between eclectic parameters.

**Tab 3: Harmonized level of each shared demonstrator characteristics**

Characteristics \ Level	-	♦	♦♦	♦♦♦
1-User-driven approach	Without	For	For & with	For & with & by
2-Collaborative process	Without	Distributed	Collaborative	Distributed & collaborative
3-Integrated solution: sustainability and viability	≥1 SD dimension	≥2 SD dimensions	≥3 SD dimensions	≥4 SD dimensions
4-Industrial scale	Concept	Scale model	Prototype in real-life	Experiment in real-life
5-Number of spatial scales	≥1	≥2	≥3	≥4
6-PPPP (number of type of stakeholders)	1	2	3	4

According to our characteristics’ definitions, Tab.4 gives our previous projects evaluation. This auto-evaluation is based on the highest observed level in our research-action. It means that sometimes the level can be lower.

**Tab. 4: Evaluation of our previous projects**

Characteristics	User-driven design	Collaborative process	Integrated solution	Industrial scale	Number of spatial scales	PPPP (number of type of stakeholders)
Completed projects						
Dupont’s thesis	♦♦	♦	-	-	♦	♦♦
WUI	♦	♦♦	♦	♦	♦♦	♦♦
LF2L	♦♦♦	♦♦♦	♦♦	♦	♦♦♦	♦♦
NIT Foundation	-	-	♦♦♦	-	-	♦♦
LSCLL	♦♦	♦	♦♦♦	♦	♦♦♦	♦♦
La Fabrique	♦♦♦	♦♦♦	♦♦	♦	♦♦♦	♦♦
Skiba’s thesis	♦	♦	-	-	-	♦
Shared demonstrator objectives through LL approach	♦♦♦	♦♦♦	♦♦♦	♦♦♦	♦♦♦	♦♦♦

Our analyze shows UL succeeds to support user-driven design and collaborative process. It can generate integrated solution taking multi spatial scales into account. Nevertheless, the theoretical highest level of industrial scale is never reached. And we can also underline that even if PPPP characteristic is the same level in every case except one, stakeholders are not the same. Academics, elected representatives, territorial engineers, industrials, and citizens are involved in our different projects, but not together. None can be considered as a shared demonstrator. Nevertheless, our previous actions contribute to a global answer for SC and it could be relevant to link our project. Thus we had the idea to create the “Chaire collaborative REVES”, a new type of PPP project, based on an integrated demonstrator to reach the highest level of each characteristic. The concept is to combine our market penetration, market development, and product development.

### 4.3 An innovative PPP to support Smart City in the Region of Lorraine

UL federates energy suppliers and local authority and together they have decided to support urban transformation. On legal aspect, “Chaire REVES” founders sign a charter with UL Foundation and make bilateral three years contracts. These contracts refer to the “Chaire REVES” charter and are renewable. On operational aspect, the partners adopt the following methodology: focusing on key area in urban transformation; understanding and connecting major issues of sustainable city; developing new practices with shared demonstrators and specific partnerships. On scientific aspect, our laboratory dedicated to innovation leads researches and mobilizes others laboratory or experts when it is necessary.

Furthermore, our experience shows SC concept require consider four global parameters in parallel:

1. Generate collaborative processes that take into account both stakeholders’ needs and constraints on a territory. The partners have their own skills, training, various objectives and representations. Thus, very different profiles make it difficult to collaborate. While, all these persons are users in the broadest sense of the term. Thus involvement’s stakeholders promoting “usage” approach could optimize solution integration and ensure smooth running of project operations.
2. Consider use as an integrative component of solutions in an ecosystem. This approach aims at identifying emergent behaviors and patterns among users. But also to assess socio-economic implications carried by solutions. The objective is to assess whether future solutions can be easily integrated into current practices.
3. Integrate and adopt solution in its ecosystem. Giving solution only by considering citizens is not enough; creation of suitable solutions has to take into account territory’s features i.e. historical, cultural, geographical, political context and even resources and constraints. Links between these elements and with project’s must be studied. Finally, partners must admit complexity and work with adapted concepts. Experiment in real-life increases stakeholders’ awareness.
4. Find a sustainable and viable solution. Nowadays we can't seek for SC without thinking sustainable development. Solutions must be designed “for”, “with” and “by” citizens as close as possible to real-life situation. This mix approach with users enables to understand current and future needs and (real) usages. Short, medium and long-term consequences can be evaluated from use point of view. Decision-making process benefits from an assessment of potential risks and changes.

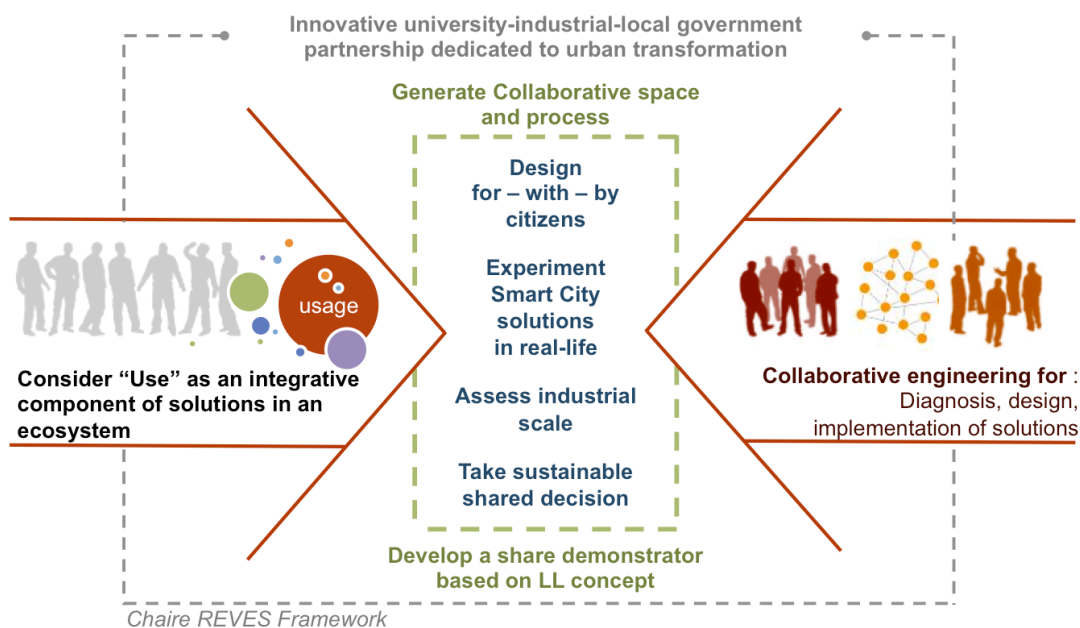


Fig 4: Chaire REVES’ shared demonstrator for Smart city based on Living Lab concept

Thus, our next experimentations and collaboration will be made through shared demonstrators based on LL concept (Fig.4). Indeed with the Chaire REVES project partners pool their resources. UL previous projects give tools, methods and experiences on the main identified characteristics, except for industrial scale. Chaire REVES aims to create favorable conditions for collaborations between industrials and local authorities. Private partners, especially ERDF leads Chaire REVES industrial strategy. Their skills and resources should enable to achieve industrial experimentation in real world, at various spatial scales, with users.

## 5. Conclusion and perspectives

At local level, rise of digital era is transforming medium-size cities and small European regions. In the same time, energetic, ecological, economic, and social transformations revolutionize our behaviors and expectations such as: mobility, from active mobility to chosen mobility; building sector and its contribution for energy efficiency and active health; new type of consumption and way of life for well-being and active health. This generates a deep urban and rural transformation. Moreover sustainable solutions are waited and new relations between stakeholders and territories appear. In this context, local dynamic supported by universality of the university and based on collaboration between local authorities and companies can generate sustainable development.

Literature review shows SC strategy needs inter alia strong contextualization, balance between ICT infrastructure and soft approaches, new stakeholders collaboration for sustainability. Nevertheless, users' involvement at industrial scale remains a challenge. Thus experiment as soon as possible solution for urban transformation depends on financial, time and human parameters.

A multi-case study shows UL can create an innovative PPP with companies and local authorities for sustainable urban transformation. This original collaboration is in demand of various historical partners of the university. Nevertheless, UL have to adopt a diversification strategy to build new product in new market: shared demonstrators based on LL concept. The Ansoff's Matrix helps to describe and outline this original strategy and several experiments indicate “Chaire REVES” project can create optimal conditions for sustainable solutions. Nevertheless, shared demonstrators need further development and methodologies. This step is still working. After one year, three specific theses are begun. The topics are eco-mobility, energy efficiency, and active health. Others scientific projects supported by LL concept have to be confirmed by new partners. Moreover, new companies and local authorities are currently waited in our PPP. They will strengthen experiments at industrial level and reinforce regional innovative process.

Our perspectives are optimization of new integrated solutions. Our research investigates promotion of collaboration between different territories and stakeholders: academics, institutions, companies, and citizens. We shall strengthen “use” point of view, as principal way for integrated solution in its ecosystem. From a conceptual outlook, we shall seek to clarify ecosystem concept through state of art and several case studies (energy efficiency system, electro-mobility system, active health system). Besides, researches shall study decision making technics within complex system and contributing to sustainable development.

Finally, a monitoring and an evaluation of “Chaire REVES” impacts remain to build. But the shared demonstrators' characteristics should enable future scientific analyses and smartness impact assessment study for territories.

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