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Anastasia Stratigea
Dimitris Kavroudakis *Editors*

Mediterranean Cities and Island Communities

Smart, Sustainable, Inclusive and Resilient

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Preface

The *core theme* of this book concerns *sustainable development*, which, still in our times, remains a key planning goal, largely defining the policy agenda at the global and mostly the urban level, illuminated as the one being under severe pressure due to the rapidly escalating urbanization trend in the current 'Urban Age' (Suzuki et al. 2010; Smith 2012), but also possessing a decisive role in reaching global sustainability objectives. Shaping a sustainable future for urban constellations seems to be a rather intriguing goal, which has to be achieved within a globalized decision environment, marked by high complexity and uncertainty as well as an evolving economic, environmental, social, institutional, and technological context.

Speaking of the *technological context*, amazing developments have been taking place during the last decades, as a result of the convergence of telecommunications, computers, consumer electronics, and interactive media. These mark the transition toward a new paradigm in the post-industrial era, at the core of which lies 'information.' The power of information and communication technologies (ICTs) and their abundant applications in various sectors and scientific/policy fields have broadened the perspectives of various actors (policy makers, businesses, people, institutions, etc.) to search, gather, store, elaborate, generate, present, and visualize as well as transmit information in various forms (Bangemann 1994), guiding thus more *informed and knowledgeable* decisions. Based on this power, modern technology is nowadays perceived as a powerful lever for reshaping the economic, societal, and governmental/institutional scene, largely affecting the ways people live, produce, consume, work, commute, socialize, interact, etc., and supporting the migration of economic and social transactions from 'place' to 'space,' i.e., an electronically created environment, where *value* flows in webs (Kelly 1998).

Within such an environment, the concept of *smart city* was born, a currently '*hot*' *theme* in the research and policy agenda for coping, among others, with the unprecedented sustainability challenges faced by cities. Although the smart city concept remains a core issue of research endeavors for almost two decades now, and despite the plethora of scientific articles exploring the various dimensions addressed to this concept (economic, social, environmental, technological, educational, etc.), it is still a highly ambiguous, fuzzy, and equivocal concept, a concept that, as quite successfully was stated by Zait (2017: 3), "... *strives to clarify its identity*". Nevertheless, smart city developments seem to have created high ambitions so far with regard to their ability to effectively and efficiently handle or, according to others' view, largely determine the aspects of economic development and prosperity, organizational performance, social equity, and quality of living in urban environments (Stratigea 2012; Stratigea et al. 2017a). Moreover, their potential toward providing access to data, information and knowledge; supporting interaction and networking; and steering intelligence gathering has been largely acknowledged, mainly due to their value to create more active and informed citizens and leverage community development perspectives (Albert et al. 2009).

The *geographical focus* of this book is the *Mediterranean Region*, a very special area of the world, and a '*hot spot*' in many respects (climate change, urbanization, scarcity of resources, political instability, etc.), but also a *cradle* of civilization, an area endowed with distinguishable natural and cultural resources, a mild climate zone of the planet. Smart city developments acquire a unique meaning and essence in seeking to achieve sustainability objectives in the large number of *small and medium-sized cities and communities as well as insular territories*, lying in the Mediterranean Region. These are distinguished for their highly valuable historical/cultural heritage; the coastal character of numerous cities; the globally recognized tourist attractiveness with severe repercussions to sustainability and adequate resource management; the high vulnerability with respect to natural disasters (e.g., earthquakes and floods); the peripherality and limited accessibility both within the Mediterranean area (e.g., insular regions) and at the European context (cities in the periphery of the European territory); etc. (Stratigea et al. 2017b). Moreover, Mediterranean cities are currently confronted with peculiar and disturbing circumstances caused by the severe recession state, which strongly affect efforts for paving smart and sustainable urban development paths and re-orient the setting of policy priorities, while they result in pretty high levels of unemployment, brain drain, considerable in- and out-migration movements, and destabilization of production patterns.

Speaking of the notion of smart cities in this specific environment and taking into account the very peculiar features of Mediterranean cities, the editors of this book share the conclusion of Meijer and Bolivar's (2016) work, stating that a city:

- Cannot be characterized as '*smart*' *or* '*stupid*' and its progress should be explored in an integrated way in all three key domains of a smart city, namely smart technology, smart people, and smart governance, taking into consideration its *structural and cultural attributes*.
- Can progress gradually in smartening up to one or more of these domains, with this progress being largely determined by a city's *historical context, needs and future expectations as well as challenges ahead*.

Having the above in mind, in the chapters to follow research efforts, progress and evidence-based results emerging from the Mediterranean scenery are presented, while also experiences from the research community and practitioners outside this geographical focus area are brought on board. Moreover, we consider that the effort to smarten up Mediterranean cities, these peculiar in terms of size, distinct natural and cultural assets, sustainability objectives and their intensity, starting point in smart city progress, and under severe stress due to the austerity, places, has to follow a *human-centric, place-based, and problem-solving approach*, in alignment with their historical paths and distinct cultural trajectories forged through the centuries.

Before embarking on the themes presented by the *twelve chapters* of this book, it should be mentioned that this constitutes a cooperative effort of numerous distinguished researchers and younger colleagues who, Mediterranean or not, are sharing our concerns and have largely contributed to the realization of this edited volume.

The book is organized into *twelve chapters*, which are shortly outlined in the following.

More specifically, the first two chapters of this essay have a specific focus on the technological dimension of the smart city, presenting recent developments in support of smart city data visualization and monitoring (Chap. 1) as well as the concept and constituents of a smart city ecosystem (Chap. 2).

Thus in Chap. 1, on “Virtual Reality for Smart City Visualization and Monitoring”, Manousos Bouloukakis, Nikolaos Partarakis, Ioannis Drossis, Manos Kalaitzakis, and Constantine Stephanidis explore a new paradigm for creating immersive experiences in virtual reality. This work claims that in the context of smart developments, new visualization challenges are emerging that can largely support a digitally enabled dialogue in urban planning processes. This dialogue is based on cutting-edge technologies embraced by smart city components in the current IoT era, enabling complex scenarios to be explored and decision-making, prediction, and intelligent actuation to be undertaken. The authors claim that in a smart city context the need for information visualization is increasing, in order this to be properly communicated to end users in a smart, sustainable, and resilient way, while the necessity for strengthening interactivity of end users with data visualizations for better grasping the urban environment and the policy options ahead is also raising. Toward this end, the chapter builds on top of ongoing research work carried out at the Human–Computer Interaction (HCI), Laboratory of ICS-FORTH, Crete, in the domain of visualizing and interacting with information in ambient intelligence (AI) environments. The scope of this work is to end up with the design of an interactive Smart City Visualization framework, incorporating advanced user interaction techniques, such as gesture-based interaction with high-resolution large screen displays in alternative contexts of use and immersive VR experiences. To this end, several gesture-based interaction techniques have been validated in order to conclude with a sufficiently rich, ergonomic, intuitive, and easy to perform and remember set of gestures that are adaptable to user and context requirements, while remaining metaphorically appropriate for the addressed functionality. Additionally, big data visualization is accomplished by employing 3D solutions. The proposed design supports experiencing and interacting with information through VR technologies and large displays, offering improved visualization capacity and enhanced dimensionality of data, thus overcoming issues related to data complexity and heterogeneity.

In Chap. 2, on “Building a Smart City Ecosystem for Third Party Innovation in the City of Heraklion”, a research team, consisting of Manos Kalaitzakis, Manousos Bouloukakis, Pavlos Charalampidis, Manos Dimitrakis, Giannis Drossis, Alexandros Fragkiadakis, Irini Fundulaki, Katerina Karagiannaki, Antonis Makrogiannakis, Georgios Margetis, Athanasia Panousopoulou, Stefanos Papadakis, Vassilis Papakonstantinou, Nikolaos Partarakis, Stylianos Roubakis, Elias Tragos, Elisjana Ymeralli, Panagiotis Tsakalides, Dimitris Plexousakis, and Constantine Stephanidis, deals with the implementation of the Internet of things (IoT) and open data infrastructure in a specific Greek smart city, the city of Heraklion, Crete. Heraklion is one of the pioneer cities joining the smart city journey in the Greek territory, consecutively awarded by the Intelligent Community Forum (ICF) (years 2012, 2013, and 2014). This work describes the use of Internet of things (IoT) and open data infrastructure in the city of Heraklion, as planned and implemented by the Institute of Computer Science of the Foundation for Research and Technology—Hellas (ICS-FORTH). The focus is on presenting the implementation of mature research and developments, aiming at promoting the domains of telecommunication and networks, information systems, signal processing, and human–computer interaction in building the core of Heraklion ICT infrastructure, which is currently being released and becomes available to the municipality and the public through the Heraklion Smart City Web portal. It is expected that such infrastructure will, in the future, act as a core pillar for tracking paths to sustainable growth and prosperity in this specific city, supporting enhanced overview of the municipality over the city; fostering more effective planning and improved decision-making processes; enhancing the context of social services offered by the Heraklion municipality; and, ultimately, leading to improved quality of life for both citizens and visitors.

As technology in a smart city context is perceived as a *lever* and a *new force* for effectively *governing cities*, in a smart, sustainable and resilient way, within a highly connected, knowledge-, and information-intensive era (Stratigea 2012; Lövehagen and Bondesson 2013; Stratigea and Panagiotopoulou 2014, 2015; Stratigea et al. 2017a), the next two chapters elaborate on the role of technology for improving governmental processes and services offered (Chap. 3) or, even more, supporting the transition from government to smart governance (Chap. 4).

More specifically, in Chap. 3, on “Smart Cities on the Cloud”, the Urban and Regional Innovation Research Unit (URENIO) group members Christina Kakderi, Panagiotis Tsarchopoulos, Nicos Komninos, and Anastasia Panori elaborate on the topic of cloud developments and their value with regard to more effective and digitally enabled public/municipal service provision within such an environment. They stress the significant benefits of cloud computing, as these emerge from the abundance of publications on the topic, ranging from governmental reports to corporate studies. They also numerate the significant benefits of cloud computing and their potential toward smart government, and the more effective and digitally enabled service provision to citizens and businesses, as a result of migration of these services to the cloud. The authors also point out the value added by such a migration, both in terms of big data storage and analytic capabilities as well as in terms of smart city service provision, while also arguing that despite the availability of information, the landscape with regard to cloud computing adoption is still quite blurry. At the core of the paper lies the effort to provide methodological guidance on the potential offered and the steps that need to be undertaken in order the cloud computing paradigm to be taken up in a smart city context. In this respect, they present, in a roadmap form, the steps that need to be followed for migrating public services to the cloud, along with a set of recommendations that facilitate decision-making at various stages of this process. They also argue that the adoption and use of cloud computing should not be perceived as an isolated action of an organization or a city authority/governmental agency but, on the contrary, it should be part of a wider strategic model, based on open innovation practices, i.e., use of open-source technologies for the cloud platform and applications, use of open data, adoption of user engagement methodologies, use of innovative business models.

Shifting from smart government to smart governance is nowadays a remarkable trend, reflected in the efforts of many cities around the globe. Smart governance actually represents a new city government state that targets the strengthening of capacity of urban systems and their constituents for: tackling contemporary challenges and risks in a rapidly evolving, complex, and uncertain global environment; and producing value for local communities in a smart, sustainable, and inclusive way.

Along these lines, Chap. 4, co-authored by Nektaria Marava, Andreas Alexopoulos, and Anastasia Stratigea, elaborates on the smart governance topic in the work entitled "Tracking Paths to Smart Governance: The Case of Korydallos Municipality—Greece". The paper attempts, in its introductory part, to set the 'scene,' within which decision-making at the urban level is taking place, sketching a range of contemporary challenges and the necessity for cities to cope with them in a stagnating economic environment. Next, in order paths leading to smart governance to be traced, this work capitalizes on the rich literature on smart cities and smart governance so as to conceptualize smartness and smart governance and shed light on key organizational attributes that can pave the way toward the transition from government to smart governance. Based on these attributes, the trajectory toward smart governance of a rather typical, small and medium-sized, Mediterranean city—Korydallos Municipality—is highlighted by tracking institutional, organizational, societal, etc., developments in the time span 2004–2016. The scope of the empirical study is to: illuminate barriers and gaps in the trajectory of the specific city to smart governance, both before and during the economic recession, faced by the Greek economy, thus exploring also austerity impacts in such an effort; and provide useful inferences and evidence-based results for similar cities that strive to ride the smart governance wave.

In the current globalized, turbulent, and highly uncertain times, both *technology*, offering effective and efficient ways for spatial (large) data management and ubiquitous, time- and place-independent interaction, and *citizens and stakeholders groups' engagement* in decision-making processes for making more knowledgeable and vision-driven policy decisions have been largely recognized as *carriers of change* in various public realms and have been largely acknowledged for paving more sustainable and resilient future development paths in both urban and rural environments. The next four chapters of this book are falling within this context and deal with *technological and/or community engagement aspects* for handling critical challenges rising in urban (Chaps. 5 and 6) and peripheral/rural (Chaps. 7 and 8) environments; all sharing a common attribute, namely the weight attached to cultural aspects for reaching sustainability objectives in both Mediterranean and non-Mediterranean city contexts.

More specifically, in Chap. 5, entitled "'The Urban Walk Architecture Talk'—Bridging Socially Engaged Art, Urban Processes and Cultural Development", Justyna Borucka and Marta Wróblewska elaborate on the concept of public space as a theater of multi-layer and multisensory action, serving a variety of users' needs; and the opening up of this space to outdoor artistic initiatives in a process of democratizing the public agora and promoting social inclusion and equality. In this work approach, artists were engaged in presenting and documenting sensitive areas of the city and bringing them to the attention of the public in outdoor initiatives; and vice versa; i.e., artists were guided by participants (citizens) to spaces that were intriguing or attracting them in order to interact with these places and collect/produce related content. Such an approach targets long-term effects for a specific case study—the city of Gdansk, Poland—to be reached, based on art's descriptive power to inform and affect/motivate developments of urban and social systems, inspired by the rich local tradition and cultural heritage of the city. Of importance are the digitally enabled means established for serving work in a range of projects, implemented in Gdansk city, namely a GPS-based mobile application—G-RASS—and a social platform—the Inspirations Bank—motivating all those involved to become prosumers (producers and consumers) of content, memories, storylines, etc. The various projects implemented in the context of this work reveal the power of culture for engaging, motivating, storytelling, and building networks and identity as the ground for reaching urban development and wealth objectives.

In Chap. 6, entitled "'Wanderlost'—A Participatory Art and Design Endeavor", Thore Soneson and Michael Johansson address the growing complexity of life in contemporary city spaces and the imminent challenges faced by urban environments through the experience gained by 'Wanderlost,' i.e., a project stressing artist's collaborations and interactive participatory setups in public, theater, and performance spaces. The paper addresses issues raised and challenges at all three stages of preparing, setting up and implementing the so-called storyworld Wanderlost, falling into the project CubeX 'The Journey to Abadyl.' Out of this, knowledge, methods, and participatory concepts are drawn by means of work carried out along the collaborative network PRAMnet, using as a backdrop a virtual city, the city of Abadyl. Work accomplished in this paper sheds light on collaboration, research, and methods that promote participation in a storyworld, challenging the imagination to perceive the world and our relations anew. The 'Wanderlost' concept as well the knowledge acquired, as authors claim, can be reused and re-situated in other urban contexts and environments, keeping the fundamental three formats with a digitally mediated tool, physically guides and explorative walks and a map of amusing and provoking artworks as a matrix.

In Chap. 7 on "Investigating Territorial Specialization in Tourism Sector by Ecosystem Services Approach", written by Francesco Scorza, Beniamino Murgante, Giuseppe Las Casas, Ylenia Fortino, and Angela Pilogallo, the idea of ecosystem services (ES) approach forms the core for investigating territorial specialization of the tourism sector in a naturally and culturally endowed environment of the Italian periphery, the Region of Basilicata. This work uses the concept of ES, grounded on European and global initiatives, such as the 'Millennium Ecosystem Assessment' and 'The Economics of Ecosystem and Biodiversity,' as a decision support tool in order to match territorial planning and policy making with environmental assessment. More specifically, the paper builds upon interpretative models in support of the understanding and evaluating of ecosystem services and assessing their contribution to territorial tourist attractiveness and specialization. The work makes use of the Integrated Valuation of Ecosystem Services and Tradeoffs model (InVEST), a multi-package and open-source toolkit, in order the attractiveness of the Basilicata Region to be assessed, taking into consideration a range of natural and cultural assets (regional oasis, coastlines, riverside, etc.). Strengths and weaknesses of the investigated methodology are discussed, based on experiences gained by its application in Basilicata Region. The contribution of the paper to the identification of territorial tourism specialization according to ecosystem services can be proved valuable for driving more informed and knowledgeable policy decisions as to the development of sustainable, place-based, natural, and cultural tourism-related programs in a highly endowed area, such as the Mediterranean.

In Chap. 8 on "Participatory Planning in Support of Resilient Natural/Cultural Resource Management", Maria Panagiotopoulou, Giorgos Somarakis, and Anastasia Stratigea deal with the issue of sustainable and resilient cultural resource management in lagging behind peripheral areas of the Mediterranean Region. The paper elaborates on the rising interest in the cultural/tourism complex which, enriched and crosscut by the radical technological developments, marks nowadays a noticeable 'cultural turn' of the tourism sector in numerous communities around the globe, in their effort to trace sustainable, resilient, and inclusive local development paths. The paper is grounded in the view that participation and collective action are of crucial importance in this 'cultural turn' and that its planning needs to be built upon the strengthening of local skills and competencies as well as the setting up of an inclusive discourse, capable of safeguarding natural and cultural resources, and handling them, in the development process, in a sustainable and resilient way. Based upon this rationale, the *focus* of the paper is on developing and implementing a *multilevel participatory spatial planning framework*, aiming at supporting policy making with regard to resilient cultural tourism development of a particular, lagging behind, and culturally wealthy rural community of Crete (former Province of Kissamos). Such a framework is: based on effective spatial data management technologies mapping tangible (and intangible) natural and cultural assets; and used for setting up digitally enabled strategic guidelines that are inspired by the sustainable and culturally resilient exploitation of these resources. These guidelines are framed by the general policy agenda at the EU and the Greek state level as well as the policy directions set up by the Research and Innovation Strategies for Smart Specializations (RIS3) at the state/regional level, depicting the salient nature of the culture/tourism/ICT complex for gaining competitiveness in such kind of regions.

Energy and transport are two important sectors of concern in the context of smart, sustainable, and resilient city development, having so far attracted the interest of urban planners and policy makers as well as EU research funding. Coping with the critical impacts of the raising energy consumption and intensifying transportation burden in the emerging highly urbanized world is a crucial issue nowadays. The importance of these sectors is further highlighted in areas such as the Mediterranean, mainly due to the scarcity of energy resources and the immense visibility of the region as a notably rated, at a global level, tourist destination, attracting many visitors and exposing both sectors to severe pressures and risky high peaks (Stratigea et al. 2017b). Dealing with the challenges appearing in these two sectors, as these are witnessed by the extended literature on both of them, introduces the need for better understanding these issues by means of *data* acquiring and managing as well as making *policy choices* that are grounded in cooperative planning approaches. The latter are assisted by classical and digitally enabled participation tools, in order important issues raised to be grasped by citizens and stakeholders; their awareness and motivation to engage in more knowledgeable, smart and sustainable daily choices to be strengthened; and more qualitative and resource-efficient conditions of living in urban environments to be reached.

Along these lines, Chap. 9 entitled “A Method for Developing a Game-Enhanced Tool Targeting Consumer Engagement in Demand Response Mechanisms” by Ioannis Lampropoulos, Tarek Alskaif, Machteld van den Broek, Wilfried van Sark, and Herre van Oostendorp, attempts to shed light on the engagement of energy consumers on energy demand management. More specifically, the focus of this work is on the enhancement of consumers’ engagement in demand response mechanisms, employed by electricity suppliers, other market parties, and transmission and distribution system operators, through the use of ‘gamification’ techniques. Use of such techniques for enhancing and motivating consumers’ interaction with energy supply gives flesh to flexibility mechanisms at the demand side, an issue that is nowadays considered a key aspect for an effective energy transition, setting as a prerequisite the active participation and empowerment of consumers in the energy system. The paper argues that full flexibility is difficult to be achieved, mainly due to the insufficient consumer engagement and awareness regarding energy usage. It is also claimed that empowering energy consumers through serious games and gamification can enable a playful interaction between technology (e.g., smart metering systems, energy management systems and smart appliances) and consumers, which can result in higher engagement in demand response. A literature review on gamification techniques, carried out by this work, reveals the strategies promoted for increasing consumers’ engagement in demand response mechanisms. Finally, the paper elaborates on a user-centered, iterative design method for the development of a game-enhanced tool, through which collaboration between players can be stimulated, whereas the impact of applying the game-enhanced tool on consumer engagement can be empirically verified.

In Chap. 10 on “Tools and Technologies for Enhancing Public Engagement in Sustainable Urban Mobility Planning—The Case of Rethymno, Crete”, co-authored by Efthimios Bakogiannis, Maria Siti, Charalampos Kyriakidis, Georgia Christodoulopoulou, and Avgi Vassi, the focus is on urban transportation and more specifically on sustainable urban mobility. This topic constitutes a high priority in policy agenda, strongly supporting and motivating cities to push forward a more sustainable, energy-saving, and environmentally friendly mobility pattern. In this respect, Sustainable Urban Mobility Plans (SUMP), as a new planning perception, have come to the forefront, setting as a key component for their development citizens’ engagement in developing and implementing a shared vision of mobility aspects in their cities. Taking into consideration that, in Greece, maturity and practices in participatory planning in general and sustainable mobility planning in particular are lagging behind the common know-how and practice of other European cities/states, this work attempts to establish an integrated participatory methodological approach in developing SUMP, in alignment with guidelines established by the European Union on this topic. The participatory context adopted embeds the use of both classical (i.e., questionnaires, mini surveys, workshops, and public meetings) and ICT-enabled participation (i.e., map-based questionnaires, inclusive Web-based participation) tools in order the highest possible public engagement level in the decision-making process to be achieved. Additionally, these tools are utilized for collecting commuting data from citizens/visitors as well as public opinions for future planning purposes, while the emphasis is placed on the development of a Web-based crowdsensing tool as a key for gathering distributed knowledge and views on sustainable urban mobility issues. This approach is tested in a specific case study, the city of Rethymno, Crete, Greece, a coastal Mediterranean urban environment, distinguished for its beauty and its role as a highly attractive tourist destination of the Crete Region. Finalization of this empirical exercise will facilitate identification of barriers to participation as well as effective ways for eliminating them and supporting more active public engagement in SUMP development in coastal urban environments.

In Chap. 11 on “Location—Allocation Modeling for Emergency Evacuations in the Aegean Sea”, a joint effort by Dimitris Kavroudakis, Christos Kalloniatis, and Panagiotis Theodorou, the focus is on a sensitive but highly important part of the Mediterranean Region, namely the insular communities, i.e., lagging behind regions due to their isolation from the mainland. More specifically, the issue of emergency health service provision is explored, namely a crucial issue for many Mediterranean islands, lacking equal access to health infrastructure, compared to the mainland. The issue becomes more important, considering the large number of visitors that resides in such islands for a certain period of the year, with seasonality of island’s population challenging local decision-making regarding health services’ provision. This chapter analyzes the spatial distribution of national aero-evacuation means, such as helicopters, in order to inform the debate about decentralized services of emergency evacuations in the Aegean sea, while elaborating on a location–allocation model of helicopter bases in the islands of the Aegean Sea. The results of this work aim at shedding light on the spatial optimization of the helicopter bases in the area and discuss the trade-off conditions of emergency evacuation services in such a fragmented geographical space. Finally, after utilizing a number of large-scale geographical simulations for allocating a number of aero-evacuation bases, the use of spatial analytics is illustrated for making informed decisions in areas, where dynamic seasonality of population seems to be a severe obstacle for rationalizing decision-making on health services' provision.

The power of technology in general and ICT in particular has been largely acknowledged as a key driver for re-engineering and/or reshaping the *economy*, with the tourism sector being a prominent example of this argument, as a highly data- and interaction-intensive sector. Gaining competitiveness in this specific sector implies the heavy use of powerful information management and communication platforms (Palmer and McCole 2000; Stratigea et al. 2008), seeking to achieve effective, real-time, reliable, direct, time-, and cost-saving exchange of information between both the tourist businesses (B2B interaction) and the tourist businesses and their customers (B2C interaction). ICT-enabled data management and interaction potential in a smart city context have supported the dawning of a new concept, the smart tourism (Buhalis and Amaranggana 2014; Panagiotopoulou et al. 2018). This reflects the increasing reliance of destinations, tourism industries, and tourists on emerging forms of ICTs that allow *massive data amounts* to be collected, managed, transformed, visualized, and communicated, properly forming value tourism propositions (Gretzel et al. 2015). Within the evolving smart city tourism ecosystem, newly emerging trends appear, such as the *sharing economy* in the accommodation sector, an important issue explored in the last chapter of this book and a considerable contribution for a globally acknowledged tourist destination as the Mediterranean as a whole.

More specifically, Vicky Katsoni elaborates on the "Sharing Economy Perspectives in the Tourism Accommodation Sector", in Chap. 12 of the present edited volume. The focus of this work is on digitally enabled newly emerging tourism market trends, appearing in this highly important sector for the Mediterranean Region, but also for other regions of the world as well. More specifically, the focus of the paper is on the new provocative and hybrid economic activity of the sharing economy, and its counterpart in the tourism sector, where sharing economy has managed to bypass well-established distribution channels and disrupt the traditional structure of the tourism business. The paper attempts to: elaborate on the types and presence of the sharing economy in the tourism accommodation sector, and its disruptive innovation nature; analyze developments with regard to the sharing economy framework in the Greek tourism industry; and elaborate on the potential impacts of the shared economy in tourism, while also discussing potential future implications of these trends.

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Chapter 1
Virtual Reality for Smart City Visualization and Monitoring

Manousos Bouloukakis, Nikolaos Partarakis, Ioannis Drossis, Manos Kalaitzakis and Constantine Stephanidis

Abstract In the present Internet of Things (IoT) era, smart city components (e.g. Smart buildings, Smart infrastructures, etc.) are increasingly embracing cutting edge technologies to support complex scenarios that include decision-making, prediction and intelligent actuation. In this context, there is an increased need for information visualization, so as to propagate information to end users in a smart, sustainable, and resilient way. Currently, despite the growth of the IoT sector, many IoT operators only provide static visualizations. However, interactive data visualizations are required to achieve deeper and faster insights, beyond what is available in existing infrastructure, towards supporting decision-making by city authorities; while offering real time information to citizens. This paper builds on top of ongoing research work carried out at the Human Computer Interaction (HCI) Laboratory of ICS-FORTH in the domain of visualizing and interacting with information in Ambient Intelligence environments, in order to propose the design of an interactive Smart City Visualization framework. In this context, advanced user interaction techniques can be employed, including gesture-based interaction with high resolution large screen displays in alternative contexts of use and immersive VR experiences. To this end, several gesture-based interaction techniques have been validated to propose a sufficiently rich set of gestures that are adaptable to user and

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context requirements and are ergonomic, intuitive, and easy to perform and remember, while remaining metaphorically appropriate for the addressed functionality. Additionally, Big Data visualization is accomplished by employing 3D solutions. The proposed design supports experiencing and interacting with information through VR technologies and large displays, offering improved data visualization capacity and enhanced data dimensionality, thus overcoming issues related to data complexity and heterogeneity.

Keywords Big data · Internet of Things · Smart infrastructure management Big data visualization

1.1 Introduction

The evolution of Smart Cities may assist facing a wide variety of societal challenges in the coming decades, stemming mainly from over-population, lack of resources, energy overconsumption, waste management, but also critical dimensions such as safety and security. However, there is still a gap between what technology offers and the requirements imposed by such challenges. Building blocks of existing smart city infrastructures are the virtual sensors and actuators, which abstract physical objects and their virtual behaviours on top of their physical networks. The coexistence of, maybe thousands, Physical IoT devices and the corresponding data (distributed in IoT environments) inevitably result into a vast amount of data that needs to be processed and reasoned upon. In such context, Big Data analytics and advanced visualization techniques are a necessity towards dealing with system-level problems that cannot be solved by conventional methods and technologies.

Big Data produced by an IoT infrastructure in a smart city, in its raw form, is difficult to handle, as it rapidly grows very large and complex. Understanding a pattern from incoming data is a challenge. The huge amount of data can be understood only through a series of analytic steps, and visualization holds an important role in this strategy. Bar graphs and pie-charts do play a useful role in understanding Big Data, but they can only provide the headline figures. Cities are already facing difficulties in extracting and visualizing useful information from Big Data to make decisions (Greco and Cresta 2017). This challenge does not concern the technology itself, but the tools and components required to present Big Data in the form of useful information to users, and especially city authorities and decision makers. According to Yafooz et al. (2016), the two main challenges in Big Data visualization are as follows:

- *Human perception*: when the number of data entities is very large, users will experience difficulty in extracting meaningful information.
- *Screen space limitation*: when large data are displayed on the screen in terms of data items, the screen space will be insufficient.

Recently, Virtual Reality has emerged as a medium to assist with such challenges by enhancing the user experience regarding perception and presence and by immersing the users in a virtual world, where vision and hearing are captivated and elided from the real environment (Tan et al. 2015). Using Virtual Reality techniques, it is possible to build 3D digital models for any real or virtual IoT "object" and then visualize, enhance and share these objects. In this context, the proposed work aims to fill-in the gap of innovative real-time smart city infrastructure visualization and management in the context of Big Data, by combining state-of-the-art 3D visualization techniques and rich interaction.

The work presented in this paper aims to transform traditional smart city data interfaces to easily perceivable rich visualizations, which are characterized by the following:

Immersive data visualization: immersive data visualization is a new trend used by data scientists to perceive and manipulate data in VR, as stereoscopic rendering opens up a world of possibilities. Data visualization tools employing VR displays can be coupled with haptic or kinaesthetic interfaces, making it possible to capture body language, human touch and expression. This allows for intuitive data understanding and straightforward pattern recognition even among enormous data sets.

Increased efficiency through cross-referencing data: VR enables users to stack relevant data, create correlations and visual cues so that they can cross refer it instantly, allowing each user to view huge amounts of data at a glance. The information volume is expected to expand massively and VR can facilitate data perception and analysis through efficient visualizations that take advantage of three dimensions.

Rich interaction: virtual reality allows users to be absorbed in the context of data visualization. Users can manipulate data streams, push windows around, press buttons and actually walk around data worlds in a more direct, immersive experience. In order to enhance immersion, intuitive and rich interaction techniques should be employed so as to facilitate the manipulation of 3D environments, thus allowing users to make more accurate data analysis and ultimately, faster decisions. Interaction facilitates the manipulation, perception and comprehension of data in real time.

In the context of this research work, mid-air gestural interaction was chosen as a natural means of interaction without additional equipment. Apart from being intuitive, gestures were chosen as an interaction technique due to the rich vocabulary they can support, allowing the complex process of manipulating three dimensional environments. The proposed setup includes a Leap Motion sensor placed in front of an Oculus Rift, allowing robust hand and finger tracking through computer vision software.

1.2 Related Work

Smart cities and IoT envision a future, where the sensing and actuation functions blend into the background; and the access to new information sources offers new capabilities (Gubbi et al. 2013). Visual analytics are a driving force for generating value from data, usually combining several visualization methods in order to maximize efficiency.

Web technologies are the most widespread approach for performing visual analytics in the context of smart cities and IoT networks (Mikusz et al. 2015). Stakeholders involved in smart cities, namely professionals and the public, are familiar with web-based applications, since they constitute an approach with which they come to contact on an everyday basis. A typical example of a web-based solution is SensMap (Simek et al. 2013), a framework focusing on the visualization of sensory infrastructure in indoor and outdoor spaces. Web analytics, including charts, graphs, diagrams, etc., are integrated into visualization systems, either as standalone systems or in combination with other visualization techniques (Zhang et al. 2012).

Cartography constitutes a traditional, yet effective and intuitive technique that displays information in accordance to its spatial characteristics. Colpaert et al. (2016) use geospatial visualizations of location logs in order to identify travel patterns. Even though cartography can provide a quick area overview, the necessity often arises to display additional information. In the domain of IoT visualizations, Blackstock and Lea (2012) combine maps and web analytics in the form of dashboards, correlating the sensors' values with their spatial distribution. Furthermore, Ioannides et al. (2013) reconstructed cultural heritage content in 3D spatial reconstruction plus the time.

Apart from traditional 2D interfaces, visualizations using 3D environments and virtual reality are being increasingly adopted by researchers in the context of urban planning (Billger et al. 2016). Visual analytics are proposed by Batty and Hudson-Smith (2014), combining geospatial data with visual analytics. Apart from chart representations and cartography views, 3D environments visualize urban areas in the context of aiding the process of urban design (De Amicis et al. 2009). Another interesting approach is TrajGraph (Huang et al. 2016), which combines graph visualizations and GIS data, generated by drivers in order to create a visual analytics system for studying and planning urban networks.

Virtual reality (VR) is described as a 3-dimensional, computer-generated environment, which can be explored and interacted with by a person (Burdea et al. 2012). The related technology has been around since the 90s, but has not yet acquired widespread popularity. Since 2010, with the vast technology outburst of the 21th century, large tech corporations such as Google, Facebook, Sony, Samsung, etc. started to invest in this technology and making it publicly available. Despite this, published implemented applications of Big Data visualizations in VR are not common in academic literature. Head-mounted devices, such as Oculus Rift (Desai et al. 2014), are widely employed nowadays for virtual reality applications. Several approaches in literature employ virtual reality head mounted displays for specific purposes, e.g. discrete event simulation (Hutabarat et al. 2016). Another approach, which does not require head-mounted devices, is rooms equipped with motion sensors, such as the CAVE system (Torres and Palafox 2015). This approach, however, requires large space, costly installations and is difficult to be employed on a mass scale.

Olshannikova et al. (2015) present state-of-the-art issues and challenges in terms of Big Data visualizations with augmented and virtual reality. Helbig et al. (2014) use a virtual reality environment to visualize massive weather forecasting data. Another interesting approach is the immersive visualization of a landscape in Mars (Donalek et al. 2014), augmented with data describing the surface characteristics. Another domain in which virtual reality is employed is visualizations for Geographic Information Systems (GIS), which can distribute large data volumes in accordance to their spatial characteristics (Wang et al. 2015). Li et al. (2016) combine web based and VR visualizations in order to perform traffic and transportation analysis. Finally, three dimensional environments are combined with gestural interactions in the domain of data center infrastructure management (Drossis et al. 2016), providing a solution to navigation and item selection in 3D visualizations.

Interaction with virtual reality environments is primarily performed via touchless interaction. The aim of human-computer interaction is to eventually reach a point, where interaction is performed in a completely natural manner. The appearance of the users' hands within the virtual environment enhances the feeling of presence in this environment and control over the application (Tecchia et al. 2014). Hand tracking is mainly implemented using sensors, such as Kinect and Leap Motion (Marin et al. 2014). Hand gestures can be employed for actions like pan-and-zoom (Nancel et al. 2011), device control (Mauser and Burgert 2014), writing in the air (Zhang et al. 2013) and spatial navigation in 3D environments (Valkov et al. 2010). Finally, multimodal interaction (e.g. speech-gestures combination) (Piumsomboon et al. 2014), offers a mechanism, which combines different communication channels, in an effort to increase expressiveness and imitate human habits.

1.3 Smart City Visualization Application Domains

Enhanced visualization techniques for smart cities can assist municipality personnel that handle typical daily tasks, such as the monitoring and control of city infrastructures. At the same time, at a higher level, these can also assist decision makers to improve operational efficiency, reduce cost, and minimise risks in managing city's resources and infrastructure. The following domains constitute indicative areas, where visualization can assist the decision-making process:

Security/Policing: visualizing predictive analytics has been used in several cities across the world to help predict where crimes are likely to take place through historical and geographical data (Leitner 2013). Such approaches have been proven successful in many cities in the US (Levine 2006). By employing the power of data, a city can better manage law enforcement by focusing on areas where police intervention is more likely to be required. This can result into safer cities, with more reliable and trustworthy law enforcement policies.

City Planning: data can facilitate efficient city planning by maximizing accessibility of certain areas or services, whilst minimizing the risk of overloading important elements of the city's infrastructure. At the same time, we often see buildings being built in areas that seem suitable but can have a considerable effect on other areas, without this being taken into consideration during the planning process. By employing data and modelling, it is possible to map infrastructure and building to city loads with a higher degree of accuracy (Sunesson et al. 2008).

Transport: public transport organizations can utilise data and analytics to manage and verify public transport route planning. Such systems can allow public transportation to input data from events, so as to predict passenger flows and thus optimise their effectiveness (Pereira et al. 2015). By employing data throughout a transport network, a city can provide effective and flexible public transport, decreasing delays and increasing efficiency. In addition to the prediction of peak times for upcoming events, data analytics can be used for traffic monitoring, improving reliability and decreasing the probability of accidents.

Future proofing: often, when new areas are created or become popular, the infrastructure in place is not sufficient to sustain continued growth, a fact that can hinder further improvements in the area. Even basic services, like water and electricity, can be affected by a sudden influx of businesses or residents. Through the use of modelling and predictive analytics, it becomes possible for city planners to see where these areas of growth are likely to be located; and how large this increase will be (Lede et al. 2016). Services can then be upgraded to accommodate growing needs, facilitating thus smooth growth.

Sustainability: one of the keys to sustainability is monitoring and acting in order to keep a city's resources at certain levels. Data is the most decisive factor here, as it allows for cities to monitor how their decisions are having a positive or negative result on the city as a whole. Being able to check and control the levels of pollutants can help with zoning, placing pollutants in areas of the city where they can do the least harm or helping them to reduce their harmful effects (Siregar et al. 2016). Monitoring also creates the opportunity to investigate which technologies work best in reducing pollution; and what new innovations could be used in particular areas in order to prevent further environmental damage.

Photogrammetry and 3D city modeling: 3D city modeling and urban visualization, using the technology of photogrammetry, is one of the most growing research topics in digital architecture. There are many different methods of 3D city modeling, employed for various applications of 3D city models. The 3D city models are created not only for scientific visualizations, but also for architectural design evaluations. Another example of 3D modeling using photogrammetry tools is Esri's CityEngine software.[1] Esri CityEngine is a three-dimensional (3D) modeling software application, developed by Esri R&D Center Zurich (formerly Procedural Inc.); and is specialized in the generation of detailed large-scale 3D city models in order to improve urban planning, architecture, and design.

[1]ESRI's CityEngine Software webpage, http://www.esri.com/software/cityengine. Accessed 13 March 2018.

1.4 System Architecture

The proposed approach aims at creating an adaptive, multi-purpose system, which is able to allow city stakeholders (e.g. administrative personnel, technical authorities, decision makers) to manage city data effectively and efficiently. Taking into consideration the potential benefits of VR towards smart city visualization, this paper proposes a VR-based approach, targeted to bringing immersive graphics and natural interaction experience to users. To this end, the system employs a three-dimensional virtual environment to visualize the city's geographical context. The proposed approach renders the virtual city's area, preserving the actual arrangement of buildings/infrastructure and visualizing their current state (along with other environmental data, e.g. indoor/outdoor temperature, noise level, air quality indicators); while it notifies users about potential anomalies. The visualization includes several condition indicators, updated in real time, as well as a colour-coding scheme for the current infrastructure condition, referring to a scale from normal to critical. Furthermore, the system supports on demand exploration of individual city's data feeds (e.g., arrays of sensors data), providing detailed information about its condition for a specific time span, and combining historical analysis of previous values and the prediction of potential future state.

The visualization technique proposed in this paper can help stakeholders browsing for unknown relationships and question answering. In a planning environment (Suneson 2014) for example, the nature of two separate data sets might initially be fully understood, but not their interrelationship. A spatial analysis operation, such as visual overlay in a 3D environment, can be used to determine possible spatial data relationships. Questions such as “is there a spatial correlation?”, “what is the best site?”, or “what is the shortest route?” are typical of analytical uses of visualization tools and methods. Added value can be provided by performing post-processing on data flows to produce new knowledge regarding the visualized ecosystem. The system architecture of such a visualization framework is presented in Fig. 1.1.

The main components of the framework are:

Devices: Sometimes referred to as “Things” or “end points”, devices can involve software or hardware components that generate data or measurements from the object they are monitoring and/or controlling. Some examples include temperature, voltage, humidity and machine rotation sensors. Sensors can be co-located as in the case of a wind turbine or a car, or can be part of another device (like the Smart Watch with biometric data), while some have control features like industrial valves.

Edge/Gateways: gateways are usually deployed closer to the edge (e.g., sensor node, some might actually be part of a sensor collection and are deployed with the sensor) and allow for the collection and selective transfer of data to the Hub, while providing some command-and-control functionality back to an automated device. This area is further expanding into what is called edge computing (Shi et al. 2016).

IoT data collector: an information collection daemon that can collect metrics from a wide array of inputs (IoT nodes) and write them into a wide array of outputs.

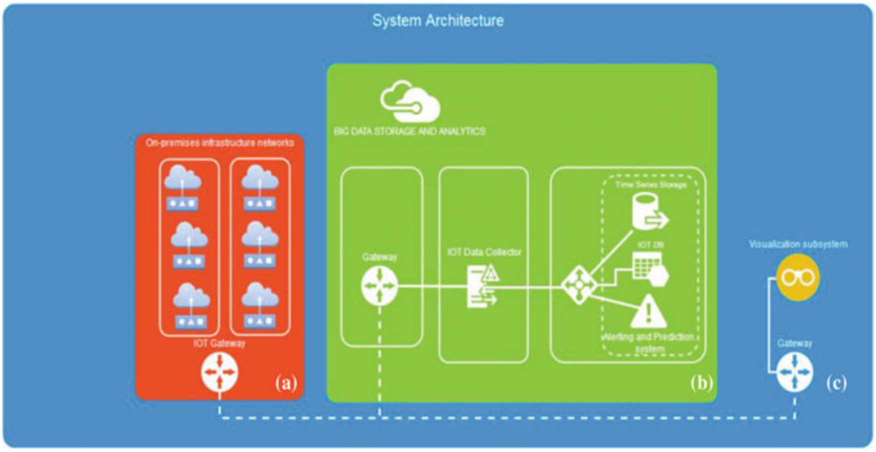

Fig. 1.1 System architecture

It can be deployed in a distributed manner to collect, normalize, correlate, and aggregate metrics and events from sensors and other important data sources.

Time series database: A data storage service that supports high write loads and large dataset storage as well as preserves space through downsampling, automatically expiring and deleting unwanted data, as well as backup and restore. The developed component uses InfluxDB (Ahmad and Ansari 2017), allowing data analysis through an easy-to-use SQL-like query language.

Alerting and prediction system: This component can process both streaming data and batch data from the data store. The specific subsystem supports the plug in of custom logic and user-defined functions (e.g. custom rules, state alerting). Furthermore, machine learning libraries can be used to process data feeds and create alerts. In the context of alerting, it can support dynamic thresholds, perform pattern matching, compute statistical anomalies, etc., that can then trigger user-defined functions to form the basic IoT control plane. The component is designed to process streaming data in real-time and can be deployed across the infrastructure, both as a pre-processor downsampling and for performing advanced analytics before shipping the data to InfluxDB time series database.

Visualization system: in order to create the Virtual City, the visualization system communicates with the time series database and the IoT database to retrieve all the required data, analyse it and create the necessary data structures in memory for the scene data elements information representation.

1.4.1 Interaction

The interaction techniques for VR environments presented in this paper are based on the Leap Motion sensor mounted in front of an Oculus Rift, which displays a virtual world to the users. This setup allows free user movement in space, enabling them to turn their head towards any direction.

Gesture recognition is accomplished with the camera placed in front of the user's head and therefore the user's hands are never occluded by the user's torso, which is a shortcoming for different setups where the depth sensor is placed in a static position. The user's hands are rendered in the virtual world in a one to one mapping to the physical world, creating the feeling of a mixed reality environment, as the users perceive the hands that appear in their VR view as their own, and thus are confident that they have full control of the system. Several space navigation alternatives were examined. Based on previous work (Drossis et al. 2017), a closed fist gesture was selected for supporting navigation. Users can therefore move their closed fist towards the preferred direction and the camera will move accordingly. Even though the feedback of movement in the virtual space might be sufficient in the case of travelling in environments with nearby points of reference, such as the ground, walls or trees, when travelling at a distance from displayed elements, e.g. flying over a world, in space or in underwater environments, the movement speed and direction may be unclear. Therefore, an arrow indicating the user's movement speed and direction is visualized over the closed fist that carries out travelling.

As far as rotating the viewport in the virtual three dimensional space is concerned, users are able to rotate their head and freely look in any direction in the virtual city. In terms of item selection, directing the pointer finger at an item is used for aiming at an element. The pointing direction is lighted and a circular cursor is placed on the interactive element, if any, to designate the ability to select it. Selection is accomplished through pinching, following the metaphor of clicking with a mouse.

1.4.2 Data Exchange

The initial population of the data structures that are required to visually represent the aforementioned information in the 3D scene is accomplished using standard HTTPS Calls in order to fetch initialization parameters. Communication messages use JSON syntax. JavaScript Object Notation (JSON) is a text-based data interchange format derived from the JavaScript scripting language that is very small and light weight. It is formatted as key-value pairs and is often lauded as being a lower-overhead to XML because it focuses more on content and less on formatting. This works to our advantage when we want to keep data interchange packets as compact as we viably can.

On the server side, parsing of JSON streams is faster due to small syntax, leading to faster responses. JSON server-side parsing is the strong point that indicates us to use the JSON on the server side.

An example response for two example buildings is presented below:

Code block 1 Initialization data exchange protocol


```
 "POIS": [
 { "id": "1B342",
  "type": "Building",
  "name": "municipality building",
  "longitude": 35.339723,
  "latitude": 25.133853,
  "datafeeds": [
  { "type": "temperature", "iotfeed": "https://139.91.1.23/api/1B342/temperature"
},
  { "type": "barometric", "iotfeed": "https://139.91.1.23/api/1B342/barom" }
  ]
 },
 { "id": "1x731",
  "type": "Building",
  "name": "Library building",
  "longitude": 35.339723,
  "latitude": 25.133853,
  "datafeeds": [
  { "type": "temperature", "iotfeed": "https://139.91.1.23/api/1x731/temperature" },
  { "type": "barometric", "iotfeed": "https://139.91.1.23/api/1x731/barom" }
  ]
 }
 ]
```


Each building or asset (JSON defined in POI/node/type) is described with its name (POI[2]/name), GPS location (POI/longitude, nodes/POI/latitude). All the data feeds URL's are defined in POI/node/data feeds and include the type of data and the HTTPS link to the resource. Data feeds also return JSON time series data. The next code block displays the data format from a sample temperature sensor (2 samples example):

[2]POI: Point of Interest.

Code block 2 Sample data from temperature sensor

```
{
 "series": [
  {
 "name": "Temperature",
 "columns": [ "time", "value" ],
 "values": [
  [1511218805926, 12.7 ],
  [1511218877917, 12.7 ]
 ]
 }
 ]
}
```

1.5 The Virtual City Environment

The presented application aims at helping city's stakeholders to get an intuitive overview of their city regarding its current/historical conditions of distributed IoT sensors. A hybrid approach, which combines a three dimensional environment and a visual analytics platform, adapted to a virtual reality environment is proposed. Therefore, users can act immersed in a 3D environment, interact with dynamic representations and still benefit from the statistical representation that visual analytics offer. Examples of statistical representations are presented in Figs. 1.2 and 1.3.

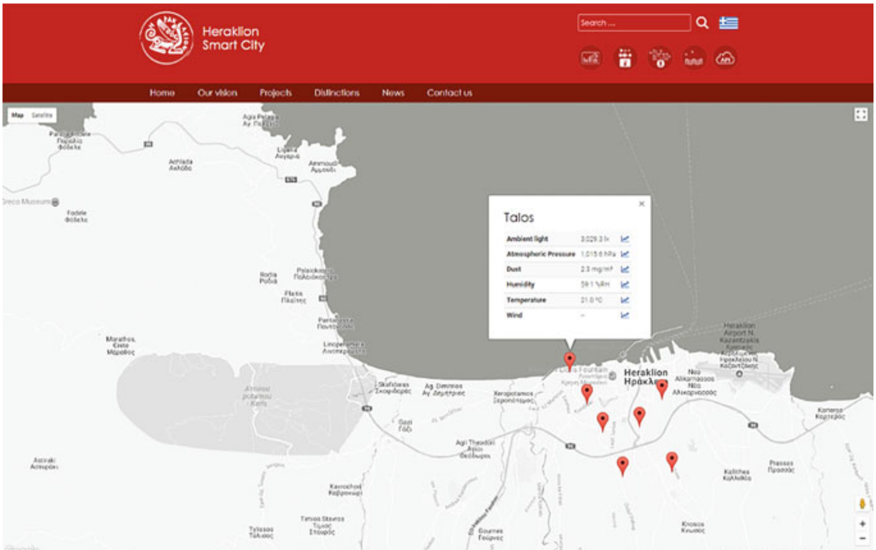

Fig. 1.2 POIs with real time sensor measurements

Fig. 1.3 The environmental data explorer

The VR application facilitates the inspection of the buildings and city's infrastructure by the users and warns them, in an intuitive manner, about infrastructure state that needs further investigation, such as an anomaly regarding particular machinery (ex. pump machines) that may bring to surface malfunctions or degraded operation in the city. In addition, the users can inspect city's assets, retrieving supplementary information and employing visual analytics on demand.

Our approach employs the map metaphor, as it is based on the concept of having a virtual geospatial visualization, which constitutes the foundation of user collaboration. Thus, the city's virtual environment extends along a plane, which is placed on a virtual table, constituting a common ground on which users can make observations, reason on data, gain insights and ultimately draw conclusions that can assist decision-making.

The application currently supports up to two users, who view the virtual city from their own perspective, in accordance to their physical location and viewport. Each user can employ hand gestures in order to modify the virtual map representation, allowing common actions, i.e. panning and zooming. By performing a fist gesture on the virtual table's perpendicular axis, the users can zoom in or out the presented map. In addition, the fist gesture offset along the table's plane is applied for panning on the map and allowing the flow of city's areas. Furthermore, the selection of any city asset is visible to both users, allowing each user to share his/her findings and collaborate with others.

The main screen of the Smart City 3D Visualization application, which comprises a virtual representation of the city and the basic interactive UI components, is depicted in Fig. 1.4. All buildings are grouped and displayed as 3D objects according to their physical location in the city's space. The virtual city is constructed by using digital models of urban areas that represent terrain surfaces, sites, buildings, vegetation, infrastructure and landscape elements as well as related objects (e.g., city furniture) belonging to urban areas. The city's sensory infrastructure is visualized as a network of interconnected points of interest (POIs). Each point of interest holds its own minimal representation (Fig. 1.4), which can be extended to host a short description of its current status.

Users can select the various points of interest by either pressing them with their virtual hand representation or by employing point-and-click. Upon the selection of a POI (e.g. a city asset or a specific building), the visualization changes and extended information per asset is displayed. The close up view (Fig. 1.5) contains historical data information, which is automatically updated when the IoT infrastructure provides new data. Historical data is presented using line charts in a spherical view, resulting in the enclosure of the user in a spherical display of information. The presented chart representations can be altered by hand gestures,

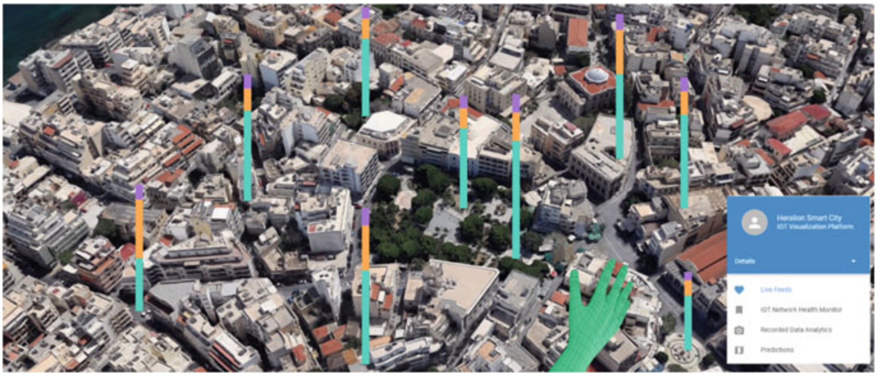

Fig. 1.4 IoT live data exploration

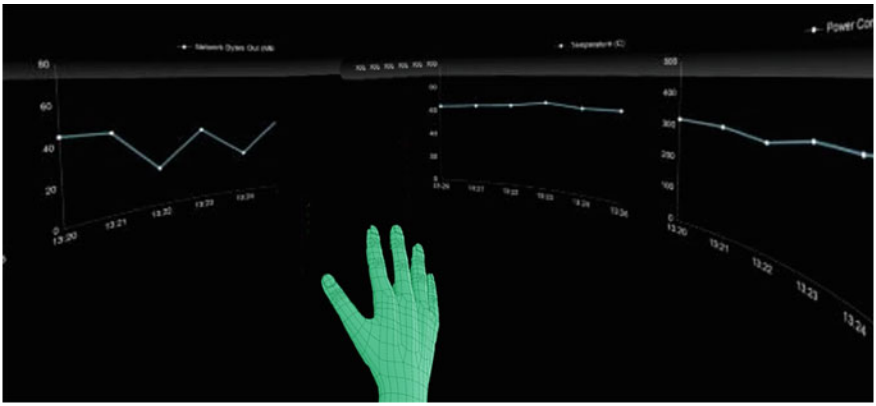

Fig. 1.5 Interaction with temperature values of a POI in close-up view

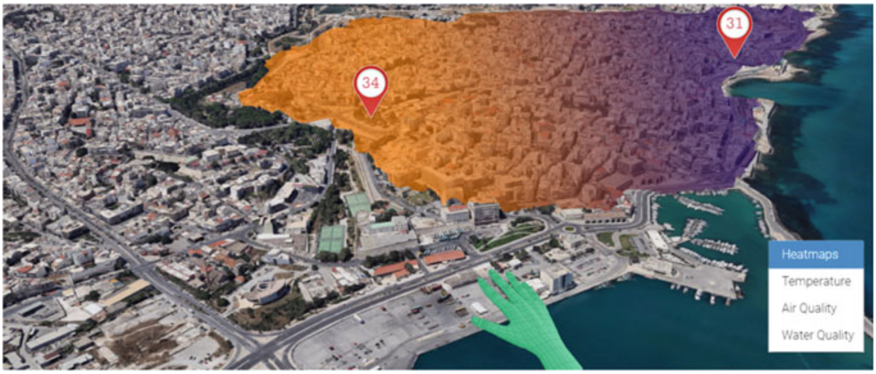

Fig. 1.6 Sample data from temperature sensors

as users are able to pinch and drag diagram axes in order to extend the viewport of the provided data.

Apart from representing distinct values about city assets, the presented application facilitates the visualization of trends in data. The 3D rendering process can be altered to apply advanced rendering techniques (e.g., global illumination and shadow calculation, illustrative rendering, heat mapping) in order to visualize geospatial distributions of data. Such representations can be useful for providing macroscopic inspection of metrics, which share similar values in accordance to their distribution in space, such as air quality, pollution indicators and temperature (Fig. 1.6). These visualizations can facilitate pattern recognition and correlation of metrics, e.g. wind direction with air pollution, unique micro-climates within the city, etc.

1.6 Evaluation—Validation

The visualisation infrastructure presented in this research paper was technically validated at the premises of the FORTH-ICS AmI research facility. The validation was carried out in an iterative process. Initially the visualisation framework was instantiated on top of a city model, generated through Google Maps and with offline dummy datasets. This step was required so as to test the capability of the framework to visualise information on top of city models; and at the same time validate the visualization structures and algorithms employed.

The second step involved the validation of interaction. For the purposes of this experiment, a setup was made involving one high end desktop PC (Intel i7 processor @ 4.6 GHz, 8 GB Ram, NVidia GTX 680), an Oculus Rift device, a Leap Motion sensor mounted on the HMD and a leap controller. During validation with a limited number of expert users (members of the Human Computer Interaction Laboratory of the Institute of Computer Science of FORTH with expertise on VR), interaction was fine tuned for both free hand interaction and controller based interaction in the virtual world. The experiment involved both visualisation tasks and navigation on the city model for real time data exploration.

The final validation step was conducted by integrating data from the Heraklion IoT and Open Data ecosystem, currently developed under a Programmatic Agreement between the Municipality of Heraklion and FORTH-ICS. This final step was essential in order to discover the usability of the framework in an actual smart city platform. The third step was conducted with the same user set of the second experiment. The goal was to cross-correlate the experience on dummy data sets with the one gained when exploring an actual smart city infrastructure.

1.7 Conclusion and Future Work

Blending VR with data visualization brings out new ways of creating added-value services across a wide range of sectors, from industry to services and utilities. Effective data visualization remains one of the key challenges in the era of Big Data—a cognitive bottleneck on the path between data and discovery. Our goal is to maximize the intrinsic human pattern recognition (or visual discovery) skills through the use of emerging technologies, associated with immersive VR.

> The biggest difference between virtual reality and flat, map-based data visualizations is that you can be placed “inside” the data, rather than above it. We’ve experienced an unexpected intimacy from these visualizations, along with a sense of scale… The subjective point of view is also more cinematic than a map, making it potentially more powerful for storytelling.” Brian Chirls, Creative Developer.[3]

Regarding future exploitation, the proposed framework will be further extended to support the full set of data generated by the Heraklion IoT and Open Data ecosystem, together with data stemming from other municipal services. At the same time, the final prototype will be evaluated by actual users, stakeholders of the municipality of Heraklion (administrative personnel and decision makers), both in terms of visualization and interaction.

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[3]POV—https://docubase.mit.edu/tools/data-visualization-for-virtual-reality-cities/.

[4]FORTH-ICS AmI Programme: http://www.ami.forth.gr.

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Chapter 2
Building a Smart City Ecosystem for Third Party Innovation in the City of Heraklion

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Abstract This paper describes the implementation of an Internet of Things (IoT) and Open Data infrastructure by the Institute of Computer Science of the Foundation for Research and Technology—Hellas (FORTH-ICS) for the city of

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Heraklion, focusing on the application of mature research and development outcomes in a Smart City context. These outcomes mainly fall under the domains of Telecommunication and Networks, Information Systems, Signal Processing and Human Computer Interaction. The infrastructure is currently being released and becoming available to the municipality and the public through the Heraklion Smart City web portal. It is expected that in the future such infrastructure will act as one of the pillars for sustainable growth and prosperity in the city, supporting enhanced overview of the municipality over the city that will foster better planning, enhanced social services and improved decision-making, ultimately leading to improved quality of life for all citizens and visitors.

Keywords IoT · Smart cities · Open data · Data analytics · Smart city visualization · Sustainable growth · Third party innovation

2.1 Introduction

As the IoT landscape is growing, expectations are also raised from both the citizens (i.e. consumer) and the industry's (i.e. producer) point of view. The smart city concept aims at combining modern technology with social activities in the city to address societal challenges. The term itself has been defined in many different

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ways; and several working definitions have been put forward and adopted for both practical and academic use (Chourabi et al. 2012). According to Caragliu et al. (2011), the common characteristics of smart cities are the: (a) utilization of a networked infrastructure for improving economic and governance efficiency and enabling social, cultural and urban development; (b) underlying emphasis on business-led urban development; (c) usage of high-tech and creative industries in long-run urban growth, and (d) pursuit of social and environmental sustainability. For the purposes of the research work reported in this paper, the following broad definition is adopted:

> *A city striving to make itself "smarter" (more efficient, sustainable, equitable, and livable)* (Natural Resources Defense Council n.d.)

Worldwide, an enormous amount of resources is currently dedicated to the development of smart city ecosystems. Additionally, in such contexts, the widespread usage of Open Data addresses the need of data availability and access to knowledge. These two notions can be combined in a single vertical platform that serves a twofold purpose, namely the: monitoring, harvesting and analyzing of data flows on the one hand, and dissemination of these data to all interested parties on the other.

From a technical perspective, the smart city remains a challenge due to the lack of interoperability of the heterogeneous technologies currently used in city and urban development. In this respect, the IoT vision, in a smart city context, aims at providing a single extendable and interoperable smart platform that can ultimately become a building block to realize a unified urban-scale ICT platform (Chourabi et al. 2012). As such it can unleash the potential of the smart city vision (Hernández-Muñoz et al. 2011; Mulligan and Olsson 2013).

Taking into account the aforementioned consideration, this paper presents the challenges faced in designing and implementing an IoT and open data infrastructure for the Municipality of Heraklion, Crete. The infrastructure is being developed under a Programmatic Agreement between the Municipality of Heraklion and FORTH-ICS, one of the largest research centers in Greece. In this process, R&D outcomes of four laboratories of FORTH-ICS are exploited, including research outcomes achieved through the collaboration of FORTH-ICS and the Municipality of Heraklion in the context of European funded projects [e.g. FP7 RERUM project (RERUM n.d.)]. The discussion on this paper focuses both on fundamental technological components and strategic decisions towards an open innovation ecosystem.

Currently, the IoT infrastructure consists of the following nodes: (a) environmental and weather monitoring, (b) air quality monitoring, (c) water quality and management monitoring, and (d) smart parking. Furthermore, the intelligence of the smart city platform is provided through an open data middleware and portal, a data analytics platform and an open API for third party innovation. By releasing this open infrastructure, it is expected that the city of Heraklion will, in the near future, be capable of: presenting a new business model for sustainable growth, based on cutting edge IoT technology; and promoting more intelligent city data collection, analysis, and rationalization, so as to foster intelligent decision-making by the city's authorities. This will also allow SME's to exploit and create added-value services for both citizens and visitors, including the elderly and people with disabilities.

2.2 Background—State-of-the-Art

This section focuses on the technological advancements that are related to the main architectural components of a smart city infrastructure. These range from an overview of the state of the art in IoT and smart cities to the different approaches regarding network architectures, IoT and Open Data middleware technologies, data analytics and information visualisation.

2.2.1 State-of-the-Art in IoT and Smart Cities

The evolution of computing technology is inevitably leading to a new ICT landscape, where in a near future the objects of everyday life will be equipped with microcontrollers, transceivers for digital communication, and suitable protocol stacks that will make them able to communicate with one another and with the users, becoming an integral part of the Internet (Atzori et al. 2010). Such a technological evolution is already happening and expands to the city context, as it responds to the strong interest of many national governments and regional organizations (e.g. municipalities) to adopt ICT solutions in the management of public affairs, thus realizing the so-called smart city concept (Chourabi et al. 2012).

In smart cities, IoT technology has the main role in supporting value-added services for the administration of the city and its citizens (Zanella and Vangelista 2014). At the same time, the existence of a connected, distributed and autonomous sensing infrastructure leads to an exponential growth of data that should be collected, maintained, processed and reasoned upon (Molinari et al. 2014).

Taking into account this situation, building a Smart City ecosystem requires special care. The main challenge is to ensure that the infrastructure will be scalable, resilient to changes, secure from the point of view of both the infrastructure and users, and open for third party innovation in the city, by exposing functionality and data.

In the context of this case study, in order to address the aforementioned challenges, five important components of the infrastructure where carefully designed, so as to ensure that the ecosystem will be able to support the today's requirements and at the same time to evolve as new technologies and requirements are generated. These components are described in detail in Sect. 2.4 and they consist of the:

(i) physical sensor infrastructure and the network communication protocols, (ii) IoT middleware, (iii) Open Data middleware, (iv) analytics component and (v) visualization layer.

2.2.2 Network Topologies/Architectures for Smart City Infrastructure

IoT refers to the interconnection of a large number of smart objects that are mainly able to sense the environment and report their findings to centralized entities like cloud servers. The term smart object refers to entities like wireless sensors, smart phones, smart cars, etc. Due to the rapid advance of technology in terms of hardware, miniature wireless sensors can provide a plethora of sensory data like ambient temperature, humidity, gas concentration, weather monitoring, etc. Moreover, the proliferation of operating systems for miniature devices like the ContikiOS (Contiki n.d.), TinyOS (n. d.), etc., has enabled the interconnection of these devices using IP-based protocols (e.g. IPv6). On top of IP, several other communication protocols provide energy-efficient interconnectivity between the sensors and the backend servers.

For efficient data collection, a number of protocols are used like the COAP, MQTT, etc. COAP (Constrained Application Protocol) is a network-oriented protocol based on REST architecture and it executes over UDP to avoid congestion in Wireless Sensor Networks (WSNs). Resources in COAP are identified by URIs, and clients send requests to a server based on a specific URI. Clients interested in a specific resource (sensory data), subscribe to a server (e.g. Gateway) and receive the corresponding measurements as soon as these become available.

From a telecommunication and networks point of view, IoT architectures currently face a number of challenges:

- *Security*: Protocol inefficiencies and software vulnerabilities have led to numerous attacks against IoT networks, like DoS attacks, wormholes, Sybil attacks, routing attacks, eavesdropping, fabrication, message replay, etc.
- *Privacy*: As sensors can collect and convey sensitive information, as for example in the case of healthcare scenarios, privacy preservation is of paramount importance. IoT wider acceptance also depends on privacy preservation.
- *Interoperability*: A large number of IoT architectures have been proposed so far, with significant contributions and technological advances in several areas (e.g. energy efficiency, etc.). However, interoperability has not been properly addressed, leading to 'silos' where each single architecture is isolated from the others.
- *Scalability*: Very often, the smart objects (i.e. sensors) are severely constrained devices in terms of processing, memory and storage. This, along with several protocol inefficiencies, degrades IoT networks' performance in terms of throughput, delay and packet loss.

A few “lighthouse” projects have significantly contributed to the maturity of IoT. These are:

- *RERUM* (RERUM n.d.): a successful IoT platform, funded by EC as an FP7 project. The functional architecture of RERUM is based on the architectural reference model of IoT-A. However, it follows not only a service-oriented approach, like IoT-A as well as most IERC projects (Tragos et al. 2016), but also assumes that the devices have an important role in ensuring the security and privacy of the architecture.
- *IoT-A*: one of the first IoT projects, focused on the creation of a generic Architectural Reference Model (ARM) that is used for deriving concrete IoT architectures. The ARM consists of several sub-models that set the scope of the IoT design space (Carrez 2013). These are the: (i) IoT communication model, (ii) IoT trust, security and privacy model, (iii) IoT functional model, (iv) IoT information model, and (v) IoT domain model.
- *FIWARE*: aims at building a core platform for the Future Internet and adopts the notion of “Generic Enablers”, components that offer reusable and commonly shared functions, serving a number of application scenarios. The generic enablers provide architecture reference model for: (i) cloud hosting, (ii) data/context management, (iii) applications/services ecosystem and delivery framework, (iv) IoT services enablement, (v) interface to network and devices, and (vi) security (Krco et al. 2014).

IoT technology fragmentation, along with the lack of global IoT standards, has led to isolated IoT systems, incapable of communicating with other systems that use different technologies, thus creating barriers for interoperable IoT systems. The *INTER-IoT* project (INTER-IoT Project n.d.) addresses interoperability issues by providing all those building blocks needed in order this to be achieved, including a framework, a methodology and the associated APIs and tool boxes.

2.2.3 IoT Middlewares

Typical IoT architectures are based on a number of sensors, often heterogeneous in nature, with different software and hardware capabilities. Moreover, several operations, like service discovery and orchestration, device registration and management, security, privacy and authentication, etc., are required. These tasks are accomplished by the so-called IoT Middleware (MW) that resides between the devices and the upper layers (e.g. cloud servers, consumers’ frontend), hiding the heterogeneity of the devices. Also, MW provides abstract layers for hiding the heterogeneity of the various medium access layers used (e.g. Bluetooth, LTE, ZigBee, etc.). A typical MW reference model is shown in Fig. 2.1.

Typical MW functionalities include code and service management, resource discovery and management, service integration, location tracking, semantic

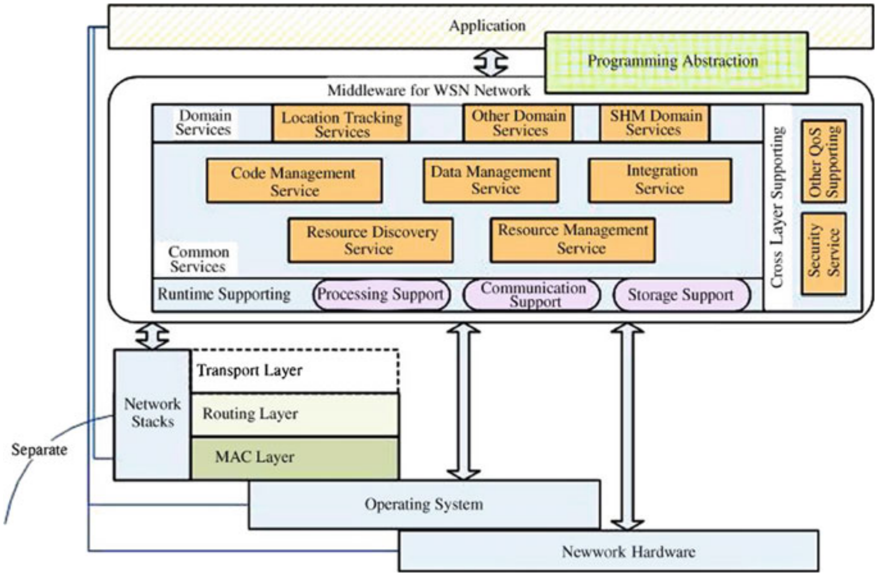

Fig. 2.1 IoT middleware reference model (Wang et al. 2008)

annotation, communication support, etc. Existing IoT MW architectures fall into three categories, namely the (Ngu et al. 2017): (i) *service-based*, where the service-oriented architecture is adopted, (ii) *cloud-based*, where the sensory data are stored in cloud servers and services like Testbed-as-a-Service, Measurements-as-a-Service, etc., are provided to users/consumers, and (iii) *actor-based* that focuses on open, plug-and-play IoT architectures.

There is a large number of significant research contributions on the IoT area, like OpenIoT (Soldatos et al. 2015), Node-Red (O'Leary and Conway-Jones 2017), Google Fit (Google Fit n.d.), Paraimpu (Pintus et al. 2012), etc. However significant challenges still remain. Key essential properties for a robust IoT MW are *security and privacy*. Due to the resource-constrained nature of sensors, the adoption of common cryptographic primitives and privacy-enhancing techniques is not always feasible. Strong encryption and privacy-enhancement is required for the transaction between the sensors and the MW. Furthermore, user authentication and authorization operations have to be supported by the MW.

2.2.4 Open Data Middleware Approaches in Deployed Smart City Infrastructures

Although IoT architectures are primarily evolving over network technologies and IoT middleware, currently the exponential growth of devices and sensors is leading to the generation of vast amounts of data from the smart infrastructure.

This inevitably has created the need for specialized data processes, such as storage, inference and analysis of the large amount of information. In this context, research is currently employing the power of semantic web technologies (e.g., SQL query (Lee 2010), SPARQL query (Apolinarski et al. 2014), RDF/RDFs and OWL languages (Zygiaris 2013) on top of linked data repositories. Such smart cities frameworks are discussed below.

Gambas (Apolinarski et al. 2014) is a middleware for the development of smart city applications that supports data acquisition, distribution and integration. The platform was deployed for several months in the transportation domain in Madrid, Spain. A Semantic Data Storage (SDS) component is used to store the data in the form of Linked Data. Query processors are used for data exposure to services and applications. The execution of these queries can be applied with the help of SPARQL query languages. In environments such as smartphones, the execution of query can be applied with the help of RDF-on-the-go (Le-Phuoc et al. 2010).

Sentilo (Bain 2014) is a platform for the management of sensors and actuators, deployed in the city of Barcelona, Spain. The platform includes many features, such as Cloud Computing, a non-SQL database, a memory database and a simple RESTful interface. Sentilo is designed and developed using open source components, such as Redis, MySQL and MongoDB databases, Hibernate, JSON or JQuery. A weak point of this platform is the lack of real-time data analyzing, obtained from different sensors.

Anthopoulos proposes an architecture that identifies a model for urban information, deployed in Kyoto, Amsterdam, Copenhagen and Trikala (Anthopoulos and Fitsilis 2010). This system follows a Service Oriented Architecture (SOA), where all services are stored and presented to stakeholders. The proposed architecture consists of five layers: the infrastructure, information, service, business, and stakeholder layers.

Zygiaris (2013) proposes an architecture that can be used in smart urban planning. This model was deployed in Barcelona, Amsterdam and Edinburgh. An important aspect is the storage and access of applications using Cloud Computing technologies. Semantic Web services and ontologies can provide an important interoperable data representation standard, while languages such as RDF-S and OWL allow the exchange of data across city domains. Data is exposed with the help of Visualization APIs.

WindyGrid (Rutkin 2014) is a platform for Smart Cities that presents real-time historical data, deployed in the City of Chicago. Specifically, the platform provides three main systems to the city of Chicago, which are: situational awareness and incident monitoring, historical data analysis and advanced real-time analytics. Big Data technologies were used for developing the platform, such as MongoDB, NoSQL database and parallel data processors. Examples of data include traffic conditions, buildings' information, and logs of emergency calls.

Table 2.1 contains an overview of the core functionalities and technologies of the aforementioned frameworks.

Table 2.1 Functionalities for smart cities' platforms

Smart city architectures/ platforms	Data acquisition	Data management	Data processing (service layer)	Data storage	Smart city deployed
Gambas	✓	✓	–	Semantic Data Storage (RDF, RDF-on-the-go)	Madrid
Sentilo	✓	✓	–	MySQL, MongoDB	Barcelona
Anthopoulos and Fitsilis (2010)	✓	✓	SOA	Mobile or Social network storage	Trikala, Kyoto, Amsterdam, base Copenhagen
Zygiaris (2013)	✓	✓	✓	Ontologies (RDF-s, OWL)	Barcelona, Amsterdam, Edinburgh
WindyGrid	–	✓	✓	MongoDB, NoSQL	Chicago

2.2.5 *Data Analytics*

IoT deployments for smart city applications are challenged by the need of dealing with the analysis of massive and heterogeneous data, in order the extraction of meaningful observations from raw sensing streams to be enabled. Towards this direction, addressing the accuracy of sensing data streams in real-time is of paramount importance for providing sophisticated services (Sun et al. 2016). This becomes even more evident as the community observes smart city platforms, being enriched with crowd-sensing models, wherein the use of error-prone, non-dedicated sensing elements are employed (Habibzadeh et al. 2017). Recent approaches in data analysis over IoT sensing streams are discussed in the rest of this section.

Considering the case of performing data analysis over a cloud-based architecture, Csáji et al. (2017) present a Smart City prototype, installed for monitoring pollution and traffic in Budapest. The respective architecture considers acquisition of information from the installed IoT sensing elements, and their integration over a software module, responsible for handling missing and noisy data; while being capable of creating short-term forecasts, accompanied by reliability estimates, in a batch-processing manner. Along the same direction, a four-tier architecture for smart city development and urban planning using Big-Data technologies (e.g., Spark Hadoop) is presented by Rathore et al. (2016). The objective of data management and analysis module is emphasized by combining historical information with real-time data for the prediction of future dynamic events. Similar principles, in terms of statistical data analysis, are also met in the City Data and Analytics Platform (CiDAP, SmartSantander project) (Cheng et al. 2015), which aims at processing both historical and real-time data.

Concisely, the CiDAP architecture defines a distributed computing framework and API for performing both internal (i.e., indexing, simple aggregation and first-order statistics) as well as external processing (i.e., clustering, anomaly detection, and classification). The information-based framework, presented by Jin et al. (2014) invests on sophisticated computational intelligence techniques (e.g., genetic algorithms, and neural networks) for converting information into knowledge, thereby silently implying that the raw streams of input data are a priori processed, cleaned, and normalized. Ultimately, the approach presented by Kolozali et al. (2014) elaborates on the reliable information processing over smart cities data, by means of patterns creation, fault tolerance mechanisms when malfunctioning or disappearing sensor are detected, and conflict resolution strategies when data analysis results in conflicting information; while it combines reliable (e.g., government) and non-reliable (e.g., crowd sourced) data.

Despite their scalable and modular architectures, the aforementioned approaches neither consider the inaccuracy of IoT urban measurements for the data analysis process, nor incorporate the extraction of on-line alerts while the system is in operation. In this sense, there exists a literature gap in extending statistical data analysis for IoT-based smart cities' applications beyond essential pre- and post-processing steps. As such, realistic factors that are sources of increasing level of uncertainty in raw IoT sensing streams, while enhancing the validity of detected alerting phenomena are not taken into account. Towards this direction, the herein employed statistical data analysis architecture differs from the current state of art in the following ways:

- It incorporates recent theoretical results that consider the characteristics of the sensing elements (e.g., accuracy, precision, resolution, sensitivity) for the lightweight and efficient quantification of the uncertainty;
- It adopts the respective toolbox as an inseparable part of the overall architecture for the on-line statistical data analysis;
- It employs the resulting uncertainty-aware information for the extraction of alerts that are associated to different types of system or data failure.

2.2.6 Information Visualization for Smart Cities

Information nowadays is rich and interconnected. It is actually not enclosed in a specific system, but is omnipresent in our surroundings, producing networks which create an Internet of Things (IOT). In this direction, the adoption of highly interactive visualizations holds a key role in providing insights on Big Data and IoT (LaValle et al. 2011). Both administrators and the public require intuitive visualizations, which provide access to data collected from IoT networks and illustrate information in an easily perceived manner. Application fields include energy management, networking, decision support systems, traffic monitoring and logistics (Singh et al. 2014).

2.2.6.1 OLAP—Charts

Big Data usually consists of multidimensional data sets, which are cumbersome to perceive and present. Online Analytical Processing (OLAP) is a widespread approach for interactively filtering out extrinsic information and its analysis, providing a clear view of the data from different perspectives. Pivot tables, also mentioned as cross-tabs, constitute a traditional interface for displaying OLAP data by employing a multidimensional spreadsheet in which a measure of interest is selected and corresponding dimensions present additional measures (Cuzzocrea and Mansmann 2009). Several types of plots are employed to illustrate multidimensional data, including numeric, ordinal, temporal and geographic values (Liu et al. 2013). Additional visualization methods include treemaps, circle packing, sunburst, parallel coordinates, streamgraphs and circular network diagrams (Wang et al. 2015).

2.2.6.2 Web Visualizations

Visualizations based on web technologies constitute an integral part of displaying cross-platform visual analytics in a manner familiar to both administrators and the public. Web analytics (Mikusz et al. 2015) are applied for gaining insights on statistical characteristics of IoT infrastructure and metrics. Additionally, web visualization is employed for spatial data representations. AVIoT (Jeong et al. 2015) is a proposed web interface that is suitable for both indoor and outdoor locations and can facilitate actuator placement in IoT environments. Visual analytics are proposed by Batty and Hudson-Smith (2014), combining chart representations, cartography, augmented and virtual reality in the context of urban design.

2.2.6.3 Geospatial Data

Geospatial data are present both in the context of Big Data and IoT technologies. The significance of spatial data characteristics was mentioned in 1970 by Tobler's first law of geography (Tobler and Waldo 1970), where "near things are more related than distant things", regardless of information interconnections. Geospatial big data constitute a significant portion of Big Data (Lee and Kang 2015).

Interactive maps are the prevalent interface applied for geospatial information, constituting a geographic visualization based on a common point of reference that displays information with regard to their location in space. Actions on the geospatial representations include map projection, pan and zoom (Cartwright et al. 2001). Common visualization approaches, utilizing map interfaces, include heat maps (Fisher 2007) and hypermaps (Kraak and Van Driel 1997). In terms of IoT visualizations, Merlino et al. (2014) combine maps and dashboards in order to visualize the sensory spatial distribution and the corresponding values respectively.

2.3 Heraklion Smart City Ecosystem

2.3.1 Introducing the City of Heraklion

Heraklion is the largest urban centre in Crete, the capital of the region and the economic centre of the island. The town enjoys a dynamic and imaginative combination of natural beauty climate, strategic position, cultural heritage and scientific background that has created a unique environment to support the broader entrepreneurial activity in the region and stimulate the local economy. Today Heraklion is the top choice for tourist destinations in the Mediterranean area, thanks to its strategic geopolitical position that connects three continents and many different cultures. According to the results of 2011 census, the population of the city was 173,993 inhabitants; while the Heraklion urban area has a population of 225,574 and it extends over an area of 225.5 km^2 (87 sq. mi).

According to a recent report published by travel analysts Euromonitor International (Euromonitor International 2017) and launched at the World Travel Market in London, Heraklion is Europe's fastest growing tourism destination for 2017. The city welcomed 11% more visitors in 2017, compared with the same period in 2016, surpassing its European rivals. In total 3.2 million visitors arrived in 2017.

The Mediterranean encompasses an amalgam of diversified nations and cultures. Despite this cultural barrier, there are similarities and common issues that can be found across the Mediterranean cities. Climate related issues, such as limited water supply and high temperatures during the summer, call for immediate action for an effective and sustainable way of water resource management. In addition, the current economic recession coupled with the refugee crisis across many Mediterranean countries requires new tools and methods for efficiently governing and managing cities and swiftly responding to an ever increasing demand for resources.

Challenges considered by this research work include the: (a) empowering of citizens by providing access to information and to new innovative services; (b) deployment of tools and services that will support intelligent decision-making for city management; (c) creation of added-value services for both citizens and visitors.

2.3.2 Ecosystem Architecture

Planning and developing a smart city ecosystem for the Heraklion case study required a careful and thorough examination of existing paradigms, architectures and technologies, such as the ones described in Sect. 2.2. Best practices in successful smart city instances were taken into account, leading to the development of a modular platform that encompasses the integration of disparate systems and caters for future system scalability and expandability.

The Heraklion Smart City ecosystem (Fig. 2.2) consists of *3 interoperable layers*, namely the Data Sources Layer, the Smart City Platform Layer and the Data Consumers Layer.

The *Data Sources Layer* contains the physical layer of the IoT infrastructure and the external Open Data sources, both of which act as data feeders of the Smart City Platform Layer.

The *Smart City Platform Layer* comprises:

- The core engine of the Middleware infrastructure, linking physical asset monitoring and external data extraction with databases and analytical engines.
- The Smart City web portal, serving public dissemination of accumulated knowledge.
- The monitoring and management services, providing smart city governance and city management tools.
- A public web API, available for third-party agents.

The *Data Consumers Layer* represents the Smart City end-users, namely:

- Public Administration
- Citizens and city visitors
- Commercial App providers

Access to these data represents an opportunity for SMEs to exploit and create added-value services for both citizens and visitors. A few examples of such services are travel applications based on real-time information, targeted advertising services

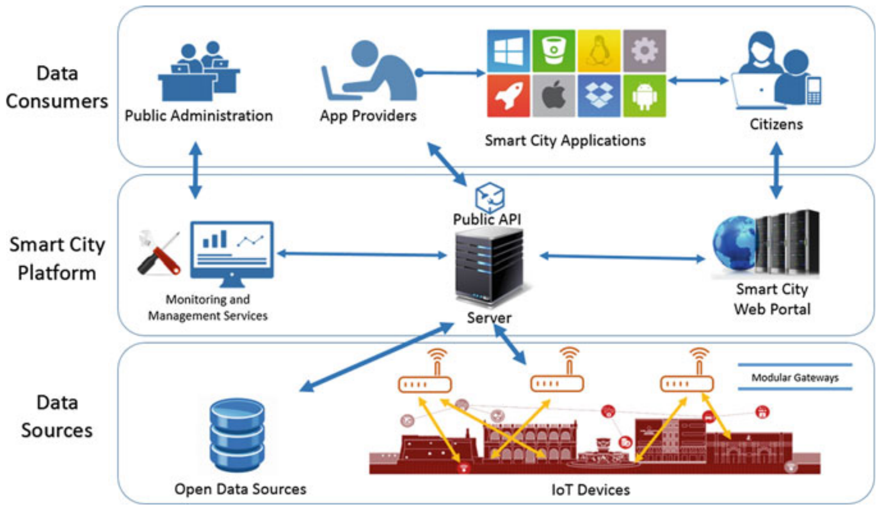

Fig. 2.2 Heraklion smart city ecosystem

and real estate tools that compare the potential value of alternative business or building locations. These data-enabled services could also provide a potential source of revenue for the data owners.

2.4 Heraklion IoT and Open Data Ecosystem Architecture

This section discusses the system architecture and the individual components that were integrated for building the core infrastructure of the Smart City ecosystem (Fig. 2.3).

2.4.1 Technology

The telecommunication standards, which may be incorporated in the case study architecture, are not fixed or predefined by the architecture. Any suitable communication technology can be integrated by the implementation of the proper software interfaces. Initially two standards were selected, based on their capabilities, performance, and robustness in large scale deployments, the LoRaWAN (LoRa Alliance n.d..) and the IEEE 802.15.4g (IEEE Std 802.15.4g-2012 n.d.), assisted by the 6LoWPAN (IETF n.d..) technology. In addition, this section covers the technological choices made for the platform's data repository and data analytics.

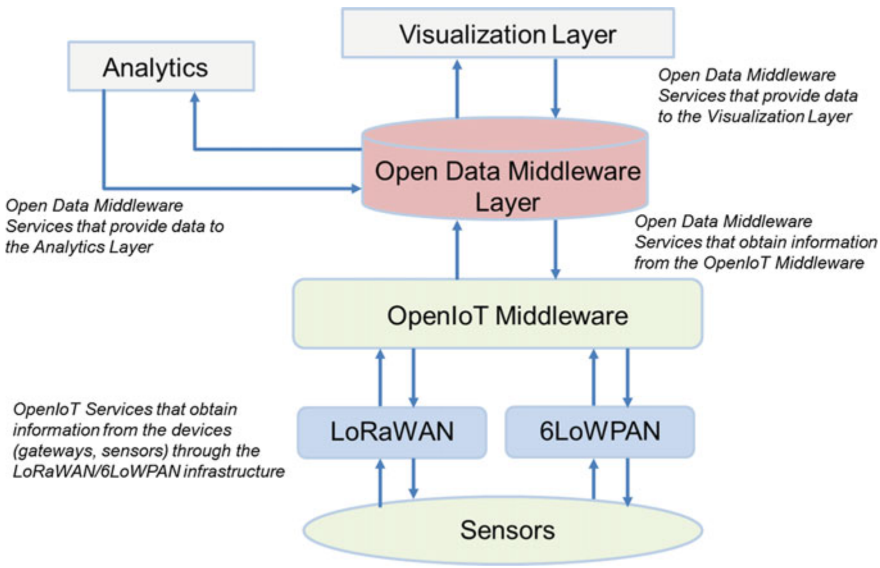

Fig. 2.3 Heraklion smart city architecture

2.4.1.1 Communication Standards Details

One of the most promising LowPower WAN technologies is LoRaWAN. It has been developed by a large multi-disciplinary consortium of companies; and it is based on the proprietary LoRa physical layer technology. It is based on the chirp spread spectrum (CSS) technology, providing many advantages over single carrier technologies, being very robust against interference.

LoRaWAN supports 6 spreading factors, from 7 to 12, depending on the selected data rate. The frequency bands for Europe are 863–870 MHz and 433 MHz, although there are no products yet to implement the 433 MHz band. EU868 MHz end-devices should be capable of operating in the 863–870 MHz frequency band and should feature a channel data structure capable of storing the parameters of at least 16 channels.

LoRaWAN networks are typically deployed in a star-of-stars topology, where Gateways, a.k.a. Concentrators, relay messages between end-devices and a central Network Server, which forwards the packets to the appropriate Application Server via the Internet. End-devices use single hop LoRa communication to one or more Gateways.

6LoWPAN is the acronym of IPv6 over Low-Power Wireless Personal Area Networks. It is an open IETF specification for the use of IPv6 networking over IEEE 802.15.4 based networks. Mesh routing, header compression and encapsulation are provided and optimized for the use with the 802.15.4 technology. Due to the use of IP technology, the connectivity of such networks to the Internet is seamless.

The set of standards under the umbrella of IEEE 802.15.4 is large. The one that currently provides a good balance between range and data rate is the 802.15.4g or Wi-SUN. It is optimized for very large scale applications use, mainly targeting on low power consumption, low data rate smart metering systems and advanced utility management systems.

IEEE 802.15.4g supports multi-rate and multi-regional frequency shift keying (MR-FSK); multi-rate and multi-regional orthogonal frequency division multiplexing (MR-OFDM); and multi-rate and multi-regional offset quadrature phase-shift keying (MR-O-QPSK) modulations. The frequency bands, which may be used in Europe, are 863–870 MHz and 2400–2483.5 MHz. The rate with respect to the modulation can be from 6.25 to 200 kbit/s.

2.4.1.2 Data Storage

The data storage component used by the Open Data Middleware (ODM) uses the relational database PostgreSQL (PostgreSQL n.d.) for storing the data produced by the IoT Middleware. PostgreSQL was selected over other database solutions for a number of reasons. It is a robust open source, object-relational database, with a very large community of users and developers. PostgreSQL carries many advantages such as flexibility, stability, usage of a standard data access language (SQL), support of ACID transactional consistency, limitless indexing, built-in data integrity and a vast eco-system. Moreover, it supports a large number of advanced data types, such as multi-dimensional arrays, user-defined types, as well as geographic data types, provided by the spatial database extender PostGIS(PostGIS n.d.). PostGIS provides support for location SQL queries, a quite useful feature for IoT infrastructures, employed in the context of smart cities. PostgREST (PostgREST n.d.) is used for data exchange interoperability with the visualization layer and other 3rd party data consumer applications. PostgREST is a standalone web server that turns PostgreSQL database into a high performance RESTful API. PostgREST handles authentication via JSON Web Tokens (JSON Web Tokens n.d.); and delegates authorization according to the access control policies as specified and stored in the database, resulting in a single declarative source of truth for security.

2.4.1.3 Data Analysis

Going well beyond the calculation of first order statistics, the objective of the statistical data analysis herein employed is to timely detect abnormal changes in the sensing data streams, and enable early prediction of alerting phenomena. To this end, the High-level Data Management Toolbox (HDMA) (Tzagkarakis et al. 2014 and Tzagkarakis et al. 2015) is employed, originally designed and developed to meet the objectives of industrial Cyber-Physical Systems in general, and smart water networks in particular.

The key elements of HDMA (Fig. 2.4) are the quantification of uncertainties in given raw sensing streams; and the calculation of extreme events, considering the uncertainty-aware data. Concisely, the uncertainty in a quantity to be measured, henceforth called sensing modality (e.g., temperature), characterizes the dispersion of the values that could be attributed to that quantity (Aggarwal 2010). Thus, the uncertainty provides an indication on how inaccurate or incorrect a measurement is, as a result of the imperfections in the underlying sensing infrastructure.

The HDMA toolbox differentiates the independent sources of uncertainty into either statistical or systematic. The resulting values of uncertainty are consolidated

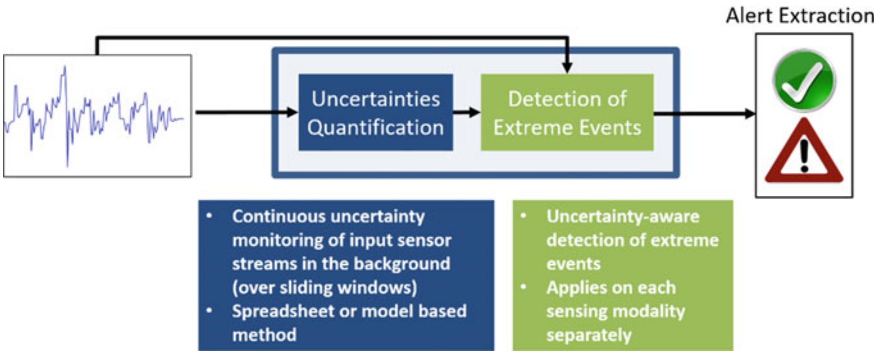

Fig. 2.4 The architecture of the HDMA toolbox (Tzagkarakis et al. 2014, 2015)

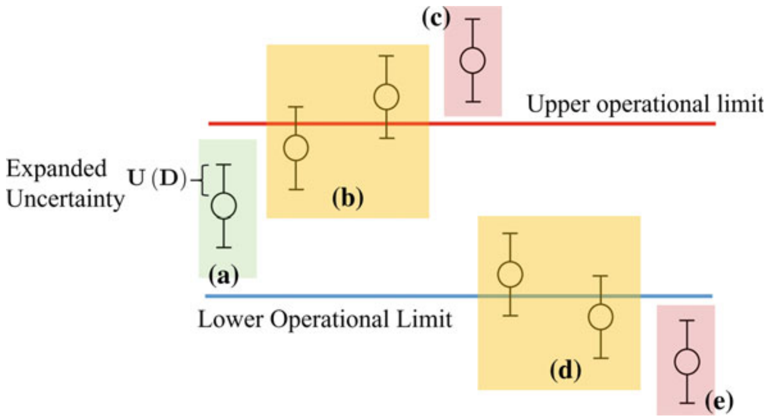

Fig. 2.5 The compliance with operating limit over the uncertainty-aware data stream (Tzagkarakis et al. 2014 and Tzagkarakis et al. 2015), indicating: **a** the case of full compliance with operational limits, **b**–**d** the uncertainty-aware value is below or above the upper operational limit, but the limit remains within the uncertainty, **c**–**e** the uncertainty-aware value exceeds the upper or lower limit

in order to calculate both the combined uncertainty, which characterizes the sensing modality; and the expanded uncertainty, which expresses the combined uncertainty at a specific level of confidence.

The expanded uncertainty for each sensing modality is in turn employed for enhancing the detection of extreme events over the data streams. Specifically, driven by the demand of providing timely notifications of alerting phenomena, the HDMA toolbox considers a modified version of the compliance-with-operating-limits method that incorporates the estimated uncertainty into the streaming data for detecting when the measurements exceed the upper or lower application-specific operational limits (Fig. 2.5).

While this method extracts an inference for each individual measurement of the input stream, the early-warning mechanism of the HDMA toolbox relies on a majority rule, according to which an alert is generated if N consecutive uncertainty-aware measurements exceed the operational limits.

2.4.2 *Backbone Components*

2.4.2.1 IoT Nodes and Sensors

This section provides a brief description of the hardware and software components that constitute the Nodes of the Heraklion IoT ecosystem. The nodes are distinguished into 6LoWPAN-enabled and LoRaWAN-enabled, since they differ in terms of wireless technology and smart-city services they support.

6LoWPAN Nodes

Each 6LoWPAN-enabled Sensor Node (SiSN) is built upon a Zolertia RE-Mote platform that hosts an ARM M3-Cortex running at 32 MHz, 32 KB RAM and 512 MB Flash Memory; and offers dual radio operation both in ISM 2.4 GHz and ISM 863–950 MHz frequency band, under IEEE 802.15.4 standard. External sensors can be attached to the RE-Mote platform through a number of communication ports (I2C, SPI, 12-Bit ADC with configurable resolution). The interested reader is addressed to (Angelakis 2016) for a more detailed characterization of selected sensor hardware.

IPv6 connectivity, specifically tailored for the low-power and resource-constrained nature of the RE-Mote platform, is offered by the Contiki OS (Dunkels et al. 2004). On the application layer of the network stack lays the Constrained Application Protocol (CoAP) (Bormann et al. 2012). Measurements collected through sensor drivers are exposed as CoAP resources by a CoAP server running on the RE-Mote. The CoAP asynchronous notification mechanism (OBSERVE) is used for periodic sensor measurement collection over UDP transport with application layer reliable unicast. Apart from sensory measurements, self-monitoring resources that report network statistics, device hardware/software info and power consumption are also exposed.

6LoWPAN-enabled Sensor Nodes interact with the OpenIoT Middleware (OMW) through the 6LoWPAN IoT Gateway (SiGW), which has fog characteristics such as local data processing, storage and networking services (Charalampidis 2017). It is mainly responsible for providing network and application protocol translation (translate a CoAP/UDP packet to a HTTP/TCP packet and a 6LoWPAN (IPv6) to a standard Ethernet/WiFi packet (IPv4) and vice versa). Apart from that, the SiGW offers functionalities such as sensor registration, monitoring and management, measurement aggregation and forwarding. Essentially, it hosts two different network interfaces. On the one side, there is an IEEE 802.15.4 interface, offered by a RE-Mote (acting as the 6LoWPAN border router) that enables connectivity to the Sensor Nodes. On the other side, connectivity to the OMW is provided by common interfaces, i.e. either the Ethernet or WiFi interface of a Raspberry-Pi 3 running Raspbian OS.

Each SiGW installed in the Heraklion IoT ecosystem ensures that the registration of the SiSNs to the OMW is performed in an easy, transparent and adaptive way. In particular, a CoAP server, running at the SiGW, plays the role of a registrar that handles registration messages received from the SiSNs; stores necessary identity information in a local database; and forwards registration messages to the OMW. Moreover, the SiGW implements a mechanism for per SiSN measurement collection activation/de-activation. Finally, additional security and reliability enhancing techniques include connectivity between OMW and SiGW, realized through the use of a VPN connection as well as local logging and monitoring, which ensures that transmission of measurements to the OMW is not disrupted by i.e. a reset of the gateway or a reset of a sensor node.

LoRaWan nodes

LoRaWAN-enabled Sensor Nodes (LoSN) are commercial-off-the-shelf (COTS) devices by Libelium (n.d.). There are two distinct categories of nodes, parking sensors and water quality sensors. According to Polycarpou et al. (2013), the expanding use of IoT technologies enables the collection of parking availability information even from on-street parking spots. The parking sensors are based on the measurement of the magnetic field strength in 3 orthogonal axes. The sensors are installed on the road surface and, at a programmable interval, they provide a status for the occupation of the parking space, based on the field strength compared to a predefined threshold. The water quality sensors are installed in city's water reservoirs and provide measurements about: temperature, conductivity, pH, water height, and chloride, ammonium, nitrate, calcium ions. All sensors are using the Microchip RN2483 LoRa modules, which are certified to the LoRaWAN specification (LoRa Alliance n.d.).

The respective LoRaWAN Gateways (LoGW) are built around the iC880A—LoRaWAN concentrator module. Based on the Semtech SX1301, the iC880A module is capable of receiving concurrently 8 LoRa packets with different spreading factors and channels. The module is connected to a Raspberry-Pi 3 computing device, combined with LoRa Gateway open source software provided by Semtech. The LoGW is providing the connectivity to the LoRaWAN server.

2.4.2.2 OpenIoT Middleware

As earlier mentioned, the OpenIoT middleware is a fundamental component of the IoT platform. The middleware realizes a layer between the IoT Sensor Network and the various applications that need to use the facilities of this network; and it seamlessly interconnects the IoT Network, exposing it as a virtual representation to end users, while also providing extra functionalities for improved security and privacy.

The OpenIoT middleware consists of several core components, namely (Fig. 2.6): the LSM Server, the Scheduler Core Server, the RabbitMQ Server and the RDF Server. The LSM Server and the Scheduler Core Server are deployed in an application server. The RDF Server and RabbitMQ server are standalone applications, which run on the same workstation. A rich HTTP Restful API is also used for serving communication among the middleware components of the Heraklion Smart City platform.

The LSM Server component is responsible for managing the IoT Network. One of its main functionalities is to listen for registration requests from the IoT network components, while registering and granting them access to the Heraklion smart city ecosystem. The notion of Features of Interest (FOIs) is employed. FOIs are digital representations of a physical or geographical object and logically represent the entity, which a sensor or a group of them is able to observe or manipulate through

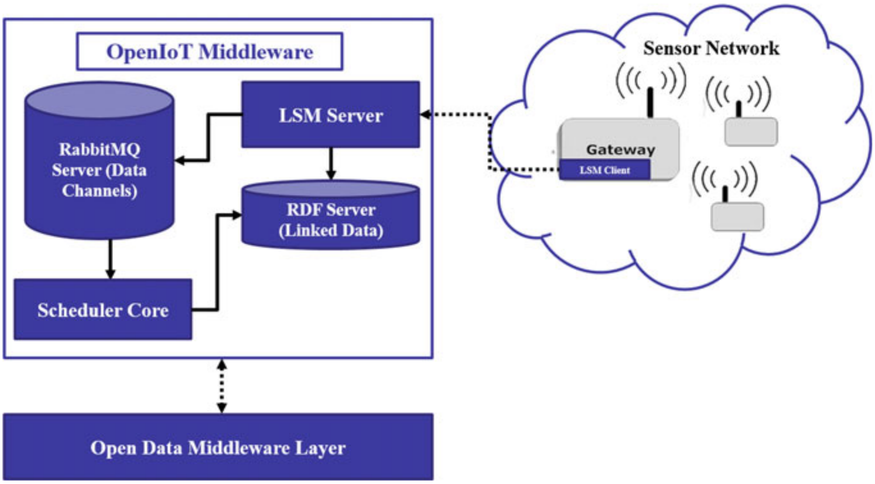

Fig. 2.6 Middleware components

sensing or actuation. The LSM Server registers IoT Gateways and IoT Sensors, while mapping them according to specific predefined FOIs. The LSM server component receives data from the sensors and publishes them to the RabbitMQ Server. It maintains the status of the IoT network and periodically updates metadata related to the network components.

The Scheduler Core component is responsible for handling the service requests from the Open Data Middleware (ODM) Layer. Due of the nature of the architecture, it provides an abstract view of the Testbed Topology to applications through random generated "handles". This component also manages and maintains various data channels according to active handles and active data streams. The Scheduler Core HTTP Restful API provides functions, such advertising a full list of available FOIs and the type of metrics that can be acquired from them. Other functions such as the ability to get a handle, based on a specific FOI, while getting data using it is also exposed. The Scheduler Core finds the mapped resource and creates the appropriate data stream from the resource that the ODM Layer has requested, thus generating and providing the handle on-the-fly.

The RDF Server is an instance of a Linked Data Server. OpenLink Virtuoso is being used, a scalable cross-platform server that combines Relational, Graph, and Document Data Management with Web, providing Resource Description Framework (RDF) capabilities. Its main purpose is to securely store and maintain data about the smart city topology (Sensors, Sensor types, IoT Gateways FOIs), such as geographical data, type of sensors per gateway, network information (IPs, ports), unique IDs for every component and their properties, etc.

For non-persistent storage, the RabbitMQ Server is used, which is an open source message broker software. Temporary buffers are created for those readings, which are relevant for an application or even multiple clients' requests, and which are meant only to store the sensors' data until their consumption. A time-to-live flag for each queue makes sure that data are not kept indefinitely. Using this technique, only requested data are maintained in the memory of the middleware, which auto-expire when they are not needed anymore, thus saving disk, memory and computing resources.

2.4.2.3 Open Data Middleware

The Open Data Middleware (ODM) is responsible for collecting, storing, maintaining and delivering data acquired from sensor data streams (through OpenIoT middleware) and external open data municipal sources (Fig. 2.7). Sensor data is retrieved by a set of Data Loaders, implemented in Java, separately for each modality (temperature, humidity, atmospheric pressure etc.).

Each data loader uses the OpenIoT middleware API to access and collect the recorded measurements, which, as described in Sect. 2.4.1.2, are then stored in a PostgreSQL database, a part of which is shown in Fig. 2.8.

Database entities are classified into the following four main categories:

Sensor network tables

These tables model the network of sensors that constitute the IoT infrastructure. Such tables are FOIS, DEVICES and SENSORS. The FOIS table holds all the features of interest (foi) that have been defined for the city of Heraklion, e.g. Eleftherias square, Morosini fountain square etc. Each foi can be linked with one or

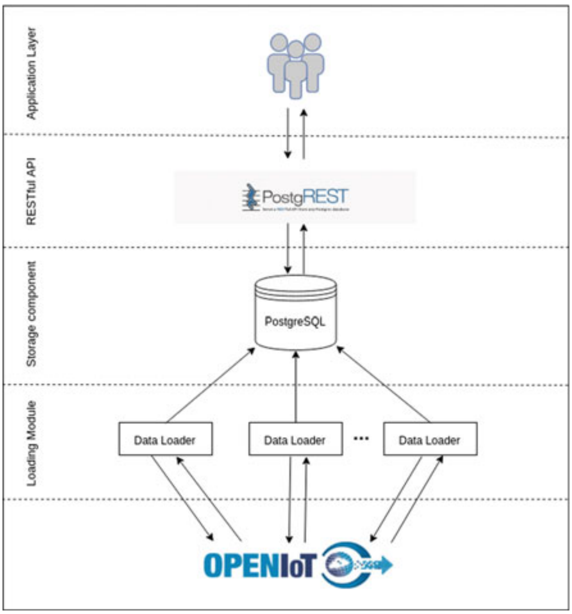

Fig. 2.7 Middleware interoperability

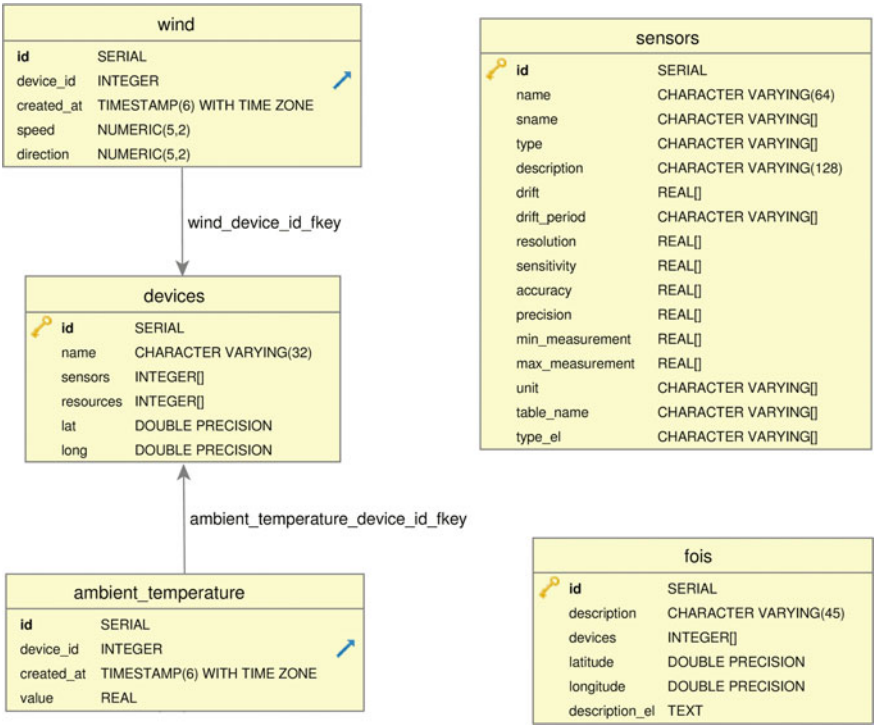

Fig. 2.8 Open data middleware—database schema example

more DEVICES, which represent the physical devices in which different sensors are installed. The available devices and sensors, along with their characteristics, are stored in the DEVICES and SENSORS table respectively.

Sensor measurement tables

Sensor readings are stored in different tables, based on the modality of the measured value (e.g. Temperature, Noise, Wind etc.). Each modality table stores the time series retrieved values together with all related metadata (e.g. Fig. 2.8—AMBIENT_TEMPERATURE table).

Non-IoT Open Data tables

A separate set of tables is used for storing municipal open data from external sources. Such tables are shown in Fig. 2.9 and their content is described in details in Sect. 2.4.3.1.

Statistical analysis tables

This set of tables is reserved for storing the output of the Statistical Data Analysis Component. Attributes related to the analytics process. such as the temporal window of values examined, calculated uncertainties and identified alerts

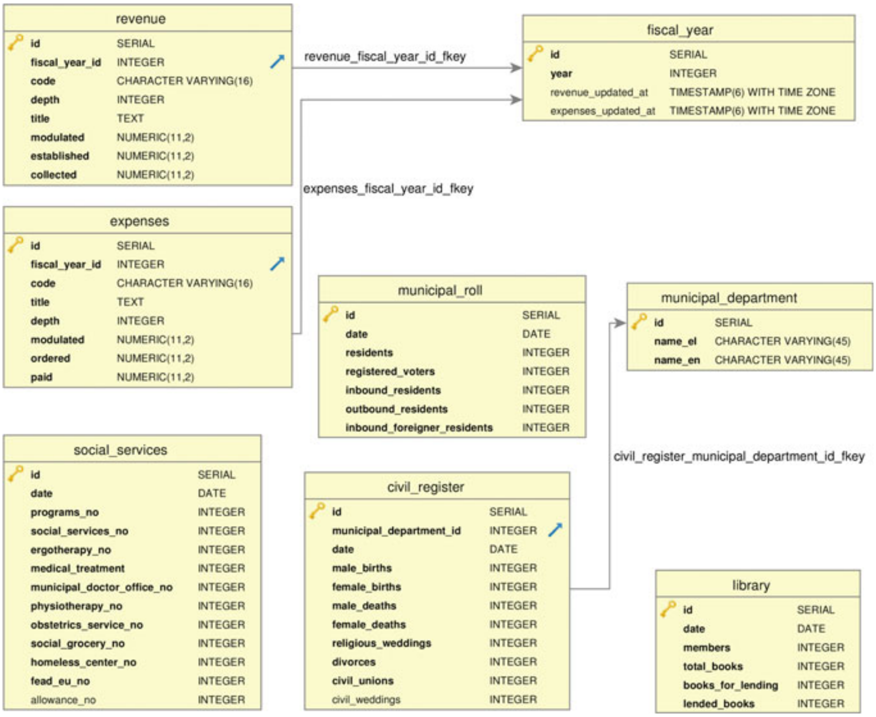

Fig. 2.9 Municipal data from external sources

(based on the Alert Level definition described in Sect. 2.4.2.4) are stored and maintained within these structures (e.g. Fig. 2.10).

As mentioned in Sect. 2.4.1.2, stored data is exposed to application level (both native and 3rd party applications) through a RESTful API defined by postgREST. The provision of complex aggregated data requests is accommodated by a set of user defined functions, aggregates and views. Examples are the:

- *avg_cyclic* user-defined aggregate function, which calculates the average wind direction.
- *get_wind_history* function that summarizes information about wind speed for a specific time period. Such function returns the occurrences of recorded measurements, for each secondary inter-cardinal wind direction (N, NNE, NE, etc.) and wind speed range in the Beaufort scale (calm, 1–2, 3–4, 5–6 and over 7). This function is used for visualizing wind historic data on a wind-compass schema.
- *dashboard_data* view returns the latest average values for all features of interest and for all modalities.
- *get_measurements_averages* function returns the average values given a modality, a set of devices, a time window and a granularity level of aggregation.

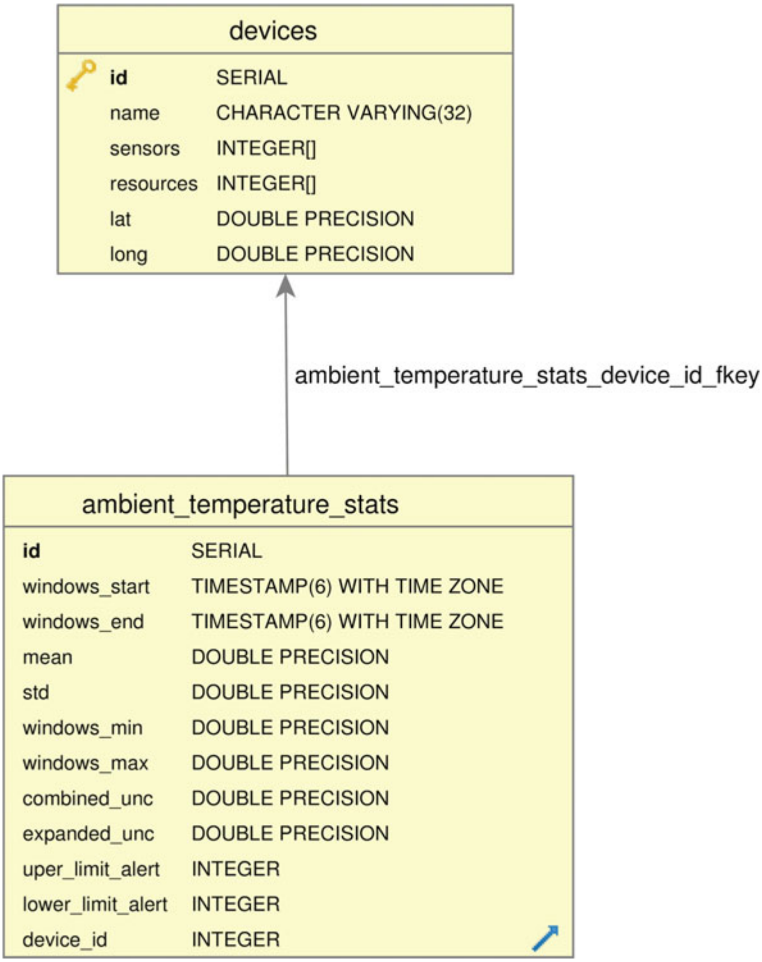

Fig. 2.10 Ambient temperature analytics

2.4.2.4 Analytics

A common concept for IoT deployments for smart cities' applications is that sensing streams arrive at a centralized data management entity at extremely frequent time intervals from multiple locations. The herein architecture for the Statistical Data Analysis Component, presented in Fig. 2.11, considers this rationale for performing on-line quantification of uncertainties; and generating different levels of alerts.

Specifically, the Acquisition module is responsible for directly interacting with the Open Data Middleware and retrieving the sensing modalities $S\_p = \{s\_1, s\_2, \ldots, s\_N\}$

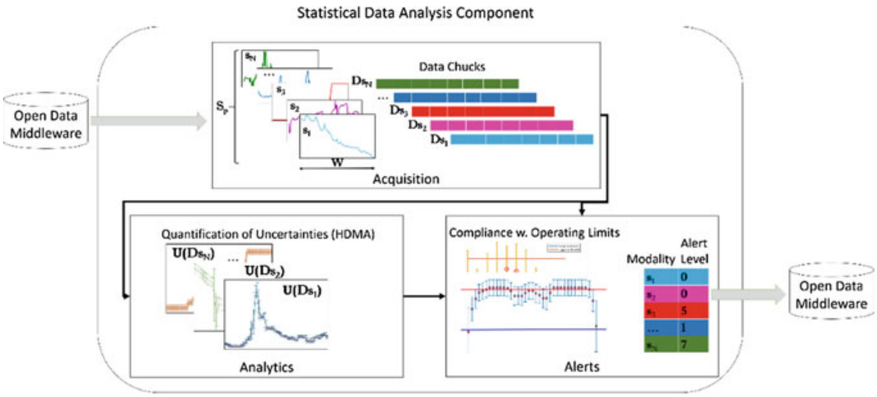

Fig. 2.11 The architecture of the statistical data analysis component

of each IoT sensing platform p deployed within the city. Depending on both the sampling rate of the sensing modalities and the on-line requirements of the end-user, these streams are derived in temporal windows, corresponding to W units of time (e.g., minutes). The resulting data chunk D_s for each sensing modality s ∈ S_p, is fed into the Analytics module, which is responsible for checking the contents of D_s for consistency, estimating the expanded uncertainty U(D_s) (Sect. 2.4.1.3), and providing first order-statistics for D_s over the temporal window W. Subsequently, the result of the Analytics module is employed by the Alerts module, which is responsible for categorizing the status the s-th modality of the p-th platform in different levels of alert, encoding different states of the s-th sensing modality:

(a) The absence of data from the s-th modality at the specific temporal window W;
(b) The provision of a data chuck D_s with no statistical variance [var(D_s) = 0];
(c) Non-compliance with the manufacturer operational limits;
(d) Non-compliance with the application-defined limits for the uncertainty-aware data chunk [D_s ± U(D_s)] (Sect. 2.4.1.3), which are associated to the application-defined limits (e.g., nominal range of temperature, healthcare limits for emission of gasses in the atmosphere).

Table 2.2 summarizes the different types of alerts considered.

The output of the statistical data analysis component (i.e., 1-st order statistics, expanded uncertainty and level of alert) is stored back to the Open Data Middleware. The above procedure is repeated for as long as fresh data streams arrive at the ODM, since the phenomena associated with these applications alternate at a frequent pace.

Table 2.2 The different types of alert that the statistical data analysis component considers

Alert level	Description	Reasoning of alert
1	Lack of data from the s-th modality within W	Platform/Network failure
2	No statistical variance of D_s	Sensor failure
3	Contents of D_s are below the lower operational limit of the sensor manufacturer	
4	Contents of D_s are above the upper operational limit of the sensor manufacturer	
5	$D_s \pm U(D_s)$ are above the lower operational limit defined by the application	Ambient of pollution emerging phenomena
6	$D_s \pm U(D_s)$ are below the upper operational limit defined by the application	
7	$D_s \pm U(D_s)$ are below the lower operational limit defined by the application	
8	$D_s \pm U(D_s)$ are above the upper operational limit defined by the application	
0	Normal status	

2.4.3 *Heraklion Smart City—Open Data Web Portal*

The Open Data Web Portal is a key component of the municipality's strategy towards building a smart and open city. It serves as an information hub as well as a repository for storing and distributing the municipality's open data (Fig. 2.12).

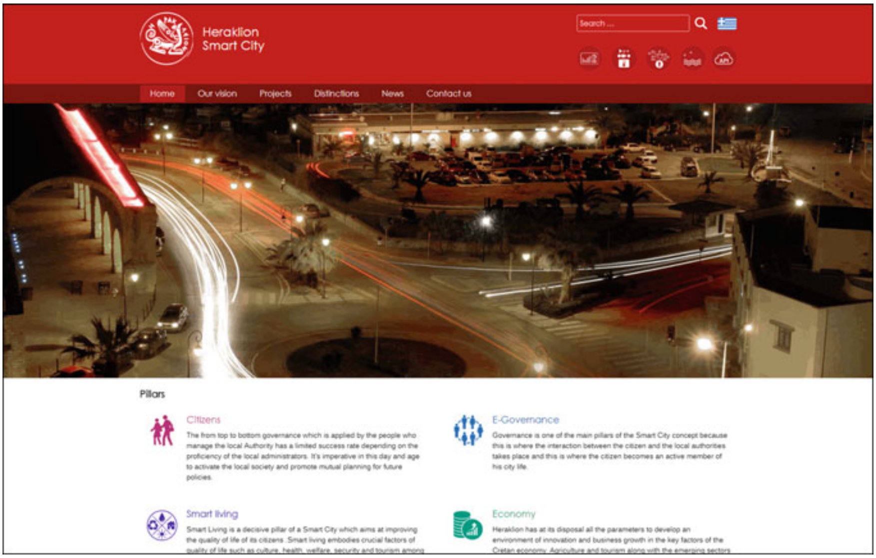

Fig. 2.12 Heraklion smart city web portal—home page

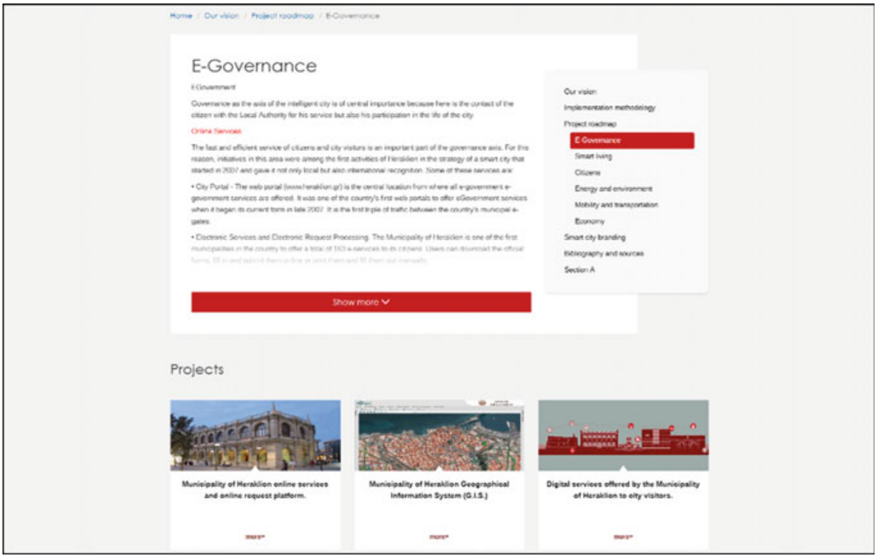

Fig. 2.13 Page with the detailed description of the e-Governance pillar together with the pillar's related projects

The portal provides a detailed description of the municipality's vision of a smart city. The vision aims to address the specific needs and challenges of the city; and focuses on six distinctive categories: e-governance, smart living, smart citizens, energy and environment, mobility and transportation, and economy. Citizens can view information regarding each category and related city projects that belong to the selected category (Fig. 2.13).

Additionally, the portal offers:

- News and updates regarding the municipality's actions, events, festivals, etc.
- Updates about nominations and awards received by the city.
- Visualization of open data collected by the IoT infrastructure (either real time or by exploring historic data).
- Visualization of Municipal data.
- Access to Open Data Datasets.
- Web APIs for third party integration.

In addition, the portal provides a Management and Monitoring System (see Sect. 2.4.3.2), which on the one hand displays information regarding the current operational status of the IoT infrastructure (Gateways and individual devices' status); and on the other hand, it contains an alarm notification system that informs the portal administrators of extreme events (e.g. when CO_2 health limits are exceeded) and of potential malfunction of specific sensors. The Management and Monitoring System can only be accessed by authorized users.

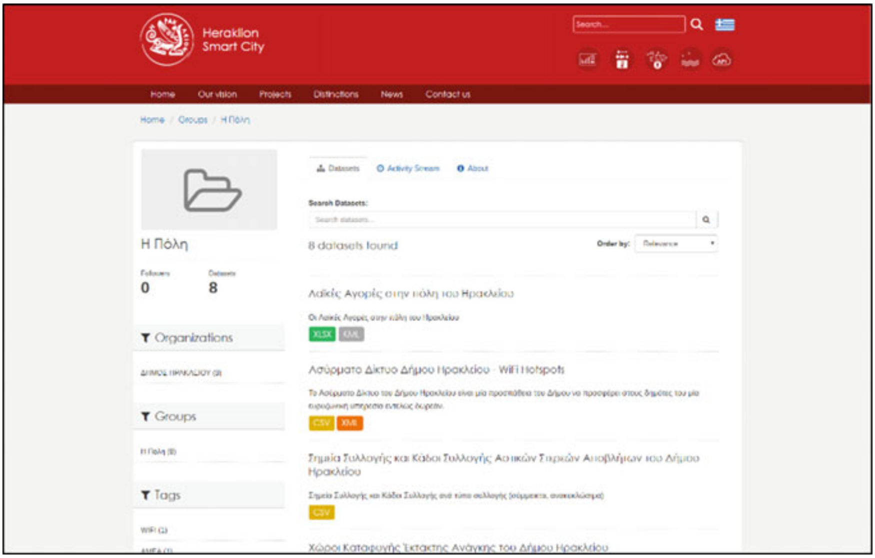

Fig. 2.14 CKAN dataset management system

On a technical level, the Heraklion Smart City Open Data Web Portal consists of three distinct components, the Content Management System, the Datasets Management System and the Open Data Visualizer. The three components are configured to provide a unified user experience, with seamless transitions between the components.

WordPress was selected as the Content Management System for its easy and comprehensive administration interface. CKAN was employed as the Datasets Management System (Fig. 2.14). CKAN is used by many public institutions seeking to share their data with the general public. The Open Data Visualizer was implemented as Single Page Application using Google's AngularJS framework. The graphs are dynamically generated SVG images. which are rendered using the D3js library.

2.4.3.1 Open Data Visualization and Exploratory Search

The Open Data Visualizer provides visualizations of sensor measurements, recorded by the IoT infrastructure and collected by the Open Data middleware, as well as data from other sources, such as the municipality's social service, the civil register, the demographics service etc. The Open Data Visualizer employs both infographics and basic charts (e.g. line charts, bar charts, etc.) for displaying information. Infographics are used as visual shorthand for presenting complex data quickly and clearly. Basic charts are used when the user needs an extended view of the collected data. Basic Charts are presented alongside with exploratory search mechanisms for the examination and comparison of collected data.

The Visualizer employs the notion of Features of Interest (FOIs) for aggregating a set of devices and sensors under a single unit. Visualization of FOIs data is an aggregation of the recorded values of the individual devices or sensors in a specific geographic area.

The Open Data Visualizer is organized under the following categories: urban environment, water resources, parking monitoring and municipal open data.

Urban environment monitoring

The Urban environment monitoring component provides an interface for examining the Heraklion IoT infrastructure, displaying real-time data and exploring historic data. The following parameters are monitored: ambient temperature, ambient humidity, atmospheric pressure, wind (speed and direction), dust, VOC (volatile organic compounds), noise level, luminosity, and gases concentrations (SO_2, NO, NO_2, CO_2, O_3).

Water resources

Water sensors are installed on the municipality's water reservoirs. The water sensors record measurements regarding the quality and the quantity of the water (water level, water temperature, conductivity, PH and ions {NH_4+ , NO_3−, Cl−, and Ca_2+}).

Parking monitoring

Parking sensors are placed in various locations in the city, where parking is prohibited. For that reason, the views for the parking sensors can only be accessed by municipal police. A hypermap is used to display the real time status of each parking sensor (either free or occupied). The map gets real-time updates by the Open Data Middleware for the current sensor status.

Other municipal data

Besides the data collected by the IoT infrastructure, the Open Data Visualizer also displays Municipal Data collected by other sources, such as the Civil Register, the municipal library, the social services, etc. Data is combined and presented in infographics that are generated dynamically by changing the selected time period (semester or year). Furthermore, individual dataset exploration is provided.

In order to enhance the user experience, several visualization components have been deployed with different user interfaces and functionalities, each serving a distinct scope.

Dashboard

The dashboard offers a quick overview of the real time data. The main goal of the dashboard is to display an integration of various data and to get the user familiarized with the different types of data that is being collected. The information displayed on the dashboard is organized in panels. Each panel is dedicated to a different aspect of the smart city ecosystem, such as the municipality, the citizens, the urban environment, etc. Users can interact with the panels and switch between

Fig. 2.15 The open data visualizer dashboard

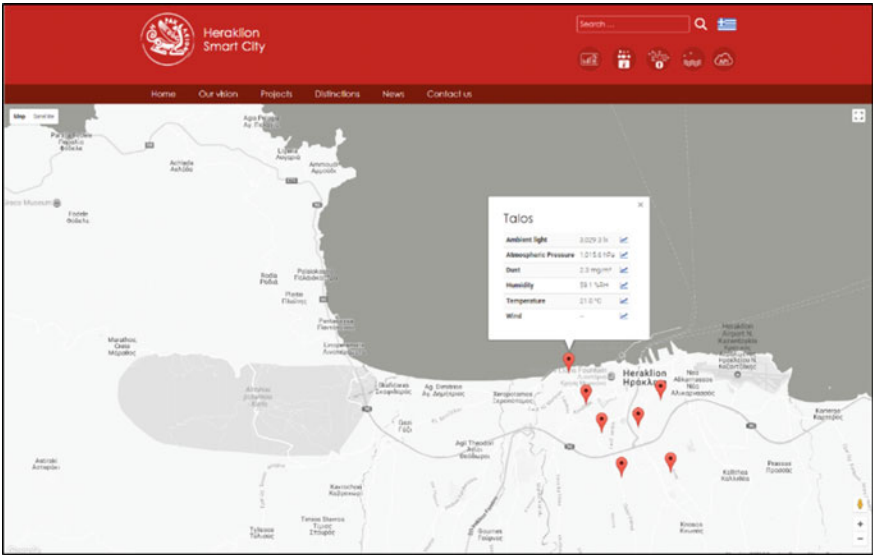

Fig. 2.16 FOI's with real time sensor measurements

views of the data being displayed. Each panel offers a link to a relevant page of the Visualizer, where the user can explore in detail the displayed data (Fig. 2.15).

IoT infrastructure

A hypermap is used for displaying the spatial distribution of the environmental IoT infrastructure. FOI's are displayed on a map that users can interact with, by panning and zooming as well as selecting specific FOIs. By selecting a FOI, a user can examine which parameters are being monitored and view their respective current values (Fig. 2.16).

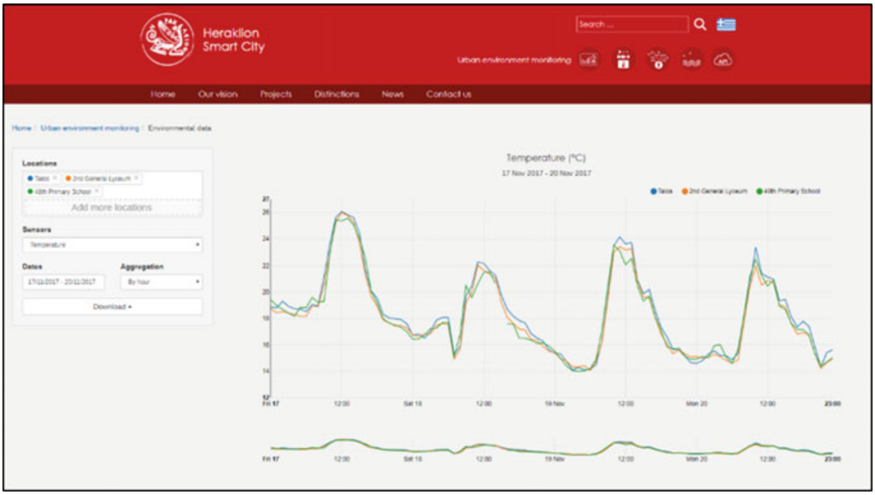

Fig. 2.17 The environmental data explorer

Live data

The Live data view visualizes the latest unprocessed (raw) values of the selected FOIs. Users can examine the real-time stream of data for all recorded parameters. Users can select the list of FOIs to be displayed; and adjust the length of the selected time window between one and six hours.

Environmental data explorer

Historic environmental data can be explored for each individual sensor modality. Data is displayed on a line chart with each line representing a FOI. The displayed values are aggregated by predefined time intervals. Users can adjust the selected time window as well the aggregation of the values. Possible aggregation values are by hour, day, week and month (Fig. 2.17). Moreover, wind measurements are additionally visualized using a compass rose (also known as wind-rose), which delivers a more concise perspective of the prevailing wind speeds and direction for a given location.

2.4.3.2 Managing and Monitoring System

Heterogeneous networks are systems encompassing components that differ in terms of software and hardware. A managing and monitoring system is required to present information regarding the status of the nodes, sensory data, network statistics, etc. The correlation of network statistics and weather condition can aid the network administrator to detect potential problems and take the necessary actions. A Monitoring Server (MS) has been developed for the Heraklion smart city ecosystem, collecting and displaying metrics acquired by the sensor network. MS is

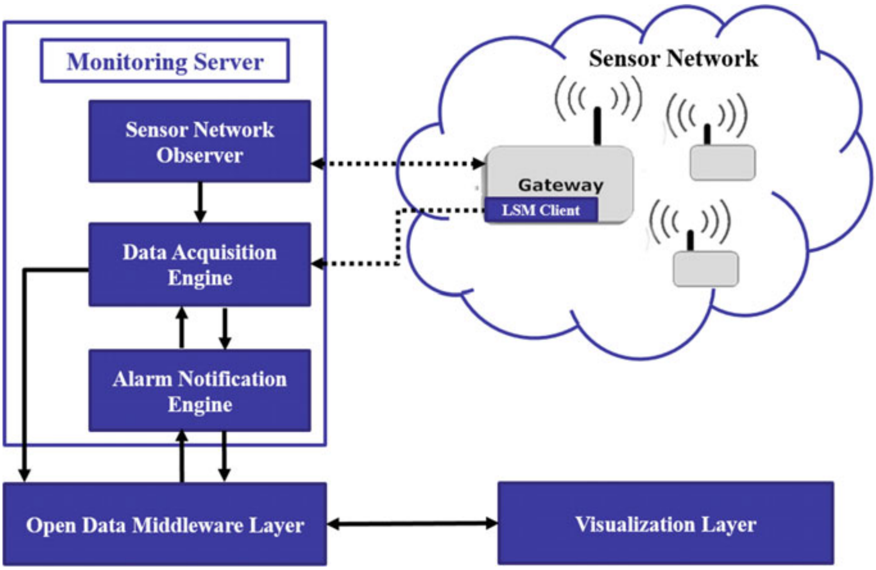

Fig. 2.18 Monitoring server architecture

also responsible for sending instant alerts in case of network failures or extreme environmental events.

The MS consists of the following modules (Fig. 2.18): The Sensor Network Observer, the Data Acquisition Engine and the Alarm Notification Engine. The goal is to develop a handy tool that incorporates all modules in a single instance; and can be deployed on various different platforms; hence it was implemented using NodeJS. The HTTP Restful API is used as the communication module of the system.

The Sensor Network Observer is responsible for acquiring data regarding the status of the Sensor Network. It polls the IoT Gateways periodically at configurable time intervals. At first, information such as the online status of the Gateway, the date that it was last seen online, the number of the respective sensors that it manages and which of them are online, are gathered by this component. The second level of information encapsulates data regarding the sensors, such as their unique ID, their Type and the types of measurements they are capable of providing, their IPv6 addresses, their status (online/offline) and the date their last activity was reported. HTTP GET requests are used for the polling procedure, and the format of information data is based on JSON.

The role of the Data Acquisition Engine module is to receive data from the Sensor Network Observer module, to aggregate it and transmit it securely in the Open Data Middleware Layer. In addition to that, it receives sensory data from the sensors, issuing HTTP posts. The IoT Gateways relay these measurements from the sensors to the Acquisition Module as soon as they receive them from the sensors they manage.

The Alarm Notification Engine is one of the basic parts of the Monitoring Server. Its main goal is to monitor the data, relying on a framework of rules; and alert the network administrators in case any rules have been violated. This framework is a logical combination of simple comparisons. For example, if the temperature is above 40 degrees or rainfall exceeds a certain threshold, then alert the administrator. Administrators are aided by the Alarm Notification Engine to take precautions or forecast an imminent failure of the network.

The extracted level of alerts for all sensing modalities over subsequent temporal window that are stored in the Open Data Middleware are fed into the Managing and Monitoring System of the Open Data Web Portal, for providing on-line notifications of the status of both the sensor modules as well as the ambient and pollution conditions around the city. Specifically, the Managing and Monitoring system yields notifications for the sensing modalities presented in Table 2.3. The lower and upper operational limits associated to either the manufacturer specifications or the nominal conditions[1]defined by the application (RERUM EU Project 2016) drive the extraction of alerts {3, 4} and {5, 6, 7, 8} respectively.

Table 2.3 The lower and upper operational limits for each sensing modality for the calculation of alerts

Sensing modality (unit)	Lower operational limit (manufacturer)	Upper operational limit (manufacturer)	Lower operational limit (application)	Upper operational limit (application)
Ambient light (Lux)	0.1	40,000	0	12,000
Loudness (dB)	34.6	95	34.6	85
Rainfall (mm)	0	10	0	8
Temperature (C)	−40	125	−10	50
Volatile organic compound (VOC) (ppb)	0	600	0	600
Sulphur dioxide (SO_2) (ppb)	0	20,000	0	7.09
Ozone (O_3) (ppb)	0	20,000	0	47.3
Nitrogen dioxide (NO_2) (ppb)	0	20,000	0	19.7
Nitrogen oxide (NO) (ppb)	0	250,000	0	25,000
Particle matter (mg/m^3)	0	0.8	0	0.05
Humidity (%RH)	0	100	0	100
Carbon dioxide (CO_2) (ppm)	0	20,000	0	430
Atmospheric pressure (hPa)	300	1100	600	1050
Wind speed (Km/h)	0	96	0	50
Wind direction (deg)	0	359	0	359

[1]European Environmental Agency, https://www.eea.europa.eu/

Different levels of alert are addressed to different users of the Open Data Web Portal. Specifically, the levels of alert {1, 2, 3, 4} are associated to failures of the sensing or network underlying infrastructure (e.g., consistent packet losses, power/hardware failure) and are therefore aimed to the administrators of the platform. In contrast, the levels of alerts {5, 6, 7, 8} map to the emergence of meteorological (e.g., heat wave, flash flooding) or environmental (e.g., CO_2 emission) alerting, and thus are addressed to the environmental scientists and the municipal/prefectural civil protection agencies.

2.4.3.3 API—End User Documentation

The Open Data Web Portal exposes public web APIs available for consumption by third-party agents. The APIs endpoints provide direct access to data stored by the Open Data Middleware system and the Datasets Management system. The APIs are documented using the OpenAPI specification standard; and are offered with read-only access to the general public. The Swagger UI is used for rendering the API endpoints in the portal's frontend.

The Open Data Middleware API endpoints are grouped in the following categories: IoT Infrastructure, environmental measurements, environmental measurements analytics and other municipal data and datasets. The IoT infrastructure group provides endpoints, which deal with FOIs, devices, sensors, modalities and the relationships between them. The environmental measurements' group offers endpoints for accessing the raw, unprocessed data as recorded by the IoT infrastructure. The endpoints of other municipal data category deal with aggregated data regarding the demographics, the library, the municipality's financial data, the social services, etc. Finally, the dataset's group deals with retrieving datasets, dataset's files and their respective metadata.

2.5 Lessons Learnt—Future Work

Following the process of creating a Smart City ecosystem in Heraklion, several lessons were learned mainly stemming from the need to combine state of the art and non-mature technologies with out of the shelf-products. Especially in the case of IoT nodes, issues were faced with the extreme weather conditions of the Mediterranean (e.g. during summer), which resulted in the development of a new prototype node that could handle the large amount of sensors employed by the infrastructure, while at the same time being robust to weather conditions.

The locations where IoT devices are installed should also be very carefully planned, since the positioning of the devices can affect significantly the measurements, i.e. if the devices have direct contact with sunlight, the temperature or the light sensors may exhibit higher values. The installation points should also be selected in order to avoid physical tampering of the devices or excessive wireless traffic that may create congestion and lost measurements. This latter part is extremely important, as most IoT devices operate in the ISM bands, which are normally congested within cities. This implies that communication links should be carefully tested prior to installation of devices at the desired locations. A reliable network monitoring mechanism should be in place so that the network administrator can easily check for malfunctioning devices or faulty links and act to solve the issues.

The configuration of IoT devices is mainly done manually with physical access to the devices (i.e. via a USB interface). Considering that in cities, hundreds or thousands of devices will be installed and many times in remote, not easily accessible, locations, it is not possible to easily reconfigure the devices manually. Thus, remote re-configuration is mandatory for IoT smart city installations and this can help significantly in the scalability of the overall system. Re-configurability can be used for solving bugs, changing security keys, adding drivers and supporting new protocols. This latter part is very important due to the severe technology fragmentation and the plethora of available communication and networking technologies and protocols.

This inevitably leads to the need for standardization, as existing IoT solutions follow different communication standards and platforms. Furthermore, as the infrastructure expanded, the need of data and device management became apparent. This can be perceived in terms of devices as the need for automated reporting, self-analysis, self-validation, self-operational assessment and ultimately self-healing (coping with the lack of human-resources in municipalities as a result of the economic recession in Greece). At the same time, the need for reporting was addressed through both the web portal and the VR visualization framework.

In the future, the ultimate goal is to disseminate the outcomes of this research work, while continuously updating the infrastructure to keep up with new scientific and technical developments. Updates in the IoT infrastructure include the deployment of more smart parking sensors throughout the city, city center traffic monitoring, municipal buildings energy management, etc. Furthermore, fostering the exploitation of the smart city ecosystem by the ICT sector at the city of Heraklion will create innovation and new added value services for all citizens.

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Chapter 3
Smart Cities on the Cloud

Christina Kakderi, Panagiotis Tsarchopoulos, Nicos Komninos and Anastasia Panori

Abstract The emergence of the cloud computing paradigm has found fertile ground in the smart cities discipline, especially with regards to its benefits both in terms of big data storage and analytic capabilities and in terms of smart city service provision. Over the past years we have noticed an abundance of publications on cloud computing; from government reports to corporate studies, all show the significant benefits of cloud computing and the opportunities presented by the migration of public/municipal services to the cloud. Despite the availability of information, the landscape with regard to cloud computing adoption is still quite blurry. This chapter aims to provide methodological guidance to public/city authorities on the use of and the actual steps towards taking up the cloud computing paradigm. More specifically, it offers a simple methodology in the form of a roadmap with the main roadblocks one can expect to encounter when migrating public services to the cloud, along with a set of recommendations that facilitate decision-making in various stages of this process. We also argue that cloud computing adoption should not be an isolated action of an organization (city authority/ governmental agency), but part of a wider strategic model based on open innovation practices (the use of open source technologies for the cloud platform and applications, the use of open data, the adoption of user engagement methodologies etc.) as well as the use of innovative business models.

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Keywords Smart cities · Cloud computing · Migration to the cloud
Cloud platform · Applications

3.1 Introduction

Cloud computing has received significant attention over the last decade especially with regards to the benefits it creates in the case of large organizations with high levels of complexity and limited financial and operational resources. Despite the emergence of a large volume of scientific publications as well as of corporate and governmental reports on the subject, the landscape with regards to cloud computing adoption is still quite blurry. First, there is not a clear picture on how city authorities can practically document the benefits to be enjoyed from cloud computing. This does not only refer to monitoring the changes in the performance and cost of stand-alone applications, but also to documenting the overall impact on their organizational efficiency and smart city strategic goals. Second, there is limited evidence on how city authorities can overcome the main challenges that appear due to the transition of their services to the cloud. One might think that leveraging cloud computing would only require the existence of technical capabilities on the part of the public authority. Nevertheless, there are many more challenges that have to be addressed; institutional and legislative limitations or organizational deficiencies are only a few of many. Also, as cloud computing adoption is not a one-step process, but rather a selection among multiple route paths and levels of engagement or acceptance, the development of a cloud migration strategy is far from 'a one size fits all' plan. Therefore, city authorities must fully comprehend the rich but mostly fragmented information they have in order to develop their own strategy that will reflect a series of choices on multidimensional aspects.

Cloud Computing entails significant operational and financial benefits to cities, allowing them—among other things—to select, adapt and re-use ready-made and tested smart city services/solutions. Besides, cities worldwide face more or less the same socio-economic and environmental challenges. Nowadays hundreds of applications exist (open source or proprietary) that try to cope with complex urban problems such as traffic management, environmental pollution, safety and security and so on in cities (Komninos et al. 2014). The challenge therefore is not to develop smart city services, but to prioritise needs, leverage new technologies and capitalise on different business models.

This implies that cloud computing alone is not sufficient to transition to this state of 'smartness'. Besides, the potential of smart cities lies not only in the use of ICT infrastructure and the development of digital services but also in the redefinition of their innovation ecosystem with the aim of establishing and nurturing structures for collaborative intelligence (Komninos et al. 2012). During recent years, cities in Europe and the rest of the world have been urged to attract external resources and involve various actors in dealing with urban problems. We are witnessing cities embracing a culture of 'openness' through the adoption of open innovation, the use of open data or the development and sharing of open source smart city applications. Tsarchopoulos et al. (2017) discuss the adoption of open innovation practices in smart cities through: (i) the establishment of collaborative communities with the aim of crowdsourcing ideas and/or effort in addressing complex urban problems, (ii) the formation of competitive communities such as hackathons and smart city application development contests, and (iii) the development and offering of applications which target common urban problems through open online repositories with the aim of them being to be reused by other cities. Lastly, the adoption of new technologies leads to the emergence of innovative business models that depart from traditional models of infrastructure financing; and reveal new business opportunities and complex relationships among the stakeholders and the financial system (Hamilton and Zhu 2017; Díaz-Díaz et al. 2017).

Building on this discourse we concur with the organizational and financial benefits that cloud computing provides to city authorities in order to achieve their smart city vision. Our aim in this chapter is to provide methodological guidance on the use and the actual steps required in taking up the cloud computing paradigm. More specifically, we offer a simple methodology in the form of a roadmap with the main roadblocks encountered when migrating public services to the cloud, along with a set of recommendations that facilitate decision-making in various stages of this process. We also argue that cloud computing alone is not sufficient and that the added value of its benefits can only be maximised once it is combined with a broader strategy for smart city development. In other words, cloud computing adoption should not be an isolated action of an organisation (city authority/ governmental agency), but part of a wider strategic model based on open innovation practices (the use of open source technologies for the cloud platform and applications, the use of open data, the adoption of user engagement methodologies, etc.) as well as the use of innovative business models.

This chapter is organised into four sections. After the introductory section where we describe the context and general problem on which this work is focused, the second section reviews the literature on cloud computing and the way it is connected to the smart cities literature. The section ends with a description of the STORM Clouds[1] platform and services (a H2020 project outcome) and the overall methodological experiment on migrating smart city applications to the cloud. The third section describes in a detailed set of sequential steps and sub-steps the process of migrating public services to the cloud and provides a set of recommendations targeted to city authorities that ensure the success of this task. The final section highlights that in order to fully reap the benefits of the 'smartness' paradigm, public authorities have to adopt a wider set of strategic choices apart from just leveraging cloud computing. These choices refer, among others, to the use of open data, the creation and sharing of new data or the adoption of user engagement methodologies.

[1]STORM CLOUDS Project, http://stormclouds.eu/. Accessed 20 December 2017.

3.2 Smart Cities and Cloud Computing: A New Pair of Concepts in the Recent Literature

3.2.1 Cloud Computing Definition and Implementation

Cloud Computing (CC) has received considerable attention over the last decade as an emerging paradigm beyond a simple computing system structure (Kakderi et al. 2016a; Seo et al. 2014). In simplified terms, it can be understood as the possibility to store, process and use data on remotely located computers accessed over the Internet (EC 2012). *"Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction"* (Mell and Grance 2011: 2). Therefore, it is an all-inclusive solution based on the concepts of converged infrastructure, shared services/resources and dynamic reallocation based on demand, which has the potential to bring significant benefits to its users (citizens, businesses, government), such as cost savings, increased efficiency, user-friendliness, accelerated innovation (Mahmood 2016; ECPSB 2014).

Cloud computing can be classified on the basis of targeted service and its prospective use (Zhang et al. 2010; Seo et al. 2014) in four main types: public clouds, private clouds, hybrid clouds and community clouds. Nowadays, one can find numerous reports and contributions providing a detailed description of the prevailing categories, which may altogether be referred to as the Cloud Computing Stack: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS). A simplified description of what each one of these categories entails is that: (a) SaaS applications are designed for the end-users and are delivered over the web, (b) PaaS is the set of tools and services designed to make it easy to code and deploy these applications in a quick and efficient way, and (c) IaaS is the hardware and software (servers, storage, networks, operating systems) that powers all the above (Tsarchopoulos et al. 2017).

As a technology and an industry, cloud computing seems to have reached a certain level of maturity, allowing for full commercial exploitation. It is estimated that, with the right policy framework, the cloud economy could generate nearly 1 trillion in GDP and 4 million jobs by 2020 in Europe (IDC 2012). A KPMG study for Australia shows that the increased adoption of cloud computing in the country would lead to a growth of annual GDP by \$3.3 by 2020 (KPMG 2012). At the global level, IDC estimates that it can create \$1.1 trillion of business revenues per year. Although it is now established in the technology toolbox, the rationale for using cloud continues to evolve (Miller et al. 2018). In fact, as shown by Fig. 3.1, it is not the technology itself that has sparked a growing interest in the academic literature, but its unlimited implementation in the field of smart cities.

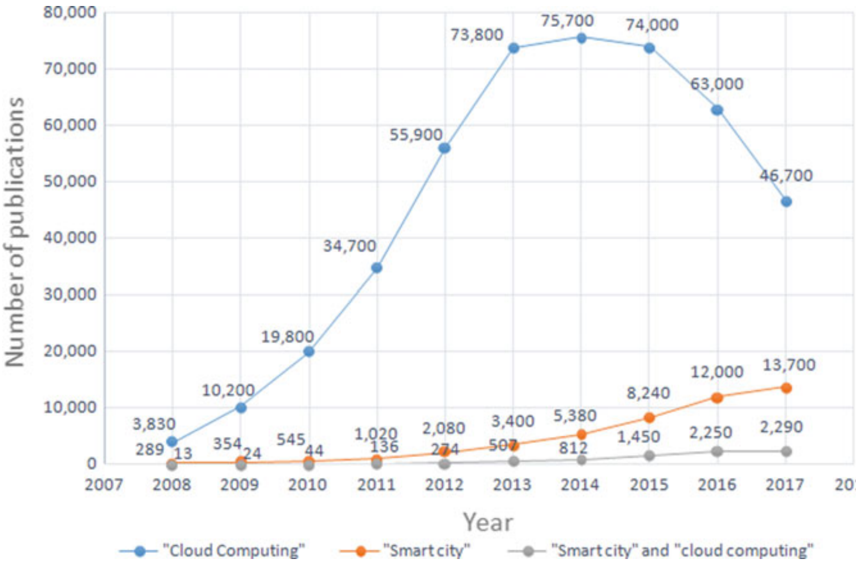

Fig. 3.1 The evolution of academic publications on CC and CC in smart cities. *Source* Own elaboration based on Google search data (2008–2017)

3.2.2 The Field of Smart Cities

Smart cities is a particularly popular concept that has emerged since the beginning of the millennium, covering a wide range of scientific disciplines including urban planning, computer science and sociology to name just a few (Mora et al. 2017). It reflects both the vision of a new generation of cities and a new planning paradigm (Komninos 2015) towards more efficient and sustainable cities that offer a high quality of life to their citizens. The concept does not limit itself to the use of new technologies that create efficiencies for urban problems. Technology is just an enabler empowering emergent innovation ecosystems in the urban space to create collective intelligence (Schaffers et al. 2011).

The popularity of the concept has led cities worldwide to adopt smart city strategies and develop services for their citizens, focusing on different city domains (economy, infrastructures, governance etc.) that deal with various challenges of the urban environment (investment attraction and entrepreneurship, mobility, waste management, etc.) (Komninos 2015). This task can be overwhelming in terms of IT infrastructures and capabilities. Due to high technological requirements, many multinational technology and consultant companies have found fertile ground to become involved not only by developing technology products and solutions, but also by shaping the theoretical framework and research agenda in the field of smart cities (Komninos 2015). The market potential is almost unlimited. According to a report by Global Industry analysts in 2016, the global market for smart cities is projected to reach $1.2 trillion by 2020.[2]

3.2.3 Cloud Computing and Smart Cities

Cloud computing seems to have a key role to play in the development of smart cities. Among the numerous corporate reports and scientific papers, we can distinguish some efforts to combine the two notions. A special issue on smart cities and cloud computing that was recently published (Kakderi et al. 2016b) discussed the main pillars for developing or migrating smart city services to the cloud: the design and development of the Cloud environment, the selection and adaptation of the services that are most suitable for the selected Cloud environment, and the use of data mining and analytics in order to gain insights from the data on the cloud. Besides this, a couple of reports and EU-funded research projects, such as EPIC and STORM Clouds reflect the interest in the decisions that city authorities have to face as they transition to the cloud, and have tried to address obstacles that hinder the use or contribute to the slow uptake of cloud technologies, especially within their smart city strategy.

The attention on the coupling of these two notions can be attributed to two strands of literature. The first strand has to do with the nature of city authorities as complex organisations and the benefits that cloud computing creates for entities with such an extended size and scope of services. More specifically, most city authorities are very complex in nature with many entities (departments, agencies etc.) sharing large volumes of data, but also have rigid organisational structures and significant funding restrictions in terms of innovation. They also encompass services in diverse business and technological domains, which are often based on monolithic architecture models, disconnected from each other and difficult to re-use (EC 2014). In recent years many city authorities have been seeking out new ways to improve their service quality and delivery, transparency, responsiveness as well as the effectiveness of their investments, hence there is an increasing interest in cloud computing. The concept of cloud computing is not only relevant due to its significant benefits, such as coherence, flexibility and economies of scale; it is also linked to the idea of open, connected and re-usable public services (EC 2014). According to Hamilton and Zhu (2017) the more fundamental services available on the cloud, i.e. basic public services, the higher the opportunity to re-use and combine them with existing services from other governmental departments or to develop new services in collaboration with third parties (Angelidou et al. 2017; Komninos et al. 2016).

[2]http://www.strategyr.com/MarketResearch/Smart_Cities_Market_Trends.asp. Accessed 4 April 2018.

The second strand of the literature has to do with the challenges that city authorities face in their effort to deal with urban problems. To do that, they have to collect and manage an enormous amount of heterogeneous data coming from a variety of sources (sensors and other devices, smartphones, domestic appliances, etc.). They also have to be able to analyse these data and extract meaningful insights that can be used in their smart city operations. Kakderi et al. (2016b) describe the need for cloud computing in smart cities in three main areas: (i) the facilitation of big data storage, processing, mining and analytics as well as visualisation integrating various objects in IoT, (ii) the ability for virtualisation which abstracts the physical infrastructures and creates various dedicated resources according to user needs, and (iii) the applicability of all three service models (IaaS, SaaS and PaaS) of cloud computing to smart city solutions.

The main impacts of cloud computing in service delivery are that it reduces the need for internal resources (cost, time), enables the provision of more integrated and user centric services, improves agility and transparency and facilitates the development of innovative services (Deloitte 2011; Chandrasekaran and Kapoor 2011). Mahmood (2016 xvii) has summarised the benefits of cloud computing adoption by public organisations by grouping them in two categories: the ones that address the public organization themselves and the ones that address citizens. More specifically, governments can have improved management; cost and time savings; more precise and timely information; automation; easy maintenance and upgrading of services; and harmonious collaboration with other governmental departments whether vertical or horizontal. Citizens, on the other hand, have access to easy-to-use and on demand e-services; reliable and timely information and services available around the clock; opportunities for participation in decision-making, also through digital means.

Despite the significant benefits described above, there are a number of reasons cloud adoption is not occurring more rapidly in the public sector. Many challenges relate to its newness and the relative underdevelopment of the marketplace for cloud services (Craig et al. 2009). The most common concerns are related to security and data protection, privacy, portability and interoperability. However, there are also some organizational challenges that public authorities have to consider before moving their services to the cloud. The first is related to the *lack of flexibility in public procurement*. Public authorities can use their procurement weight in order to promote the development and uptake of cloud computing based on open technologies and secure platforms (EC 2012). However, IT budgets in the public sector are usually planned in advance, allowing little flexibility for last minute changes. The second refers to the *lack of uniformity in standards* across nations. Contrasting rules on privacy, security, storage and accessibility create difficulties for cloud providers in delivering on the full promise of information technology (West 2010). Finally, there are some *cultural problems* which emerge from the fact that different organizations—or departments within the same organization—are not used to collaborating or sharing solutions with each other.

3.2.4 Cloudification of Smart City Services

Cloud migration is an application landscape redesign that changes not only the way IT administrators interact with the public organization's systems but also the way applications interact with each other and are delivered to end-users (Brophy 2016). The decision to migrate an application to the cloud requires a very deep understanding of the application architecture, the operational requirements, the business requirements, and the security requirements in order to make the most well-informed decisions (EPA 2017).

The fundamental issue public authorities face, when moving to the cloud, is the identification and implementation of the appropriate strategy, which meets the aims of their organization whilst enjoying the cloud's significant benefits. Migrating to the cloud raises many questions and poses a number of risks for organizations if not handled correctly. As it has already been mentioned, published reports review the main aspects of cloud computing, however, the exact way in which such a task can be undertaken is still an unknown process. In fact, there is not a single strategy: a public service organization can choose to be one of three things; a user, a provider or both. The complexity also derives from the fact that all key players, such as regional governments, citizens and service providers, can get involved (Accenture 2013).

The migration of public services and applications to the cloud should be done in a strategic and methodological manner, after considering a large number of key aspects, such as the cost of migration, application redesign, application performance and availability, security and privacy requirements, regulatory requirements, etc. (CSCC 2018). Although there is not a single path, planning for cloud migration should entail careful preparation and a defined strategy in a form of a roadmap that will act as a guide, as well as a checklist with technical, managerial, financial and other considerations.

The following section presents some useful guidelines on how to address the process of moving towards a cloud-based solution for public authorities and policy makers. We use the experience gained from STORM Clouds,[3] an EU co-funded CIP project, which aimed to accelerate the pace at which public authorities move to cloud computing.[4] The guidelines that are presented below have been prepared

[3]STORM CLOUDS Project, viewed December 20, 2017, http://stormclouds.eu/.

[4]Some of the core elements of the project, which facilitated this experimentation, are the following:

(i) A cloud-based platform that provides the environment to host the smart city applications. The STORM Clouds Platform (SCP) is a layered cloud architecture that is based on open source technologies (Battara et al. 2016). The platform provides an advanced and customizable IaaS solution that supports both public and private cloud deployment models, facilitating the deployment of civic applications in a cloud environment.

(ii) A list of cloud-related services, such as security and data protection, resource monitoring, automation etc.

based on direct experimentation in 4 European cities (i.e. Thessaloniki, Valladolid, Agueda, Miscolc), creating a set of relevant use cases and best practices that allow public authorities to take full advantage of the cloud computing model.

3.3 A Roadmap for the Migration of Public Services to the Cloud

Drawing on the experience gained from this project we have created a roadmap that aims to help public authorities in their migration to the cloud. The roadmap provides a set of guidelines with regards to the technical, organizational and business challenges in the transition of smart city services to the cloud. An illustration of the roadmap can be found in Fig. 3.2.

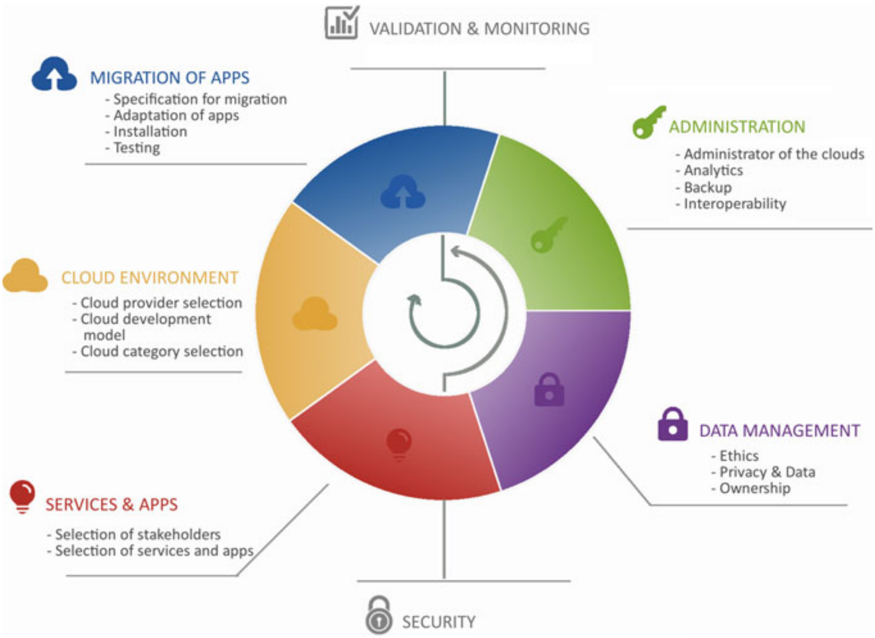

Fig. 3.2 A roadmap for planning public services' migration to cloud computing. *Source* Own elaboration

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(iii) A portfolio of consolidated and interoperable open-source cloud-based smart city services that cover a variety of city functions, such as the innovation economy, city governance and quality of life. These services can be easily transferred and adapted to other cities. This process can be facilitated with the use of the SCP and the accompanied services as well as with the methodological guide provided below in the form of a roadmap.

The roadmap includes five sequential steps (services and applications, cloud environment, migration of applications, cloud administration, data management) and two parallel procedures (security and validation/monitoring). We argue that these steps represent the main roadblocks that public authorities have to face and for each one we provide guidance, either by describing a case study solution or by providing a set of recommendations/guidelines.

3.3.1 Step 1—Services and Applications

The *first step* in the roadmap starts with the *identification and engagement of the stakeholders* that will participate in this user-driven process as well as the *selection of the most suitable services* to be cloudified.

Step 1a. Selection and engagement of stakeholders

Engagement strategies should start from the first stages of the migration process in a series of iteration cycles that should include the following steps:

i. The identification and classification of stakeholders according to the type of services, in order to involve as many as possible. Stakeholders might be internal to the public organisation itself, such as groups of employees or departments (legal, IT, budget/financial, procurement), but also external, such as community groups, business associations, NGOs, Cloud Service Providers, etc.
ii. Segmentation of stakeholders based on their level of interest and influence as well as definition of the roles and potential responsibilities. As not all of them can contribute to the same degree, public authorities should also identify which ones are expected to influence the service by acting as co-creators, as contributors or as users.
iii. Mapping or creating and utilising (digital and traditional) tools and methods that will enable continuous collaboration with stakeholders. Different stakeholders might need to be contacted via different communication channels (e.g. newsletters, social networks, personal meetings and working groups). Also, different tools might be used for different levels of engagement (information, consultation, training, etc.).
iv. Analysing different elements in order to prevent potential problems and defining contingency strategies (Table 3.1). For example, cloud migration might trigger a reluctance to change among some employees; therefore change of management processes might be needed.

Step 1b. Selection of the services to be cloudified

Before transitioning to the Cloud, it is vital that public authorities first determine which applications better fit into the Cloud environment. Identifying and prioritizing the best applications to be moved to the cloud means considering and analyzing different factors that have to do with the service/app itself (architecture,

Table 3.1 Method to identify cloud migration risks and define contingency plans *Source* Own elaboration

Element	Risk	Contingency plan
Technical staff	Feel that their job is at risk and don't collaborate in the migration process	Training sessions to improve their skills so they can work with the cloud Job redefinition
Management	The resources required for the project are not provided	Apply long-term reasoning to show that a current investment will bring future savings

design, potential usage, technical and legal specifications, etc.), the experience and expectations of the responsible organization, dependence on third party software, etc. The selection of services should primarily be made based on the organization's objectives and needs, and for this, internal reviews might provide important insight. However, in general terms, the most suitable ones are applications that make the most of the elasticity of Cloud Computing and can lead to significant financial savings.

For each of the services identified, one must collect information on the technologies currently in use such as the operating system, programming language, databases, web/app services, frameworks, application lifecycle tools and whether the app exists (or not) in an open source repository. Migrating services to the cloud implies the possibility of other city authorities accessing services and transferring them without the need to develop them from the scratch. Such a task includes analysis of a different set of criteria such as: (i) documentation, (ii) target users, (iii) flexibility, (iv) language, (v) compliance with internal security regulations, and (vi) specifications.

3.3.2 Step 2—Cloud Environment

The decision on the Cloud environment which comes as a *second step*, relates to *cloud service category selection* (IaaS, PaaS, SaaS), the *selection of the cloud development model* (public, private, hybrid, community) and technologies as well as the *selection of the Cloud Service Provider*. The available choices in this step have mostly been analysed in the recent literature.

Step 2a. Cloud service category selection

With regards to cloud service category selection, each of the available services (IaaS, PaaS, SaaS) has its own specific implication for using it. SaaS describes the most abstract layer of the cloud stack and it is more suitable if the organization wants ready-made online applications, although it cannot be applied if one is migrating an existing application to the cloud. Usually, most common choices involve a combination of SaaS and IaaS as public authorities first concentrate on the infrastructure (Bonneau et al. 2013). If public authorities want to migrate their own applications to the cloud, they have to select between IaaS and PaaS, both of which enable the extension of platforms so that public authorities' IT can respond proactively and reactively to increased demand for services at a lower cost (VMware 2011). IaaS is the most flexible (as it does not require any architectural changes to be made to the applications or to have full control of the resources for deployment) albeit a more complex solution, given that it requires prior installation and configuration of all the components for high availability and scalability. PaaS on the other hand offers the cloud infrastructure and manages levels of scalability, software upgrades and maintenance, although it might require significant changes to the applications (Tsarchopoulos et al. 2017).

Step 2b. Cloud deployment model selection

To select the best cloud deployment model (public, private or hybrid), the organization has to make a number of decisions with regards to the level of control, security requirements, and cost. While public clouds may be the best option for smaller organizations with limited funds, private or hybrid clouds, which offer more control and/or security, are more suitable for larger organizations with available manpower and a budget to manage those deployments effectively.

Step 2c. Cloud service provider selection

As public authorities shift to cloud computing, they have to choose a cloud provider to host their cloud-based virtual machines. The choice of a Cloud Service Provider (CSP) requires evaluation of an extensive list of options, such as:

- *Service Levels* as public authorities in most cases have strict needs regarding availability, response time, capacity and support. Cloud Service Level Agreements (CSLA) establish a clear contractual relationship between a cloud service customer and a Cloud Service Provider of a cloud service.
- *Support* could be offered online or through a call centre, and in some cases, it could be necessary to refer to a dedicated resource with precise timing constraints.
- *Security*. When a public entity enters the cloud, it is entrusting its information assets to a third party provider. Although normally the potential supplier should follow recognised security policies in line with industry best practice, city authorities have to be able to assess essential features regarding the security level offered by providers such as the mechanisms in place to preserve client applications and data.
- *Privacy* i.e. the legal requirements for the protection of the personal data hosted in the cloud service, including issues such where the CSP's data will be located, including any trans-border data transfers, if applicable.
- *Open Standards* in order to avoid getting locked into cloud infrastructure that has restrictive contracts or proprietary technologies.
- *Compatibility* meaning that the cloudified applications have to fit into the CSP's existing pre-configured templates. The CSP's architecture should also meet scalability, availability, capacity and performance guarantees and should be sufficient for agency requirements.

- *Interoperability* enabling workloads to span multiple environments. For greater interoperability value, it is best to look for a provider that offers a common infrastructure platform for public and private hosted clouds, as well as an on-premises private cloud (Frost and Sullivan 2011).
- *Pricing* given that the complexity of the pricing formulas makes it very difficult to estimate the cost for each service in order to be able to make a meaningful comparison (Posey 2015). The terms of the contract, payment methods and payment dates can be decisive factors as well. City authorities should validate the cost model against the CSP's pricing by considering the following (Australian Government 2011): (i) the transparency of the pricing system, e.g. subscription or pay-as-you-go pricing, upgrades, maintenance and exit costs, (ii) potential costs for unexpected peaks in demand, (iii) service prices for upgrade and maintenance fees appropriate to the services being procured; some upgrades may be automatic and included in the service, (iv) suitability of the cost model allowing for scaling and changes to service, (v) commitment requirements, such as minimum use, (vi) setup, training and integration fees and (vii) the ongoing cost of service.
- *Redundancy* as adequate backup procedures and robust disaster recovery plans must be incorporated into the cloud offering.
- *Easy-to-use administration environment*, which refers to a user-friendly client portal that allows administrative tasks to be carried out or storage space or services to be added quickly.

3.3.3 Step 3—Migration of Applications

Third comes migration of application, i.e. the process of redeploying an application, typically to newer platforms and infrastructure.

Step 3a. Specifications for migration

This is a multifaceted process, which begins with an assessment of the hosting environment already in use. The analysis covers both the network (e.g. configuration, connectivity requirements from the city authority's premises to the Cloud environment, and supplementary services such as SMTP, DNS and WWW) and architecture (e.g. use of resources, underlining technologies, licences, and security mechanisms) of the service. Together with the hosting environment it is crucial to analyse the applications' readiness for the cloud. Aspects such as customisation, regulatory compliance, complex service architectures and service maturity need to be carefully investigated, as they could negatively impact the cloudification process. A critical aspect is the availability of both the application's source code and documentation (installation manual, code dependencies, required software packages, etc.).

Next, public authorities should define the functional and technical characteristics of the Virtual Machines that will host the applications in the new Cloud

Environment. The analysis of the functional requirements covers technical details (e.g. Operating System, Scripting Language, Database, Web/Application Server, Data Formats, Frameworks/Libraries and External Services used), interoperability issues, and static characteristics, such as hard-coded IP addresses and directory paths. Furthermore, the analysis of the non-functional requirements addresses issues related to the proper functioning of the application, such as security, regulatory compliance, performance, availability, backup, privacy, reusability, and interoperability. An estimation of the use of resources regarding RAM, Disk Space, CPUs, Bandwidth, Hits/Month, Registered Users, Max Online Users, and Average Online Users helps calculate the expected workload per application. An important characteristic that should be examined in this step is whether the application's design supports its deployment on multiple servers. In that case the application will take full advantage of the performance benefits that the cloud offers.

This analysis of the functional and technical requirements also highlights potential obstacles to the transformation or the porting of the applications to the cloud due to technical or functional reasons. For example, applications implemented with legacy technologies might require licenses in order to use commercial software products. When porting an application to the cloud, one should make sure that it does not constitute an infringement of the licensing rights that the application proprietors have in place with the software vendor. From a functional point of view, a potential problem might be the use of sensitive information, such as personal data that could raise privacy and security issues. In addition to the implementation of extensive security controls like unauthorised access prevention, data encryption and an ad hoc firewall policy, there still remain questions about where the data are located.

Step 3b. Adaptation of the applications

The applications that have been selected for migration to the Cloud may require significant changes to take full advantage of Cloud characteristics. Applications should be re-designed in order to take full advantage of the Cloud's features, especially when: (i) hardware cost is substantial, (ii) IT staffing levels are low, as moving to the cloud automates a lot of server and application management, as well as maintenance tasks that would otherwise be performed by in-house IT staff, (iii) geolocation is a requirement, (iv) the application needs to scale for predicted, but infrequent, uptime as the cloud allows systems that have occasional spikes to quickly and easily scale servers on demand without an expensive hardware investment or footprint. Determining the right migration strategy for an application depends on its level of cloud alignment, cloud readiness, the potential benefits achieved from migrating, and the risks entailed.

Step 3c. Installation

The next step in the migration process is deployment in the new environment. Depending on the type of workload being considered and the type of target Cloud environment chosen, migration might be moving from the non-Cloud environment to the Cloud environment, cross-platform migration or application-only migration (Writer 2013). During the migration process considerations arise with regards to privacy, interoperability, data integrity, data application portability and security, which may cause a high level of complexity. Over recent years a large number of online tools and services have helped to simplify this process. Automated tools can help design the Cloud environment and plan the migration. Such tools may be of general purpose or application specific. Most common are automated tools that help with setting up the replication of Virtual Machines from on-premises installations to the cloud, such as OpenStack Heat.

Step 3d. Testing

Cloud scalability does not always eliminate application performance problems, and even after migrating to the cloud applications might not scale up correctly (Pelerin 2015). Performance testing aims to ensure that the deployed applications are fully functional and that they meet the initial set of requirements regarding cloudification. It also helps to solve issues such as database errors or application and website crashes. Testing should be done periodically and include general performance and compatibility tests, stress and load tests and security/vulnerability tests.

3.3.4 Step 4—Administration of the Cloud

The fourth step is the administration of the cloud.

Step 4a. Administration of the cloud

Due to the characteristics of the cloud, system administrators no longer need to provide servers, install software and wire up network devices, since all this work is replaced by a few clicks and command line calls. Nowadays, most of the daily tasks performed by system administrators are related to the applications. The Cloud environment should offer both system administrators and application owners the necessary tools required to manage and maintain the platform and the deployed applications. Using these tools, they can focus on how to optimise the cloud-based application in order to increase cost savings.

Step 4b. Analytics

Administration platforms are usually accompanied by monitoring tools that facilitate data analysis in order to find meaningful insights and empower administrators with knowledge that lets them optimise their cloud systems. Monitoring tools are used for cloud monitoring, performance management, automation, cost management, etc. Over recent years, a number of cloud monitoring tools have been developed including Nagios, Prometheus and Zabbix (open source), CloudMonix, New Relic, AppDynamics, etc. These provide the ability to collect and visualise information using table and graphs, analyse historical trends, create alerts and perform a variety of functions from a single web-based console.

Step 4c. Backup

Administration of the cloud also includes backup, which is the process of making a secondary copy of data that can be restored to use if the primary copy (the production copy, which is the official working copy of the data) becomes lost or unusable. Backups usually comprise a point-in-time copy of primary data taken on a repeated cycle—be it daily, monthly or weekly. It is the most important means of keeping the data from being lost due to intentional or unintentional access. It is also important to encrypt the up-to-date backups. Backup is the easiest and the most familiar process for most situations. A backup copy is used to recover data needed to restart an application correctly. Backups may be required in the following scenarios:

- *Logical corruption.* This can happen due to application software bugs, storage software bugs or hardware failure, such as a server crash.
- *User error.* Where an end user may accidentally or intentionally delete a file or directory, a set of emails or even records from an application.
- *Hardware failure.* In the form of hard disk drive (HDD) or flash drive failure, server failure or storage array failure.
- *Hardware loss.* Possibly the worst case scenario where an event such as a fire results in hardware being inoperable and permanently unrecoverable.

Step 4d. Interoperability

Finally, issues of interoperability should be solved, which can be understood as how well a public administration service interacts with external entities in order to organize the efficient provisioning of its public services to other public administrations, businesses and or citizens. Some recommendations for interoperability include the following:

- Each interoperability attribute differentiates between at least two maturity levels.
- The improvement tables provide recommendations on how to improve maturity step-by-step for a specific interoperability attribute.
- When a public service does not have the maximum level yet for a specific interoperability attribute, a recommendation is given to make the move towards the next interoperability level.
- When a public service does have the maximum level for an interoperability attribute, no recommendation is given.
- When the foreseen maturity improvement is a sliding scale (e.g. from less to more), a generic recommendation (not maturity level specific) is given to improve the maturity further along the sliding scale.

3.3.5 Step 5—Data Management

The next phase is related to the administration of the cloud, including issues of *ethics*, *privacy* and *data* as well as *ownership*.

Step 5a. Ethics

In terms of ethical issues, it is recommended that an ethical issues' strategy should be based on the following three tasks:

- Proactivity: It is vital that all parties involved in cloud computing are proactive, in order to anticipate unforeseeable consequences. Players should never use uncertainty to refrain from designing and providing services that invite morally sound use and inhibit undesirable or controversial actions. It is thus recommended as ethical for Cloud providers to have a *Terms and Conditions* available and for users to know the Terms and Conditions offered by providers.
- *Regulations and policies*: All technology should be subjected to regulation arrangements at least just enough to have innovation that can benefit society and not enough to limit innovation. In any case, regulations can have ethics integrated into technological development and use. It is vital that governance arrangements are more conducive to the inclusion of ethics; this should also cover regulations for private companies, which are usually much less subject to ethics-related oversight and are more geared towards profit generation. Such regulations will adapt as cloud computing evolves. In any case, it is important to remember the core definition of corporate responsibility and follow policies defined by the European Union, such as the ISO26000 standard.
- *Responsible Research and Innovation*: Responsible Research and Innovation (RRI) is of a particular importance. It can be defined as an inclusive approach to Research & Innovation (R&I), aiming at better aligning both the process and outcomes of R&I with the values, needs, and expectations of society, notably through reinforcing public engagement, open access, gender dimension, ethical issues, and (formal and informal science) education.

Step 5b. Privacy and data protection

Privacy is understood as the right of a person to have his/her personal data properly secured. Moreover, it is related with the ability of persons to control, edit, manage and delete information about them and to decide how and to what extent such information is communicated to others (ICO 2014). Data protection is the process of safeguarding important information from corruption and/or loss (Microsoft 2014).

Cloud services make it easier for public authorities to take advantage of opportunities to share information. For example, sharing personal information with another public authority or agency may be achieved by simply creating user accounts with the appropriate permissions within a SaaS solution rather than having to implement a system-to-system interface to exchange information. Although cloud services have the potential to lower the technical barriers to information sharing, public authorities must ensure that they appropriately manage access to personal information and comply with the requirements of the European and national privacy legislation.

Step 5c. Ownership

Cloud providers should commit to protecting the data and limit the use thereof. The data that public authorities host in cloud services belongs to them and should not be used by a cloud provider for purposes other than to provide the customer’s service. Moreover, cloud providers should not use customer data for purposes unrelated to providing the service, such as advertising. Additionally, each service has established a set of standards for storing and backing up data, and securely deleting data upon request from the customer.

The best-designed and implemented service cannot protect customer data and privacy if it is deployed in an environment that is not secure. Customers expect that their data will not be exposed to other cloud customers. They also assume that the processes used at the data centre, and the people who work there, all contribute to keeping their data private and secure.

Despite the five sequential phases, we have two more horizontal issues described here: (i) cloud security which refers to policies, technologies, and controls deployed to protect data, applications and the associated infrastructure, and (ii) monitoring and validation, which targets the business aspect of application migration.

3.3.6 Security

Cloud computing security refers to the broad set of policies, technologies, and controls deployed to protect data, applications, and the associated infrastructure (EC 2015). As cloud computing technology and business models evolve, each year a number of publications appear with new recommendations on this issue (ENISA 2009; CSA 2016; UKCloud 2016). There are a number of security concerns associated with cloud computing, which can be broadly grouped into: (a) issues faced by Cloud Service Providers who have to ensure that their infrastructure is secure and clients' data and applications are protected; and (b) issues faced by their customers, who have to make sure that their provider has taken appropriate security measures to protect their information. The security expectations and obligations for both sides are described in Service Level Agreements (SLAs) (Gianakoulias 2016).

It is essential that public authorities understand the specific security requirements of each application they want to migrate to the cloud, especially with regards to data protection, audits, etc. To achieve this, they should map every application that is a candidate for migration to cloud computing to a set of security, governance, and compliance issues that are specific to that application. This will enable them to understand the application requirements, and how the migration and re-development effort to the cloud could impact application operations (Tsarchopoulos et al. 2016).

The UK's National Technical Authority for Information Assurance, which provides advice on Information Assurance Architecture and cyber-security to the UK government and the wider public sector and suppliers to the UK government, published 14 security principles to consider when evaluating cloud services, such as protection for data in transit; operational, personnel and supply chain security; governance framework, identity and authentication; service management and service administration, etc. (Cloud Security Guidance 2016). Consumers of Cloud services should decide which of the principles are important, and how much assurance they require in implementing these principles, while providers of cloud services should consider these principles when presenting their offerings to public sector consumers. This will allow consumers to make informed choices about which services are appropriate for their needs.

3.3.7 Validation and Monitoring

As Tsarchopoulos et al. (2017) mention, monitoring and validation target the business aspects of applications rather than the technological ones. Validation can be done from different perspectives, such as:

- Validation of the services deployed. This includes the service itself, utilising feedback from both the stakeholders and the technical staff.
- Validation of the migration process for existing applications on the Cloud that public authorities want to utilise.

Cloud migration of public services is not a process visible to citizens; therefore, validation of the migration process might be limited. However, leadership from top management within the organization is essential. Technical people in charge of migration will have to consider political cycles and be prepared for changes in the management structure. There may be internal personnel in the city authorities who are reluctant to change. Therefore change management policies must be foreseen and put into practice from the very beginning. These actions may require training activities for personnel to adapt their competencies to a new IT environment. In order to monitor from a technical point of view, one has to consider the following aspects:

- Before going into a migration process, it is imperative to check that all documentation for the applications is available. If this is not the case, the impact must be evaluated.

It is particularly important to have a detailed technical plan to ensure that all the required elements will be available prior to migration. This refers to aspects such as source code, documentation, availability of technical support -whether internal or external- similarities/differences between the existing IT environment and the Cloud environment and ways to cope with these differences (e.g. OS versions), etc.

- The availability of trained personnel for the new environment needs to be ensured, either by training existing technical people or by hiring new personnel.
- The ownership of applications to be migrated must be ensured before the process is to start. Existing applications may be locked in by legal agreements with vendors.
- Security and data privacy are a serious concern. Technical staff must ensure these points and effectively communicate them to management.

3.4 Conclusions and Discussion

The guidelines analysed in the previous section allow city authorities to take full advantage of the cloud computing paradigm, providing innovative and highly reliable services to their citizens, despite any resource constraints. Today, the majority of existing cloud offerings are implemented in proprietary and highly standardized form, not only creating vendor lock-in, but also creating limitations to fully reaping the benefits of cloud computing. Systems composed of *open technologies* provide the freedom to change environments and deliver a robust and secure experience, extending existing IT to the cloud. Experience from experimentation in the four pilot cities has made it clear that embracing an open cloud should be done by using widely accepted open source technologies in all components of the platform and any micro-service endpoints, such as OpenStack, Cloud Foundry, Docker, LAMP for the implementation of applications' VMs, MySQL for database services, HAProxy for load balancing, Zabbix for monitoring, etc. The adoption of open source technologies means that benefits will be created without significant development effort; while new, emerging standards will also increase the portability and interoperability of systems across Cloud Service Providers, and will reduce or eliminate this current barrier to cloud adoption.

This idea of openness does not only refer to the adoption of open technologies but also to other components of a city's smart city strategic vision, creating externalities to all aspects of the innovation ecosystem. This means that city authorities should focus on adopting an *open innovation methodology* aiming to gather external and internal knowledge to accelerate the process of innovation. As the role of government has shifted over recent years from managing and administering to the orchestration of open innovation processes, stakeholders have become key players in deciding on, contributing to and delivering services (The World Bank 2015). Such a development has not only removed the entire burden from public authorities to a wider group of actors, but has also increased openness, transparency and inclusiveness. Thinking about public online services, means to improve the organization of public administration and to facilitate communication between public authorities and citizens. As public services have multiple stakeholders, each one deriving some value (Hartman et al. 2010), their engagement is an integral part of the success in any migration strategy. Even for a very technical task, such as migration of a public service to the Cloud, stakeholders' involvement strengthens public awareness with regards to the efforts made by the public authorities to modernise themselves. Experience from the STORM Clouds project has shown that cloud migration should be an open innovation activity, at the end of the day though, it is important to focus on 'quality', i.e. the involvement and true commitment of a limited number of stakeholders, rather than 'quantity'.

While moving to the Cloud environment, the decisions that city authorities have to make are complex and in many cases constitute a deterring factor for Cloud adoption. Deployment model, service category, and Cloud provider can create an overwhelming situation that requires technical, legal, financial decisions to be made. As already explained in the roadmap, out of the three cloud service categories IaaS might be the most flexible solution for authorities that want to use their own applications. However, it depends on cloud platform administrators when it comes to configuring all the components for scalability and high availability. Experimentation in the four STORM Clouds project cities provided a two-model solution that offers high availability and scalability features, coupled with high transparency to application owners. More specifically, by accompanying the IaaS layer with the Data Service layer and Access layer, the data and the HTTP traffic management are delegated to the platform; while the application's business logic is still contained on the VM(s). This approach offers great flexibility as it does not require architectural changes to the applications but also keeps the deployment complexity low because the application owner "leverages" the high availability and scalability features of the platform (Battarra et al. 2016). When selecting the service cloud provider, as previously mentioned, an OpenStack based service provider was used. Open Stack Foundation maintains a marketplace that helps public authorities make informed decisions, while also carrying out interoperability testing to validate OpenStack powered products. Other criteria for the selection of the provider were the location of the infrastructure as well the offering of a monthly calculator that allows public authorities to evaluate different hosting options and the operation of alternative architectures.

Once these initial decisions are taken, city authorities move on to the migration process, which -for most- is more of a trial and error phase without careful prior planning. In the STORM Clouds project, we generated evidence that for a successful redeployment of applications to the Cloud environment, city authorities have to design a comprehensive plan and to automate the migration process. Automation, which is encouraged in the case of the cloud as it is a programmable infrastructure, can be achieved through the use of a set of tools and procedures. In the four pilot cities, participating in the project, automation was achieved with the use of Open Stack Heat, in two steps: first in order to prepare the bash shell scripts that configure the VM hosting the applications and install and configure the application and its dependencies, and second for creating the Heat scripts that describe the architecture of the applications and integrate them with the installation and configuration scripts. Automation also allows other interested cities to select and deploy applications through a cloud-based services portfolio.

Cloud computing is a disruptive innovation that is expected to bring a new wave of benefits over the coming years. Apart from being a catalyst in terms of technology, it is also expected to create new business models and ways of collaboration allowing SMEs, but also non-IT companies and organizations to capitalise on the Cloud (Hobson 2014). Actually, it divides the role of service providers into two: the infrastructure provider, who manages a cloud platform and leases resources according to a usage-based pricing model; and the service provider, who rents such resources to serve the end-users (Zhang et al. 2010). Based on this and the principles of open innovation, cloud computing allows the selection and re-use/replication of software applications, targeting common urban challenges from software repositories or other online smart city platforms. This allows the uptake of a large number of smart city applications by standardising and simplifying their customisation and use.

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Chapter 4
Tracking Paths to Smart Governance: The Case of Korydallos Municipality—Greece

Nektaria Marava, Andreas Alexopoulos and Anastasia Stratigea

Abstract Strengthening capacity of urban systems and their constituents in order to effectively tackle contemporary challenges and risks in a rapidly evolving, complex and uncertain global environment; and produce value for local communities in a sustainable and inclusive way, brings to the forefront the concept of smart governance. Tracking paths to smart governance, being the focus of this work, implies the need to conceptualize smartness and governance; and shed light on key organizational attributes that can pave the way for the transition from government to smart governance. Having identified these attributes by literature review, the paper highlights institutional, organizational, societal etc. developments in a Greek city, Korydallos Municipality, in order barriers and gaps in its trajectory to smart governance to be illuminated, both before and during the economic recession and austerity stress, faced by the Greek economy. Experiences gained by this pilot example, representing a rather typical small and medium-sized city in the Mediterranean context, provide useful inferences and evidence-based results for similar cities that strive to ride the smart governance wave.

Keywords Urban management · Smart governance · Information and communication technologies (ICT) · Offline and online participation · Economic recession Social innovation

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4.1 Introduction

The world is currently witnessing an escalating *urbanization wave*. Indeed, in 2016 more than half (54.5%) of the world's population lived in cities, a figure that is projected to reach 60% by 2030 (UN 2016: ii). The pace of urbanization is accelerating quite fast, rendering the 21st century the "Urban Century or Age" or the "Metropolitan Century" (Alvarez et al. 2008; UN-Habitat 2009; UN 2015; OECD 2015; Stratigea et al. 2017a). As Suzuki et al. claim, urbanization is nowadays the most important *global trend* and the *"… defining feature of the 21*st *century"* (Suzuki et al. 2010: xv). This noticeable trend can be perceived both (Stratigea et al. 2017a):

- *Positively*, with urban areas being considered as *motors of growth and prosperity* (Clos 2016), a *magnet* for highly qualified, talented and young labour force, and thus important *nodes* for innovation and creativity. They currently count for 80% of the global Gross Domestic Product GDP (Clos 2016), forming the *backbone* of the global economy. Considerable importance is also attached to urban areas in the European territory, where cities are claimed to boost European innovation and productivity; and become key drivers for steering the revival of the European economy (EU 2011; Stratigea and Panagiotopoulou 2015a; European Commission and UN-Habitat 2016).
- *Negatively*, with overcrowded urban areas being conceived as the *source* of the currently witnessed global challenges and risks that are due to the excessive use of resources (e.g. energy, water and land), pollution, congestion, irrational consumption patterns, overproduction of waste, unemployment, migration, segregation and poverty, etc. As such, urban areas are nowadays at the forefront of policy concern for serving *glocal* (global/local) *sustainability objectives*, i.e. focus areas in seeking to cope with current environmental, social and economic inefficiencies.

Cities nowadays are in front of a variety of challenges and risks that are case-specific, e.g. the rapidly ageing population or the urban sprawl in developed countries; the urban poverty and slums' creation in developing ones (UN Habitat 2009). However, they share an *overriding planning goal*, i.e. the struggle for reaching *urban sustainability objectives*, implying the pursuit of prosperity and innovation, the establishment of conditions for social cohesion/inclusion and health/safety for their communities, the adaptation to climate change impacts, etc. (Stratigea 2012, 2015; Tao 2013).

The *scene* within which sustainability goals have to be achieved by urban settlements is marked by a range of current transitions, namely:

- The evolving *collaborative, decentralized and smarter governmental structures* that are largely grounded on *institutional rearrangements* and *political will/vision*, capable of establishing wider partnerships and coalitions crosscutting the urban or even wider spatial scales. These structures aim at: increasing *awareness* about various urban problems; collecting *distributed knowledge* for better grasping risks and policy options ahead; and identifying *policy priorities and paths* that can ensure *consensus* as well as effective and efficient *implementation* of plans coping with these risks (Burby 2003; Elliott and Slocum 2005; Stratigea 2015; Rodriquez Bolivar 2018).

- The revolutionary *technological developments* permeating all different dimensions of urban life/management and supporting the establishment of effective means for: *interaction* among urban actors (citizens, entrepreneurial and research communities, decision makers); gathering of *intelligence* and new ideas emerging from *synergies' creation* among them; broadening *(e-)participation* potential; supporting the provision of innovative public services, etc. (Rodriquez Bolivar 2018).
- A changing *societal environment*, where issues like justice, fight of poverty and social equity, empowerment and motivation to engage and participate in more substantive ways in decision-making processes, increase of awareness and sharing of responsibility, shift in power structures, consensus building etc. become *key issues* of policy concern and planning practice in searching sustainable future pathways; and reveal the importance of the *local level* as the most challenging one for inspiring and engaging communities in fulfilling global sustainability objectives (Nalbandian et al. 2013; Stratigea 2012, 2015). Following this rationale, *citizens and communities' engagement* is nowadays perceived by many researchers and decision makers as a no longer optional choice, but an imperative one (Nalbandian et al. 2013); and one that has at its heart a more *human-centric approach* of urban management, largely supported by current ICT-enabled urban developments (smart city, smart governance, smart environment etc.) (Coe et al. 2001; Lombardi et al. 2012; Stratigea and Panagiotopoulou 2015a; Panagiotopoulou and Stratigea 2017; Prado Lara et al. 2016; Bell 2017).
- The *economic recession*, implying scarcity of financial resources for investing in urban environments; and introducing the need to explore new, innovative and more resource-efficient urban problem-solving ways for producing wealth and services for their citizens. Such ways are nowadays enhanced by technological advances as well as the ICT and their applications in the urban context (Stratigea and Panagiotopoulou 2015a; Rodriquez Bolivar 2018).

Within such a scene, the shift of local governments towards more collaborative decentralized structures has enforced the debate and triggered even more the need for *partnerships' creation practices* in urban policy making. The increased importance attached to partnerships is associated with: different aspects of urban life, from urban management to urban planning, e.g. collaborative planning (Healey 1997); and a variety of fields in urban policy-making e.g. participatory budgeting in Brazil; urban public-private partnerships for coping with resource scarcity and the raising infrastructure demand, imposed by the escalating urbanization trend (Abers 2000; Healey 1997; Kyvelou et al. 2011); etc. Management of complex urban problems through such practices is subject to *collaborative endeavours*, seeking to pool knowledge and resources from the variety of urban actors, with the support of technological advances and ICT developments. As Brabham (2006:29) states *"... interdisciplinary and participatory design collaborations seem to be the best option for problem solving in a democratic society of the digital, postindustrial age"*.

The recognition of the value of collaboration and partnerships' creation within the urban policy arena has paved the way for the transition of the urban political system *from government to governance* (Stoker 1998; Rhodes 2000). Governance, in this respect, constitutes another *global trend*, recognizing the need for *cooperation* among different actors and levels of government in order complex problems of urban areas to be properly addressed and solved. The term was originally introduced by different disciplines (institutional theory, public administration, international theory, political science) (Rosenau and Czempiel 1992; Rhodes 2000; Heywood 2002). As such, it has *"meant different things"* (UN-Habitat 2009: 6) to different scientific communities. Two diametrically opposing views are the one presented by the World Bank (Maldonado 2010), taking an *administrative and managerial stand* of governance interpretation; and that presented by the UN-Habitat Global Campaign of Good Governance (UN-Habitat 2002), taking a more *democratic as well as human and civil rights' stand*. In the course of the governance debate, World Bank has adjusted its approach to incorporate *participation*, as a means to fight against corruption and support transparency and unimpeded access to information, thus widening the context of '*good governance*' agenda (Maldonado 2010). Today, urban governance has grown to a prevailing concept in politicians' rhetoric and policy considerations (Jessop 2002); and governmental structures at various scales strive for gaining capacities needed to "ride the wave".

Progress in urban governance has been largely facilitated by the intensifying digitization of urban environments. Indeed, digitized environments enable city governments to cope with challenges in a more *effective and resource-efficient* way (Winters 2011; Baskerville 2012; Walsham 2012; Hoon and Lee 2013; Stratigea and Panagiotopoulou 2015a; Panagiotopoulou and Stratigea 2017; Stratigea et al. 2017a); and carry out their tasks in a *legitimate and transparent* manner. In such a context, digitization supports remedy of former governance failures and transformation of urban government to collaborative governance (Caragliu et al. 2011; Chourabi et al. 2012; David et al. 2018). The crosscutting power of digitization in urban environment is sketched by its impact upon all spheres of urban life, society, economy, environment and government, revealing new opportunities but also challenges for urban problems' solving; while it also offers new ways of e-interaction and e-collaboration among cities' actors.

From the previous discussion it is evident that smart governance is actually based on the interplay among complex technological, institutional and societal changes (see also Sect. 4.3.1). Since technological aspects are extensively discussed in the literature, the focus of this paper is mostly on the institutional and societal aspects. More specifically, the *goal* of the paper is to *track paths to smart governance* by identifying *key organizational attributes* of local governments that can support such a transition. This is accomplished by a conceptual exploration of both the smart city (smartness) and smart governance, grounded on literature review.

Based on this exploration, the paper attempts to highlight institutional and societal developments in a Greek urban environment, Korydallos Municipality. Trajectory and experiences gained by this pilot example, representing a rather typical case study in terms of similarities to many other small and medium-sized urban environments in the Mediterranean, could provide useful inferences for relevant cities that strive to follow such paths.

The *structure* of the paper has as follows: first it elaborates on the conceptualization of smart city and smart governance in an effort to delineate a range of attributes that characterize these concepts. Next, the steps undertaken so far towards smart governance by the specific Greek case study are discussed with respect to the above identified attributes, so that the trajectory of this typical city example (small/medium scale, lagging behind town in the Mediterranean/Greek context) and the pros and cons that are marking the paths followed to be illuminated. Finally, certain conclusions are drawn, grounded on the conceptualization of smartness and smart governance and the evidence-based results of the case study at hand.

4.2 Shifting to Smart Governance—Key Drivers' Exploration

4.2.1 Conceptualizing the Smart City Concept

The concept of *smart city*, as a contemporary ICT-enabled approach for serving sustainable urban development objectives, is currently at the top of the research and policy agenda for coping with the unprecedented challenges faced by cities in the "Urban Age". At the same time, it is also constantly gaining popularity among various cities around the globe in order to cope with the most pressing problems of today that occur at the urban scale. However, it still remains a highly ambiguous, fuzzy and equivocal concept; a concept that, as quite successfully was stated by Zait (2016: 3), *"… strives to clarify its identity"*. This implies the lack of an *operational definition* and a *semantic interoperability* of the term across disciplines, as can be depicted by the large number of definitions articulated in various research papers (ITU Report 2015; Kummitha and Crutzen 2017; Stratigea et al. 2017a; Panagiotopoulou et al. 2018); and the exponentially growing literature on the topic (Deakin 2014; Albino et al. 2015).

A literature review could reveal different *conceptual approaches* of the smart city concept, emanating from different theoretical streams and stands of respective researchers (Stratigea et al. 2017a). For example these may refer to the use of ICT for effectively managing the six dimensions of an urban space, namely economy, people, governance, mobility, environment, living, articulated by Giffinger et al. (2007); the smart city's conceptualisation developed by Hollands (2008) who, while emphasizing the role of sophisticated ICT and their applications, he is also stressing the importance of gathering stakeholders and community groups' intelligence; the *innovation theory approach*, within which smart cities are considered as the ground for promoting innovation strategies in social or economic fields (Hoon Lee et al. 2013); but also the more advanced conceptualization of participatory or collaborative governance, stressing the importance of network interaction and collaborative decision-making processes (Castelnovo et al. 2015). Recently, there is an effort for integrating key concepts and theories, articulated so far, in order an all-encompassing approach for smart cities' notion to emerge (Meijer and Bolivar 2016; Przeybilovicz et al. 2017; Castelnovo et al. 2015).

Research works of Nam and Pardo (2011) and Meijer and Bolivar (2016) converge towards the classification of existing definitions/conceptualizations of smart city in *three distinct streams*, appearing in various research efforts. Such a classification is based on the core perception of these definitions, referring to the *technological, the human resource and the governance stream.*

The *technological stream*, i.e. the *hard dimension* of smart cities' designation, as stated by Zait (2016), actually emerges from smart city definitions that emphasize the role of technology and ICT as the defining features of the concept. This technologically-grounded, rather narrow, smart city perception is effectively promoted mostly by the ICT industry, but also by a certain part of the research community (Keeling and Mooney 2011; Zhuhadar et al. 2017). It is usually sketched by a *'smart' compartment*, i.e. an implicit reference to the technological dimension, coupled with terms reflecting a *sectoral interest*, e.g. ('smart') water, waste, energy, buildings, health, education, mobility; a *social interest* e.g. ('smart') people, living, inclusion; a *spatial interest*, e.g. cities, communities, territories, regions, environment; and a *policy interest*, e.g. ('smart') economies, governance, development, strategies etc. The number of works falling into this stream far exceeds articles related to the rest two ones (Zait 2016). The technological stream endorses qualitative and high-speed ICT infrastructure, forming the backbone of smart cities or being integrated into urban systems (Dirks et al. 2009). This infrastructure is grasped as enabler of cities' transformation to more intelligent, interconnected, innovative and sustainable urban spaces (Komninos 2011; Dirks et al. 2009). Despite the criticism exerted on this stream with regards to its *"technological determinism"* (Castelnovo et al. 2015: 5), this has been acknowledged for the huge potential that digital technology can offer towards more informed, data-intensive urban policy making.

Second lies the *human resource stream*, the *soft component* of the smart city (Zait 2016), which addresses *human capital/smart people* as the main constituent of smart cities, considering technology more as a leveraging rather than a defining attribute of such a city (Lombardi et al. 2012; Shapiro 2006).This stream features the role of a highly qualified, intellectual social capital for adopting and using ICT infrastructure in urban reality, endorsing transformation of urban environments into smart and creative places (Albino et al. 2015; Zait 2016). The importance of this component is delineated in the work of Deakin and Allwinkle (2007), Deakin (2009a, b), and Deakin and Al Waer (2011), addressing a *community-led smart city approach*. In this approach, it is stated that the transition of a territory to smart relies on its *capacity to learn and innovate*. This, in turn, is built upon the *creativity* of its population, the availability of institutions for knowledge production and finally the disposal of digital infrastructure, enabling communication, empowerment and training of people. Moreover, in this approach emphasis is placed on the enhancement of participation and democratic debates as well as on inclusive vision-building processes.

Last is the group of smart city definitions that are falling into the *governance stream*. This rather recently emerging stream in the vast smart city literature, highlights, *as a determining feature* of a smart city, the *productive network interaction and smart collaboration* among various urban actors and stakeholders' groups (Meijer and Bolivar 2016). Its value towards effectively implementing smart city initiatives has been recognized by a range of researchers (Bélissent 2010; Washburn et al. 2010; Misuraca et al. 2011; Albino et al. 2015; Zait 2016). According to the rationale followed by this stream, a smart city is the outcome of *cooperative stakeholders' efforts*, collaborating in partnerships of different shape and form, in order to produce value through the collective planning, implementation, monitoring and assessment of city- and citizen-specific smart initiatives, policies, programs etc. (Stratigea and Panagiotopoulou 2015a).

Based on the above three streams' discussion, Meijer and Bolivar (2016) reach the conclusion that a city:

- Cannot be characterized as *'smart' or 'stupid'* and its progress should be explored in an integrated way in all these three domains, i.e. smart technology, smart people and smart governance, taking into consideration its *structural and cultural attributes*.
- Can *progress gradually in smartening up* to one or more of these domains, with this progress being largely determined by its historical context, needs and future expectations as well as challenges ahead.

4.2.2 Conceptualizing the Smart Governance Concept

Further to the above discussion on grasping smart city constituents, various attempts have been made towards smart governance conceptualization (Torfing et al. 2012; Meijer and Bolivar 2016). In this respect, four literature-driven, ideal or typical conceptualizations have been identified by Meijer and Bolivar (2016). These actually reflect different theoretical perspectives with regards to the role of government and the level of certain *institutional rearrangements or transformations* at the governmental level in order the transition from government to smart governance to be accomplished. They argued that what actually may occur can be represented by a *ranking of cities* according to the current level of transformation, ranging from an *institutional conservation* (traditional governance of a smart city) to an *institutional transformation* (smart urban governance), with intermediate stands between

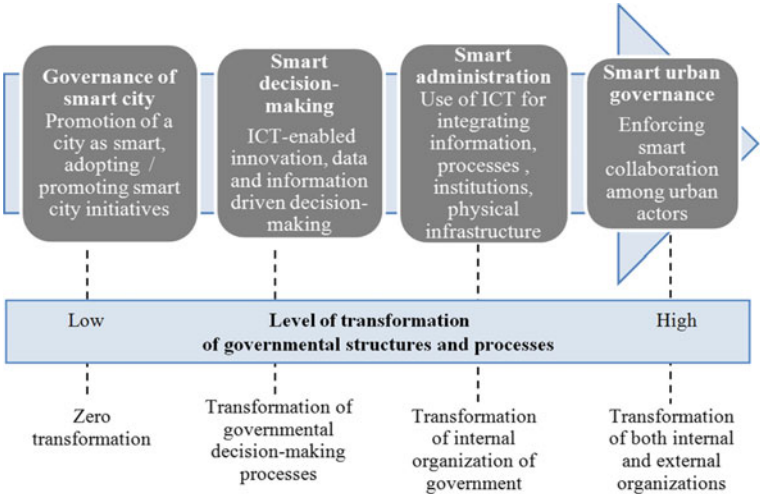

Fig. 4.1 Gradual transformation of governmental structures and processes towards smart governance model (Adapted from Meijer and Bolivar 2016)

these two edges being the ones of *smart decision-making* and *smart administration* (Fig. 4.1).

According to Meijer and Bolivar (2016), the most conservative conceptualization of smart governance refers to simply *governing a smart city*, i.e. make the right policy choices and find effective ways for implementing them. Next comes the one of *smart decision-making*, placing emphasis on the role of technologies for collecting and elaborating a huge amount of data for better informing decision-making processes and their implementation. This is followed by the third level—*smart administration*—incorporating a certain transformation of governmental structures; and accommodation of more sophisticated technologies for integrating information, processes, institutions and physical infrastructure and better serving citizens' needs. Finally, the most transformative level of smart governance conceptualization, calls for *smart collaboration* among a variety of city actors. This implies an ideally transformed *networked governance system*, where collaboration in both decision-making and policy implementation is apparent; and value for the city as a whole is produced.

The networked governance system is qualified by Meijer and Bolivar (2016) as the highest level of transformation, bound by the radical changes of both the government internal organizations and the external organizations. According to Tapscott and Agnew (1999), this also constitutes a more *community-based model* that is leveraged by technological developments as enablers of ubiquitous digital connectivity. This is in alignment with the definition of smart governance by Misuraca (2010), Castelnovo et al. (2015), and Przeybilovicz et al. (2017). This definition designates this model as a technology- and ICT-enabled (social media, Internet, open data, citizen sensors, etc.) city governance, targeting the more effective and efficient internal administrative governmental operations; as well as proactive and open-minded governance structures, capable of collectively-designing policy decisions through online and offline interaction between government and community actors. In this way, it opens up *better opportunities* for all actors of a local ecosystem to participate in decision-making processes.

At the same time, Meijer and Bolivar (2016: 403) also argue that "… *one cannot assume beforehand that a higher level of transformation of urban government is by definition more effective in smartening up a city"*. The effort of a city to become smarter entails the need to transform governmental processes alongside with internal governmental organization structures in such significant ways that the city's potential to cope with sustainability objectives and negative externalities will be strengthened, keeping track with *historically grown path dependencies* (Meijer and Bolivar 2016; Przeybilovicz et al. 2017; Edelenbos et al. 2018).

Based on the above discussion, it is evident the highly appreciated role of city governments (elected such as mayors or members of city council, city's committees and/or delegated leaders or chief executives of local government organization) as *key actors* in motivating engagement of local stakeholders' groups and co-designing—co-deciding those smart initiatives that can pave the way towards a smart transformation of communities, nicely acknowledged by the work of Barber (2013), stating that *"mayors can change the world"*. This depicts the power attributed to local governmental organizations in making those decisions that can support the smartening up of their cities.

But how this can be accomplished? Or what are those decisive *organizational attributes* of local governments that are capable of marking the path towards smart governance? This concern brings to the forefront a rather *new dimension* of smart governance discourse, largely connected to *technology and innovation*, as well as *public engagement*. Moreover, while e-government and organizational aspects are issues already widely explored in the literature, this does not hold for research on tracing the above mentioned decisive organizational attributes (Chourabi et al. 2012; Przeybilovicz et al. 2017).

The recent work of Przeybilovicz et al. (2017) elaborates on the above raised topic, through a systematic literature review, taking into consideration a number of articles that present different theoretical approaches. Their findings are quite useful, drawing upon an exhaustive literature search and producing a coherent synthesis out of knowledge gathered. More specifically, they claim that smart governance is an *urban innovation perspective* that can be grasped as the *"interplay among technological, managerial, organizational and policy innovation"* [Przeybilovicz et al. (2017: 1)]. Additionally, they identify a range of *key organizational attributes* of local governments for shifting to smart governance, which are falling into three distinct *layers*, namely the *governance, assets and management layer*. The essential elements of each single layer are presented in Fig. 4.2.

The *first layer* of organizational attributes—*governance layer*—refers to the *nature and scope* of interaction between the government on the one hand and the *actors* of a local ecosystem on the other (institutions, business stakeholders,

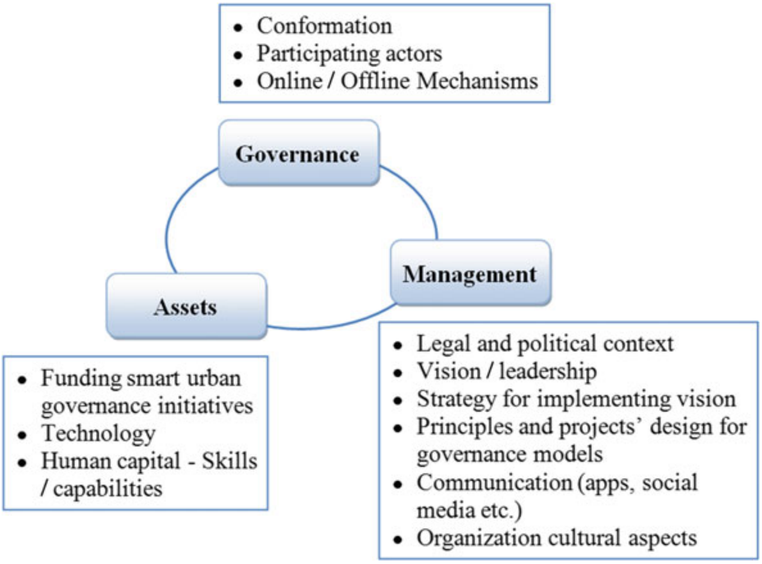

Fig. 4.2 Layers of organizational attributes for shifting from government to smart governance (Adapted from Przeybilovicz et al. 2017)

research and civil society, etc.). Essential attributes falling into this layer are Przeybilovicz et al. (2017):

- *Conformation*, implying the ways in which *governance is activated*. This relates to different *streams* of actors' engagement, which in turn is associated with their role in the decision-making process (from purely informative to more substantial one, being active part of such a process), control over planning information (open data), level of empowerment, as well as control over the final policy decision (Stratigea 2015). Literature review, as conducted by Przeybilovicz et al. (2017), reveals three *main streams* of actors' engagement, namely the: *participative model*, where government adopts participatory planning approaches for actors' engagement in the process of designing and delivering policies; *collaborative model*, where actors are getting involved at certain stages of the planning process in order knowledge exchange and empowerment of those involved to be achieved; and *co-creation model*, implying full engagement of actors throughout the stages of smart governance planning process attributing, to those engaged in a more substantial and active way, the power to define the type of desired applications and become content developers and consumers.
- *Actors' engagement* is one of the most critical factors of success of governance structures towards smartness (Luna-Reyes et al. 2007; Stratigea and Panagiotopoulou 2015a); and a factor that has been given less attention on the expense of comprehending better technological and policy aspects of smart cities (Chourabi et al. 2012). Reaching a *variety of actors' networks* is crucial for: ensuring a rich diversity of views, perceptions, motives, etc.; and

accommodating conflicting interests as to the policy problems at hand in the planning process and outcomes (Stratigea 2015). The higher the diversity of actors' networks the more enriched the decision-making process and the policies emerging out of it.

- With regards to the *mechanisms* available for engaging actors in governance processes, a wide variety of tools are available, both *offline* (e.g. policy exercises, consensus conferences, planning cells) and *online* (e.g. crowdsourcing, social media) (Stratigea 2015; Panagiotopoulou and Stratigea 2017; Krommyda et al. 2017; Czepkiewicz et al. 2017), as well as hybrid forms, such as *living labs*. The latter, by combining online and offline tools, seek to formulate innovative policy outcomes to urban problems, based on the shared power of various actors engaged (Steen and van Bueren 2017).

The *second layer* of organizational attributes—*assets*—involves *funding, technology and human capital*. More specifically (Przeybilovicz et al. 2017):

- Smart urban governance initiatives depend on *financial resources* for e.g. deploying the necessary ICT infrastructure or implementing participatory processes. Scarcity of resources is a significant *barrier* to following smart governance pathways.
- *Technology* is another critical asset, establishing the ground for actors' interaction and e-engagement in policy making procedures (Panagiotopoulou and Stratigea 2017). Tools exploited should be user-friendly and easy to handle by participants. A useful option for ensuring high usability is to develop the necessary governance tools through *co-creation processes*, taking into account different users' profiles, specific requirements etc. of each single urban context.
- *Human capital* refers to technological capabilities, skills and competencies of human staff of local public administration as essential elements for progressing towards smart urban governance.

The last layer of organizational attributes relates to *management*. This incorporates (Przeybilovicz et al. 2017):

- *Legal and political context*: that frames the decision-making context, i.e. norms and rules of both internal (city at hand) and external environment, within which smart urban governance can be planned and implemented. Inefficiencies or absence of such a context (e.g. lack of a legislative framework that enables participatory practice in smart urban governance) can place *barriers* to fulfillment of smart governance objectives.
- *Vision/leadership*: an issue of pivotal importance for paving the way towards smart governance is the setting up and effective communication of a vision for guiding decision-making processes towards this desired end state. Mayor and city council have a crucial role as leaders of both vision-building processes and the consistent implementation of this vision through targeted policy actions (Mooij 2003; Chourabi et al. 2012; Barber 2013). The effectiveness of city leaders in such a role is assessed through the way they succeed to motivate actors and broaden their engagement in planning and implementing this vision. As stressed by Heinelt et al. (2006: 15), *"… leadership plays a crucial role as*

enabler of community involvement"; and successful initiatives of urban governance tend to be *"sealed by a leader's commitment, dedication and visibility"* (Heinelt et al. 2006: 17).

- *Strategy for implementing vision*: relates to the governance model used for implementing the vision. This can be grounded on various *principles and projects' design* in pursuing smart urban governance; which in turn implies a different level of commitment of those engaged at the stage of implementation.
- *Communication*: addresses the variety of *means* used for interaction between government and actors of the local ecosystem. A pool of options is available in this respect, addressing *one way* (from government to local actors e.g. means for broadcasting information) or *two ways interaction* (from government to local actors and vice versa e.g. use of social media) (Stratigea 2015; Panagiotopoulou and Stratigea 2017; Afzalan and Muller 2018).
- *Organization cultural aspects*: various organizational principles are falling into this category, largely bound to cultural aspects. As such can be referred flexibility, interactivity, transparency, adoption of participatory democracy etc. Cultural aspects can to a large extent determine inclination of organizational structure to change, i.e. move away from traditional routines and values; and thus positively or negatively affect the way to smart governance.

Having conceptualized smart governance as an *innovative urban governance approach* for coping with contemporary urban challenges and sustainability objectives, in the following section, an attempt will be made to assess efforts of a specific case study, the Korydallos Municipality—Greece, towards smart governance.

4.3 Smart Governance in Korydallos Municipality—Tracking Organizational and Societal Attributes

4.3.1 Setting the Scene—The Korydallos Municipality Context

Korydallos Municipality is an urbanized area, a suburb of the Athens metropolitan region. The city is located in the neighbourhood of the industrial zone of Western Attica and Piraeus, the biggest port in Greece.

A major landmark of Korydallos Municipality is the location of the *largest state prison complex*, somehow "sealing" past and current developments of the locality; and raising negative psychological, security and aesthetic concerns for the local society. Degradation of the city's image due to the location of this complex has favoured affordable housing opportunities for low income population. This, coupled with its location next to Piraeus port and the Western Attica industrial zone, has throughout the years led to the attraction in the area of a large and rather diversified number of rural immigrants and later on foreign migrants, marking thus a continuously increasing population trend (Stratigea et al. 2016a). This trend has been reversed during the last decade, following the population decrease pattern of both the Greek state and the Attica Region. The population decrease has definitely revealed the municipality's low *resilience* with regards to the deindustrialization wave, beating the Greek economy in general and the city of Korydallos in particular during the '90s and the beginning of 21st century. The situation has been further worsened due to the economic recession and austerity stress, experienced by Greek cities and regions during the last decade.

Future trajectory of Korydallos municipality in a recession era is fraught with difficulties, but also challenges and opportunities that originate from the structure of both the local population and the economy. Indeed, economic stagnation has had severe impacts on employment opportunities of the low skill and educational profile population in the study region. Noticeable outcomes during the years of stagnation, such as high unemployment rates, rising social inequalities and steady increase of NEETs' population, reveal the inherent weaknesses of the local society and its limited capacity to cope with changing skills' demand of the new reality. The local economic structure has also been affected by recession stress, with important sectors of the local economy, such as retail trade, being considerably shrunk (Stratigea et al. 2016a).

On the other hand, the different origins of Korydallos population that are due to certain migration waves, directed to this area, have given rise to the establishment of a distinct *cultural environment*. Within this environment, a number of cultural associations are activating, in an effort to preserve and promote culture of their place of origin. Throughout the years, cultural associations and related activities as well as cultural infrastructure have matured; and have built up an important element of the city's identity. This sets the ground for the creation of a favorable environment, a comparative advantage of Korydallos municipality, capable of supporting the flourishing of a *Cultural Creative Economy*.

Planning and implementing future smart and sustainable pathways for recovering social cohesion and restructuring/reorienting local economy towards more dynamic sectors in an environmentally friendly way in the Municipality of Korydallos seems to be a rather tricky and difficult task. Such a task has to be carried out within: (i) an environment of economic recession, implying severe municipal budgetary constraints; (ii) an institutional context for local government in Greece that has evolved from a centralized to a decentralized one, setting up new challenges for local governments; and (iii) a fastening Europeanization pace (Kyvelou and Marava 2017), deriving from European decisions and impacting policies as well as political and administrative structures at the local/national level (Héritier et al. 2001). Moreover, accomplishment of such a task calls for *smart governance approaches* that are capable of identifying *strengths* of the region at hand as well as building up *consensus* on a *shared vision*; and motivating local population and stakeholders for reaching this vision through the establishment of durable multi-actor partnerships and networks for planning and implementing *co-operatively designed policy decisions* (Stratigea et al. 2015c, 2017b).

Based on the specific case study context, but also the conceptualization of smart governance discussed in previous sections—*governance, assets and management as decisive layers*; and the *interplay among technology, people and governance* –, the trajectory of Municipality of Korydallos towards this end is explored in the following. The scope of this exploration is to identify inefficiencies and barriers as well as gaps in terms of the above described interplay. This will support more informed and knowledgeable decisions of local government with regards to the steps needed for the transition to a more successful and smart governance model. The *time span* of this exploration expands from 2004 to 2016. During this period, Greece has entered in a prickly pathway, marked by the economic recession and austerity, strongly affecting all different levels of government. Taking this into consideration, exploration of the Korydallos trajectory towards smart governance is split into *two distinct periods*, the one before recession and the one falling into the turbulent period of the socio-economic crisis, aiming also to identify the impact of austerity in such an effort.

4.3.2 Smart Governance Pace Before Recession—Key Attributes

Year 2004 can be perceived as the point of departure of the first major participatory initiative in Korydallos city, which originated by the *vision and leadership* of the Mayor at that time, who envisaged a more *strategic approach* for managing local affairs. During his term, and following his own vision, radical government transformations took place, which are summarized into (Fig. 4.3): (i) the drawing up of the first *integrated strategic development plan* of the city (Municipality of Korydallos 2004), in absence of any kind of relevant legislation at that time, an endeavor that has signaled the lunching of participatory approaches in local decision-making processes; (ii) the development of *Multi-annual Operational Municipal Programs* (MOMPs) emanating from law enforcement (2006); and (iii) the introduction of the concept of *participatory budgeting*, a pioneer movement

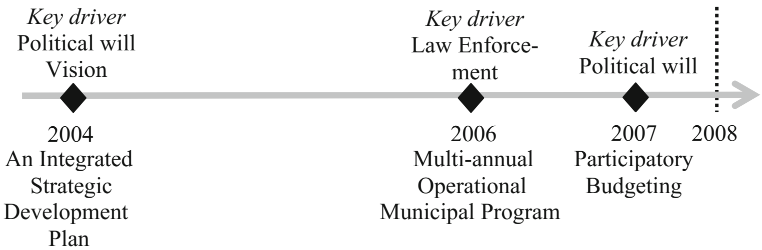

Fig. 4.3 Before recession—key milestones of participatory strategic management in Korydallos municipality

of Korydallos municipality for setting up policy priorities and managing local resources in alignment with societal expectations.

Speaking of the *governance* layer during that particularly time span (2004–2008), it could be noticed that this was driven by *political will and vision*; and was inspired by the concern of strengthening citizens and stakeholders' engagement in co-defining strategic priorities for the future of the municipality. This is more distinctly noticed in 2007 (participatory budgeting initiative) (Alexopoulos et al. 2011), where participatory approaches were used for decision-making with regards to the prioritization of city's interventions and respective public resource management to the benefit of the local population.

More specifically, the drafting of the integrated strategic development plan in 2004 has conducted a grid of participatory actions. The *mechanisms* utilized at that time incorporated *surveys* on: (i) a sample of *households* in selected neighborhoods of the city, which was organized and carried out by a municipal expert and a team of external experts; and (ii) a sample of *local businesses*. The main aim of these surveys was to gather information on the: perception of participation by local population and businesses; problems they face in their neighborhoods; proposed priorities in key sectors of the locality, etc. Moreover, *three Focus Groups meetings* were organized, elaborating on aspects of the local economy and entrepreneurship, environmental and cultural issues as well as life-long learning and education themes. These were attended by representatives of local authority's institutions, social actors and active citizens.

Rate of participation in both households and businesses' survey was lower than expected. In the case of *household survey*, half of the respondents (154 out of 310 households selected) refused to engage. Although the research group had emphasized the scope and importance of participation for setting up municipality's strategic directions, household population was disputing the way their views could be handled by local leaders in the planning process and outcome, revealing thus a *deficit of trust* between citizens and municipal authority. *Entrepreneurial survey* has depicted more promising results with respect to participation, although still a significant percentage (35% of respondents) denied engagement, citing either *lack of time* to do so or *dissatisfaction* to municipal authority actions. These results demonstrate a certain reluctance for a more formal and structured way of engaging, reflecting preferences of the entrepreneurial community (and at that time current practice) for more interpersonal, informal interaction with local leaders.

In spite of the shortcomings of this first initiative, it is important to acknowledge its contribution to the inauguration of participatory endeavours and a more strategic approach to local policy making. This has been considered as an *innovative pilot action* both at the Korydallos municipality level and the realm of local authorities at the state level, taking into consideration that strategic planning at the time was not institutionalized. As such, this initiative has been acknowledged by the Greek Ministry of Interior and the Hellenic Agency for Local Development and Local Government (EETAA); and has been incorporated into a guide for drawing up municipal operational programs (EETAA 2007).

Moreover, it has prepared the ground for the accomplishment of the first obligatory *Multi-annual Operational Municipal Program* (MOMP), the *second important initiative* of this period, emerging as a *law enforcement action* in 2006 (Law 3463/2006); and establishing as *key consultation mechanism* for drafting MOMP, namely the *online engagement* through municipalities' websites. In addition to the online engagement option, *consultation mechanism* in MOMP preparation was, in Korydallos municipality, enriched by a leaflet, addressed to 10,000 households. In this leaflet, the main axes of the strategic plan were presented, coupled with a short supplementary questionnaire, inviting citizens to express their views as to the key municipal priorities set up in MOMP (Municipality of Korydallos 2008). Response rate was lower than expected, but better than the one in previous initiative; while municipality's strategic priorities were communicated to a larger audience. Questionnaire was also uploaded to municipality's website alongside with the strategic MOMP document. The latter has received no comments from citizens or social partners.

Last initiative during this period, leaded by *political leadership and will*, was an endeavor to develop an innovative practice for engaging local community in a *strategic participatory budgeting process*, feeding the preparation of Korydallos annual technical program. By this process, citizens and local stakeholders could influence decisions on environmental, social or other projects for further implementation. This practice was applied for a period of five years from 2007 to 2011. As *consultation mechanism*, face-to-face interaction was selected, conducted through a range of neighbourhood (8 meetings/year) and thematic meetings (3 meetings/year). Participation was again lower than expected (e.g. in 2008, 645 citizens had attended neighbourhood meetings and 220 people—representatives of relevant institutions—the sectoral ones) (Alexopoulos et al. 2011).

Obviously, all three initiatives have enriched the way *governance* was implemented in Korydallos municipality (Table 4.1), sharing the concern for scaling up citizens and stakeholders' engagement in setting up commonly agreed strategic future priorities. In the way from the first to the third initiative, *political will and vision* is a key driving force and an important managerial attribute for shifting to smart governance; citizens and stakeholders have gradually been engaged and educated in more *cooperative decision-making processes*; and the role of both *face-to-face and digitally-enabled* means as complementary *participation mechanisms* (Papadopoulou and Stratigea 2014; Krommyda et al. 2017) was fully comprehended.

Speaking of the role of *technology*, it should be noted that the low level of ICT-enabled interaction along all three initiatives of this period witnesses the low level of ICT usage at that time, by both Korydallos citizens and municipal staff. For instance, during the first initiative, no computer network infrastructure (Intranet) or e-portal existed in Korydallos municipality (Municipality of Korydallos 2004). From the first to the second initiative, political leadership realizes the potential of ICT for wider diffusion of information and transparency; and takes steps towards this direction, although relevant skills' availability of local population is still lagging behind.

Table 4.1 Before recession—organizational attributes of smart governance layers in Korydallos municipality—*governance*

Initiative	Governance		
	Conformation	Partnerships–actors	Mechanisms
An integrated strategic development plan (2004)	Local councillors invite citizens and stakeholders to participate for drafting key policy choices for future strategic development	Citizens, businesses, associations	Online presence of key documents
			Organization of different face to face workshops in the city Questionnaire survey for engaging a sample of residents' groups
Multi-annual operational municipal program (MOMP) (2006)	Consultation of key strategic priorities of MOMP based on legal prerequisites	Citizens, households, firms, local institutions	Online consultation of the strategic MOMP document
			Leaflets Questionnaire distributed to 10,000 households Online questionnaire
Participatory budgeting (2007)	A more participatory in nature project Citizens are co-designing the technical program of Korydallos municipality	Citizens, social actors, NGOs, associations, firms and municipal organizations	Thematic meetings for education, sports and culture, local economy and entrepreneurship Eight neighbourhood meetings at different open spaces, following municipal division

Apart from political will and vision, a key common *asset* for all three initiatives was the availability of *financial resources* (Table 4.2). Indeed, initiatives were implemented within a favorable external economic environment, particularly in the Attica Region, where a large share of public funds was available due to the 2004 Olympic Games' organization.

Additional funds were raised in 2004, where the liberal-conservative party won general state elections. The new government had placed emphasis on increasing efficiency of administrative units at all levels, by endorsing strategic public management principles alongside with a more substantial role of local government. Through the enactment of the new Code of Municipalities in 2006 (Law 3463/2006), local powers for serving development objectives were explicitly stated and stressed; while "Thisseas" development programme was financing local authorities' efforts and the drafting of Municipal Operational Programs (Kyvelou and Marava 2017; Law 3274/2004). These resources have supported the handling of the first two initiatives by external specialized staff dealing, in this respect, with a common shortage of the Greek local government (Council of Europe 2015); while these were also supported by European Funds (Operational Programmes of the 3rd Community Support Framework).

Table 4.2 Before recession—organizational attributes of smart governance layers in Korydallos *municipality—assets*

Initiatives	Assets		
	Financial resources	Technology	People—human capital (skills—capabilities)
An Integrated Strategic Development Plan	Availability of financial resources for organizing citizens and stakeholders' focus groups	Lack of knowledge on particular participation tools for citizens or stakeholders' engagement City's ICT infrastructure under development	No ICT skills available by citizens and/or stakeholders Experts hired to draw up and organize participatory events
			Municipal staff unfamiliar with ICT or engagement strategies/ tools. Staff resistance to ICT—fear of technology
Multi-annual operational municipal program (MOMP)	Significant financial resources from national budget for drafting MOMP	City's ICT infrastructure was gradually developing Upload of online questionnaire Not well organized web-based information	Municipal staff unfamiliar with ICT or engagement strategies
Participatory budgeting	Availability of financial resources	City's technology is only used for information sharing and publicity of organized meetings	Gradual development of municipality's staff expertise in participatory processes Increasing interest of citizens in neighborhoods Familiarization with participation and its value / outcomes

Moreover, common asset in all three initiatives is the limited role of *technology* in public engagement. This period is actually marked by the stepwise deployment of municipality's ICT infrastructure; and the gradually upgrading of staff's capacity to use this infrastructure, mostly for spreading information than as an interaction mechanism. Of importance is also the lack of staff expertise as to *participatory processes and related tools* as well as structured methodological approaches for serving participatory planning endeavours. Finally, it is noticeable the gradual increase of engagement through this period, depicting the flourishing of the idea of participation in local affairs; and setting the ground for further participation efforts in the recession period that follows.

4.3.3 *Smart Governance Pace During Recession—Key Attributes*

Greece was seriously affected by the financial crisis that has stricken the Euro zone since 2008, which has rapidly evolved into a debt crisis, leading to loans from TROIKA, i.e. European Commission, European Central Bank and International Monetary Fund. Loans were tightly linked to a range of commitments in relevance to, among others, local and regional authorities, deeply impacting their initiatives and financial state (Kyvelou and Marava 2017). The first impact was a *reform plan* that was put forward and the enactment of a new *law*, known as "Kallikratis" reform, which had radically changed the structure and operation of the Greek governance system (Law 3852/2010; Alexopoulos et al. 2012; Hlepas 2014; Gkekas and Mitsou 2010).

While "Kallikratis" reform was distinguished for the mandatory merging of Greek municipalities in order efficiency and effectiveness, in times of austerity, to be increased, it had also introduced new institutions to the Greek territorial governance system. These aimed at strengthening system's accountability and transparency. Additionally, it has attempted to broaden *citizens' participation* in the deployment of strategic planning and Operational Municipal Programs, predicted by this reform for each single Greek municipality. This was pursued through the establishment of a newly emerging body, the *Municipal Counseling Committee (MCC)* (Law 3852/2010, Article 76). This innovation though was perceived by many local administrations as a rather formal arrangement, having as a result, in most cases, a marginal consulting role of MCC to certain decision-making processes. Furthermore, although selection of MCC members was subject to certain objective criteria, in practice transparency of the selection process has been argued. Additionally, the lack of participation culture in the Greek context has led to a rather low interest of selected MCC members' to engage, even in cases that a truly objective selection process was carried out (Alexopoulos et al. 2012). Despite the weaknesses in practical implementation of MCC selection process and role, participation by law enforcement had established new facts in local decision-making processes for both decision makers and local communities.

Within an environment marked by the above *institutional changes* but also severe *financial constraints* (recession period 2008–2016), Korydallos municipality has continued efforts towards participatory strategic management of local affairs and governance. Indeed, by taking advantage of *institutional developments*, the municipality has attempted to strengthen *participation* in decision-making processes by establishing:

- The *MCC* (Law 3852/2010, Article 76), embedding social partners in the decision-making processes, who have had advisory roles in the preparation of the operational programming procedures (preparation of annual action programs and related budget).

- The *Council of Immigrant's Integration* (CII) (Law 3852/2010, Article 63), following already established immigrants' integration policies in the city. CII had a dynamic presence in local policy making by introducing problems faced by immigrants to municipal leaders until 2015. Beyond this year, CII has failed to keep momentum mainly due to the: barriers inherent in implementing participatory processes for immigrants (e.g. language and time obstacles); and decrease of municipality's permanent full-time personnel as a corollary of economic constraints, implying a certain deficit to staff engaged in providing administrative and scientific support to CII.

Severe *financial constraints* throughout the years of economic recession have largely affected local government affairs. Visions of local leaders had to be pursued in an environment sealed by drastic cuts in municipalities' personnel and budgets. Furthermore, the Medium Term Fiscal Strategy Framework in 2012 (Law 4046/2012) introduced various provisions for local government, which once again had strongly affected staff availability and local government finances (Kyvelou and Marava 2017). Alongside with central control of municipal budgets and the continuous escalating national debt, essential funding of local development initiatives and infrastructure had further diminished. Possible options for raising municipal financial resources were external funds through e.g. competitive European programs.

Within this *austerity era* and the new reality this has set, leaders of Korydallos municipality and advisory staff had tried to leverage such financial resources. More specifically, two important *initiatives* were implemented by use of such funds, namely the *Gastronomic Cities Project*—URBACT II (2014–15) (http://urbact.eu/gastronomic-cities), raising European funding; and the *DemoCU Project* (2015–16), raising funds from the European Economic Area (EEA Grants) (Fig. 4.4).

During this particular time span (2008–16), *governance* seems to follow different paths from the previous ones explored. Indeed, taking advantage of prior experiences, partnerships created in both initiatives had a more substantial and thus decisive role in respective decision-making processes.

In the *first initiative*, i.e. the *Gastronomic Cities' Project*, the establishment and functioning of the URBACT Local Support Group (ULSG) has inaugurated a novel style of local decision-making by deepening participation and enabling private

Fig. 4.4 During recession—Key milestones of participatory strategic management in Korydallos municipality

partnerships to co-shape local strategy for gastronomy and culture sectors at Korydallos premises (Table 4.3). Towards this end has also contributed the fact that ULSG was a formal requirement and a prerequisite for funding in the context of URBACT projects (Siršе 2014). Nevertheless, and despite the fruitful and creative interaction that took place among ULSG members, the functioning of ULSG was actually brought to standstill after the end of the project, in March 2015. The municipal authority's intention and efforts towards a durable engagement of ULSG members in gastronomy and culture local decision-making did not have the desirable outcome (Municipality of Korydallos 2015). Reluctance of ULSG members to keep track with work in this Committee was mainly attributed to the unstable political scene (local elections in 2014, two national elections in 2015) and the economic uncertainty (enforcement of capital controls to Greek economy), both altering their priorities and attitude to engage. Of importance in this respect was also the lack of entrepreneurial cooperation culture.

Worth noting also was the *participatory methodological approach* and the utilization of both *online* (Web-based) and *offline* (face-to-face) *participation mechanisms* followed by this project (Table 4.3). More specifically, it envisaged a participatory methodology and a feasibility study for transferring good practices, placing great emphasis on communication and dissemination tools (Siršе 2014). A thorough use of *web and social media* took place in this respect, alongside with dissemination of locally-organized events. Clearly, *social media* was the most

Table 4.3 During recession—organizational attributes of smart governance layers in Korydallos municipality—*governance*

Initiatives	Governance		
	Conformation	Partnerships—actors	Mechanisms
Gastronomic Cities URBACT II (2014–15)	Establishment of the URBACT local support group (ULSG) Collaboration in drafting a local strategic gastronomy plan for Korydallos City	Actors' engagement based on leaders' informal links Broadening of actors engaged (businesses, local authorities, associations etc.)	Thorough use of online participation and social media alongside with traditional ones
DemoCU project (2015–16)	Establishment of cultural consultation committee (CCC). collaboration in drafting an integrated strategic cultural plan Engagement of previously created committees (MCC and CII)	Broadening of actors engaged (Citizens' groups, cultural & sport associations, local authorities etc.) Particular emphasis on vulnerable groups (youth, elderly etc.)	Structured participatory methodology for collaborative development of a strategic cultural management plan Use of face-to-face and Web-based participation tools

preferable mechanism for dissemination and communication purposes due to their resonance and the low or zero costs involved.

With regards to the *second initiative*, i.e. *DemoCU Project* (2015–16), as *key asset* is considered the funding by the EEA Grants, in the context of the NGO Programme "We are all Citizens" (Table 4.3). The goal of DemoCU was the promotion of *smart participatory governance and democracy* in decision-making processes at the Municipality of Korydallos, having as pilot application the cultural/sports sectors (Marava et al. 2016).

DemoCU can be perceived as the most mature and integrated initiative, touching upon all three distinct dimensions of smart governance as defined by Przeybilovicz et al. (2017), namely *governance, assets and management*. This has largely been the outcome of the DemoCU *trilateral partnership*, establishing collaboration among: an *NGO*, facilitating engagement of less privileged societal groups in local decision-making in recession times; a *university* as a consultant for spreading knowledge on *well structured participatory approaches* and related *offline/online participation tools*; and *leaders* of Korydallos municipality for bridging consortium efforts to local society as well as supporting the broadening of participatory processes. Such collaboration has ended up with a *strategy* and related *policy options* that could strengthen the role of culture/sports into city's *vision and future development*.

Participation in DemoCU was carefully designed, tackling barriers of actors/citizens' engagement; and took place at all different stages of strategic cultural planning endeavour. In contrast to all previous experiences, DemoCU has carefully designed a *strategy for participants' selection and recruitment*, elaborating on selection criteria relevant to the context of the planning effort (Stratigea et al. 2015b); while participation tools were deliberatively chosen in order to best match participants' profiles (Stratigea et al. 2015c). Furthermore, a *Cultural Consultation Committee* (CCI) was established, consisting of 18 members, which represented different community stakes (municipality agents, cultural associations and citizens). CCI has acted as a consultant of the project's team; and has contributed to getting deeper insight in the studied sectors, mapping and creating content with regards to the cultural/sports profile of the city (Stratigea et al. 2016a, b).

Technology has played a decisive role in the DemoCU cultural planning participatory endeavour (Table 4.4), steering the functioning of an *e-cultural platform* in which *e-engagement tools*, such as *"tell us your opinion"* or the *"forum"* were used for spreading information on the DemoCU activities and goals; and motivating engagement at critical stages of the project. Moreover, *e-participation* was used for communicating a strategic cultural plan proposed by the project's team; and engaging local community in expressing views and opinions with respect to this plan for its further improvement and finalization (Stratigea et al. 2015c, 2017b).

Participants' engagement in DemoCU has proved rather promising. Face-to-face participation has engaged 372 participants in 16 workshops in two years' time; while e-participation for commenting on the strategic cultural plan has engaged 160 participants in two months' time. Additionally, more than 1000 people established interaction with DemoCU endeavour through the homonym e-platform,

Table 4.4 During recession—organizational attributes of smart governance layers in Korydallos municipality—*assets*

Assets initiatives	Financial resources	Technology	People—human capital (skills—capabilities)
URBACT II, Gastronomic Cities Project (2014-15)	EU Funding	Improved city's ICT infrastructure in comparison with the previous period Thorough use of the municipality's Website for dissemination purposes; social media extensively used as part of the dissemination strategy	Municipal staff and local actors partly familiar with engagement strategies through previous participatory endeavours
DemoCU project (2015–16)	EEA grants	More mature knowledge on (e-)participation City's ICT infrastructure in place—Interaction through municipality's social networks City's technology is used for information sharing and publicity of organized meetings Establishment of a dedicated e-platform for citizens and stakeholders' engagement	ICT skills available by municipality's staff, citizens and stakeholders Municipality's staff partly familiar with participation strategy—Training of staff in structured participation methodology and tools People more familiar with participation—Training to offline—online participation tools

dedicated to cultural/sports themes. Most importantly, it was realized that existing barriers to participation could be overcome by means of a well-structured and coordinated *communication/engagement strategy* (Stratigea et al. 2015b).

The step-by-step participatory building of the strategic plan has had multiple effects on the establishment of *communication/trust* among cultural/sports associations, citizens and local administration; while it has led to win-win solutions. These fall into *short term*, related to the structuring of an Integrated Participatory Strategic Cultural Management Plan, informing future policy options and the DemoCU Platform as the city's permanent digital cultural pole; and *long term*, associated with the positive experience gained by the DemoCU participatory planning exercise and the establishment of a mutual learning process that has broadened *skills and capabilities* of human capital (municipality staff and local community), opening thus up new ways for future smart governance endeavours.

Finally, in recession times it should be stressed the important role of *vision and leadership* for overcoming difficulties and exploring new, smarter ways of accomplishing tasks. The presence of a delegated leader, the Mayor of Korydallos Municipality, was a key influential factor for successfully implementing participatory processes and motivating partnerships' creation; while he has contributed to the strengthening of the *credibility* of the participatory exercise by fully integrating strategic guidelines produced to the operational plan of the municipality.

4.4 Discussion

Today, the concern about smartening up management of urban environments for achieving sustainability objectives lies top on urban agendas; and the number of cities joining the 'smart city' race is rapidly increasing. However, successful outcomes of smart efforts are, in many cases, disputed (Komninos et al. 2015; Stratigea et al. 2017a), stressing: the lack of a *strategy/vision* and an *integrated approach*, taking into consideration cultural aspects, city- and citizen-specific challenges and start line of sustainability (Stratigea and Panagiotopoulou 2015a, 2017a); and the concentration on purely technological aspects as well as the use of technology in pursuing fragmented urban management purposes. This was noticed also by Nam and Pardo (2011) as well as Meijer and Bolivar (2016), who claimed that cities should follow *progressive steps to smartness*, elaborating on *smart technology, smart people and smart governance*; and taking into consideration structural and cultural attributes, historical context and trajectory, peculiarities and needs, future expectations as well as specific challenges ahead.

In the present paper, conceptualization of smart cities and smart governance, grounded on literature review, has given rise to certain *organizational attributes* that can provide a *"guide"* for riding the smart governance wave, as a global trend attracting the interest of city leaders. Keeping these attributes in mind, paths undertaken by a specific case study, Korydallos Municipality—Greece, i.e. a typical medium scale city in the Greek context, were explored in order gaps and inefficiencies to be identified; and local government's future policy actions to be guided. These paths were studied in a time span of thirteen years (2004–2016), covering both the pre-recession (2004–08) and the recession Greek context (2008–16), thus illuminating also recession/austerity impacts on municipality's smart governance trajectory.

Efforts of Korydallos municipality towards smart governance in the *pre-recession period* (2004–08) are carried out within an institutional environment characterized by the: lack of providence with respect to participation and governance; and state funding of local governments' initiatives. Within such an environment, as a key attribute of the paths followed by Korydallos municipality towards smart governance is considered the *pioneering spirit* of its leaders. They had early enough realized the potential of communities' participation in policy choices; and have empowered local community actors to engage through innovative, for that time, initiatives (e.g. participatory budgeting), taking into consideration the limited participatory culture and the lack of relevant institutional arrangements. These initiatives though were lagging behind in terms of: a long term vision and strategy, a far reaching and integrated way of coping with city's comparative advantages, problems and strengths; sound methodological approaches and participation tools increasing effectiveness and efficiency of relative resources; use of technological advances in support of wider inclusiveness of these initiatives; and staff skills, facilitating planning and implementing of participatory endeavours.

This gradually evolving trajectory towards smart governance seems to be partly disturbed during *recession period* (2008–16). Key issues marking this disturbance were two critical, but also contradicting developments for local government's service delivery, namely the: change of the institutional environment, enriching responsibilities of local government and endorsing participation in local decision-making processes; and the considerable shrinkage of the Greek economy and respective budget cuts for, among others, the local government. Recession and its impacts on the Greek economy in general and Korydallos municipality in particular have also negatively affected the local socio-economic status; and have altered community's priorities as well as trust to political system in general and, as a result, willingness to engage in local affairs. Moreover, recession has further complicated local government's tasks and priorities. At the same time, it has also given, more than ever, meaning to smart governance processes for gaining efficiency, promoting transparency and trust, favouring solidarity and establishing smarter and more collaborative ways to cope with negative consequences of this turbulent time span.

Speaking of smart governance efforts of Korydallos municipality during this period, these have shifted to a new reality, introducing the need to: fulfill more tasks under lower budgets; cope with a new imperative, i.e. capacity building for seeking external funding sources through competitive processes; and deal with the deepening social stress, mistrust and frustration. In response to these pressures, new collaborative and creative ways, capable of coping with difficulties in the new era, were sought (e.g. solidarity actions, innovative social policy forms); while it was also pursued the establishment of a deeper and more durable cooperation between local government on the one hand and the local ecosystem and the academic community on the other. The latter has resulted to the leverage of funding resources from other sources (EU, EEA Grants), which have broadened *scope* and existing *knowledge/skills* of municipal staff with regards to more sound participatory exercises and tools; and have *trained* local society to more collaborative schemes of policy design. Moreover, based on the focus point of these initiatives (culture), they succeeded to re-motivate local community and stakeholders to engage in opening up new opportunities for the city. Nevertheless, the still fragmented character of these initiatives has to be noticed, steering developments in directions that are largely defined by scope and rationale/priorities of funding organizations.

To the positive outcomes of smart governance efforts in Korydallos municipality in the recession period fall the revocation of inefficiencies of pre-recession times, following the course of developments of the external environment, but also new opportunities emerging from extroversion and experience gained through competitive programs. These have led to the gradual strengthening of collaborative capacity of local decision-making bodies, municipality's staff and local community; the step-by-step establishment of legitimacy and trust between community and local leaders; and the deployment of effective interaction mechanisms for implementing well structured participatory governance initiatives.

In conclusion, distinct steps undertaken by Korydallos municipality towards more *inclusive governance* depict signs of a *gradual transition* to a new, more mature and responsive, decision-making and governance model. This is grounded on cohesive as well as methodologically ripe and structured participatory tools and approaches, upgrading the essence of citizens' engagement in the participation ladder (Arnstein 1969) and their role in the decision-making process. With regards to the position of Korydallos in the model of governmental structures and processes towards smart governance, presented by Meijer and Bolivar (2016) (Fig. 4.1), it could be stated that the municipality has shifted to the stage of smart decision-making, having also undertaken efforts falling into the stage of smart administration. This somehow not clear and consistent trajectory with regards to the distinct smart governance stages presented in Fig. 4.1 can be partly attributed to the impacts of recession, which have changed priorities and have interrupted the momentum that could eventually had led to more advanced stages of smart governance. Within such an environment, setting up a *strategy* and related *plan* for its implementation; and keeping track with it in a consistent and cohesive way, seems that has not yet been fully grasped by local leadership. This effort can actually be regarded as a rather complex task within a recession-marked environment, with austerity and its socio-economic impacts largely affecting local government's priorities; while disempowering local administration from valuable human and financial resources.

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Chapter 5
'The Urban Walk Architecture Talk'—Bridging Socially Engaged Art, Urban Processes and Cultural Development

Justyna Borucka and Marta Wróblewska

Abstract "Urban Walk—Architecture Talk" is a project based on an elective seminar under the same title organized at the Faculty of Architecture of Gdańsk University of Technology. It aims at getting familiar with the topic of multi-layer and multi-sensory reception of public space, mainly by recognizing the needs of its users. Additionally, it deals with the consequences of such perception and the use of space in order to build more complete architectural design and urban concepts. It also fosters the awareness of the need to design public and built space as an integral and continuous part of the urban environment, including special places of interest. It elaborates on public space and its transformation and revitalization along the course of both social participation as well as art action in such a space. The project was implemented within the "People's Smart Sculpture" context, comprising a series of workshops, meetings, lectures, discussions and study visits, conducted by three partner institutions: Gdańsk City Gallery, Faculty of Architecture at Gdańsk University of Technology and Department of Civil, Constructional and Environmental Engineering, DICEA, at Sapienza University of Rome. The main goal was to re(discover) and exchange experiences between two cities—Gdańsk and Rome—using *city walking tours towards community-based city building* in order to achieve it. The expertise gained and the exchange of best practice have served as a departing point for much complicated discussions about the transformations of the city's public space with the active involvement of art and culture. The research period in both cities was concluded by events in public space, welcoming broad public participation. In Gdańsk, the final event was entitled "Crossing the bridges—Gdańsk Osiek". The actions were directly linked with the international concept of the Jane's Walk and were accompanied by various special events, like

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urban walk, art installations in public space, cultural picnic, workshops, concerts and more.

Keywords Urban architecture · Urban planning · Public space
Art · Participation · ICT

5.1 Introduction

The project entitled the "People's Smart Sculpture 2 (PS2)" fosters the creation of socially-engaged art and joint actions, linking processes of urban, artistic and cultural development of European cities. Gdańsk City Gallery is among the twelve European partners, implementing its sub-project called "Move into the Open Space" under the common umbrella of the aforementioned PS2, taking place over a time span of three and a half years, between 2014 and 2018. During this period considerable experience was gained, as well as numerous examples of good practices were shared.

The project is based on the increasingly popular contemporary practice of breaking the constraint of museum or gallery walls, where traditionally imperative discourses have been produced by decision-makers and (hi)story writers in spaces, that are not accessible to public which is forced to passive consumption, thus reflecting one of Foucault's models of power and control (Bennett 1995). Paradoxically, thanks to the "participatory" imperative present throughout EU projects, the dreams of philosophers and artists, postulating over recent decades the change in artistic practice approach through either withdrawing art from institutional constraints by taking it physically out from the museum buildings (Eco 1993), or transforming the passive consumerist viewers not only into active participants, but even co-creators of art, thus becoming integral part of the creative process (cf. for example Beuys's notion of the social sculpture), are now being implemented in art projects on a wide, popular scale. Additionally, novel approaches, closely associated with new technologies, bring artistic practice to the level of a well-rounded and comprehensive smart participation.

It is also important to understand what does it mean for a municipal institution, like Gdańsk City Gallery, to implement a project based on the idea of the "People's Smart Sculpture". The "Gdańsk Plus 2030 Development Strategy" clearly states that it is a crucial element of the city's long-term vision to go out into the open space, avoiding any kind of confinement—be it administrative, mental, cultural, etc. —realizing that the "*public spaces are one of the city's main assets*"; while its "*inhabitants are the major creators and recipients of any changes in the city*". Moreover, culture and public space are found among the five main areas of interest as far as strategic development of the city is concerned, besides education and social capital, economy and transport, and health.

The most crucial directives for cultural development are as follows:

- protecting and strengthening the tangible and spiritual heritage of Gdańsk;
- strengthening the community and cultural identity of Gdańsk inhabitants, and creating conditions for neighbourhood integration;
- building the position of Gdańsk as an international centre of culture;
- diversifying the cultural opportunities, improving the accessibility to culture and stimulating the development of creativity and art; and
- stimulating passions and interests as well as active participation in culture, and creating conditions that facilitate personal development.

Implementation of these directives for public space development needs to be perceived by (Gdańsk 2030 Plus Development Strategy):

- determining clear and transparent principles for sustainable management of public space, taking into account the maintenance of necessary area reserves for housing, recreational, service and production purposes;
- improving the quality of functional, aesthetic and natural areas for bettering quality of life of Gdańsk inhabitants;
- keeping track with the sustainable management and protection of natural environment;
- creating optimal conditions for supporting families, increasing number of inhabitants, and promoting equal opportunities and social inclusion;
- increasing level of inhabitants' satisfaction in terms of providing accessible and qualitative public services;
- creating open, integrated and safe urban spaces, which would be accessible to inhabitants and would ensure multi-functional use, taking into account protection against extraordinary events and their adaptation to climate change impacts; and
- strengthening multi-party cooperation within the metropolis, leading to the improvement of competitiveness of the metropolitan area.

To summarize all the above, the city is interested in long-term development effects that are closely based on cultural activities, grounded on the rich local tradition and cultural heritage; and aiming at activating its inhabitants by supporting participatory initiatives, preferably happening with reference to the friendly and well-taken care of public space.

Another question that needs to be answered at this point is why moving into the open public space is so relevant in Poland in general. As has been argued by the late Polish art historian and institutional critic professor Piotr Piotrowski (2005), the debate about placing art in the public space is equivalent to the debate about the shaping of democracy. The country is still working through the aftermath of the communist regime; and as a young democracy still has to learn how to activate social participation and engagement in public matters, including public space management and culture. Thus, moving out into the open space with artistic initiatives seems like a perfect option in the process of general democratization of the public agora, minimizing any kind of social exclusion and inequality.

What are the ways of moving into the open space? As early as 1993, in his essay on museum and its transformations, Umberto Eco (1993) was endeavouring to find a solution for the museums to go beyond their interiors and open up to the outside world. One of the breakthrough ideas then seemed to be the organization of travelling exhibitions, taking art out of the gallery and museum spaces (Eco 1993). The present broad definition of art and artistic activities enables us to treat outdoor artistic interventions as an integral part of contemporary artistic practice. No longer are we compelled to put art in *"quotation marks"* presenting it into the objectivised white cube gallery spaces, drawn out of its original context (O'Doherty 1999). Nor do we understand art only through particular artefacts, defined by the process of their institutionalization within the museum/gallery space, since the art work no longer needs to become acknowledged and legitimized through this process (Golka 2008). The collective and interactive nature of the process of creation public art—or art in public space—not only builds its non-commercial and anti-elitist image, but also endows it with "the power to change urban and social systems" in the longer run (Budak and Draganović 2013). In such a context, an individual, becoming a subject of action, is encouraged to actively participate through his or her creativity, which conditions changes and developments; whereas the social sculpture is the way people give shape to the world in which they live, be it in the course of everyday work or activities, or more unique initiatives within one's own domain (Kaczmarek 1995).

The implementation of the "Move into the Open Space" sub-project has been taking place in many levels, considering both the processes of going into the public space and working with it, as well as the different approaches towards the participation itself. It has involved numerous creators, representing different creative fields (artists, historians, urban planners, architects, culture animators, IT programmers, etc.), merging their skills together in common interdisciplinary projects.

First of all, the practice included presentations in a form of gallery exhibitions of projects, created by engaged artists working with and documenting the sensitive areas of their cities. In this way the attention of the general audience is drawn to the relevant subjects tackled by the city, presented from the perspective of its most sensitive users—the artists. One of the examples of the above was the exhibition of an artistic reportage concerning the historical shipyard in Gdańsk, an area of great importance to the city. The photographer Michał Szlaga managed not only to highlight the subject of imprudent demolitions of historical architecture performed by private investors, but also to activate the historical monument protection authorities to take steps towards introducing proper laws to protect the bits and pieces of the post-industrial heritage, which was still left intact. Also a special list of important shipyard relics, scattered throughout the city, was prepared as the basis for further research and creative practices. But most of all, the project began the process of self-identification of vast groups of inhabitants, with the shipyard embodying the historical, industrial and political heritage of contemporary Poland.

Another means to investigate and compare different city spaces, using various points of view, is to facilitate *cultural exchange*. European artists, arriving in Gdańsk within the framework of artistic residency programs, were encouraged to discover the city, wandering around like Baudelaire's *flâneur*, getting inspired by the non-obvious aspects of the city space, or overlapping their own experience with the *genius loci* of the city. The mobility aspect of the artistic and cultural exchange gives not only a stimulus for creative actions, but also constitutes a perfect ground for the exchange of best practices and experiences concerning the organization and life of different European cities.

Overall, it is the public space, which constitutes the common denominator for all projects implemented by Gdańsk City Gallery within the "People's Smart Sculpture". The growing awareness of the surrounding, its close examination and rediscovery are crucial parts of the mobile application called "G: RASS",[1] as well as the artistic and social Internet platform called "Inspirations Bank"[2]. Both of them use new technologies, being however fundamentally based on walking as an "elementary form of experiencing the city", where the participants become walkers, *"whose bodies follow the thick and thin of an urban 'text' they write without being able to read it"* (De Certeau 1984: 93) In fact, the technological innovation, involving GPS-based mobile application in "G: RASS" is underlain by the traditional literary texts written by the Gdańsk-born Nobel Prize Winner Günter Grass, who became the inspiration for the walking route indication. Another time, it was the participants of creative workshops, who led the artists to those city spaces that have intrigued or attracted them; and together they gathered material, thus becoming content providers to the Inspirations' Bank, a Web database for collecting and sharing information on selected spots within the city, expressing preferences and subjective choices of local community members. The treatment of public space as a memory frame (Kapralski 2010), as well as the ground for vast cultural animation activities, not only encourages its perception in a creative way, but also builds a sense of topophilic pride and a strong bond, leading to the broadening of awareness with respect to the local and personal identity (Pirveli 2010).

[1]"G: RASS" (Gdańsk: real and simulated spaces) is an interactive art project, based on a specially designed mobile application using the Android platform. Thanks to it, the viewer, using his/her tablet or smart phone, is transferred into a virtual world—an augmented reality. This approach involves and transforms the surrounding city space in order to view it from different new perspectives. The application was a result of the collaboration based on study visits and artistic exchange between artists, literature experts, curators and IT programmers.

[2]"Inspirations Bank" is an interactive map of spaces that are artistically interesting to the citizens. Those places, sounds, colors or memories constituted the basis for further actions, together with artists in the city of Gdańsk. IB was preceded by Creative Workshops, devoted to the art in public space, whose main media were the image and the sound. The aim of the workshops was to collect base materials for artistic interventions in selected spaces of the city, engaging its inhabitants. They were conducted by invited artists and theoreticians; and coordinated by the architect and academic teacher—Justyna Borucka (Gdańsk University of Technology). http://bankinspiracji.ggm.gda.pl/. Accessed 20 Nov 2017.

5.2 'Urban Walk—Architecture Talk' (UWAT)—Part 1

It can be an important impulse for the transformation and improvement of the quality of urban space, if public participation supports the revitalization of neglected and forgotten neighborhoods; fosters the building of spatial relationships and, consequently; and creates places for better living. This was the goal of the "Urban Walk—Architecture Talk" project, realized as a part of the "Move Into the Open Space" project within the People's Smart Sculpture, through the collaboration of Gdańsk University of Technology, Sapienza University of Rome and Gdańsk City Gallery.

"Urban Walk—Architecture Talk" was based on an elective seminar under the same title, organized by the Faculty of Architecture of Gdańsk University of Technology. The origins of the program fall into the research and didactic activity, conducted during the preparation stage of the project, in collaboration with the Department of Civil, Constructional and Environmental Engineering, DICEA, Sapienza University of Rome. This was inspired by Jane Jacobs' concept,[3] which focused on citizens' engagement as a means to facilitate change and rediscovering of city space. Particularly, it focused on the "Jane's Walk"—a movement of free, citizen-led walking conversations inspired by Jane Jacobs—representing a revolutionary approach to urban design. This annual walking event is conducted all over the world in order to "*activate the ideas of Jane Jacobs by supporting a community-based approach to city building through citizen-led walking tours that make space for people to observe, reflect, share, question and collectively re-imagine the places in which they live, work and play*"[4]—as it is stated in the mission of the Jane's Walk movement.

A Jane's Walk is usually initiated and guided by representatives of a local community (but not necessarily professional experts), engaged and familiar with the area in question, presenting a particular perspective of its built environment. In the case of the Gdańsk project, the organization and general command was shifted onto the representatives of public institutions (art gallery and universities), whose role was: firstly, to provide support for the community leaders of the walk; and secondly, to act as a catalyst for different ideas coming out from the citizens. The first pilot project entitled: "Rediscover San Lorenzo—Remains and transformations in a

[3]With her journalist and activist background, but most of all personal commitment and engagement, Jane Jacobs influenced many artists, architects, urban planners, historians, museum curators, and academicians. Her theories have profoundly influenced the urban development patterns of the North American cities. In her ground breaking book: *Death and Life of Great American Cities* (1961) by introducing her big ideas for cities, she presented criticism of rationalist planning of the fifties and sixties. She was, among others, the supporter of pedestrian walkability and the importance of local residents in the development of their neighborhoods, as well as of a human scale recovery of the urban nuclei.

[4]http://janeswalk.org/information/about-janes-walk/. Accessed 20 Nov 2017.

historical city district"[5] took place in Rome in 2016, initiating the collaboration between Gdańsk and Rome universities.

The program "Urban Walk—Architecture Talk" was the continuation of this initial step, aiming at getting familiar with the topic of multi-layer and multi-sensory perception of public spaces and the use of public space, as well as the recognition of the needs of its users. It investigated the consequences of such perception and the use of space in order to build a more complete architectural design and urban concepts. It was aiming at fostering the awareness of the need to design public space and buildings as an integral and continuous part of the urban environment. It included special places of interest, exploring the subject of public space as well as its transformation and revitalization as a result of both social participation and art actions in public space.

In order to be able to improve quality of life in the city and rediscover the city space, multiple dimensions that can include both perceptual and sensory forms should be introduced. New ways and tools to reach new types of aesthetics, more suited to the experiences of modern life, should be explored in order to build identity in a way that is more consistent with contemporary experience. In this context, Jane Jacobs' ideas proved to be a useful methodological support because it takes into account the social signs and refers to them, while producing the quality of urban space as it is today.[6]

As was already mentioned, walking is the basic method of experiencing the city. *"Errare humanum est…"* says Careri (2002). He argues that "… *walking takes on a symbolic form that has enabled man to dwell in the world. By modifying the sense of the space crossed, walking becomes man's first aesthetic act, penetrating the territories of chaos, constructing an order on which to develop the architecture of situated objects. Walking is an art form whose loins spring the menhir, sculpture, architecture, landscape. This simple action has given rise to the most important relationships man has established with the land and territory*" (Careri 2002: 20).

Organized walks bring people together. They can "share stories about their neighborhoods, discover unseen aspects of their communities, and use walking as a way to connect with their neighbors."[7]

Nowadays, similar kinds of activities, including public participation, can be observed in many cities all over the world. Good examples are actions and projects implemented by different bottom up initiatives like *Urban Experience,*[8] *Stalker,*[9]

[5]It. "Riscoprire San Lorenzo. Permanenze e trasformazioni in un quartiere della città storica.".

[6]The ideas of Jane Jacobs are still the source of inspiration for younger generations of architects and urban planners, e.g. Gehl J. (2010) Cities for People. Island Press, Washington – Covelo – London.

[7]http://janeswalk.org/. Accessed 20 Nov 2017.

[8]cf: http://www.urbanexperience.it/. Accessed 20 Nov 2017.

[9]cf: http://www.osservatorionomade.net/tarkowsky/tarko.html. Accessed 20 Nov 2017.

work of groups active in Rome or *Committee of Social Initiatives* and *Storytellers*[10] in Gdańsk.

The main goal of the "Urban Walk—Architecture Talk" project was to (re) discover and exchange the experiences of two cities—Gdańsk and Rome. The specific methodology of urban research that was used in this project was based on tools of participatory character. In particular, collective walking was a process of bringing space back to the city and people. The goal was to conduct those actions in the city voids, spaces which have been neglected, considered as problematic areas. Walking became a tool for mapping the city districts and their transformation, gathering stories, recalling memories, evoking experience, and finally immersing in a place. Knowing and experiencing were key drivers throughout the project, with a focus on the combination of art and participation in public space, which can later become a tool for the city's transformation and the setting up of urban planning strategies. *"No one can find what will work for our cities by looking at ... suburban garden cities, manipulating scale models, or inventing dream cities. You've got to get out and walk."*—wrote Jane Jacobs in her article "*Downtown is for People*"[11] .

Good practices, which were developed during a pilot project in Rome, served as guidelines for selecting the topic and location for future work in Gdańsk. Locations that have been selected for this stage of the UWAT project were of similar attributes to the locations in Rome, so that the comparison of the two city contexts would be possible. In Gdańsk, the districts of Gdańsk Wrzeszcz and Gdańsk Osiek were selected, while in Rome the districts of San Lorenzo and San Basilio.

The first research step of the "Urban Walk—Architecture Talk" project was to develop the strategies that combine art in public space with cultural animation. The ideas, which were worked out for further implementation in the next stage, were capable of encouraging creative perception; and building a sense of local consciousness and identity.

The concept of intervention into the public space elaborated on aspects of public spaces and urban planning, and was consecutively combined with the practical (field) part. The preparation studies contained actions, such as: urban walks targeting the better recognition of the Gdańsk Wrzeszcz district, organized by *Committee of Social Initiatives*[12]; and participation in the urban art interventions during the "Narrations 8"[13] festival, held in Gdańsk.

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[10]cf: http://www.opowiadaczehistorii.pl/. Accessed 20 Nov 2017.

[11]Jacobs, J. (1958) (2011). Downtown is for People (Fortune Classic1958) http://fortune.com/2011/09/18/downtown-is-for-people-fortune-classic-1958/ (by Nin-Hai Tseng September 18, 2011) One of Jacobs' earlier articles republished by Fortune.com in honor of the 50th anniversary edition of Jane Jacobs' influential book, The Death and Life of Great American Cities (1961) Accessed 24 Nov 2017.

[12]pol. Komitet Inicjatyw Lokalnych (KIL) a local non-profit organization NGO.

[13]Narracje [Narrations] is the festival based on artistic interventions, organized as an annual event in the city of Gdańsk. It combines art in public space with the experience of walking and exploring particular districts. "Narrations 8" was organized on 21-22.10.2016, in the Bishop's Hill district in Gdańsk, http://narracje.eu/narracje2016/. Accessed 2 Nov 2016.

This analysis was followed by the conceptual phase. This encompassed the ideas for an outdoor site-specific art installation, as well as the preparation of the preliminary concept of a culture event, taking place in the selected public space. All this led to the second stage of the project, focusing on the preparation and implementation of the main event—the Jane's Walk—accompanied by workshops in Rome and Gdańsk.

5.3 "Urban Walk—Architecture Talk" (UWAT)—Part 2

5.3.1 Introducing Gdańsk—Osiek

One of the aspects of working with public space, especially in historical cities, is its revitalization. A city like Gdańsk, having experienced war damage that affected almost 90% of the central city space, is extremely vulnerable to the subject of protecting, preserving, renewing, or reconstructing its architectural and urban assets. Surprisingly, many areas within the Old City require revitalization due to post-war urban decisions, which separated them from the main city centre by building huge roads, cutting through those areas. Considerable efforts have been put into decreasing this isolation by means of art. Since 2005, Contemporary Art Centre "Łaźnia" has been implementing the project called "The Outdoor Gallery of the City of Gdańsk"[14] in the Dolne Miasto (Lower Town) district. Its concept consists of creating a collection of permanent works of art in the city space, as a next step towards the change of the character and function of the socially and aesthetically degraded area (Charzyńska 2009). Certainly, the whole revitalization process implies more than just an art intervention. It is actually based on the cooperation of urban planners, architects, city officials, artists, and last, but not least, sociologists as well as the local inhabitants. Again, participation is the key word in the course of such processes, as partnership with local communities is one of the main requirements of revitalization actions. Schools, local associations, activists, elderly people are the main consultation target groups (Kulazińska 2009). Numerous city spaces have been undergoing larger or smaller scale improvements, modernisations or reconstructions, as quoted by the city's development strategy again: "*A safe public space, characterised by harmony and aesthetics, will encourage the inhabitants' recreation, integration and sense of identity*" (Gdańsk 2030 Plus Development Strategy).

A city area chosen to focus on within the "Move into the Open Space" subproject was Osiek. It is not only considered to be the oldest part of the municipality, having been situated in the direct proximity to the Teutonic castle at the beginning of 14th century, but it was also a Polish language speaking area, where fishermen were living and working in the medieval fish and amber industry (Loew 2013).

[14]http://outdoorgallerygdansk.eu. Accessed 22 Nov 2017.

Nowadays, a bit isolated from the main tourist routes, Osiek represents a considerable cultural potential, housing a few important culture institutions, like the Museum of the Polish Post (part of Gdańsk History Museum), the European Solidarity Centre, the Museum of the Second World War, and an institution in progress—Daniel Chodowiecki and Günter Grass House. The last one, planned to become a comprehensive culture centre inspired by the oeuvre of two important Danzigers, is to be located in a historical orphanage, built in 1799. This architectural monument, situated at the heart of the historically oldest city district, requires a comprehensive approach. Hence, its launching is preceded not only by regularly organized pop-up art events to build up the future audience, but most of all by a number of workshops, meetings, lectures, discussions and study visits, including a broad collaboration of public and private institutions. This was the case with the "Urban Walk Architecture Talk" project, which integrated: Gdańsk City Gallery, Gdańsk University of Technology, Sapienza University in Rome, and 'The City Initiative' non-profit organization, all working under the umbrella of the People's Smart Sculpture project, implemented under the Creative Europe Program. The multi-perspective approach to aspects of protection of local heritage through the renovation of a historical building for serving public cultural functions will only be successful if accompanied by the social acceptance, ensured through the engagement of local community. This was the main goal of implementing the Urban Walk Architecture Talk program, using the district of Osiek and Daniel Chodowiecki and Günter Grass House as a case study.

5.3.2 Implementation of UWAT—Part 2—Gdańsk-Rome

Dealing with the problem of Osiek and finding the spatial and social solutions for the new established cultural institution was preceded by research, simulation and participatory actions. The strategy of the project covered a wide range of activities, in an effort to redefine this particular space, awaken social consciousness, and, in the end, rediscover the district of Osiek. Project participants represented particular groups, interested in the development of the district. The final program was based on the concepts worked out during the block seminar and workshops, forming the first part of UWAT.

Initially, City Walk and City Lab Workshops, dedicated to the problem of "Searching for Art in the City", were conducted within international students groups at Gdańsk University of Technology and Sapienza University of Rome, together with local actors. They led to the preparation and implementation of the main events: The Jane's Walk in the selected public spaces of Gdańsk and Rome.

The two weeks workshops, which followed the preliminary research and conceptual work, were conducted in Gdańsk (first week) and Rome (second week) and covered the researched areas. They concentrated on aspects of revitalization, discussing the risks and opportunities of urban changes in the city of the 21th century, taking Gdańsk and Rome as case studies. The participants took active part in the open lectures, seminars and discussions on public space and space interventions, both at the universities and in cultural institutions.

The City Walk workshop in Gdańsk covered many complex aspects of the city, such as the:

- opportunities for activating urban areas through arts and culture;
- analysis of the cultural centers and city institutions practice (Gdańsk City Galleries, St. John's Centre/Baltic Sea Culture Centre);
- visiting of alternative places, working for the benefit of neglected districts of Gdańsk, like the Lower City (Laznia Centre for Contemporary Art) and the Shipyard area (Wyspa Institue of Art).

During these walking tours, the question of adaptations of historical buildings (Bathhouse in Lower City) and adaptations of industrial ones (Shipyard) for cultural purposes was the topic of Urban Talk Seminars; and the starting point for the discussion on "revitalization by art", its challenges and opportunities. This was also a good chance to investigate examples of activities of those institutions and their impact on the social and urban structure of the districts in question (e.g. The Outdoor Gallery of the City of Gdańsk) (Fig. 5.1).

Those accompanying activities led to the crucial step for practical implementation of the UWAT program, implying the investigation and delineation of actions dedicated directly to the Osiek district, as the main case study area.

Activities like site visits and on site practice in Gdańsk Osiek district started with the City Lab Workshop entitled: "Searching for Art in Gdańsk—Water Canals." At the core of this laboratory works were the exploration of the possibilities of outdoor art interventions, seen from the perspective of the Gdańsk waterfront. The participants looked at the area of Osiek district from the site of water canals and investigated it from new perspective. Introductory lectures on ways of transforming waterfronts in urban areas completed the investigation. These played an important role in the preparation of the concept and interventions in public space; and the future concept of Jane's Walk Osiek workshop (Fig. 5.2).

Another series of City Walk Workshops and Urban Talk Seminars concerned the perspectives for a new museums quarter—Osiek (II WW Museum, Solidarity Center, Polish Post Museum, Chodowiecki & Grass House), falling into the context of activating urban areas through arts and culture.

Fig. 5.1 UWAT workshops City Walk/City Lab in Gdańsk: designing, meeting, lecturing, discussing and walking, Gdansk Osiek, April 2017 (Photos by Justyna Borucka)

Fig. 5.2 UWAT workshops City Walk/City Lab in Gdansk: designing, meeting, lecturing, discussing and walking, Gdansk Osiek, April 2017 (Photos by Justyna Borucka)

Onsite experiments and group discussion on ideas for Osiek district, as well as proposals for the future Chodowiecki & Grass House, which were conducted under the supervision of experts and researchers, urban planners, architects and artists, allowed the working out of a strategy of urban renewal through art and culture. During the workshop, creative and experimental concepts for the spatial designs of the building, the surrounding area, and the district itself, were presented and prepared for future development.[15]

5.3.3 Implementation of UWAT—Part 2—Jane's Walk Gdańsk

The culmination of the UWAT program, focused on Osiek and Chodowiecki & Grass House, became the centre for the preparation process of the Jane's Walk and accompanying events. The specific methodology for this work and studies, using alternative tools and methods of collective walking, was tested. These tools allowed the construction of "collective imagination" for this place. As described above, the method of walking "activates the area", being a crucial part of the process of recreating and revitalizing these spaces.[16]

[15] Moderators of the City Lab Workshop "Searching for Art in Osiek Gdańsk district" within the UWAT program were an interdisciplinary group of experts, giving a significant impulse into the participants' work during the workshop, consisting of: J. Borucka (Arch. Faculty, Gdańsk University of Technology, architect), M. Wróblewska (Gdańsk City Gallery, curator and art historian), C. Mattogno (DICEA, Sapienza University Rome, urban planner), A. Cappuccitti (DICEA, Sapienza University Rome, urban planner), R. Romano (DICEA, Sapienza University Rome).

[16] Compare similar actions focusing on the use of this alternative methodology, by e.g. the "Stalker" collective and "Urban Experience" association, both active in the city and suburbs of Rome and other European cities.

The final event of "Jane's Walk" in Gdańsk was organized under the title "Crossing the bridges—Gdańsk Osiek—Along the canals, towards discovering a district of the city".[17] The event was open to the public and was widely promoted in the city by posters, flyers, publication on the Jane's Walk website and social media. Among the walk organizers were experts in the fields of urban planning, architecture, culture, history, as well as invited artist, and in particular inhabitants and local actors. Together, they prepared a series of narratives, connected with selected public spaces. These were presented to the public along the special route, leading to the Osiek district and its core—Chodowiecki & Grass House. Following the Radunia River Canal and guided by this natural landscape, it was possible to discover the hidden places of this neighborhood in search for inspiration in the city. During the walk on each stop marked by a bridge, the invited guests and local citizens were sharing their stories and memories about particular places on the route. What was important is that they were expressing their personal experiences, connected with these places. The presentations included short personal speeches, music performances (the Carillon concert from St. Catherine's Church) or mini-lectures (e.g. on street art, history and architecture of the places). This collective urban experience within the Jane's Walk 2017 Gdansk enabled participants to discover the urban landscape of Gdańsk Osiek city district (Figs. 5.3, 5.4, 5.5).

The concluding picnic, combined with its accompanying events, was the great opportunity to sit back, relax and exchange the impressions after the walk.

The art installation on the facade of the future Chodowiecki & Grass House, prepared as part of the project, took the participants back to the times when all the canals in Gdańsk were flowing above ground. It was also an important point of interest for passers-by and the inhabitants of the district. The backyard of the old orphanage offered a glimpse into the future of the building—a cultural picnic with workshops, concerts and more were anticipating the new culture institution—Daniel Chodowiecki and Günter Grass House—linking the past and the present history of Gdańsk into a creative dialogue (Figs. 5.6, 5.7).

The following week programme in Rome was based on exploring opportunities in terms of Jane's Walk implementation in Rome, as well as gathering comparative experience for future actions in Gdańsk. The most important part was the co-creation and participation in the Roman version of the Jane's Walks in the

[17]pol."Przekraczając mosty—Gdańsk Osiek—Along the canals towards discovering a district of the city": An urban walk, organized in Gdańsk in 2017 by Justyna Borucka (Gdańsk University of Technology) and Marta Wróblewska (Gdańsk City Gallery, University of Gdańsk) within the "Jane's Walk" worldwide annual event. See the map with detailed description of each stop of the walk (Fig. 3).

Fig. 5.3 Flyer and map distributed during the event of Jane's Walk Gdańsk 2017 "Crossing the bridges—Gdańsk Osiek"

Fig. 5.4 UWAT Implementation: Jane's Walk Gdańsk 2017 "Crossing the bridges—Gdansk Osiek", April 2017, Photos by Izabela Uhlenberg (courtesy of Gdańsk City Gallery)

Fig. 5.5 UWAT Implementation: Jane's Walk Gdańsk 2017 "Crossing the bridges—Gdansk Osiek", April 2017, Photos by Izabela Uhlenberg (courtesy of Gdańsk City Gallery)

Fig. 5.6 UWAT Implementation: Cultural picnic, Chodowiecki & Grass House, Gdansk Osiek, April 2017, Photos by Izabela Uhlenberg (courtesy of Gdańsk City Gallery)

Fig. 5.7 UWAT Implementation: Art installation "Recalling the Forgotten Canal", Chodowiecki&Grass House, Gdansk Osiek, April 2017, Photos by Izabela Uhlenberg (courtesy of Gdańsk City Gallery)

district of San Lorenzo entitled: "Crossing San Lorenzo—Ideas for a Green Network"[18] and "San Lorenzo and its network of public spaces".[19]

The main concept of the walks in Gdańsk and Rome was to present and compare significant problems of the contemporary cities. They emphasized the need to change the perspective and rebuild a "shared image" of the city and the neighborhood, seeking the profound meaning that the community endows to living places. It led to the conclusion that the organization of space is not the result of individual choices, but comes out of complex spatial and social activities, which make it more effective and empowered, since implemented in a collective way. The major experience gained through the project was learning from the good practice of both cities, Gdańsk and Rome, by directly immersing into their space and listening to the voices of their inhabitants.

5.3.4 Dissemination of the UWAT

An undoubtedly crucial part of studies and long-term projects like the "People's Smart Sculpture" is their dissemination. As can be read on the website of the Creative Europe programmes, they consider "*the dissemination and exploitation activities as key objectives to their successful implementation*".[20] Hence a number

[18]It. "Attraversare San Lorenzo. Idee per un Green Network"—an urban walk organized in Rome in 2017 by Claudia Mattogno (DICEA, Sapienza Università di Roma), Giordana Castelli (CNR) within the "Jane's Walk" annual event. http://104.236.27.143/italy/rome/attraversare-san-lorenzo-idee-un-green-network1/. Accessed 20 Nov 2017.

[19]It. "San Lorenzo e la sua rete di spazipubblici"—an urban walk organized in Rome in 2017 by Giorgia Scognamiglio, Gloria Consoli and Fulvia Calcagni within the "Jane's Walk" annual event; "Rediscovering San Lorenzo" highlighted the district's most attended places, animated by neighborhood functions. It also focused on the activities of old reconstructed buildings, which acquired new use. The proposed walk was a part of the project ˵Go to Largo", resulted from the collaboration with the South Association and the Town Hall II for the redevelopment of the green area of Largo Passamonti. http://104.236.27.143/italy/rome/san/. Accessed 20 Nov 2017.

[20]http://ec.europa.eu/programmes/creative-europe/projects/ce-help/faq.html. Accessed 22 Nov 2017.

of activities were carried out, following the research and workshop stage of "Urban Walk Architecture Talk" project in order to ensure its broader impact not only among the local community, but also the local authorities and the international art public.

As the "People's Smart Sculpture" project is to a great extent about mobility and international exchange, and UWAT project implemented it on a considerable scale, the dissemination activities started with an artistic residency of a renowned Milanese street artist—Ozmo. This choice was by no means accidental. Apart from the aesthetical criterion,[21] street art itself plays a huge role as one of the possible tools for social change (Krajewski 2013). Additionally, it has a long and successful tradition in the post-communist contemporary history of Gdańsk, the city where "the contemporary mural was born" thanks to such artists as Rafał Roskowiński and Piotr Szwabe to name but a few (Sikorski and Rutkiewicz 2011). The term "*muralismo*", originally coined in relation with Mexican post-revolution wall-paintings, created on the walls of big public utility buildings in order to commemorate and fortify the sense of tradition and history, served as a political propaganda tool (Rutkiewicz 2013). Throughout recent years there has been a real boom in murals in Poland. Local authorities, culture institutions, private organizations in numerous Polish cities have been enthusiastically using this kind of artistic expression as a medium supporting *"revitalization, aestheticisation, social activation*, *combating the lack of social cohesion, conducting effective historical politics and promotional activities, generating identity and increasing product sales"* (Krajewski 2013:36). And there is in fact nothing wrong with murals, being basically public art, in the sense that they have always been substantially legal, approved and serving a particular goal. However, the thin line not to be crossed, when dealing with this sort of artistic medium is, first of all, not to turn it into a populistic and mass production (Krajewski 2013). The artist, instead of being a tool in the hands of the *masses* or an apologist should rather assume a critical approach *"capable of giving form to the nebulous and shapeless and concisely expressing what is ambiguous, thus strengthening the ability to act and speak out"* (Krajewski 2013:38). Considering all that has been so far written, Ozmo used his residency period in Gdańsk to do research on the location, its identity and themes connected with it. The future Daniel Chodowiecki and Günter Grass House will host two collections of works made by those reverend Danzigers. Thus, in his mural, the artist alluded to their oeuvre by using the characteristic motifs taken from their art—a hen (from Günter Grass's sculpture) and a butcher (from Chodowiecki's engraving). This is actually common practice for Ozmo. The artist's interests have been evolving around combining the traditional and the contemporary. He uses quotations from both historical and pop iconography extensively, creating, from both, new constructs. In this way, his art is an embodiment of both the respect and recognition for the heritage, and the excitement and fun of the present and future. This actualization

[21]Ozmo is one of the top street artists in Italy. http://imilanesi.nanopress.it/ozmo-gionata-gesi-milanese-di-pontedera-40-anni-street-artist/. Accessed 22 Nov 2017.

technique worked perfect in the space of the historical orphanage (and at the same time the future modern culture institution). The quotations directly taken from the art of Grass & Chodowiecki have been arranged together; and painted on a wall surrounding the historical building (the wall itself is not part of the protected area). The image, however, is kept in a rough, impressive manner, resembling the quick and spontaneous actions of graffiti artists, corresponding to the creative origins of Ozmo as a street artist (as it is indeed the frequent case that the majority of street artists' origin from anarchical unofficial art circles (Dymna and Rutkiewicz 2012). It is clearly seen that the quality of the artistic production, obtained as an end result, was not indifferent to the *genius loci* of the place. The abandoned historical buildings, reverberating with past histories, events and people, tend to be a strong motivation and inspiration for artistic creation, as the artistic response to the spot may be homage to past uses and past lives echoing within the space, testimony to historic honest endeavor or mourning for its passing (Romany 2011). This particular mural includes both the respect for the spirit of the past and the interest for the future to come.

The discussion on different approaches to practicing various forms of street art all over the world, explaining the work within different social frames and historical contexts, was accompanied by the official presentation of the mural *"Grass vs Chodowiecki"* in a form of an open lecture, delivered by Ozmo (Fig. 5.8).

The creation of the mural, together with the lecture on street art was significant elements of the main event disseminating the "Urban Walk—Architecture Talk" project, meaning the Post-Workshop exhibition. Its elements consisted of four group concepts, containing the architectural and functional proposals for the future development of the culture institution (Chodowiecki & Grass House) in the historical orphanage, including proposals for improving its immediate surrounding (the backyard and the neighbourhood) (Fig. 5.9).

They were accompanied by the material gathered during UWAT workshops in Gdańsk and Rome (photographs, films, sketchbooks), serving both as a comparative feed, but also as a creative background. The exhibition material integrated comparative, analytical and creative approaches to modern urban planning with regards to the historical context, a crucial issue for preserving local heritage; and an issue closely connected to the social awareness of cultural identity and memory in the

Fig. 5.8 UWAT Dissemination: Post-Workshop exhibition and accompanying events within UWAT project, Chodowiecki and Grass House, Gdansk Osiek, June 2017, Photos by Krzysztof Olechnowicz (courtesy of Gdańsk City Gallery)

Fig. 5.9 UWAT Dissemination: Post-Workshop exhibition within UWAT project, Chodowiecki and Grass House, Gdansk Osiek, June 2017, Photos by Krzysztof Olechnowicz (courtesy of Gdańsk City Gallery)

area at hand. The exhibition was additionally accompanied by a questionnaire directed to visitors, including aspects with respect to the future shape of the new cultural institution, the scope of demands and expectations concerning its program assumptions, and more generally the need and importance of initiatives, aiming at acquiring better knowledge about one's own city/neighbourhood/community. Eventually, all materials have been handed for further analysis to the proper department of the local City Hall, responsible for the launching of the new institution.

5.4 Conclusion

The outcomes of the workshop and projects form a good background for discussions and future works, focused on the new cultural institution (Chodowiecki & Grass House), Osiek district; and the future vision of the Gdańsk city in general.

The approach developed during the project is profoundly participatory, though still with considerable engagement of public institutions. The built environment takes a long time to respond to the needs of its inhabitants. Using cultural and artistic interventions, the project aimed at fostering collaborative action in city's transformations through engaging in social relations. Undoubtedly, socially engaged artistic actions are always strongly connected with the "nature of community and the public—hence their strong relation to the ideals represented by non-profit organizations and citizen movements" (Szyłak 2013), however a "relation" does not equal the "implementing agent". Thus, the support provided by public institutions towards the open space projects, which in well-developed participant democracies are, on a general basis, generated by the community members out of their own initiative, seemed to be still relevant here. For, the local public space is in the process of being recognized and familiarized with by its citizens. And, on the other hand, it is often the case that the audience is neither prepared nor willing to understand the nature and sense of artistic interventions in public space. (Draganović 2013). Additionally, the engagement of the institution supplements the lack of the so-called "charismatic agent" due to the low participatory level on the part of the local communities (Doherty 2013). Hence the experience, organizational and educating role of the institutions produces a model of a participatory cultural context to be developed and followed with time by the citizens alone.

As Jacobs (1993:238) argues *"Cities have the capability of providing something for everybody, only because, and only when, they are created by everybody"*. In Gdańsk, the issue of redefinition of space in the context of heritage preservation and the renewal of space in the context of theories elaborated by Jane Jacobs is extremely valid. The participation of cultural institutions in these processes stimulates more reflective and dialogical training paths, related to the context of the place.

The outcomes of the project have been achieved as planned, both on the theoretical and the practical level. The very futuristic and idealistic solutions, presented in the projects and concepts for the district during the Post-Workshop exhibition, provoked strong discussion with respect to this area. Osiek district seems to be more and more rediscovered. After concluding the workshops and activities within the "Urban Walk—Architecture Talk", the consciousness among the citizens and municipality members about the importance of the place has been increased. The creative work on the subject will be continued and the gathered good practice will contribute to the preparation of new planning strategies.

Since there were many institutions involved in the project, the dissemination of its results is very broad and effective. Therefore, the Post-Workshop exhibition became a traveling enterprise. This form of sharing the knowledge may serve as an additional impulse for the discussion. After closing the exhibition at the Chodowiecki & Grass House, the presentation of the arte facts, designs and ideas was moved to the Gdańsk University of Technology. The concluding presentation of this traveling Post-Workshop exhibition is planned to take place in Rome. This certainly enables the further discussion and thoughts exchange about the development of particular city districts through social activities, as well as art institutions practice and art interventions into their space.

As the dissemination of the ideas elaborated on within the project is now a priority for its authors, all outcomes will be gathered in a collective publication under the same title "Urban Walk—Architecture Talk". It will contain the documentation on the theoretical ground and practical issues linked to this project.

The activities undertaken within "Urban Walk—Architecture Talk" project proved that such initiatives may effectively stimulate the integration of different groups of space users. It fostered the stronger identification of the place and served as an impulse for rethinking the development of the city. Such activities, if properly integrated with city planning strategies, may appear as a powerful tool fostering social integration and sustainable urban development, which according to Throsby (2010:115–116) are: *"A form of urbanism that combines environmental concern […], the use of open space,* etc.*, with a focus on cultural values such as identity, sense of belonging, creativity and social participation that can be ensured through culture- oriented urban planning solutions. In this context, the concept of cultural capital is good for showing the place of culture in urban space. Historical buildings, cultural institutions […] can be considered as capital assets".*

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Chapter 6
'Wanderlost'—A Participatory Art and Design Endeavor

Thore Soneson and Michael Johansson

Abstract 'Wanderlost' addresses the growing complexity of life in today's city spaces and the imminent challenges to the development of the urban environment. It delineates experiences gained from a project's work, which incorporated workshops, artists' collaborations, interactive participatory setups in public, theatre and performance spaces. It is a result of two public workshops in the end of the four-year-long period in the People Smart Sculpture (PS2) framework in the cities of Kristianstad and Copenhagen, with public events in April/May 2017 and October 2017. In this article we discuss how the project was prepared, set-up and implemented. We call this storyworld 'Wanderlost', developed from the project CubeX "The Journey to Abadyl". We describe this work in the sections Collaboration, Research and Methods to show how we draw knowledge, methods and research from our work in the collaborative network PRAMnet in developing participatory concepts using a virtual city, the city of Abadyl as a backdrop. We put forward our models for engaging participation in a storyworld to imagine the world and our relations anew. We conclude that the 'Wanderlost' concept and project can be reused and re-situated in other contexts and environments; keeping the fundamental three formats with a digitally mediated tool, physical guides and explorative walks and a map of amusing and provoking artworks as a matrix.

Keywords Art · Co-creation · Architecture · City planning · Story world Interaction design

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6.1 Getting Lost as a Metaphor for Revitalizing a City for Citizens

The cultural project *'Wanderlost'* explores and discovers unknown and/or hidden cultural layers and visual experiences in a living city environment. Envisioned as a city-walk through different cultural and social experiences, it could open up the participant's eyes for gathering new impressions and thoughts.

The key to 'Wanderlost' is *involvement*, i.e. give participants means to re-discover, re-experience their experience of living in the city.

In this article we will describe the art and design project called 'Wanderlost'. The project was a result of two public workshops during the four-year-long period in the People Smart Sculpture (PS2) framework, ending with public events in April/May 2017 and October 2017 in the cities of *Kristianstad* and *Copenhagen*. It included workshops, artist's collaborations, interactive participatory setups in theatre and performance spaces and digital interaction research. We called this theatre and performance project "The Journey to Abadyl". Here we drew knowledge, methods, and research from our work in the collaborative network PRAMnet, were we developed the concept of a *virtual city* (described in the following chapters Collaboration, Research, and Methods) to put forward models for engaging *participation* in an *interactive mixed reality space*.

'Wanderlost' addresses the growing complexity of life in today's city spaces and imminent challenges to the development of urban environment. As part of The People's Smart Sculpture (PS2) framework, it explores the possibilities of participation that—quote from the projects' website—*"will become a smart culture technique as a result of the ongoing digitalization of society"*.[1]

Our presumption and artistic credo for this project stems from reflections around the contemporary culture in our western society—we live in an age of global mobility, people move to dense city areas to work; people are fleeing from war and terror; the old world melts together with the new and we, as democratic citizens, are trying to find our role in this urban territory. Therefore, we choose the metaphor 'Wanderlost', *Wander* from the need to relocate and re-establish families and social connection, *lost* from the emotional feeling of being displaced both by growing mega-cities and alienating architecture and urban planning.

Social structures, neighborhood engagement, local identities and "smart" algorithms on the Internet that feed "filter bubbles"; all these are affected by the transformation of our cities and living blocks. Our public cities are designed and also re-designed for commercial needs and for people to commute to and from work and living areas. Consequently our cities, once integrated with social and commercial functions, are now more and more dis-integrated and segregated. The more we impose planned structures on our cities, the more we seem to alienate the

[1]The People's Smart Sculpture (PS2). PS2 is a Creative Europe project (2014–2018) about new approaches, digital tools and digital art for participation in urban re-design, urban planning and urban art. http://smartsculpture.eu/. Accessed 15 July 2017..

foundations of the cities: its people, its inhabitants. As the architect Koolhaas and Mau (1997) wrote in the essay “Imagining Nothingness”: *“Where there is nothing, everything is possible. Where there is architecture, nothing (else) is possible.”*

In our research and workshops during the PS2 project, we have both questioned and developed strategies for how “The Smart Sculpture” can be created and manifested in a city space. To be more precise, we used the *“Fieldasy*” method (see ‘Method’ section) to ask ourselves how we can design an open artwork that uses cultural artifacts and activities to create a field of impressions and expressions, of engagement and active reflection for an audience. In the end, we developed something that we could not have imagined beforehand, a mobile exhibition format that through the use of technology, art, and a city space can facilitate a storyworld[2] in which producers, performers, and participants can imagine the world and our relations anew. This process has led to the development and design of three main formats, and a process on how to set them up and make use of them in a cultural event. The format and the process are described in the following.

6.2 Formats

Drawing up strategies for the public event ‘Wanderlost’ in central Kristianstad we, first of all, decided to use Swedish as the main language for the event; while the invited international artists should be presented in both English and Swedish. We mapped out the inner city, and framed a section of it taking into consideration the walking distances and the possible places for displaying exhibitions in order to organize guided tours and host the planned workshops and events. An important factor was the accessibility and openness for participation; we wanted a mixture of established art venues and unexpected areas to create a curiosity and an “interference” with the familiar and regular.

As part of the PS2 project and together with students from the Digital Design program at the University of Kristianstad we exhibited an assignment called “Non-Places = Icke-Platser” at Kristianstad Center for Contemporary Art in 2016, a mapping of the “left-over” and “in-between” spaces in the town with photographs and sketches as well as design proposals to revitalize the areas. Through this, we established a positive relationship with this institution and we were able to exhibit a Virtual Reality artwork and arrange a workshop during the final event in their space.

The city of Kristianstad and their local business organizations were briefed on the event and decided to support us with accessible and temporarily empty stores. Both the communal housing company ABK and the central shopping mall Galleria

[2]Here we use the term “Storyworld” in a wider context, as a description of a “mixed reality space”, were the artists/designers/producers, artworks, participants and the physical environment all play a part in creating the experience.

Boulevard gave us access to their available stores and helped us to communicate the event through their channels, newsletters, and public billboards.

Together these stores and art venues created the groundwork for mapping out the ‘Wanderlost’ events in the areas where people meet, stroll around, go for shopping and for taking a walk through the pedestrian areas of central Kristianstad district.

For the event in *Copenhagen*, we decided on another set-up of ‘Wanderlost’ at Warehouse 9. The live-art scene is a performance center in a former meatpacking district, where important topics for the local communities are focused on social issues, gender, and alternative lifestyles. Here the invited artists were acting as Guides, while the artworks and workshops were located in Warehouse 9.

The App ‘Wanderlost’ and ‘The Guides’, below described, were the setups only in Kristianstad, while most of the artworks were exhibited on both locations.

6.2.1 The App ‘Wanderlost’

The *first format* for participation developed is the *app ‘Wanderlost’* that invited participants to a journey, a hike in their own everyday environment in support of a reflective walking experience, moving through a city space to notice what they have already seen and to sharpen their attention about the familiar and ordinary. A first prototype was developed in the event in Kristianstad and tested out during this event (Fig. 6.1).

This experience is built upon a larger tradition in both literature and art. In her book “Wanderlust”, Rebecca Solnit (2001) gives several examples of the walking experience, stating:

> Walking ideally, is the state in which the mind, the body, and the world are aligned, as though they were three characters finally in conversation together, three notes suddenly making a chord. Walking allows us to be in our bodies and in the world without being made busy by them. It leaves us free to think without being wholly lost in our thoughts. (Aleph 2013).

The interactive element in the GPS-navigated ‘Wanderlost’ app is a walk, where the user chooses one point of the two available (Fig. 6.2). When he/she is in the range of the interactive point, a question/challenge is posted on the mobile screen, where the user is asked questions like: *“What is unfamiliar and/or alien here?”* The user replies with taking a picture and posting that in the app. After the interactive walk, the user has re-discovered and re-experienced the streets and blocks in his/her neighborhood and receives a feedback from the app with the images and captions he/she experienced and reflected upon.

The app can be re-used and re-explored several times, it opens up with an introduction where the user meets one of seven Guides. The questions/challenges he/she receives are randomized from an online database, so that each interactive walk will never be the same.

Fig. 6.1 From the opening of the exhibition at Kristianstad Center for Contemporary Art in 2016, where artist and design students investigated “Non-Places” in Kristianstad. Director Marika Reuterswärd and artist Michael Johansson

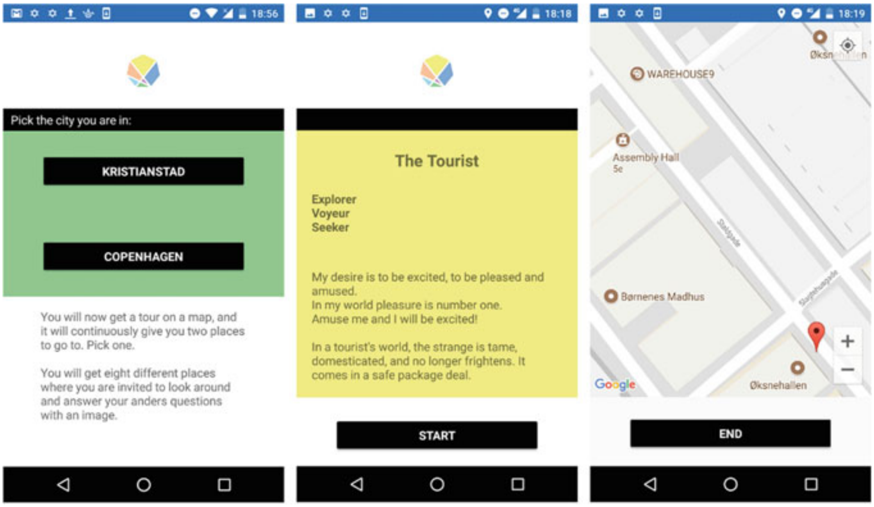

Fig. 6.2 Screen images from the app ‘Wanderlost’ (all texts in the app and the Guides are in Swedish)

6.2.2 *The Guides*

The *second format* for participation is *‘The Guides’*, developed to host scenarios, through their respective perspectives that could improvise around their “persona”.

Their overall mission was to create an interactive experience for participants to re-discover and re-examine the city at all scales—as a citizen, as a visitor, as a member of the community. Each one of 'The Guides' has its own specific experience and perspective of the world and, based on these assumptions, they will give their own special tour for the assigned participants to experience. They have an active role, improvise and encourage discussions and exchanges of opinions and views. Below is an example of one of the Guides—'The Player'—written by Åsa Maria Kraft, and translated by Marie Karlevas Fredriksssson:

> What are the qualities at play through history constructing spaces and who is invited?
>
> I want to change the rule. Is it already changed? Well, then I want to change the change. Back to the rule. So that I can change the rule, because that is what I want. I play.
>
> I play to be outside, above. I want to think that I think outside and above. The Box, where the others are. I refuse to be pigeonholed.
>
> I play. Sometimes good, sometimes bad. Perhaps I don't have anything to do. Perhaps I'm bored. My rules are the only ones that can change the play. I'm the one who is outside, above.
>
> I'm a cloud. Outside above, I float. Below are the others and they are not me. I am the cloud, I make it possible for every drop to stick to me, allowing itself to be a part of the milky white fog.
>
> I am the one who plays in order to change the play. Because then I know I'm the one who plays best.

In the 'Wanderlost' event, we did not refer to them as Guides, they were instead called "Medvandrare", which translates from Swedish as "Fellow wanderers". In this article we will continue to use 'The Guides', since that was the working name during the PS2 project.

The Player

The Guides are inspired by the sociologist Bauman's (1996) essay, in which he proposed that modern individuals have a set of characteristics that form their identity. *"Identity entered modern mind and practice dressed from the start as an individual task. It was up to the individual to find an escape from uncertainty … putting the individual responsibility for self-formation on the agenda spawned the host of trainers, coaches, teachers, counselors and guides all claiming to hold superior knowledge of what identities could be acquired and held."*

From this view of modernity and identity, Bauman (1996) extracted the following personas—The Stroller, The Vagabond, The Player, The Tourist—to which were added in our work The DoGooder, The Creator and The Homey. In the 'Wanderlost' app, the user is given challenges through the perspective of one of these seven Guides (Fig. 6.3), based on their characteristics.

For the specific role as Guides we assembled a group of stage performers, storytellers, and actors with a diverse background and a keen interest and motivation for taking on the challenge. To coach this team, Marika Kajo set up workshops and rehearsals to prepare and train the seven participants into what we called "inspirational improvisers". During these workshops, they were briefed by local historians and artists with experience from the field of stand-up comedy and role playing games.

Fig. 6.3 The seven 'Guides'

Fig. 6.4 The city of Kristianstad, still image from the VR project "Genius Loci"

They were also supplied with a written scenario and an inspirational "script" in the form of a collage, mixing reflective thoughts again inspired by Bauman's (1996) essay and interfoliated with impressions of exploring an unknown city and walking the streets in different characters. This "script" was assembled, as in this example for "The Vagabond" from the Bauman essay and from remarks and lines written by Thore Soneson for the Virtual Reality piece "Genius Loci" (Fig. 6.4)—*"No one can control me. I do not obey any laws. That's why the modern world is afraid of me/In our time the neat streets turn mean/Factories vanish together with jobs/Skills no longer find buyers/Knowledge turns into ignorance."*

6.2.3 The Portals

The *third format* for participation is *'The Portals'*, were the aim is to engage participants in the discussion of how we can develop the digital and physical city of the future: are we creating the city together or are we mere consumers of an environment designed for us? Each Portal involves people actively in a process (Fig. 6.5), where they gain insight in what it means to live in a city, about democracy and engagement, about contemporary media and our lives in present "Metopia" as some critics labels our internet social culture.

In the 'Wanderlost' event, artists and performers were invited to create and take part with artworks that focus on social and cultural issues, shaping the present city life and citizenship. The result was a mixed reality exhibition space, containing documentary digital film footage, sound, physical objects, virtual reality, computer-generated art and hidden messages that form and set the agenda for our common space and life.

The spaces in Kristianstad, used for these artworks, ranged from the Shopping Mall Galleria Boulevard, where digital theft and social activism "Beyond the smart world" were displayed to the Center of Contemporary Art with a Virtual Reality experience "Genius Loci" of the unknown non-places of the city and an empty store with a soundscape of the city called "Fictioning". One of the spaces was used as a meeting spot for the Guides and the participants, where a digital 3D work, visualizing "Ideal Spaces" designed by artists and futurists, was exhibited. Special Video Walks with personal stories, narrated by citizens, were available for loan. The Danish group CoreAct invited audience into their performance installation "My Table, is your Table", a coffee feast playing with the idea of the private vs. the public space, inviting people to participate, but instead of traditional topic, the conversation is based around identity and nationalism.

Altogether these Portals formed a visual and mediated stage, where the audience could experience, both physically and by imagination, aspects of being a citizen in both a global and an extremely close local setting. Confronted with the media

Fig. 6.5 Portal at Galleria Boulevard

Fig. 6.6 CubeX future city lab—Copenhagen 2017

worlds that are changing the representation of man and his reality, people were given the opportunity to reflect on consequences of the growing social media reality, seen in relation to the actual physical environment around us (All participating artists are listed and described in the Appendix chapter).

In *Copenhagen*, another set-up of 'Wanderlost' was tried. Here, all different parts of artists' work were located in Warehouse 9; and, by use of the spatial configuration of that space, we relied on this specific configuration for navigating visitors through its different workshops, performances, and artworks over the four days the event run. Here artworks were thematically curated, including, photos, video, prints, sound and interactive video installation. Open workshops for reusing and re-designing clothes were arranged, as well as performance and party incidents including the second Minecraft sessions that re-created buildings and citizens' spaces in the area of Kødbyen. Digital media workshops were also organized, with a focus on revitalizing the social awareness in the central area "Meat District".

In October 2017, the final event and the full presentation of CUBE X—Digital City Scapes were carried out (+500 participants). A performance installation about democracy and urban development was built, through which the audience was invited to: create visions of the city's future architecture and development in the Minecraft design game; and take a bicycle ride in VR through an ideal space. Here the audience was invited to first visit the independent FUTURE CITY LAB, a research organization which explored new forms of co-existence. In this Lab, the fictional elements were much more present; and the visitors could try-out, discuss and participate in various digital artworks and performances, guided by artists, within which virtual and actual urban landscapes could be created and explored (Fig. 6.6).

6.2.4 Lessons Learned

Using a metaphor as 'Wanderlost' for a citizens' engagement project allowed us to use a variety of artistic and interactive means to involve participants. We used the metaphor *Wander* from the need to relocate and re-establish families and social connection; and *lost* from the emotional feeling of being displaced both by the growing mega-cities as well as the alienating architecture and urban planning. Since the focus of this article is on the event that took place in the city of Kristianstad, reflections and conclusions are mainly drawn from the experiences made in this context.

As a concept, 'Wanderlost' raised some initial questions; to wander about is sometimes associated with someone who is without a plan, who aimlessly spend his/her time, is unemployed or outside of society. With our concept, we wanted to establish another fundamental discourse, where we aimed at the possible positive implications of wandering—to feel free of preconceptions, of restrains and of everyday routines. We decided early enough in the project that we would emphasize 'Wanderlost' as an "open world", an experience free from formal intentions that a local government or other organizations, working in a city, would introduce as an "instrumentalized layer" on the experience.

Likewise, the word 'lost' have similar connotations, to get lost is a terrifying feeling for many of us. We tend to follow the layout and movements city planners and our habits create for us. To get lost is, in our concept, a way of breaking the rules set up for us as citizens, a way of looking beyond the regular, through a feeling of relief and freedom.

When we communicated the concept to media and partners we used the Swedish words "gå vilse = getting lost", since this expression was more direct to understand and to spread in their channels. The language barrier needs to be taken into account when you work locally, we as designers and artists are familiar with terms used in interactive context, but an audience can feel alienated by terms they do not directly grasp.

In the guided tours, on the contrary, the 'Wanderlost' metaphor became a point of departure, a way to discuss and reflect together that helped the creation of a common ground for the groups (Fig. 6.7). It became a way to throw their pre-conceptions away and open up for insights and sharing of experiences. Instead of using scenarios as the point of departure, as we did with our Fieldasy method, the Guides here became a scenario themselves. Through their respective perspectives they improvised around their "persona" in order to create an open but also challenging atmosphere for the participants, thereby encouraging them to view the city space, the artworks and the performances from a personal and engaging mindset.

During the 'Wanderlost' event, audience and participants took part free of charge, they connected with unknown citizens and known friends in walking the streets and reflecting on their conceptions of the city and its citizens. For the participants who got the opportunity to socially interact with the Guides, this proved to be an eye-opening experience, offering the chance to reflect together on artworks and the environment they moved around in.

In retrospect, a "grass root" info campaign would have increased participants, reaching out to active citizen groups, local historians and environment communities could have sparked an interest and word-of-mouth engagement. We relied too much

Fig. 6.7 The creator guiding a group of participants in one of the portals

on the media campaign, the connections we established with the housing company and the commercial partners for spreading information via their channels. A cultural project like 'Wanderlost' needs to be more "anchored" in local communities to reach its potential.

The app 'Wanderlost', available for downloading, created an individual experience of physically re-examining well-known blocks and streets. Here our students at the University of Kristianstad, Programme Digital Design were engaged to test and evaluate the functions and the experience; a test walk was carried out with the interaction designer and the results of these evaluations were mainly positive. One drawback noticed was the GPS-positioning system and its technical limitations in a dense urban environment, as the signal varied since it repelled against the buildings and therefore was less accurate. On the whole, the impressions and feedback we got were positive (one reflection was that it had possibilities to be developed into a visual geo-catching game).

The Portals located in various spaces were open during the weekends of the week-long event. Here experience gained shows that the threshold for walking into unknown cultural spaces and exhibitions is high and that people tend to follow their habits; although the main participants were culturally open minded and accustomed to experiencing art. To bridge over the cultural gaps, there is a need for both longer cycles of events and artists working locally over a longer period. Additionally, there is a need for more active work, with a concept like 'The Guides', where the response from participants showed that our intentions with that scenario proved to create the reflections and discussions we envisioned.

The Virtual Reality (VR) experience attracted both regular visitors to the Center for Contemporary Art and special groups from schools. Here the novelty of the technique and the concept of the "unknown known" sites in a familiar hometown attracted attention.

All together the event lasted over eight days, attracting media attention and visitors well over 600 persons, including around 300 visitors in the Center of Contemporary Art alone.

In short—the 'Wanderlost' project was well received as a cultural experience. Our main agenda was to create a variety of artworks and cultural sub-projects to examine and try out how culture can act as a catalyst in remapping the experience of being a citizen. The overall impression for the participants should be/and was/a feeling of re-vitalizing their selves as citizens.

Our experience and belief are that the 'Wanderlost' concept and project can be re-used and re-situated in other contexts and environments; keeping the fundamental three formats with a digitally mediated tool, physical guides and explorative walks and a map of artworks.

In the final conclusion, we will reflect on the possibilities of using digital mediated culture in a participatory context, drawing from experiences from 'Wanderlost' and our earlier research and practice as artists. There we will, in relation to our project, discuss what the art historian Claire Bishop (2012) states about the relationship between participant and artist—*"... the artist is conceived less as an individual producer of discrete objects than as a collaborator and producer of situations."*

6.3 Collaboration

In 2003 the multidisciplinary network PRAMnet (Practice-based Research in Art and Media) was established by a group of Scandinavian artists, producers, and researchers. The aim was to *"bridge artistic research and systems' developed methods for digital media to secure that the implementation of new increasingly complex technological innovations is continuously balanced towards artistic prototypes ... to integrate complex technical and theoretical concepts developed by researchers in the artistic work process.*" Members of the network collaborated on stage performances, artistic video and media artworks; and arranged several seminars and Nordic meetings.[3]

In 2008 the network PRAMnet published a proposal for an interactive performance project called "The Journey to Abadyl". The concept outlined strategies and scenarios that are structured as a matrix, in which participants are exposed to distinct choices that include both moral, ethical, and physical dilemmas and challenges. Here we envisioned a kind of computer game in a spatial format, a playground of interactive events and tools, shaping a unique non-linear experience. Guides and participants choose to explore the room and answer the challenges

[3]A list of artistic productions, research and collaborations. http://pramnet.org/projects/. Accessed 18 July 2017.

creating an experience that evolves differently at every performance (Further described in the 'Research' section below).

At the seminar WIRELESS, arranged by PRAMnet in 2008, we focused on stage production and media-based artworks, where audience participation and digital tools play an important role in the experience. We used the "Journey to Abadyl" as a starting point and the invited speakers, among which were the interaction designer Simon Løvind and the artistic director Mika Tuomola from Crucible Studio in Helsinki, discussed the scenarios we had prepared. One of the key questions was: "How technology development and artistic production can be combined?"

Here the consensus was clear, the gaming culture and the interactive mediated participatory stage and performance culture are closely related. And the concept should always be to place the user, the participant in an active role.

Drawing on the experience gained from several interactive productions, with both online and performative audiences, Mika Tuomola formulated the basic concept of the interactive dynamic room as:

> The negotiation between the virtual and the real world and talked about the importance of the introduction to the game, which has to make it clear what you are invited to. The strength of the concept lies in letting the users themselves rather than the designer tell the story, with communication between users being a crucial point for CubeX (as our proposed project initially was called). According to his studio's research principle: "Story is told, the drama is enacted, interactive drama must be experienced". (Gansing 2009: 44)

This concept was underlined by Simon Løvind in his speech "How to stage the user—to create a place charged with intent":

> Going from the computer game field, where the user is very much the main perspective, to installation of works of art, has made him interested in "how to stage the user". That is not to, as in theatre, create a stage for the play to unfold, but to let the presence and movements of the user carry the meaning. This means creating spaces "charged with intent", as opposed to the idea of totally open social environments that are so popular today, especially on the Internet. (Gansing 2009:43)

Another leg of research we explored in collaboration with PRAMnet is how the visual and digital media could be used in an interactive stage and artistic context. Here we draw on early tryouts with sensors, Rfid, Bluetooth, mobile devices, Kinect and video beams, where we investigated with various digital means a "Dynamic Room":

> The expanding possibilities of media technologies have opened up the screen into a dynamic room, an interactive, real-time visual and cinematic stage. The screen is no longer a static element; it is scalable and flexible, its immersive qualities and interactive possibilities are challenging for visual artists to explore and use in new artistic contexts. In PRAMnet we have worked with and devised different setups, where physical movements and positions in a sensor-tracked room can trigger images, sound, video, and sequences of narrative elements. (Soneson 2011 http://www.hz-journal.org/n16/soneson.html)

Our research into interactive artistic strategies and collaborative work has led us to the involvement in People Smart Sculpture (PS2) as one of the sub-projects. During the last decade, members of PRAMnet have established the Live Art scene

Warehouse 9 in Copenhagen, a programme with interactive research and academic lecturing at the University of Kristianstad. This reflects the shift of our focus from audience interaction to experience-driven experiments, in which interactive technology in different curated artworks was used as a surface for reflecting upon moral, ethical, and physical dilemmas and challenges in our societies and communities today. From this platform, we have been engaged in re-shaping and re-forming our artistic methods and goals and conducting research work, ranging from the "Journey to Abadyl" to the four-year project, ending up with the public event "Wanderlost" in 2017 and the Cube-x Future city Lab events in 2017.

6.4 From CubeX to Journey to Abadyl—The Early Concept

The working title 'CubeX' can be seen from multiple viewpoints; the "cube" as a form is almost perfect, strictly regulated. The "cube" is also closely associated with the throwing of a dice, an old game gadget, and a random choice generator. The X-factor stands for the unknown, for the search of a logic or an order; or an X at the election poll. We make a lot of choices in our everyday life—a constant process—but do we really know the options? Or do we leave choices to the dice? The theme in CubeX is based on "The anatomy of the choice", the audience is invited to a storyworld, where it is confronted with a mixed representation of everyday reality. A world where an offer you can't refuse is proposed every second and the "free will" is regulated by the market. Ultimately, the choice in CubeX is about good or bad, life or death.

The project—"Journey to Abadyl"

To be able to use our former experience and working methods, we initiated this multi-purpose project, capable of engaging a modern public, big enough to give room for a good number of different artistic means of expression and possibilities, and yet realistic in terms of time and money. This artistic project sprung out of a lot of different positions and experiences, different needs, affections and inclinations, as well as scientific and artistic motives. From the fascination of the possibilities of "the new medium"—the computer—and the sheer curiosity, as well as the conviction, earned from years of experience with artistic means of expression, that they cannot be tested out except in a concrete context, an actual artistic production, defined by a time, a place, a public, a theme and a topic was born.

Background—Abadyl—The anatomy of choice

"Abadyl" is a virtual city and an ongoing project, which was initiated in 1997 by the Swedish artist Michael Johansson, together with more than 30 different people (http://abadyl.com).

The name is a construction from the three Swedish words: abstract (abstract), stad (city) and akryl (acrylic). Abadyl is a proposed city, a fantasy, a set of codes and models, a library of artifacts and prototypes and foremost it is its co-creators. It has become a large database of material that is interlinked through the architecture of a city, regardless of its incompatibilities. That space has proven itself as a continuously evolving platform for staging both immediate and long-term projects. We have chosen the virtual city of Abadyl as one point of departure in order to create a "playground Sandbox" for playing with the "anatomy of choice"—e.g. the notion of democracy.

Democracy

Democracy is a subject very actual to our time, but the notion does not imply a concrete description of a way of handling matters between people, a polling system or a certain construction of a constitution. Perhaps "democracy" must be experienced and (re)defined by every new generation; and the consciousness to the facts of wanting democracy—or the facts of the lack of democracy—must be constantly revised by the older generations, who may have reached a point of control with their lives, which makes them taking democracy—in their own definition and interest—for granted.

Form

"Journey to Abadyl" should be seen as a synergy of the expressions of the theatre, the exhibition, the role-play and the amusement park, using dynamic new media, a non-linear dramaturgy and theories from computer games; working with notions as "storyworld" rather than "script" and "gameplay" rather than "drama". The task is to establish a contract of fiction with the audience, based on a variety of representations, illusions and meta-levels; and to create an environment, which is believable. It is an event, which takes place over a day, engaging its public in a structured game, using the new media in all their possibilities of creating illusions and presenting the results of intricate algorithms in a few seconds; and so capable of engaging the public in an interaction, which inside the structured frame will define the outcome of the game. It takes place in a larger venue, addressing an audience of 100-200 persons, adults, youths and children above 10, together with their parents.

The role of the performers

To help the visitors/inhabitants/citizens practically, and to guide the course of the events, there will be a number of performers, embodying city guides, officials, and citizens with special tasks and missions. The performers will have a range of possibilities for actions and activities; and will use them according to the actual needs of the actual performance. Every event will be different from any other, but it is the goal of the producers to steer the events and make the experience of every new group of visitors meaningful and interesting, through the performer's skills to mediate, guide and invent solutions for the concrete conflicts, which should arise.

The role of the media and database, and the scenography

The idea of the virtual city and its seven districts is created in a new media environment, where pre-recorded and live-streamed media, coupled with physical scenography elements, are depicting the characteristics and the properties of the districts. Through the interactive media constructions, the virtual life in the city will cover job, transport, spare time activities, and entertainment, according to the needs of the actual district and the course of events. To help the "real life" performers, there will be a number of virtual performers—3D and 2D created avatars—embodying visitors, working as guides, telling stories, controlling, demanding jobs done in a certain way, not to be satisfied with half-solutions, omissions or failures.

The theme—Democracy and "The anatomy of choice"

The binary thinking of the computer already is dominating our human thinking, so we tend to act as if every choice could be reduced to a choice between a "one" and a "zero". Or from the fundamentalist point of view: Between "good" and "bad"—and the one, who is not with us, is against us. In the computer, "the choice" might be seen as a sort of tool, which helps you to fulfill your intentions—hopefully. One click—and the program pops up as expected. The computer cannot decide how a question is asked and is not wiser than its programmer is. But of course, there are questions, which can only be answered in one way: we think it is the scientifically proven truth, that if you jump out of the window on the sixth floor, you will fall down, according to the law of gravity.

Project research

As described, the aim of this project is not only to make an interesting entertainment, using fascinating mixed media and new technologies, but also to use the project as a basis for scientific as well as practical development, descriptions, and analyses. Here we do research on making. An inquiry that is based on prototyping of activities and experiments in order new insights to be gained; and theory in defined fields of attention to be developed. So, our concepts are developed by knowledge through prototyping rather than knowledge about prototyping, in which we develop new artistic expressions, concepts, moods of interaction and spatial configuration.

> Concepts are not waiting for us readymade, like heavenly bodies. There is no heaven for concepts. They must be invented, fabricated, or rather created and would be nothing without their creator's signature. (Deleuze and Guattari 2004)

Prototypes

The notion of a prototype here covers the use of mixed media in a defined context—as theatre, performance, and installation—creating new means of expression through an interaction between the media and a performer/artist/designer/producer and/or a spectator/audience.

6.5 Methods

In our workshops and seminars during the four-year PS2 project, we have discussed and presented ideas for script and drama development, for game patterns and mechanics for workable models on play design, and methods of public and participatory interaction and co-creation. Our aim with the proposed CubeX and "Journey to Abadyl" was—as earlier described—that the project should be seen as a synergy of the expressions of the theatre, the exhibition, the role-play and the amusement park. The task was to establish a contract of fiction with the audience, based on a variety of representations, illusions and meta-levels; and to create an environment, which is believable.

The sub-project events were arranged as a series of workshops for invited artists and digital professionals with public participatory events. The task was to create a "Smart sculpture" as an interactive experience, in which participants are faced with different dilemmas, staged and presented by a guide, a kind of computer game in a spatial format. This mixed reality space contains digital film footage, sound, physical objects, augmented reality, computer games and hidden messages; all possible experiences and part of a world waiting to be discovered.

To develop this kind of mixed reality we have relied on artistic strategies that are based on acquired knowledge and experiences we tried out and shaped during the development of the virtual city of Abadyl concept by Michael Johansson and the joint project "Journey to Abadyl". Several of these methods aim to bridge artistic research and systems' development methods for digital media to secure that the implementation of new increasingly complex technological innovations is continuously balanced towards artistic prototypes, enabling artists and designers to articulate their evaluation of the development process in their own language. The idea with the methods is to enable the participating artists to influence the systems' development process by:

- learning from the content-driven experience of other artists and developing a new specific artistic language within the network;
- communicating technical needs towards given standards set by the technology, based on an artistic intention and experience;
- integrating complex technical and theoretical concepts, developed by researchers in the artistic work process;
- documenting and disseminating produced experience via web-based and digital media;
- developing and customizing own editors and digital tools for specific needs; and
- using the experience gained by other artists, working with related media.

6.6 Methodological Approach: Fieldasy

The most central method used in this project is called *Fieldasy* (Johansson and Linde 2004) (Fig. 6.8), which started to evolve in 2003–2004, first presented as an exhibition in Malmoe, Sweden at the Gallery Skanes Konst. Later, this was presented as a research paper at the Pixel Raiders Conference, Sheffield-Hallam University (Johansson and Linde 2004).

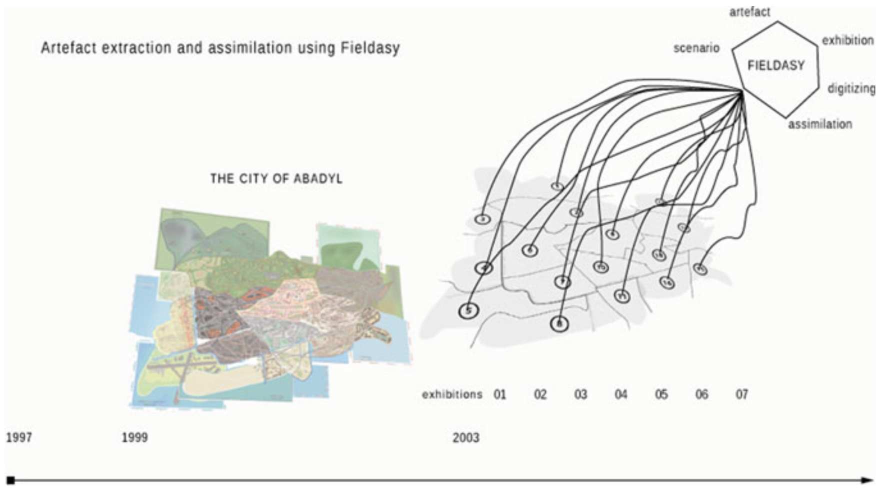

Fig. 6.8 The Fieldasy model

With Fieldasy we tried to unify different methods into one creative process that attempts to understand and redefine our world in a situation where information is lacking. This lack of information is used as a resource, for example by providing ambiguous fragments as a starting point, removing constraints of the imagination.

It was designed with respect to staging a conflict that has a mind triggering influence on the co-creator with a set of problems that only can be captured in a given material. Fieldasy was a method for engaging multiple perspectives in the creation of a world, and the mapping of its virtual space, by extracting artifacts and stories from the actual world through the developed scenarios, partitur and game-boards. Fieldasy itself refers to the methods of field working and imagination by using physical objects. The objects constitute a shared ground for collaborative creativity; while they serve as nodes in a complex narrative and as a basis for world making. Fieldasy plays a vital part in the creation of a space, where we could be in a constant dialogue with a large database of material that is interlinked through the architecture of a city, regardless of its incompatibilities.

The method establishes a multidisciplinary common ground for an art practice, interaction design and technology development, through an investigation of philosophy and criticism in a dynamic material. It reflects an open-ended way of working, where the original scenarios originate, at beforehand unknown artifacts. Scenarios' relation to the overall project is loosely defined in order to allow the creation of artworks which, though enriching the database, still are autonomous from the mother project in the sense that they can be exhibited by themselves. They also act as generators of new and unforeseen processes, which extend into new and likewise unforeseen contexts. Our scenarios are handed over to the invited temporary citizens and co-creators of Abadyl. They can then act in relation to the scenario, and choose tools and materials that in the end help them produce an artifact. Hopefully, the co-creators themselves import qualities into the world, which do not and cannot stem from the City of Abadyl itself. As one participating artist expressed it:

> Imagination was tickled by the knowledge of being part of a networked mapping I didn't know in detail. The scenario got me going, but I felt no repressing obligation towards it; and also felt more liberated than in the situations of my own work, where I'm the responsible and potential object for critique.

The scenarios we produce with this method try to bring field studies and fantasy together, to slowly create a discrete dynamic tension and/or displacement between persons, objects, time, places and events that are not usually—if ever—associated, into new and surprising conjunctions. In Abadyl, the openness towards what happens in-between the design cycles is important. We do not formulate any detailed specification or goal for the concept beforehand, apart from some dramatic or situated qualities that indirectly plot the creation of an artifact. Here we work closely with co-creators, going from scenario to concept and further on building different prototypes, later finalizing the artifact. Sometimes we use the prototypes a bit differently, where the shortcomings and quirks of the prototypes themselves can be used as major features and qualities. This scenario method can also be applied in other formats, such as we have later done in projects like "Wanderlost", where the scenario is hosted and acted out by an actor (in 'Wanderlost' by the "Guides").

So when we try to follow the co-creators intention or concept, we are open to the idea that the prototypes themselves can produce qualities not known beforehand. By continuously evaluating information together with experience, and going from total disarray to a strategy that can be articulated, the co-creators will gradually build up knowledge on how to proceed through their concept development and prototyping, making the artifact to incorporate the findings as these develop.

However, the concept first has to reach a certain state of complexity, a complexity max, to ensure thorough exploration and original artifacts. Therefore, a production environment is a crucial part to facilitate this kind of work. Since the artifacts consist of both artistic and technological proposals, we do not want them to end up with doing art well and computing more dubiously, or do computing well but the art questionable. We have recognized the persuasive act of negotiating a communicative contract with co-creators when proposing scenarios and models of possible worlds. Co-creators accept or refuse this contract, based on whether they believe the proposed world to be plausible or not. Our aim is for them to accept the world as a setting, where it is safe to play and take risks. Each component introduced in Fieldasy has the ability to play with and displace the co-creators' models of the world in different ways.

For us, this has been an important experience, learning how to design and stage both the details and the whole of the world that the co-creators are going to populate. This is a process similar to fragmented storytelling, often used in games where the player must find fragments during the progression and piece them together. By continuously introducing dilemmas (twists) and turns (creative operations) in this context, Fieldasy serves as an intriguing source that through the narrative it is, and based on the artifacts it creates, it generates ideas and concepts not known before, which could guide and help us rethink our assumptions about the future. The method establishes a multidisciplinary common ground for an art practice, interaction design and technology development, through an investigation of philosophy and criticism in a dynamic material. Through the use of Fieldasy, we have been able at the early stages of this project to help us map it's space, people and activities at the same time as we developed the formats for this event itself.

6.7 Fieldasy Exemplified

> It is, in the end, the old truth all over again: each society sets limits to the life strategies that can be imagined, and certainly to those which can be practiced. (Bauman 1996: 35)

In this project we set up our work through the Fieldasy method framework as follows:

Programming (fragments, scenarios and real history):

- Our point of departure for Wanderlost was Zygmunt Bauman's (1996) essay "From Pilgrim to Tourist- or a Short History of Identity", a text that fitted the theme of the overall project, The People's Smart Sculpture (PS2) as well.
- Instead of written scenarios, we wanted this time to use live actors to mediate the scenarios we were going to write, based of Bauman's original text. In this way, there were both scenario and artifacts in the Fieldasy methodological framework. These were set in a dialogue with the audience, motivated by the provision of ambiguous fragments and props of who they were and the different life strategies and perspectives they were expressing. By doing so, the audience was involved and lured into both the developed Storyworld (the city of Abadyl) and the city itself, in which these guided tours were set.
- In parallel, but also to cross influence the work, we started to develop the same characters perspective for the mobile app 'Wanderlost', in which these different strategies or perspectives were going to be used in taking the user for a walk—described in The App section.
- To underscore the friction between the wanderer's different perspectives and strategies, we involved the author and poet Åsa Maria Kraft to create texts in specific short format that could set the different characters in motion, both in an artwork itself but also for the performing actors to develop their specific mindset and expression—to put them in character.
- We also curated an exhibition both inside already established art venues and city spaces as well as in more peculiar and odd city places, in which the wanderers could take participants through different paths in the city.
- Rehearsal with performance artists and drama pedagogue, in order to prepare the amateur actors and storytellers for the improvisational techniques needed to support the participation with the wanderers.

- Guided tour with real experts and guides who had profound knowledge of the city's cultural, social and political history and how these relate to the present time.

Execution (walks, exhibition and mediation):

- Wanderlost—city walks. For two weekends, the seven wanderers took the audience on 60–90 min long city walks, each guide telling different stories about both the city and the artwork at the different venues. Each walk was ending with a common discussion in one of the exhibition spaces.
- A digital signpost at the Kristianstad art museum, in which the wanderers were, weeks ahead of the exhibition, inviting people to get lost in Kristianstad.
- A sound collage mixing reflective thoughts inspired by Bauman's (1996) essay and interfoliated with impressions of exploring an unknown city and walking on the streets in different characters were scripted for the Virtual Reality piece "Genius Loci", exhibited in the Kristianstad art museum Mirò room in Kristianstad during the whole event.

6.8 Participation

During the 'Wanderlost' project time, we have researched and discussed what are the implications of co-creation, co-design, event, digital and participatory culture on the relationships between producer, audience, and performer, when and how the roles meet and converge in such worldmaking (Goodman 1975).[4] Issues of art instrumentalization were also explored, as expressed by Lind and Minichbauer (2005) by the wording: *"In 2015 art is almost completely instrumentalized in the economic sense, regardless of whether financing is private or public. Art services either national or European interests … are especially useful in the construction or reinforcement of specific identities. At the same time, art is a desirable commercial product. It is ideal for collecting and it contributes to regional development whilst providing society with new creative employment opportunities."* (Lind and Minichbauer 2005: 5)

This is both a debated and overlooked aspect of cultural activism in the academic field. It is discussed by authors such as Rebecca Solnit (2001), who writes inspiringly about the personal experiences of reflecting in action; and by academics, such as Claire Bishop (2012), having a research agenda that focuses on the participatory aspect of art. Her publication "Participatory Art and the Politics of

[4]"Furthermore, if worlds are as much made as found, so also knowing is as much remaking as reporting. All the processes of world making I have discussed enter into knowing. Perceiving motion, we have seen, often consists in producing it. Discovering laws involves drafting them. Recognizing patterns is very much a matter of inventing and imposing them. Comprehension and creation go on together." N. Goodman (1975).

Spectatorship" is an essential read in this field. Her conclusion points to the need for mediating the experience for the audience:

> "In using people as a medium, participatory art always had a double ontological status, being both a reality and a play. As such, it has the capacity to communicate the paradoxes that are repressed in everyday discourse on two levels—to participants and to spectators; and to elicit perverse, disturbing pleasurable experiences that enlarge our capacity to imagine the world and our relations anew. But to reach the second level requires a mediating third term – an object, image, story, film, even a spectacle – that permits this experience to have a purchase on the public imaginary." (Bishop 2012: 284)

In a project like this, we also face another risk, the one of using new and unfamiliar technologies. This happens when/if we have the visitors exploring the technology itself, instead of the topic of our attention. Some forms of interaction with technology and the myth of usability neglects that it sometimes takes hours of practice to learn and even longer time to master, and therefore do not fit for use directly in an exhibition. The risk is that the only thing that is transferred to the visitor is the experience of the technology itself and not the content it is supposed to mediate.

Therefore, the use of new technology, although heavily utilized in the development of our public events, it was actually put in the background in the different workshops and events conducted during the project.

6.9 Conclusion

As stated in section "Lessons Learned", we will in this final conclusion reflect on the possibilities of using digital mediated culture in a participatory context, drawing from experiences gained by 'Wanderlost' and our earlier research and practice as artists.

The project examines and discovers unknown and/or hidden cultural layers and visual experiences in a living city environment. We envisioned the project as a city-walk that through different cultural and social experiences could open up the participant's eyes for grasping new impressions and thoughts, addressing the growing complexity of life in today's city spaces and meeting new people. To play with the production of space on all three levels; the 'perceived space', 'conceived space' and 'lived space' (Lefebvre 1992), we identified the need to re-discover the city space and thereby motivate citizens to renew their view and expectations of what the common spaces are, who lives there and how the city could be imagined.

Here we draw knowledge from our collaborative work "Journey to Abadyl", especially using methods from our research work and workshops, staging participatory media and working with digital mediated designs and artistic productions. As we described in the "Method" section, we developed scenarios for 'Wanderlost', using both insights and production experiences in all three main formats—The Portals, The App, The Guides. These formats are to be seen as placeholders, metaphors for the actual artworks, participatory walks and site-specific digital media we produced together with invited artists and interaction designers. Each one of the three focuses on aspects of participation, via visual and tactile artworks, via physically experiencing the city and using dynamic digital media for smartphones.

As researchers and artists, our agenda differs from a contemporary participatory culture where artists, actors, and performers often are called upon to create artworks that question, debate or otherwise focus on contemporary social and political issues (instrumentalized art). Our agenda is focused on developing artworks through setting up processes and creating open-ended reflections for both the users and the producers. As the art historian, Claire Bishop (2012) states in her book "Artificial hells: participatory art and the politics of spectatorship", there has been a fundamental change in the relationship between participant and artist during the last two decades. Bishop (2012) claims:

> …the hallmark of an artistic orientation towards the social in the 1990s has been a shared set of desires to overturn the traditional relationship between the art object, the artist, and the audience. To put it simply: the artist is conceived less as an individual producer of discrete objects than as a collaborator and producer of situations; the work of art as a finite, portable, commodifiable product is reconceived as an ongoing or long-term project with an unclear beginning and end; while the audience, previously conceived as a 'viewer' or 'beholder', is now repositioned as a co-producer or participant." (Bishop 2012: 2)

This development is in many ways parallel to the interactive digital culture. We can especially see this in the gaming culture and in the field of interactive performance culture. In both areas, the digital programmed and scripted interaction goes hand in hand with the development of artistic and cultural content. This is a significant and fundamental change, nurturing both the international entertainment industry as well as the digital hardware and software companies. Here we, as artists and researchers, work with theories and concepts that need to be considered from both angles; as interactive design tools and as participatory engaged art.

At the same time, while being innovative, the mainstream and commercial interactive productions need to conform the digital tools to conventions. This notion of the digital as a shared culture is both recognized and questioned by Janet Murray (2012), stating:

> The digital medium is becoming our powerful, silent servant in the same way that other cultural creations have come to serve us. Societies build up systems of signification that guide individuals like an extension of one´s own mind. For example, the social system of place names and street signs, and the media conventions of printed maps from a system of distributed cognition each of us use to get from place to place without having to memorize every landscape feature of every city we visit…but the computer is a reliable companion only to the extent that designers anticipate and provide for the needs of the interactors. (Murray 2012: 369)

Murray's comment on the computer as a reliable companion implies that the opposite also is a reality; when we lose our digital companion, we find ourselves in a somewhat chaotic state of mind. The computer/smart phone functions more and more as our memory. We rely on its accuracy and its "mapping" of our lives. The notion of "getting lost", used as a metaphor in 'Wanderlost', is for most of us an unwanted condition, something utterly negative. We turn that around and claim that "getting lost" can be seen as an eye-opener, a way of re-discovering the familiar.

As noticed in the section "Lessons learned", the Formats used for framing the event have proved to be valuable for both the participants and us, as researchers and artists. The combination of physical and social walking tour with 'The Guides' and the one-to-one experience with the App and the Video Walks, using digital mediated tools, created a multifaceted experience for participants.

This combination of mind and matter, of active reflecting and re-examining a known environment clearly shows that the tactile, social and the intellectual complement each other in a Storyworld as 'Wanderlost'.

We believe that this open-ended approach to participatory art have a cultural and personal quality, worth considering in urban planning and design workshops. Getting lost CAN create meaning—but it needs firm directions!

Artists Participating in 'Wanderlost'

For Wanderlost in Kristianstad we curated the content of our portals by working with mostly European artist that worked with critical perspectives on our western culture, who examines and creates work of art in different disciplines. They reflect on our culture and our social life using performance, video, photo, sound and site-specific interactive tools.

We wish to thank all of them for participating and sharing their artistic work, time and efforts to the project Wanderlost. All artworks can be found at http://wanderlost.abadyl.com.

Abdulsalam Ajaj SY
Mischa Badasyan RU
Anika Barkan DK
Bombina Bombast/Emma Bexell & Stefan Stanisic SE
Jørgen Callesen DK
Digital Design students from Kristianstad University SE
Clare Farell UK
Joakim Frieberg SE
Ulrich Gehmann DE
Miles Glyn UK
Malik Grossos DK
Theo Hansén SE
Daniel Hepperle DE
Josef Isaksson SE
Michael Johansson SE
Alexander Kadin DE
Marika Kajo SE
Halla Katla ISL
Johanna Kerbel SE

Åsa Maria Kraft SE
Kevin Kerney DE
Linda Kronman FI
Fabian Kühfuß DE
Helene Kvint DK
Anika B. Lewis DK
Michael Lewitzki SE
Petra Lilja SE
Ollie Ma GB
Juhl Nielsen DK
Raphael Perret SUI
HongLin Qian CN
Vidal Rousso SE
Martin Rieche DE
David Rix SE
Johan Salo SE
Christian van Schijndel DK
Andi Seiss DE
Thore Soneson SE
STANZA UK
Ola Ståhl SE
Alexander Stålnacke SE
Fredrik Svensson SE
Michiel Tange Van Leeuwen DK
Jacob Tekiela DK
Trine Trash DK
Peter Vadim DK
Magnus Wallon SE
Michael Wirthig DE
Matthias Wöllfe DE
Andreas Zingerle AU

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Chapter 7
Investigating Territorial Specialization in Tourism Sector by Ecosystem Services Approach

Francesco Scorza, Beniamino Murgante, Giuseppe Las Casas, Ylenia Fortino and Angela Pilogallo

Abstract From the beginning of the 21st century, following major European and global initiatives such as the Millennium Ecosystem Assessment and the Economics of Ecosystem and Biodiversity, the idea that Ecosystem services could be used as a decision support tool, gained considerable importance in several fields: from economy to public policy, from territorial planning to environmental assessment. This research is part of the methodological framework of an important strategic reference: the Millennium Ecosystem Assessment, an international project that defines ecosystem services and assesses the consequences of ecosystem change for human well-being. According to the MA, ecosystem services are grouped into four categories: supplying services, regulation services, cultural services, and support services. Starting from this, the present work contributes to build interpretative models for the evaluation of a relevant part of the fourth class of ecosystem services: the territorial touristic attractiveness. The InVEST model, an open source toolkit, has been applied to assess attractiveness of the Basilicata Region considering both natural and cultural heritage in order to highlight strengths and weaknesses of the investigated methodology.

Keywords Ecosystem services · Millennium ecosystem assessment
Tourist attractiveness

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7.1 Introduction

The 2005 Millennium Ecosystem Assessment (MA) could be considered one of the main efforts to promote worldwide environmental assessment approaches, sponsored by the United Nations. The most innovative contribution promoted by MA had been the unprecedented overview of the state of the world's natural environment, founded on the basic idea that the ecosystem value in decision-making should be grounded on the idea of services provided to humans. That approach opened up a wide range of research issues, linked to the decision makers' demand for holding new assessment tools in order more comprehensive scenario analysis to be accomplished. The implicit assumption is that additional knowledge, deriving from such new interpretative assessment models, will reinforce the rational 'decision makers' in making 'better' decisions and policy choices (Sanderson 2002; Owens 2005).

During the last decades, "sustainability" has become a main policy concern both domestically and internationally, with increasing prominent place in decision-making processes concerning environmental issues (Bulkeley and Jordan 2012). However, such a rising awareness in political debate hasn't driven effective inversion of disturbing trends; and the conflicts between human activities and natural systems have delivered more and more critical global impacts. On the one hand this represents a traditional failure of advanced knowledge transfer to political decisions systems; but on the other it also identifies the need to give a push on the research in order to achieve a better "embedding" of environmental factors into decision-making processes, which, as defined by Jordan and Russel (2014), are massively under-researched.

What we intend to discuss in this work is linked to an effort to demonstrate the effectiveness of ecosystem services approach as a *policy driver* for sectoral development programs. We present the evidence of a systemic territorial assessment of "recreation and tourism" *Ecosystem Services* (*ES*) class, as a base-map to identify tourism specialization and consequently to develop effective place-based interregional programs. We consider such an effort as a preliminary contribution in developing understanding of ecological knowledge use in policy driven processes that are more sensitive to the issues of power and control (Cowell and Lennon 2014; McKenzie et al. 2014; Waylen and Young 2014).

The results discussed in this paper regard the elaboration of a *synthetic territorial index*, delivered through the application of InVEST[1] tools on selected datasets, which describes the multidimensional domain connected with a wider definition of the tourism sector. The attention to territorial specialization falls into the strategic framework of the European Union Cohesion Policy 2014–2020 (European Commission 2008, 2010a, b; Regio 2011); the Smart Specialization Strategy (cf.

[1]InVEST documentation. http://data.naturalcapitalproject.org/nightly-build/invest-users-guide/html/index.html. Accessed 26 September 2017.

McCann and Ortega-Argiles 2015); and the Regional Operational Programs, according to the indications already formalized by the Barca Report (Barca 2009).

The delivered approach is included in a comprehensive ToolKit (Las Casas et al. 2014) supporting planning and decision-making in a more sustainable way, which could contribute to put in practice the "*place-based*" *approach* (Barca 2009); or, as the authors described in previous work (Las Casas and Scorza 2009, 2016), the "*context-based*" *approach*.

The model of territorial interpretation that is built up in this research is based on open data and open source tools, so that a high replicability of the evaluation procedures and an extension of results to other contexts and case studies is guaranteed. The analytical model used is incorporated in the suite proposed by the InVEST software (Integrated Valuation of Ecosystem Services and Tradeoffs) (Natural Capital Project 2015).

After a brief description of the territorial context of the research, the Southern Italy Basilicata Region is presented, a place characterized by peculiar features and values; then the assessment model and the process of investigation are described; finally, conclusions are provided, with regards to the interpretation of the obtained spatial index, intended as a tourism specialization degree; and its policy implications according to ongoing processes.

7.2 A Descriptive Overview of the Case Study

The case study focuses on Basilicata region, particularly on the relationship between local resources and tourism development strategies. Basilicata territory is rich in natural habitats, cultural values (Amato et al. 2017) and traditions that make possible to render tourism development the main key driver for socio-economic progress of the entire region. Tourism has gained a consistent weight in the economic and productive system of Basilicata, largely supported also by the significant public and private investments. This has led to a significant increase in tourism supply, i.e. increase in number of 'beds' and 'new accommodation facilities', with positive effects on the entire hospitality chain; and a substantial increment of tourism demand, marking the strengthening of tourist flows.

Since 2016, the Metapontino area is emerging as a major regional tourist destination, specializing in seaside tourism. Same holds for the Matera city, confirmed as the main cultural-historical pole of attraction in the study region. Positive signals come from other areas as well, where new tourist attractions are promoted, such as the Vulture area, the National Park of the Appennino Lucano, the city of Potenza—the main cultural services center—and, in general, all coastal destinations.

A further potential is also arising from the yet not fully exploited natural capital, which is often directly related to a new sensibility, emerging from the typical cuisine and the promotion of traditional recipes, as part of more comprehensive rural and environmental tourism projects. Natural tourism seems also to have a significant potential in the Basilicata Region and constitutes a rising demand segment, as more and more tourists want to: spend their time holidays in a green oasis, seeking close contact with nature as a moment of relax or practice in open air activities; learn about rural culture and local traditions; discover areas preserved and not affected by mass tourism pattern. On the other hand, food and wine tourism is a very important aspect of tourism repertoire and an important all-year round stream for dealing with sector's seasonality aspects. Well integrated with other aspects of tourist supply (rural tourism, outdoor tourism), it renders the local typical products a "vehicle" for conveying to tourists all productive, cultural and emotional values of the region. This sector can obviously be largely supported by the significant and widespread presence of certified local food and wine production (IGP, DOC, DOP, DOCG, IGT).

A further trend, recorded in recent years, concerns the movie tourism, a form of cultural tourism linked to cinematographic, television or commercial locations. This segment, depicting the influence that films or TV productions have on the purchasing and consumption behaviour of tourist products, has affected Matera and the surrounding areas (Craco, Aliano, Irsina), Vulture-Melfese (Rapolla, Melfi, Barile) and Maratea from the 1950s onwards.

Basilicata's accommodation system has shown an increase in the number of structures that raises to 56% from 1999, with an average of 68.5 beds, most of which are falling into the three and four star hotel categories. In the rest accommodation facilities, Basilicata offers about 16,000 beds. There has been a significant increase in both agrotourism and B&Bs (Bed and Breakfast lodging) establishments. Between alternative accommodation facilities, tourist villages are the most widely used, with a percentage of admissions of 85.5%.

Although the number of beds has also increased by more than 50% overall, the saturation rate of hotel beds in Basilicata is one of the lowest in Italy; while the distribution of beds by hotel category in the region (Fig. 7.1) is consistent with the national average.

As regards their spatial distribution, accommodation facilities are rather evenly distributed throughout the regional territory. Obviously, there are areas where concentration is higher, and this depends on a number of reasons. Some of these areas actually play an important role in the tourism sector, such as coastal areas and zones, belonging to the Pollino Park and the area around Matera, which have attracted a considerable number of visitors, even before the designation as European Capital of Culture 2019. The presence of an important percentage of accommodation facilities in the regional capital is probably due to a greater offer of services and offices in the city rather than to a real tourist vocation.

Concerning the average permanence, higher amounts can be observed among resorts of seaside tourism even if, following the designation of Matera as Capital of Culture 2019, the most attractive pole in terms of presence and arrivals has certainly moved towards the European capital.

The attraction system exhibits a rich variety of thematic areas (history, culture, landscape, etc.), each capable of generating significant added value, largely

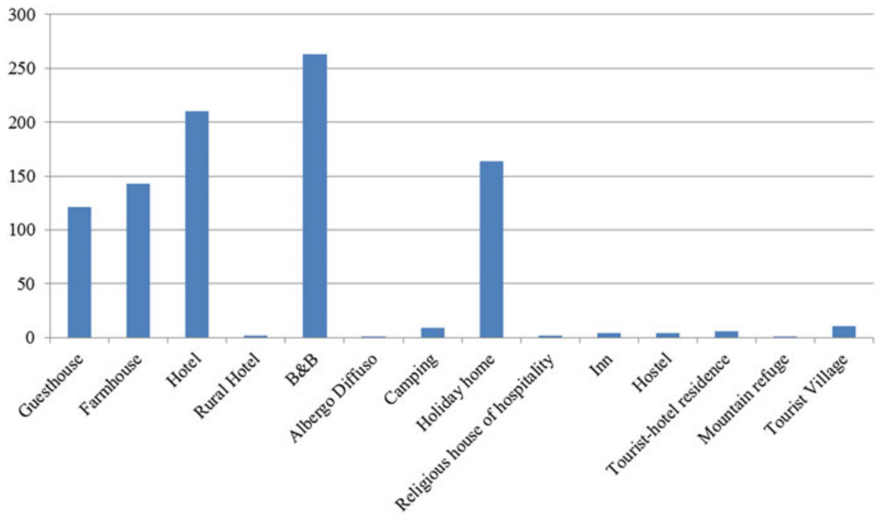

Fig. 7.1 Classification of accommodation facilities by type in Basilicata region

depending on the adoption/use of modern communication means and marketing principles that will be realized in the short term (MATERA 2019, see also Gennaro and Lucio 2014; Mininni and Dicillo 2015; Pontrandolfi and Scorza 2016).[2]

7.3 Tourism as Ecosystem Service—the Territorial Assessment Model

According to the most widespread understanding of "ecosystem" (Natural Capital Project 2015; Leone and Zoppi 2016), this refers to the capacity of the various components of ecosystems to provide support to multiple aspects of the human life (provision of raw materials, food, environmental and cultural qualities). These are recognized as "ecosystem services" and, as stated in the introduction, the idea to consider natural environment as a service-provider for human activities represents a relevant innovation for the assessment of the sustainable ratio between the natural and anthropic vocation of the territory.

The main global initiatives for the analysis of ecosystems are the 'Millennium Ecosystem Assessment' (Millennium Ecosystem Assessment (MA) 2005) and 'The Economics of Ecosystems and Biodiversity' (De Groot et al. 2012; Kumar 2010). Both have influenced European environmental policies, namely Action Five of the EU Biodiversity Strategy until 2020 (European Union 2011). Through this action,

[2]We considered as main data source the datasets and the thematic reports distributed by the Regional Agency for Territorial Promotion of Basilicata Region APT. http://www.aptbasilicata.it/Dati-statistici-2016-2013.2094.html. Accessed 18 May 2017.

the European Union invites Member States to assess the state of ecosystems in their territory. For this reason, the Group of Mapping and Evaluation of Ecosystems and Their Services (MAES) is active for Member States to carry out this activity within their territory by adopting the Common International Classification of Ecosystem Services (CISES) (Haines-Young and Potschin 2013). This work helps to build up interpretative models for the evaluation of a relevant part of the fourth class of ecosystem services: the territorial tourism attractiveness.

In recent years, cultural ecosystem services have been the subject of a large research group, which has also extensively involved researchers from the social and psychological sciences. Numerous models, methods and data are available in the literature.

Wanting to specifically focus on relationships between human needs relevant to cultural values and ecological functions, it should be noted that an overlap between cultural and other services as well as among cultural ES categories is frequent. Aesthetic and perceptive values, offered by a territory, which significantly contribute to recreational experiences, are an example of such possible overlaps.

This complexity, in some ways directly related to the importance of cultural services, is reflected as such in their identification, evaluation and management.

Also, due to the fact that recreation and tourism are important components of many national, regional and local economies, many people engage in these sectors. This means that they represent a strong nexus and a considerable opportunity for managing interactions between natural and cultural heritage and people; and for contributing to the growth of the part of population, which appreciates and supports protection of natural and cultural resources.

Furthermore, recreational activities and everything related to "living an experience" and being a tourist attraction, offer the opportunity for many people to personally explore the benefits of ecosystem services.

A variety of monetary and non-monetary methods to capture the many facets of tourism and recreation sectors have been proposed, considering different variables and factors as input parameters that are significant for the frequency and intensity of use of the ES in question. Some of the resulting visitor simulation models can evaluate the effects of changes in environmental characteristics, based on visitor behavior in space and time.

On a more detailed scale of analysis, some of them can also quantify specific contributions of setting characteristics, such as the beauty of landscapes or the probability of wildlife encounters; as well as the contribution of the degree of infrastructure development, such as the proximity to an airport or the accessibility to the area examined by major transport routes.

Many of these models take a comprehensive approach, by providing methods of data collection based on in-depth interviews, tape recordings, computer-animated choice experiments, on-site measurements experiences via questionnaires.

According to Bagstad et al. (2013), criteria to consider for evaluating ES tools so that they can actually be supportive to decision-makers and they can make ecosystem service assessments quantifiable, replicable, credible, flexible, and affordable are:

- *Quantification and uncertainty*. A qualitative evaluation may be useful in such processes like screening, scoping or ranking; on the other hand, some models return a numerical output, which is indispensable for the evaluation of ES trade-offs. In the latter case, uncertainty estimates constitute an added value, since provision of a single output value may omit important information regarding certainty of results.
- *Time requirements.* Rapidity in tool's implementation affects the widespread extent to which it is used.
- *Capacity for independent application.* The opportunity to have a software license that makes tool independently runnable or to apply the tool directly in a public domain is obviously more attractive to both academics and private decision-makers.
- *Level of development and documentation.* Tool's credibility and authoritativeness are closely depending on the availability of documents about its methods, key algorithms, assumptions as well as peer reviewed journal articles, describing its application.
- *Scalability.* Being able to use a single analysis tool at all scales is certainly more practical, even if it is always advisable to check the accuracy of the results; hardly a tool is designed to work well at every level of territorial detail.
- *Generalizability.* A lot of tools currently available are place-specific, although many others allow to customize the analysis context and to run the application in different eco-regional and socio-economic settings.
- *Non-monetary and cultural perspective.* A challenge for ES evaluation tools is running analysis and providing results from different point of view, both in terms of valuation system (monetary or not) and in perspective (for example by being able to distinguish between the perspective of local populations and that of tourists).
- *Affordability, insights, integration with existing environmental assessment.* ES evaluation tools are more appreciated, when they integrate with established management and planning processes.

Among the *technological solutions* available to produce *territorial assessment* of Ecosystem Services, operating according to framework methodologies, we used InVEST. Within the above described evaluation framework, InVEST is placed as an open source ecosystem service, mapping and valuation model, which can be independently applied and tested, while it has to be accessed through a GIS software. InVEST is a quantitative tool that provides spatially explicit ecosystem service trade-off maps and results, whose uncertainty through varying inputs is reported in an output table.

InVEST programme execution time depends on data availability for modeling support; and it generally varies from moderate to high. Analysis is scalable to different territorial details and a wide and in-depth literature is supplied on the online dedicated platform.

The InVEST model (Integrated Valuation of Ecosystem Services and Tradeoffs) (Natural Capital Project 2015) was used as an instrument for assessing the tourist attraction of the Basilicata region. InVEST is an open source software, developed by the Stanford University Natural Capital (NCP) project and the University of Minnesota. This tool allows: quantifying and mapping of the consistency of ecosystem services; and interpreting of changes in ecosystems and their relationships to human well-being. InVEST comprises eighteen distinct models. For the purpose of the present work, the "Recreation and Tourism" package was applied. The software uses a graphical interface and elaborates on a multiple linear regression model. This includes geospatial functions of a complex system of input variables, which makes possible the interpretation of *regional tourism specialization level*. It is an input-output model, based on the solution of a liner multiple regression, according with spatial functions applied on input variables.[3]

Linear regression analysis is a technique that allows to analyse the linear relationship between a dependent variable (or response variable) and one or more independent variables (or predictors). It is an asymmetric methodology that is based on the hypothesis of the existence of a cause-effect relationship between several variables. The equation shown here contributes to the formation of a global index, the regional tourism attraction index in this work. The template was applied on each domain and on proper combinations of domains to identify the most significant variable combination. The determination coefficient, better known as R2, is used as a measure of the good adaptation of the multiple linear regression model. This is a value between 0 and 1 and expresses the relationship between the variance explained by the model and the total variance. If the result is close to 1, it means that the predictors (input variables) are a good interpreter of the dependent variable value in the sample; if it is close to 0, they don't.

The significant potential that could emerge for Basilicata region from the development of a high-quality tourism sector, based on its extensive and valuable natural and cultural systems, is nowadays largely acknowledged. Of importance is also considered the creation of a profitable network that could link the very many cultural attractions of Basilicata region to the city of Matera, as a UNESCO heritage site. In this respect, the enhancement of the capacity of natural and cultural assets to offer authentic experiences, capable of attracting tourists and triggering a multiplier effect among the related sectors, such as that of high-quality food and wine productions, is essential for planning and regional development purposes of this study area.

For these reasons, in the context of this work, two territorial domains were considered in the analysis, namely: natural heritage and cultural heritage.

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[3]Based on these variables, the software processes a linear regression model. The regression equation used is the following:

$$y = \beta_0 + \beta_1 x1 + \beta_2 x2 + \cdots + \beta_i xi + e_i i = 1, \ldots, N$$

where: βi are the linear regression coefficients; *xi* are the territorial components considered as predictive variables to input into the software; *y* matches with the expected value of the model, which in the specific case is the Basilicata region tourism specialization level.

Fruition of cultural and natural resources, coupled with their reciprocal integration, is considered as a source of unique experiences that can be transformed into economic value. In this sense, the model was applied in each territorial domain and the combination of both domains.

The *first domain—natural heritage*—includes all areas, places and forms of the territory that contribute to forming the naturalistic heritage of the Basilicata region. Each of these elements constitutes one of the geometric and geo-referenced variables to be inserted into the InVEST model. The predictive parameters were then identified on the basis of the best correspondence of their spatial distribution with respect to the phenomenon to be described.

A total of *seven kinds of attractions* were considered:

- *Regional oases*. The three oases of the region, currently managed by WWF Italy, are the Lake Pantano in the municipality of Pignola (PZ), the Lake San Giuliano between the municipalities of Matera, Miglionico and Grottole (MT) and the Oasis Bosco di Policoro (MT). Since 1988, when the first regional oasis in Pignola was established, the WWF has been able to protect against building speculation and hunting 1476 ha of nature. At present, these constitute an important reserve of biodiversity within the regional framework, allowing the conservation of more than 2000 species of beetles, including the rare Alpine Rosalia; 170 species of birds, living in the coastal jungle of the oasis of the Policoro Woods; the sea turtle that is treated in the recovery center for wild animals of the same oasis; the Neophronpercnopterus that lives in one of the rare wetlands of the central Apennines, the Pantano di Pignola Oasis. The Oasis of Lake San Giuliano is one of the most important wetlands of Basilicata, where the variety of environments and habitats favors the presence of a diversified fauna, especially with regards to the ornithic species, including storks, cranes, spatulas and herons.
- *EUAP areas*. Official List of Protected Natural Areas (EUAP) was established on the basis of Law 394/91, framework law on protected areas. The official list currently in force is that relating to the 6th update approved by Ministerial Decree n. 27/04/2010. In the Official List, protected areas are classified in National Parks (PNZ), Marine Protected Areas (AM), National Nature Reserves (RNS), Other National Protected Areas (AAPN). Regional and Interregional Natural Parks (PNRs), Regional Natural Reserves (RNRs), Other Protected Regional Natural Areas (RRAs). The list is drawn up and periodically updated by the Ministry of the Environment and Land and Sea Protection. For state-owned protected areas, i.e. the first four groups of protected areas (PNZ, AM, RNS and AAPN), the list can be constantly updated. For non-state protected areas, i.e. for the following three groups of protected areas (PNR, RNR and AAPR), the regions communicate the updated list only when the DM is drawn up, and this list is therefore periodically updated only on that occasion. The protected natural areas in Basilicata cover an amount of more than 322 ha, which corresponds to more than 30% of the total area of the region.

- *Coastlines*. Basilicata is the only region in Italy that has access to two seas: the municipality of Maratea (PZ) along the Tyrrhenian coast and the municipalities of Nova Siri, Rotondella, Policoro, Scanzano Jonico, Pisticci and Bernalda (MT) along the Ionian coast.
  For years coastlines have contributed in a predominant measure to Lucanian tourism sector, offering a variety of choices in terms of landscapes and reference targets.
  Along the Gulf of Policastro, in fact, there is a series of coves and cliffs overlooking the sea, many of which are accessible only by boat. These have helped to make Maratea a renowned and exclusive resort, also called "the pearl of the Tyrrhenian Sea".
  The Ionian coast, on the other hand, with its long, shallow and sandy beaches, has built up over the years the fame of an ideal seaside tourism destination for groups and families, offering the possibility of staying in residences, villages and campsites located along the entire coast.

- *Attractions*. A considerable boost to tourism in Lucania has been provided in recent years by the so-called "big attractors", the result of projects co-financed by the European community. These were able to enhance the territory, giving visitors the opportunity to live an unusual experience that recalls the culture of the place and is strongly linked to the surrounding landscapes. The first one of these, and probably the most famous beyond the regional and national borders, is the Volo dell' Angelo, which allows visitors to glide with a pulley along a steel cable that connects two peaks of the Lucanian Dolomites.
- *Riverside*. Over the millennia, the image of the river has been a source of meditation for poets, writers and philosophers. Being perceived as places of inspiration and cradles of civilization, or important transport and communication routes, rivers have always played a fundamental role in territorial development. Their charm due to the power they can express, the beauty of the landscapes crossed and also the often unusual point of view they offer constitutes always a source of attraction, which has been exploited by several European countries that have promoted river tourism packages to their visitors.
  For the Basilicata region, a place traditionally considered a land of water and forests, river tourism represents a great potential for local development, thanks to the presence of numerous waterfalls and spectacular views along major and minor rivers hosted in this area.
- *Naturalistic trails*. Being for long time widely ignored and undervalued, naturalistic trails are today considered as a real resource for mild local and rural development, hosting a variety of activities, such as hiking, trekking etc. Exploitation of naturalistic trails, nowadays widely spread among the population of all European countries, has evolved; and informal recreational activities carried out in these trails have shifted to real forms of natural tourism, capable of generating significant economic benefits at the local level. The Lucanian hiking network, although not yet well-structured or adequately enhanced, is made up of a dense network of paths and itineraries, with a wide variety of characteristics

that can easily be enjoyed by a rather disparate audience and not necessarily athletic. This implies that an adequate planning in terms of territorial marketing can have important effects on a large segment of tourism that increasingly demands to gather experiences in contact with nature and follow slow and relaxed rhythms. For Basilicata region, this type of sustainable and responsible tourism could be an unmissable opportunity to relaunch development of hinterland and enhance potential of small businesses, still widespread in the region.
- *Protected areas*. This group of attraction includes all the Lucanian sites belonging to Natura 2000 network, the largest coordinated one in the world. Stretching over across all 28 EU countries, both on land and at sea, its aim is to ensure the long-term survival of Europe's most valuable and threatened species and habitats, listed under both the Birds Directive and the Habitats Directive. Thanks to the great variability of the Lucanian territory, Basilicata Natura 2000 network consists of 54 ZSC, 1 SIC and 17 ZPS, representing a complex mosaic of biodiversity, covering 17, 1% of the regional area.

The role of the Oasis and in some cases of other kinds of attractions within the Lucanian tourism and recreational system is multifaceted, because in addition to attracting visitors who love nature and observation of various species of flora and fauna, it also attracts different kinds of audience depending on type of event or manifestation organized. In fact, these centers often host conferences or events related to the world of scientific research and dissemination, while at other times they are addressed to the smaller ones with laboratories and summer camps, useful for the promotion of sustainable tourism and the education about forms of fruition of the territory compatible with habitat conservation.

With reference to the *second domain*, that of *cultural heritage*, we have tried to consider not only the locations and physical structures that play an important role by hosting events and exhibitions of cultural importance, but also associations that are involved in different ways in the tourism and recreation sectors.

Into the "Cultural heritage" group in Basilicata territory are falling points of interest, which differ by type, such as natural caves with rock paintings from the Iron Age, or anthropogenic elements that testify in some way the succession of historical events and the evolution of society along the centuries.

This typology includes, for example, aqueduct systems dating back to the Roman era; the numerous fountains and drinkers that were once widespread in the territory; cellars which are natural or semi-natural cavities that have always been used by man for the storage of food or land products to be preserved; a lot of fortified farms that, although belonging to different eras, testify the degree of garrison of the territory even in the most remote areas. It also includes a whole series of elements related to industrial archaeology, such as steel bridges and other transport and connection infrastructures; the numerous water mills serving the textile or cereal industry depending on their location; and oil mills located along the hills surrounding Matera but also in the area of Vulture and Val d'Agri.

There are also numerous archaeological sites in Basilicata that illustrate the succession of stories and populations that have shaped Lucanian identity over the millennia. Some of them are the destination of discreet tourist flows, motivated by the international importance of the sites themselves as well as by their favourable position. Examples are the Palatine Tables in the archaeological area of ancient Metapontum, home of the Pythagoric school; and the excavations of the Roman Grumentum near which one of the epic battles against Pirro and his elephants were celebrated.

The numerous theatres and museums in the Basilicata region could not be ignored as cultural attractions. In addition to hosting exhibitions and events sometimes of international importance, in some cases they are real shrines of cultural richness. An example is the ethnographic museum in San Costantino Albanese municipality which, even if small in size, preserves an important historical memory within the overall mosaic of the Lucanian culture, also thanks to the strong sense of identity of people of Arbereshe origin.

Although not physical places or proper attractions, it was considered appropriate to incorporate cultural heritage associations and Pro Loco in the domain of cultural heritage, since these play an important role in attracting visitors and tourists through the organization of celebrations, festivals and events able to enliven traditions and attract a significant number of visitors.

Finally, historical centers have been considered as part of the cultural heritage domain, constituting places of historical memory and indispensable spaces of social life. These correspond to the part of the municipal territory of the oldest formation, still not properly exploited for attracting tourists, which is currently subject to protection policy in order the preservation of historical, artistic, environmental evidences to be ensured.

In Figs. 7.2, 7.3 and 7.4 are shown the results obtained for each single domain and the results provided by the model for each variable.

The model allows identification of territorial specialization of the southwest of the region in terms of naturalistic-environmental attractors (Bagstad et al. 2013); it also highlights the role of other peculiar landscapes that characterize the area, such as Monte Vulture, the graves area in Matera and part of the Appennino Lucano National Park. The contribution of coastal areas and the one of many protected areas is also visible, with both representing the most important features of attractiveness, steering the region's tourism offer.

Concerning the cultural heritage domain, results show the distribution of the historical/cultural sites; and particularly the contribution of historical centers and archaeological sites in the regional tourism specialization. Matera city, where specific activities in the sector of cultural tourism are concentrated, mostly associated with the declaration of Matera as the 2019 EU Capital of Culture, is the main historical/cultural attraction pole in Basilicata; while Potenza is the center of cultural services.

The combination of "natural heritage" and "cultural heritage" domains provides a representation in which the natural components of the analysis prevailed on the others. The model allows specifying areas in which tourism specialization is grounded on the integration of elements of the "natural heritage" and "cultural heritage" domains (Fig. 7.4).

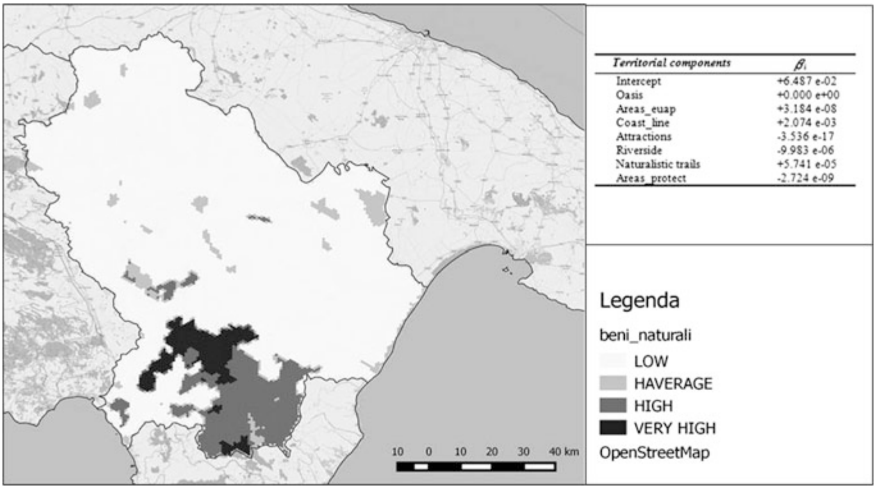


Fig. 7.2 Tourism specialization degree in "natural heritage" domain for Basilicata region. Classification ranges from very high values (high specialization) to low values (no specialization)

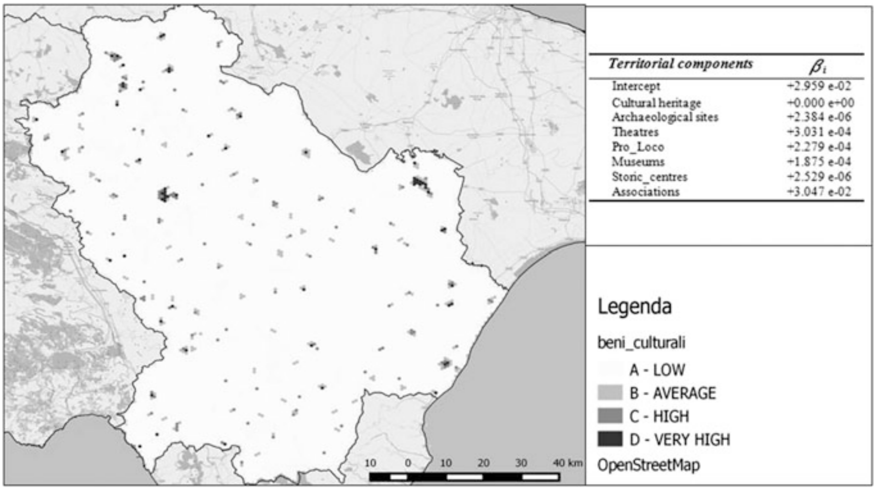
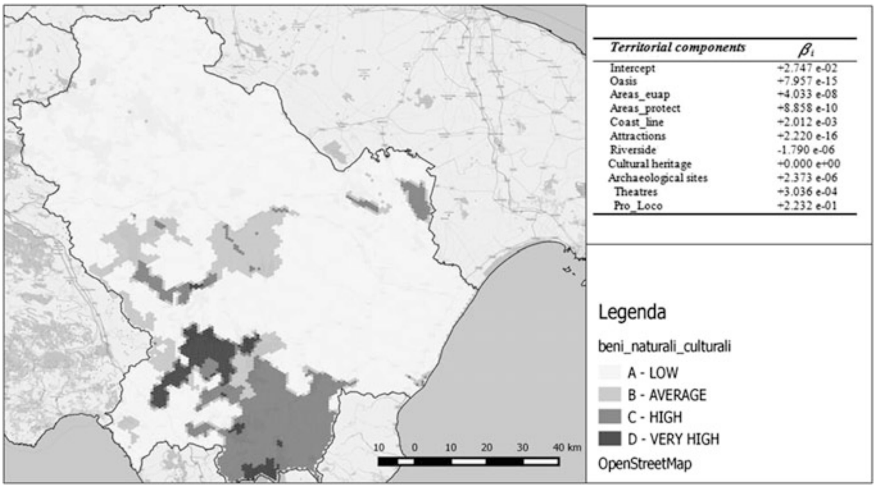


Fig. 7.3 Tourism specialization degree in "cultural heritage" domain for Basilicata region. Classification ranges from very high values (high specialization) to low values (no specialization)

InVEST, the model of analysis used to estimate tourist attractiveness, is based on an innovative source of data, information and digital media available on the Flickr platform, which can be considered, in its own right, a new social website.

This constitutes an important methodological innovation, because values and ecosystem services, related to the receptivity and touristic fruition sectors, have



Territorial components	β_i
Intercept	+2.747 e-02
Oasis	+7.957 e-15
Areas_euap	+4.033 e-08
Areas_protect	+8.858 e-10
Coast_line	+2.012 e-03
Attractions	+2.220 e-16
Riverside	-1.790 e-06
Cultural heritage	+0.000 e+00
Archaeological sites	+2.373 e-06
Theatres	+3.036 e-04
Pro_Loco	+2.232 e-01

Fig. 7.4 Tourism specialization degree deriving from the combination of elements of the "natural heritage" and "cultural heritage" domains

always been studied by conducting surveys and questionnaires, given to users at entrances to the main attractions such as national parks.

However, although this new tool makes it possible to overcome the limitations resulting from the cost of such a survey and the rather limited coverage of spatial and temporal information, the interpretation of the results must take into account the availability and distribution of the geo-referenced photographs available on the web.

In fact, the number of photos on the Flickr platform in the period of 2005–2014 referring to Basilicata region is rather small (Fig. 7.5).

The small number partially reflects the low attractiveness of Basilicata, which for only a few years has been investing in a more structured and publicized tourism system, but also partially reveals a limitation of the model use. In fact, it certainly depends also on the diffusion of technology linked to the possibility of taking geo-referenced photos and on the propagation of social media that in 2005 were not as common as at present.

Another limitation of the model is that many of the uploaded photos refer to the same initiative so the correspondence between the various photos and the number and destination of visitors is not always accurate.

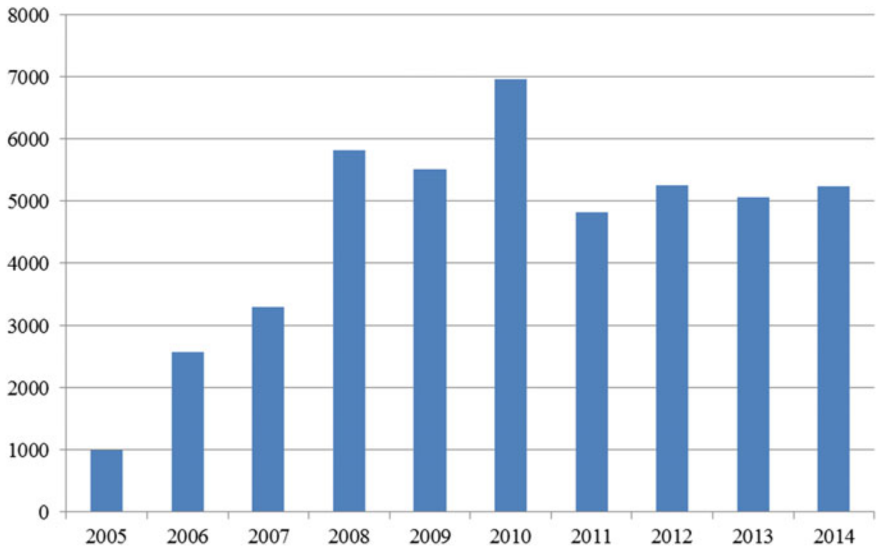


Fig. 7.5 Number of photos shot in Basilicata and uploaded on the Flickr platform for each of the years considered

7.4 Conclusions

In recent years, the Basilicata region has been trying to focus on sustainable tourism based on the fruition of environmental resources that are particularly appreciated for their widespread presence throughout the region and for the great variety of landscapes and biodiversity.

On the other hand, the designation of Matera as the European Capital of Culture for the year 2019 has been a significant boost for cultural tourism that has involved, in addition to the well-known enhancement of the Sassi, the rediscovery of archaeological settlements located in the Murgia Materana area and along the Ionian coast.

A global strategy aiming at enhancing different types of sustainable tourism forms could be pursued although, with regards to tourism and recreational sectors, Basilicata region depicts certain weaknesses such as remoteness, hard-to-get-to places (both in terms of the location of tourist attractions and hence of journey time needed for reaching them and the organization of the transport system within the region), competition with a lot of world-famous Italian destinations and a hospitality system that is not very sophisticated and in many cases difficult to cope with the mass tourism load.

Smart planning and programming of the tourism and reception sectors should focus on turning these into possible strengths, making Basilicata region an ideal destination for enjoying authenticity of places, nature and environment at times still unspoiled, strong identity culture that rejects globalization and tenaciously proposes slow rhythms, tailored to people's needs.

In order to ensure more knowledgeable planning of the tourism sector in this area, it is considered that a clear and easily understandable evaluation of the ES could allow to identify specialization drivers and effective policy implications, as also demonstrated in recent studies (Vizzari and Modica 2013; Antognelli and Vizzari 2016, 2017; Cannas and Zoppi 2017; Floris and Ruggeri 2017). In particular, we consider these methods to be quite effective in the sector of recreation and tourism as they allow integrating physical variables describing territorial values, tourism facilities, tourism perceptions etc. The effort to combine qualitative and quantitative information in territorial analysis represents a traditional territorial modeling effort, oriented to provide comprehensive support to decision makers. Recent studies in the field of urban sustainability assessment and smart city seek to explore ways for identifying systems of territorial indicators as descriptors of urban and territorial environments' quality (Garau and Pavan 2018) as a form of "context-based" policy design (Las Casas and Scorza 2009).

The research described in this work proposes a global interpretation of the regional territory in terms of tourist attraction with the ambition that this information could support the governance processes of tourism development (Stratigea et al. 2015; Scorza et al. 2017) as a component of the wider rational planning framework, described by Las Casas et al. (2017). Or stated differently, it could be considered as a supportive tool, a kind of land suitability map, for deliberate tourism development policies.

The research highlights the incomplete information in terms of availability of spatial data and on the other hand the opportunity to exploit non-conventional data sources in order to improve the level of spatial knowledge as a key input factor for InVEST model.

About the methodological profile, the InVEST model was useful for the geospatial features offered. In order to reach a more significant representation of the territorial tourism attractiveness levels, there are few possibilities to define a weighting system for input variables.

As a potential extension of the analysis in the specific case of Basilicata region, it should be compared with the spatial distribution of natural risks, including land take, and spatial planning system. Recent relevant research in this perspective is conducted by Amato et al. (2015, 2016; Martellozzo et al. 2018) in order a more comprehensive and integrated approach to be provided.

A potential extension of research is to rebuild the interpretative system in another scale in order to extend the spatial analysis area to an interregional or national context.

Finally, as a framework research domain, the ecosystem services' approach represents a promising tool to renew territorial management/governance models through effective synthetic territorial assessment domains, representing drivers for sustainable spatial decision-making (Scorza and Grecu 2016; Dvarioniene et al. 2017).

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Chapter 8
Participatory Planning in Support of Resilient Natural/Cultural Resource Management

Maria Panagiotopoulou, Giorgos Somarakis and Anastasia Stratigea

Abstract Radical developments of Information and Communication Technologies (ICT) have severely affected various sectors, with culture and tourism being among the direct recipients of this technological revolution. Supported by ICT, the efficient and innovative management of cultural resources as well as their interlinkages with the tourist sector—the *culture/tourism complex*—are nowadays perceived as a vital *policy choice* in pursuing sustainable local development; and lie at the heart of strategic cultural tourism planning and decision-making processes in numerous communities around the globe. Along these lines, the *focus* of the present paper is on the development and implementation of a *participatory spatial planning framework*, aiming at supporting policy making with regard to resilient cultural tourism development of a particular, lagging behind, culturally-wealthy rural community of Crete (former Province of Kissamos). Based on this framework, strategic guidelines that are grounded on the sustainable and culturally-resilient exploitation of these resources, are set; and are framed by the general policy agenda at the EU and the Greek state level as well as the policy directions set up by the Research and Innovation Strategy for Smart Specialization (RIS3) at the regional level (Region of Crete).

Keywords Rural and insular communities · Cultural heritage · Cultural resilience Cultural tourism · ICT · Participatory spatial planning

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8.1 Introduction

Tourism is nowadays grasped as a main driver for economic growth of numerous countries and regions worldwide; while it is predicted that developments of the particular sector will be greatly escalated in years to come. The sector is perceived as well-placed in order to promote environmental sustainability and green growth (United Nations official Website); and contribute to many of the contemporary challenges humanity is confronted with. The role of tourism in this respect has also been acknowledged by the United Nations Conference on Sustainable Development (Rio + 20) as well as by the G20 Summit in Mexico, since it was recognized as a sector with an important influence on all three pillars of sustainable development (Stratigea and Katsoni 2015; Alvarez et al. 2016).

Cultural heritage is also perceived as a significant bedrock and a strategic resource for *smart, sustainable and inclusive development* (Hawks 2001; COM 2007 242 final; INHERIT 2007; Labadi and Logan, 2016; Beel et al. 2017], cutting horizontally all three sustainability pillars and enabling exchange of intercultural values and authentic experiences (Cohen 1988).

According to the literature review (Lazaretou 2014; Stratigea et al. 2015; Panagiotopoulou et al. 2017), both *tourism and culture* proved to be remarkably *durable sectors* under the current pretty ominous circumstances, such as global economic recession and climate change. Moreover, the '*culture-tourism complex*' is nowadays grasped as a *source* of significant new opportunities for further development of *qualitative and experience-based tourism products* that are closely linked to *local identity and cultural capital*. Along these lines, management of cultural resources for *cultural tourism development* is considered as a top policy priority by numerous countries around the globe and the EU member states as well (COM 2010352 final). Such a management is further broadened by the use of ICT and their applications as effective tools for digital cultural content creation; mapping of cultural resources (Duxbury et al. 2015; Stratigea et al. 2008; Stratigea and Hatzichristos 2011) and crowdsourcing (Brabham 2008; Oomen and Aroyo 2011; Aitamurto 2012; Ebadi et al. 2014); effective ICT-enabled marketing of cultural tourism products, etc. These are nowadays perceived as an integral part of *cultural planning initiatives* for serving strategic future development objectives of many destinations around the globe, while marking the *smart* tourism development context (Gretzel et al. 2015a, b; Buhalis and Amaranggana 2014).

Contemporary evolutions in the tourism market witness that the current massive and industrialized pattern of *tourism development* is gradually losing its past glory. Instead, a *milder tourism model* is emerging, which is strongly linked to *cultural capital*; and is highly respecting preservation of local resources and identity, carrying capacity of related destinations, prevailing social system and its values and traditions (Langdon 1994), etc. In such a model, a *cultural turn* (Mercer 2006) of the tourism sector is salient, with tangible and intangible cultural resources as well as the way these are exploited, being factors of crucial importance. The defining role of these resources to the development of *cultural tourism* is reflected in the way prominent international organizations such as the World Bank, UNESCO, the Organization for Economic Cooperation and Development (OECD), the Council of Europe and the World Tourism Organization, etc. promote them. These organizations embed cultural tourism into their programs either as a central objective or as one of the most important instruments for sustainable development exhibiting, when properly handled, the least possible impacts on the environment and local cultures.

Along these lines, the focus of this paper is on the development of a *multilevel participatory methodological framework* in support of strategic decision-making, so as *sustainable and resilient cultural tourism development* to be achieved (INHERIT 2007; Labadi and Logan 2016; Stratigea et al. 2015; Panagiotopoulou et al. 2017; Beel et al. 2017). The sustainable management of the cultural resources of a specific study area of the Crete Region, the *Province of Kissamos*, is placed at the heart of this framework. The scope of the planning exercise is the spatial delineation of *alternative future cultural tourism paths* that are effectively integrated into the local economic and social structure; and serve the attenuation of developmental disparities and the achievement of *integrated and resilient heritage-led local development* (Stratigea et al. 2015; Panagiotopoulou et al. 2017).

The *structure* of the paper has as follows: first, it elaborates on the issue of cultural resilience, framing the way cultural resources are dealt with; then the multilevel participatory methodological approach is discussed, integrating a range of planning tools (Geoinformation tools for spatial data analysis, tools for visualization/mapping of cultural resources, identification and stakeholders' analysis, participatory scenario building and assessment, etc.); next follows the implementation of this framework in the specific case study, leading to knowledgeable policy choices on future resilient cultural tourism development paths; finally some conclusions are drawn regarding the experience gained from this spatial planning exercise.

8.2 Setting the Resilient Natural/Cultural Resource Management Context

Urban and rural communities are systems that evolve in a dynamic way, mainly driven by developments occurring both in the external and the internal (regions per se) environment. Such an evolution does not always follow a smooth trajectory, i.e. gradually evolving changes that can be easily absorbed by these systems. On the contrary, changes may take the form of a *shock*, namely a quite radical alteration which, although in most cases emerges from factors of the external environment (e.g. climate change), has severe implications at the local level (urban or rural spatial scale).

The ways such shocks can be overcome by urban or rural communities bring to the forefront the concept of *resilience* that is nowadays falling, among others, into the *planning and policy discourse*. Resilience, though originating from the ecological science and related research, has recently been developed at an exceedingly fast pace (Beel et al. 2017); and has permeated a variety of different scientific disciplines in order ecological, economic, social etc. systems and their interactions to be analyzed. Such an expansion of its use has obscured the conceptual clarity of the word, prevailing in the pure ecological view at its early stages (Brand and Jax 2007).

Various definitions of the term exist in the literature. Apart from those emanating from the ecological science, an *operational definition* has been introduced by Cumming et al. (2005), stating that the term describes the ability of a system to maintain its identity when coping with internal changes and external shocks and disturbances. Of great interest is also the sociological view of the term, as this was articulated by Adger (2006). According to this, resilience is perceived as the *groups or communities' ability* to cope with external stresses and disturbances that emerge from social, political, and environmental changes. Folke (2006) comprehends resilience as an *approach* or a *way of thinking* that is capable of collecting *distributed knowledge* and using it for interpreting complex systems (Anderies et al. 2006), as well as guiding their future trajectory. United Nations (2016: 22) delineate resilience as the *"ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions"*. Rose (2017) provides a broader definition of resilience, which refers to the ability of a system to withstand and recover rapidly from short- and long-term threats.

Carpenter et al. (2001) note that resilience of a system is grounded on two specific attributes, namely its *vulnerability* and *adaptive capacity*, both of which are strongly linked, among others, to the *social dimension*. This opinion is also shared by Beel et al. (2017), stating that *human agency* is a central issue in pursuing resilience objectives. Furthermore, these researchers claim that resilience is closely associated with *cultural heritage* and related activities; and constitutes the mean or the catalyst for building more robust to uncertainties communities.

A more comprehensive definition of resilience that sets the ground for coping with the complexity inherent in social systems is provided by Magis (2010:402), defining resilience as *"… the existence, development and engagement of community resources by community members to thrive in an environment characterized by change, uncertainty, unpredictability, and surprise. Members of resilient communities intentionally develop personal and collective capacity that they engage to respond to and influence change, to sustain and renew the community, and to develop new trajectories for the communities' future"*.

The above definition stresses two very important issues that are inherent, in one way or another, in several of the aforementioned definitions and are relevant to the planning and policy analysis disciplines. The first relates to the fact that resilience does not necessarily imply recovery towards a previously undisturbed state. On the contrary, it may result in another stable regime (Brand and Jax 2007), governed by a different set of variables and owing a different structure. This implies that *purposefully planned new, more stable regimes* can cope with vulnerabilities and associated risks of urban and regional environments, revealing the value of *planning* for serving, among others, *resilience objectives*. The second addresses *human capacity and knowledge* that are built upon *cultural values* and can broaden ability of local communities to become agents of change; and question, challenge and invent new ways of doing things (Daskon 2010). This, in turn, brings to the forefront the issue of *communities' engagement* in decision-making processes with respect to *planning for resilience* as an essential element and a basic principle in any planning endeavor (Evans 2016).

Speaking of strategic cultural planning, which is the focus of the present paper, communities' engagement becomes an indispensable dimension of relevant planning exercises. This reflects the *right* of local communities but also their *responsibility* to be part of the decision-making processes with regard to the management of local cultural heritage, serving a *two-fold purpose*, namely to:

- ensure *safeguarding and resilience* of scarce, precious, sensitive and non-renewable local resources, which are of decisive importance for maintaining *identity*, *historical memory* and *roots* (Panagiotopoulou et al. 2018); and
- use cultural resilience as bedrock for building stronger, more solid and more *resilient*, in other also respects, communities.

Participatory planning approaches in such a context are of crucial importance for getting insight in the *narratives hidden behind local cultural heritage*; and highlighting *region-specific ways* that have supported the maintenance of different cultural repertoires and their passing through subsequent generations. Moreover, it can illuminate a set of relationships and connections in the local scenery that, in the information era and digitalization but also standardization of cultural heritage, can continue to maintain those cultural repertoires now and in the future (Beel et al. 2017).

8.3 Methodological Approach

In an effort to accommodate *sustainable, inclusive and resilient management* objectives of local natural and cultural resources in future development paths of the particular case study, a *multilevel participatory methodological approach* is designed (Fig. 8.1), with involvement of local community (citizens, stakeholders, decision makers, cultural and tourism associations etc.) cross-cutting all steps of the planning endeavor. Such an approach aimed at engaging this community in serving a three-fold purpose, namely to: (i) enrich the *knowledge base* of the planning exercise with regard to the cultural capital, by gathering information on local assets; (ii) grasp the *narratives* and *values* attached by the local community to the various types of cultural resources; (iii) *co-design alternative scenarios* for their sustainable exploitation and *co-decide* the one that best fits to local expectations/visions,

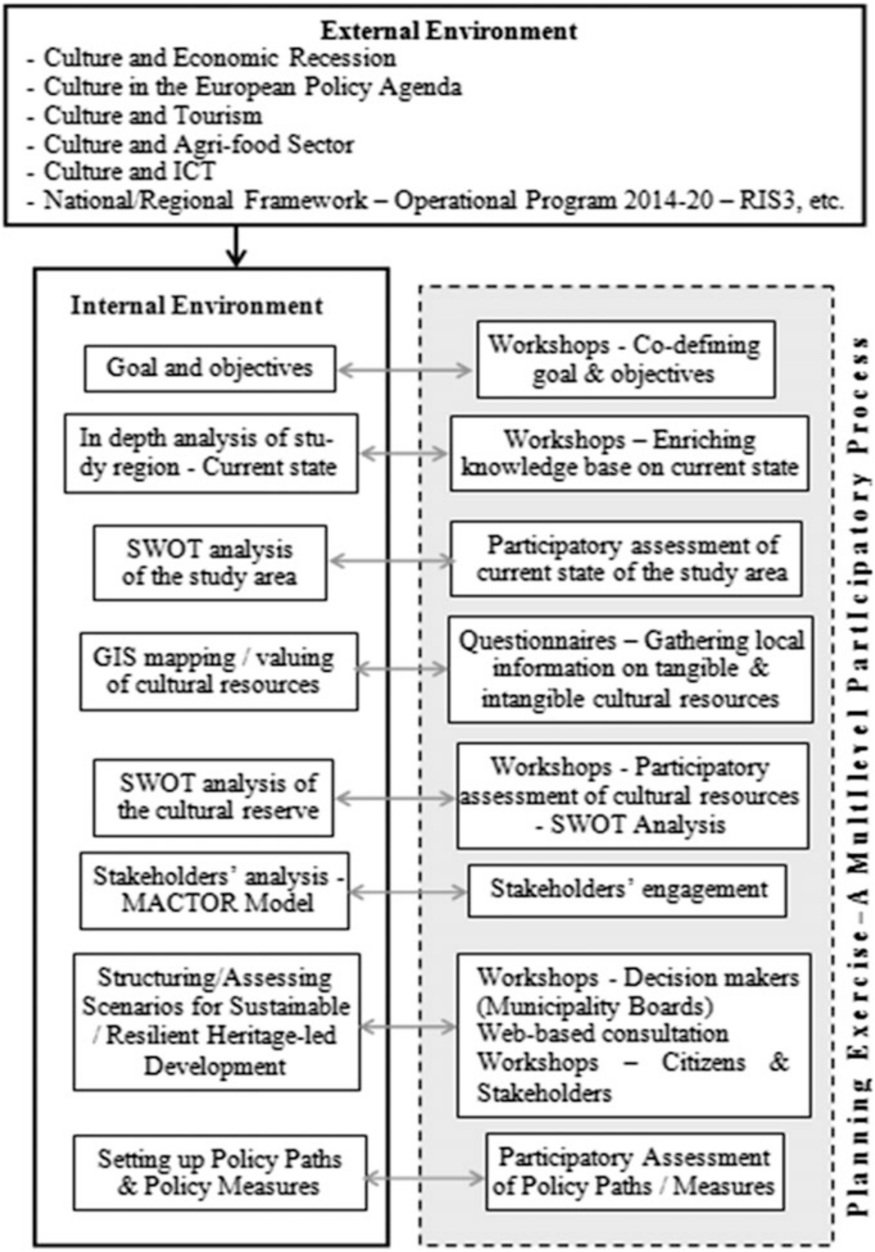

Fig. 8.1 Proposed multilevel participatory planning framework

seeking resilient heritage-led development pathways that preserve local identity and deliver it to the next generation; and (iv) reach *consensus* on those policy choices that can implement the desired future pathways.

More specifically, the steps of the proposed multilevel methodological approach have as follows (Fig. 8.1):

- First the focus is on the exploration of the *external environment*, i.e. the identification of the culture-related dominant trends and interdependencies, which can frame decision-making regarding cultural resource management of each single study region concerned. This incorporates the: (i) comprehension of the role of this sector in an economic recession era and the new opportunities that this brings to the forefront when exploring alternative heritage-led future development options; (ii) grasping of the position of the cultural sector in the European and national policy agenda and other related policy frameworks, steering sustainable cultural tourism development paths; and (iii) exploration of potential linkages of culture with other sectors e.g. agri-food sector and the way such linkages can be used for strengthening a region's identity and extraversion, through for example gastronomic tourism.
- Next comes an in depth analysis of the *internal environment*, i.e. the study region. More specifically, this incorporates the: (i) setting of the planning *goal* being the "sustainable, inclusive and resilient cultural tourism development", which is further analyzed into a number of *objectives*; (ii) exploration of the *current state* of the area under study (social attributes, local economic structure, infrastructures, natural characteristics, comparative advantages, problems, etc.) and its participatory assessment through a SWOT analysis; (iii) GIS-mapping and participatory assessment of local *cultural and natural resources*; and (iv) implementation of a *stakeholders' analysis*, by use of the MACTOR model, in order the influence-dependence relationships among stakeholders as well as their position regarding the goal and objectives set by the particular (spatial) planning exercise (convergence or divergence) to be ascertained.
- Based on the study of the external and internal environment, possible *alternative heritage-led future development scenarios* of the region under study are structured, through which goal and objectives are fulfilled. During the scenario building process, particular emphasis is placed on the *spatial pattern of natural and cultural resources* as well as on the *level of integration* these exhibit. Moreover, this process is placing effort on the mild exploitation of these valuable local assets, seeking to compromise their role as a vehicle for local economic development and social cohesion on the one hand; and their protection for serving cultural resilience purposes on the other. Finally, special care is also taken for ending up with a more *spatially balanced pattern of exploitation*, serving integrated regional development objectives and revocation of socio-economic disparities in the study region.
- Scenarios of the previous step are subjected to *participatory assessment*. The aim of this step is to support a transparent and legitimate process of scenarios' prioritization; and end up with the prevailing one that embeds local

stakeholders' expectations and visions. The outcome of this step is the selection of the *dominant scenario* (final planning decision), i.e. the most preferable scenario for serving sustainable, inclusive and resilient heritage-led futures.
- The final step of the proposed participatory approach elaborates on the *policy framework*, i.e. the most relevant policy paths and policy measures, for implementing the selected scenario. Finalization of this framework is subjected to participatory assessment in order this to be validated by the local community and consensus to be reached as to the policy choices this puts forward.

8.4 Paving Sustainable, Inclusive and Resilient Heritage-Led Development Paths in Kissamos Area—Crete

In the following sections, the implementation of the aforementioned policy analysis framework on a specific Greek region—Province of Kissamos-Crete—is exemplified.

8.4.1 Study of the External Environment—Policy Directions, Priorities and Trends

The main trends that can particularly affect the management of cultural resources of the study area, by rendering them a substantial tool for sustainable heritage-led future development, are illuminated in the following.

Culture in the European policy agenda—A pillar for coping with economic recession

The value attached to the European cultural heritage, distinguished by its richness, diversity, uniqueness and excellence, has been clearly reflected in the *Treaty of the European Union* (EU 1992). There, it is stated that all member States should: contribute to cultural development; respect EU's rich cultural and linguistic diversity; and ensure that Europe's cultural heritage is safeguarded, enhanced and promoted. Taking into consideration the global effulgence and reach of the European cultural resources, the cultural sector has, in the 2007 *European agenda for culture in a globalizing world* [COM (2007) 242], been recognized as an indispensable element for achieving EU's strategic objectives for prosperity, solidarity and security. At the same time, culture has been perceived as a *powerful tool* for spreading cultural, religious and humanist inheritance of Europe at the international scenery; while also promoting economic development, social inclusion, awareness of local communities and co-operation towards common goals, self-confidence and feeling of belonging to a historical community.

In Europe's 2020 strategy for *smart, sustainable and inclusive growth*, culture is conceived as an important pillar, namely a strategic resource for a sustainable Europe, with cultural heritage being a significant *'vehicle'* for achieving the objectives of this strategy. The recognition of the inherent value of cultural heritage for both forming the identity and re-booting the economy in the current recession distress, has led EU to rate *heritage-led development* quite high in the policy agenda, broadening thus previous *cultural policy initiatives*.

In order to further strengthen the role of culture in the European territory, the European Parliament's Resolution of September 8, 2015 *towards an integrated approach to cultural heritage for Europe* (Committee on Culture and Education 2014) has laid the foundations for a new cultural approach, which takes into account the cultural, economic, social, historical, educational, environmental and scientific dimensions. Within this approach, emphasis is placed on the dissemination of the cultural reserve and the values this conveys to different groups of recipients; and the increase of awareness and knowledge stock of future generations with respect to this reserve.

According to the aforementioned Resolution, the ultimate goal is to protect the European cultural heritage and disseminate its values, since it is acknowledged that *"…cultural heritage as both movable and immovable, tangible and intangible is a non-renewable resource whose authenticity must be preserved…"* (Committee on Culture and Education 2014:30). This effort requires new *models of participatory governance* for the management of cultural heritage that recognize it as a "common good" and strengthen *bonds and coordination* among local, regional, national and European policies. The implementation of this new strategy is reinforced by significant resources available through a range of financing tools, such as "Creative Europe", "Horizon 2020", "Erasmus +", "Europe for Citizens" as well resources from Structural Funds. *Policy directions* and *funding tools* are anticipated to support the sustainable and resilient exploitation of cultural resources for *economic recovery* under the current ominous recession circumstances.

Culture and tourism

In globalization times, favoring branding and cultural standardization, an increasing emphasis is placed by local communities on the role of culture for maintaining *identity*, *historical memory* and *roots* (Panagiotopoulou et al. 2018). Furthermore, the globally increasing tourist interest towards enjoying authentic cultural and aesthetic experiences has rendered cultural heritage a valuable resource and bedrock for *sustainable and resilient urban and regional development*. As such, cultural heritage and resources have gained planners and policy makers' attention in their efforts to plan and implement a *"cultural turn"* (Mercer 2006) of cities and communities by setting up *strategic, durable and qualitative, policy paths* for exploiting cultural assets in a *sustainable, creative and resilient way* (Labadi and Logan 2016; Beel et al. 2017). The ultimate goal of this turn and related cultural planning endeavors is *twofold*, namely to (Hawks 2001; INHERIT 2007; Panagiotopoulou et al. 2018):

- Incorporate cultural heritage in the way planners and policy makers evaluate the past and plan for the future, perceiving culture as an overarching and underpinning aspect for durable heritage-led development, carrying *intrinsic spiritual and unique values* of *societal knowledge* and *identity*.
- Initiate lasting improvements in cities and communities by transforming, in a sustainable and resilient way, cultural heritage assets into market-driven commodities. This will enable *instrumental benefits* to be achieved, namely: (i) *economic benefits*, e.g. economic revitalization and growth, investments, new marketing and branding potential; (ii) *area benefits*, e.g. improved area's profile and branding, regeneration inducing life into decaying assets (Said et al. 2013), attractiveness, etc.; (iii) *community benefits*, e.g. value of cultural heritage, distinct community spirit, engagement and ownership, social renewal, awareness of history and glory of the past etc.; and (iv) *individual benefits*, e.g. employment, income.

Culture and agri-food
Culture and agri-food constitute two largely interacting and interwoven sectors, with the latter being largely affected by social and cultural elements of a specific place; while these elements are embedding traditional paths of local agri-food production and processing. Linking the *agri-food sector with culture and tourism* is nowadays one of the strategic priorities in many national policy agendas for creating the dynamic complex of *"agri-food-culture-tourism"*, mainly expressed through *gastronomic, experience-based, products*. The gastronomy of a place, as a specific attribute of local culture and agri-food production/processing, can nowadays become an integral part of local identity; while, as empirical evidence shows, this remains one of the main factors for tourists' inclination towards selecting a specific destination. Promoting *"agri-food-culture-tourism complex"* has been set as a high priority in the Greek policy agenda as well, in alignment with the Research and Innovation Strategy for Smart and Sustainable Specialization (RIS3 Greece 2015).

Culture and ICT
ICT and their applications are nowadays offering a tremendous potential for the *digitization of cultural heritage*, thus largely affecting the way cultural products are produced, assessed, consumed, managed and promoted (Stratigea et al. 2016a). Creation and proper management of *cultural content*, but also further developments in the field of digital technologies targeting the modeling, analysis, understanding and preservation of cultural heritage are nowadays at the forefront of technological research and innovation endeavors. Developments in the field are expected to widely affect the marketing potential of *cultural destinations* and their ability to strengthen their attractiveness, based on a well-planned strategy and the use of ICT for its implementation.

Culture in the national policy agenda—Regional Innovation Strategy (RIS3)
Culture in Greece constitutes one important sectoral priority, supported by the national Strategy for Smart Specialization that includes eight priority sectors, namely (Hellenic Republic—ESPA 2014–2020 official Website): agri-food; health

and medicine; ICT; energy; environment and sustainable development; transport and supply chain; materials and constructions; and *Culture, Tourism, Cultural Creative Industries (CCI).*

The main aim of RIS3 at the national level is, among others, the recognition of the *"culture-tourism" complex* as a *key driving force* for the development of internationally competitive, authentic and experience-driven products and services in the field of culture and tourism, based on the adoption and use of *new cutting-edge technologies* (RIS3 Greece 2015). This is especially addressed at the Region of Crete, recognizing the particular island as a famous, international, and glamorous tourist destination, with a strong entrepreneurial base and large scale investments in the tourist sector. At the national level, RIS3 mainly aims at further enriching or specializing national and sectoral policy choices, articulated in respective national/sectoral strategic spatial plans as well as in Operational Regional Programs and Regional Spatial Plans.

Culture at the regional level—RIS3 in Crete Region—Culture-Tourism-ICT complex

The Region of Crete has, through time, exhibited a stable growth rate in line with the national average; and a relatively well balanced economic structure, having mostly an export and extrovert orientation. The two major pillars dominating the regional economy, namely the *agricultural production and tourism*, have gained international recognition and popularity.

Crete's prominent position in the tourist market is based on its extremely wealthy natural and cultural environment, rendering thus the relevant resources a remarkable local comparative advantage. The main goal, at the Regional level, regards the: further development and promotion of the *"culture-tourism" complex*; reverse of the *tourist seasonality phenomenon*; diffusion of tourist flows in the hinterland through the efficient management of natural and cultural peculiarities; and production of innovative, high-quality, experience- and Cretan spirit-driven tourism products these peculiarities can synthesize.

Taking into consideration the structure of the Cretan regional economy, the economic recession has greatly affected numerous sectors, but especially constructions and agriculture (dramatic drop in oil production). At the same time, tourism has exhibited remarkable *resilience* in recession times and has increased its share in the local economy (Urban Management SA 2014).

However, despite the remarkable *comparative advantages* of the Crete Region in many fields, these have not yet been transformed into *dynamic competitive ones*, through appropriate policy initiatives. Indeed, Crete is characterized by low level of competitiveness with regard to the national average, mainly due to the limited innovation, weak entrepreneurship and constraints inherent in the current institutional environment (Urban Management SA 2014). While the developmental 'gap' between the Region of Crete and other similar competitive Regions of the southern Mediterranean is relatively small and can be bridged through medium term policies; the gap with the developed regions of the European North is considerably higher. Bridging this presupposes the promotion of structural changes and reforms, as a result of long-term planning and policy-making as well as systematic and consistent implementation of these policies.

In this direction, the *Smart Specialization Strategy for the Region of Crete* (RIS3-Crete) is designed in support of long-term development perspectives and competitiveness. At the same time, this strategy attempts to constrain or remove inherent structural weaknesses, by placing emphasis on *innovation*, *research and development*, *entrepreneurship*, upgrading of *human resources*, etc. as horizontal actions in a number of the Region's productive sectors (Stratigea et al. 2015).

A key issue for the implementation of RIS3-Crete is the shift towards a *high-quality entrepreneurship* and the shaping of the appropriate conditions and environment for knowledge diffusion from the regional research centers to the local entrepreneurial community. To this end, RIS3-Crete sets up a series of priorities, which are considered as fundamental for re-launching development of the Crete Region. Its implementation is fleshed out through the creation/reconstruction of four *integrated productive clusters*, namely (Urban Management SA 2014):

- An *agri-food complex* that is adaptive to climate change, highlights the value and significance of the Cretan diet, and strengthens export activity.
- A *"culture-tourism" complex* that acts as a key driving force for global reach and competitiveness gains.
- New activities regarding the *"education-research" complex* (innovative educational services, emergence of new investment opportunities, etc.); and the *environmental complex*, with particular focus on energy saving, smart water management, Renewable Energy Sources (RES), exploitation of marine resources, etc.
- A strengthening of technological activities and their applications, crosscutting all sectors.

These are further specializing or complementing strategic directions that are set up by the Regional Operational Program 2014–20 and Regional Spatial Plan of the Crete Region.

8.4.2 Study of the Internal Environment

The present section sketches the internal environment of the study area by delineating its key socio-economic attributes; the local cultural and natural assets and their spatial distribution; and the stakeholders that need to be engaged in the planning endeavor. Moreover, it elaborates on the goal and objectives set in the context of this specific participatory spatial planning exercise (Fig. 8.1).

Goal and objectives
The *goal* set in this participatory planning exercise refers to the sustainable and inclusive management of natural and cultural resources; and their mild exploitation

Table 8.1 Planning objectives of Kissamos participatory spatial planning exercise (Stratigea et al. 2016a)

Planning objectives	
Objective 1	Mapping/promoting of local cultural identity
Objective 2	Linking natural & cultural heritage—integration of local resources
Objective 3	Spatially balanced development of cultural products, based on cultural and natural resource availability
Objective 4	Integration of the cultural and tourism sectors—Creation of the "culture—tourism complex"—Sustainable exploitation of cultural resources
Objective 5	Use of ICT for a more effective marketing of cultural tourist products
Objective 6	Promotion of local entrepreneurship, placing at the epicenter the cultural heritage of Kissamos
Objective 7	Improvement of infrastructures for unimpeded accessibility to areas of natural and cultural interest
Objective 8	Increasing awareness of local population on the value of natural and cultural resources—training—experiential learning—voluntarism
Objective 9	Activation of local cultural associations—coordinated actions
Objective 10	Placing of culture as a pillar of social cohesion and community development

as a vehicle for heritage-led local development, having at its heart the achievement of *cultural and community resilience*. This goal is further analyzed into a set of *objectives* (Table 8.1).

Current state of the study area

The study area expands in a region around the northwest edge of the island of Crete (Fig. 8.2), known as Kissamos Province. Due to its strategic geopolitical location, the area has a long history starting since Neolithic period. It also holds significant role through other historical periods (Minoan, Roman occupation, Byzantium and Venetian domination period). The above mentioned historical phases have gradually sculpted contemporary culture in the area, being the outcome of incessant evolution through thousands of years.

Getting insight in the area at hand and conducting a SWOT analysis that illuminated strengths and weaknesses of the current state, has led to a series of conclusions, largely summarized as follows (Stratigea et al. 2015):

- The particular area is marked by a discrete cultural identity and tradition.
- The tertiary sector dominates the local economy, followed by the remarkable agricultural production; while the contribution of the secondary sector is significantly weaker.
- Local population exhibits a declining and ageing pattern.
- Severe spatial disparities are observed between the developed and mostly overcrowded coastal areas and the lagging behind hinterland.

- Access to the northern part of the area is relatively satisfying, while the same does not hold true for the western part and the hinterland (poor road network quality).
- Despite the natural and cultural wealth of the region, which constitutes a valuable comparative advantage, the relevant resources are not efficiently linked to tourist activities.
- Culture and cultural identity play a critical role in social standards and social development, especially in the hinterland.
- Cultural planning is not fully integrated into the strategic planning of the two municipalities concerned.
- A significant number of cultural associations are active in the study area and majorly contribute to the preservation and promotion of the natural and cultural reserve and the local cultural identity.

GIS-mapping of natural and cultural resources
The study area is endowed with an extremely wealthy natural and cultural environment. Data and information on the location and attributes of *local tangible natural and cultural resources* (NATURA 2000 areas, canyons, monuments of nature, archaeological sites, traditional settlements, churches, castles, watermills, windmills, bridges, etc.) (Panagiotopoulou et al. 2017) are collected, recorded, elaborated and visualized, in order the *cultural map* of the region to be created (Fig. 8.2). The *intangible cultural resources* are also recorded (Stratigea et al. 2015). This whole procedure, meaning the collection, analysis, visualization and

Fig. 8.2 GIS-mapping of tangible cultural resources (Stratigea et al. 2016a)

assessment of data relevant to the local cultural capital, tangible and intangible, forms the basis for the scenario building process.

The multi-level participatory context
While exploring the internal environment of the study region and setting objectives for serving the goal of sustainable and inclusive cultural management for culturally-resilient heritage-led development, a range of *participatory workshops* was carried out. The aim of these workshops was twofold, namely to:

- establish communication and trust between the research team and the local community from the very early stages of the participatory planning process; and
- enrich the team's background knowledge as to the peculiarities of the specific region by gaining good insight into both: the region and its natural and cultural resources; and the value of these resources to the local community.

Good insight of natural and cultural resources was further enriched by means of a *questionnaire*, addressed to a large number of cultural associations activated in the area. Elaboration of data gathered has revealed local specificities relating to tangible and mainly intangible cultural heritage aspects.

Additionally, *participatory SWOT analysis* was conducted during these workshops in order to engage local stakeholders so as to *cooperatively assess strengths, weaknesses, opportunities and threats* of both the current state of the study region and its cultural and natural resources. Finally, participatory procedures were followed for the implementation of *stakeholders' analysis*.

Stakeholders' Analysis
This section makes a brief reference on the stakeholders' analysis that was carried out in the context of this particular spatial planning project (Panagiotopoulou et al. 2017). This is accomplished by use of the MACTOR model, part of the LIPSOR approach, which focuses on the study of *actors' games* in seeking to gauge the balance of power among actors and study convergences and divergences of a number of stakes from objectives set (Godet et al. 2004). More precisely, the actors involved in the study are explored on the basis of their attributes, power relationships, goals and objectives, projects in progress, preferences, motivations, internal means of action, past strategic behavior, constraints, etc. The scope of the analysis is to both: *get insights* into the influence—dependence relationships among the stakeholders in the study region; and study the *stakeholders' position* as to the objectives pursued in the study area (convergence or divergence).

Stakeholders engaged in the present study (Table 8.2) are all those who are affected or can affect the planning outcome or have a certain interest/experience or can share, useful to the planning exercise, knowledge (European Commission 2003).

The most significant results obtained from the stakeholders' analysis as well as some critical remarks made out of them have as follows (Panagiotopoulou et al. 2017):

Table 8.2 Stakeholders' groups engaged in Kissamos participatory planning exercise (Panagiotopoulou et al. 2017)

Stakeholder (St)		Description
St-1	Regional authority	Region of Crete—Regional Entity of Chania, setting strategic objectives and funding relating projects
St-2	Local government	The two municipal authorities responsible for decision-making at the municipal level
St-3	Local councils	Having a consulting role to the local government
St-4	Farmers	Stakeholders emanating from the agricultural sector e.g. olive-oil and cheese producers
St-5	Manufacturing	Associations relating to primary products processing
St-6	Cultural associations	Cultural associations activated in the region
St-7	Commercial associations	Local commerce representatives
St-8	Tourist businesses	Local representatives from tourist business, apart from hospitality businesses
St-9	Tourist accommodation associations	Hospitality businesses
St-10	Archaeological Service	Managing archaeological heritage in the study region
St-11	Environmental agencies	Representatives from environmental agencies, supporting environmental integrity of the study region
St-12	Citizens	Community groups of the local settlements
St-13	Women associations	Associations having an active role in the study area

- No powerful stakeholders (with high degree of influence and low dependence) exist in the study area.
- Stakeholders with high influence but also high dependence –key stakeholders—are: St-4 (Farmers), St-6 (Cultural associations), St-7 (Commercial associations), St-8 (Tourist businesses), St-9 (Tourist accommodation) and St-13 (Women associations). This remark reflects the dominance of the agricultural and tourist sector in the local economy, while it also highlights the important role of culture and related actions undertaken by cultural and women associations. Moreover it exhibits high interdependence of the agricultural, cultural and tourist sectors, setting the ground for the establishment of the "agri-food—culture—tourism" complex that is considered as the main developmental vehicle for the study region.
- Certain degree of consensus, in respect of the objectives set, has been reached by the majority of stakeholders' groups.
- Disagreement is clearly emerging as to the objectives that directly or indirectly entail some kind of interventions, serving tourist development purposes in natural or cultural sites, implying a sort of resistance to the further annoyance of these sites.
- Finally, a certain disagreement is expressed by tourist agents (St-8 and St-9) as to the increase of awareness on the value of local natural and cultural resources and training of local population, connoting a certain concern about the potential implications on the unimpeded tourist development of the region.

8.5 Structuring and Assessing Scenarios for Resilient Natural/Cultural Resource Management

The scenario approach constitutes a *foresight technique* used for medium to long-term strategic analysis and planning that aims at exploring possible alternative futures (Puglisi 2001). Scenarios, in this respect, intend to represent future states that are plausible, internally consistent, based on rigorous analysis, engaging and compelling (Stratigea and Katsoni 2015). They set the ground, upon which robust, resilient, flexible and innovative strategic policies are sought (Rhydderch 2009), turned thus into useful *'management tools'* for both private and public institutions (Sardar 2010).

In order scenarios to be structured, a range of *alternative methodologies* can be adopted, whose selection depends on the particular study context. It is important to keep in mind the need to explore a range of *plausible futures*, which can fulfill goals and objectives and present a *portfolio of possible future states* of the region at hand within different decision environments (Lindgren and Bandhold 2003), thus complementing and informing decision-making and planning processes (Olsmats and Kaivo-Oja 2014). Moreover, such an exploration can also: contribute to the identification of risks; provide a more robust way of testing strategies (Rhydderch 2009); anticipate wild cards and support the selection of proactive reflections for effectively coping with them (Cornish 2004).

8.5.1 Scenario Building Process

From the set of available methodologies, the *'two uncertainty axes'* scenario building process is applied to the particular planning exercise (Jäger et al. 2007; Stratigea and Katsoni 2015). Such an approach is built upon two uncertainty axes, which reflect two specific objectives of the study, exhibiting the *highest degree of uncertainty*. In the present case study, this uncertainty is mainly due to policy priorities.

More particularly, the *horizontal axis* refers to the *spatial pattern* that each scenario adopts—*concentrated vs de-concentrated spatial pattern*; and the *vertical axis* regards the *level of integration* of natural and cultural resources—*high vs low level of integration* (Fig. 8.3). These two axes result in the delineation of *four qualitative, normative, contrasting, well differentiated future images*, which can further be enriched by fleshing them out with lower level details to complete each specific future 'image' and properly communicate it to local stakeholders (Stratigea and Katsoni 2015).

A preliminary *qualitative assessment* of these four scenarios, conducted by the research team, leads to the *exclusion of scenarios III and IV* that seek a low level of integration of natural/cultural resources; and the selection, for further exploration, of *alternative scenarios I and II* (Panagiotopoulou et al. 2017).

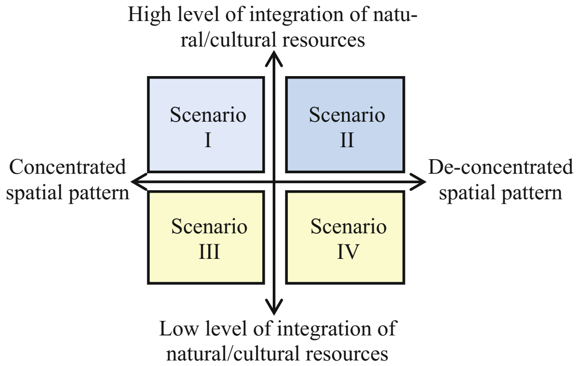

Fig. 8.3 Building process of alternative scenarios (Stratigea et al. 2016a)

8.5.2 *Description of Alternative Scenarios and their Assessment*

The present section delineates the two selected alternative scenarios—Scenario I and II –, structured on the basis of the previously described methodological approach. Development of these two scenarios is driven by the: spatial distribution of *tangible* cultural resources and their *integration* with the *intangible* ones; the strengthening of *cultural resilience*; and the contribution of these scenarios to the (Panagiotopoulou and Stratigea 2014):

- attenuation of regional disparities through a more *balanced pattern* of tourist activities, dispersed throughout the study area;
- strengthening of bonds and interaction among different spatial units, serving *spatial cohesion*;
- rendering of the study region a *functional spatial entity* as a whole, whose development perspective is based on *complementarity and synergies* among both individual spatial entities and productive activities;
- enhancement of *extroversion* of the study area; and
- promotion of the study area as a *regional node* of prominent cultural and natural importance.

Scenario I—"Development of Thematic Natural/Cultural Routes" (Fig. 8.4), is built upon a *concentrated spatial pattern* of natural/cultural resource management, placing emphasis on the development of *four region-wide thematic cultural routes*. These comprise the most significant cultural resources of similar nature; and, from a spatial point of view, constitute an *integrated network* of cultural routes that are interconnected in specific nodes. The *thematic cultural routes* created are (Fig. 8.4):

- Archaeological route;
- Route of agricultural museums;
- Natural heritage route; and
- Religion route.

Fig. 8.4 Scenario I—Development of thematic natural/cultural routes (Stratigea et al. 2016a)

Scenario II—"Polycentric Model of Natural/Cultural Resource Management" (Fig. 8.5)—focuses on a *de-concentrated spatial pattern*, seeking the *polycentric cultural development* of the study area through the sustainable and resilient exploitation as well as the efficient integration of different resource types (of local/supralocal importance, and different thematic interest) for the creation of *evenly distributed, complementary in nature, cultural hubs*. In this respect, the region

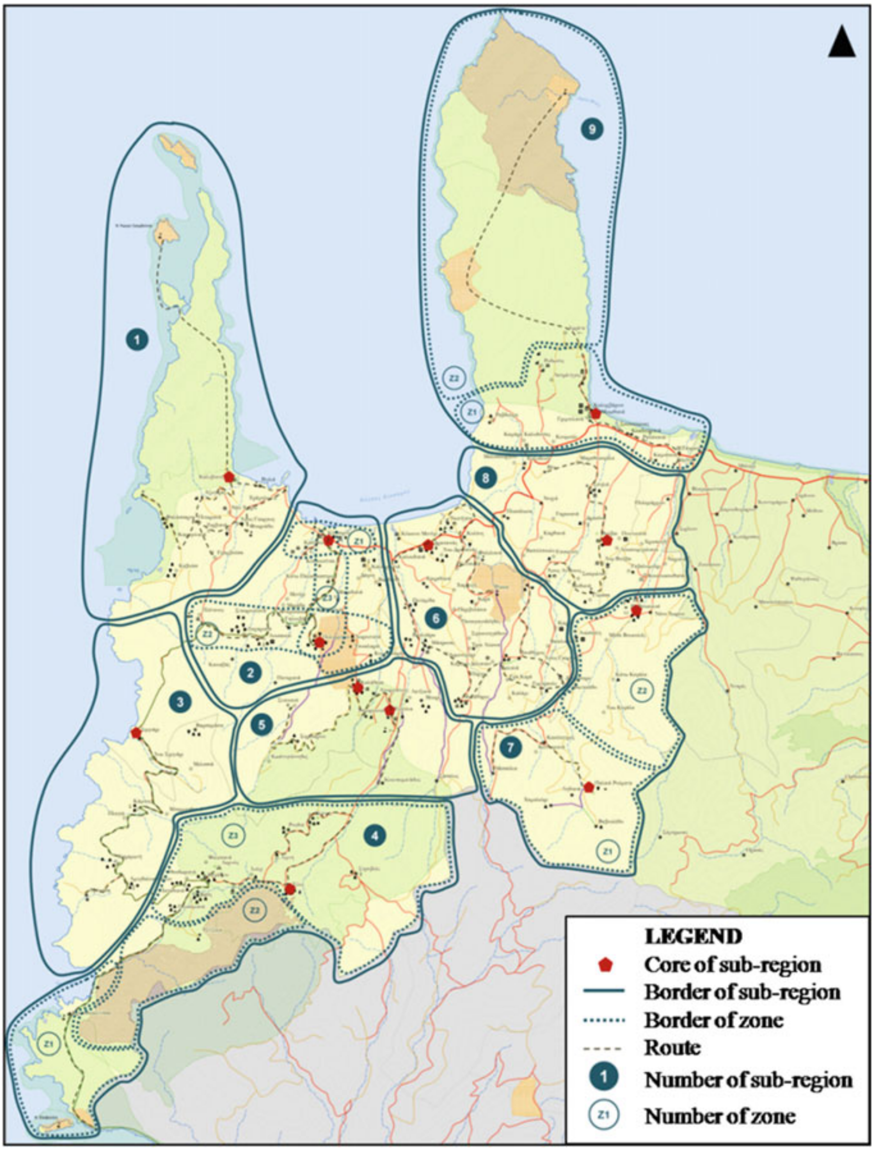

Fig. 8.5 Scenario II—Polycentric model of natural/cultural resource management (Stratigea et al. 2016a)

under study is divided into *nine sub-regions*, while each of them has its own discrete cultural identity, forming thus *small scale integrated multi-cultural routes*, which operate as "vehicles" for local development.

The two proposed scenarios were subjected to in depth discussions and participatory assessment by a wide audience, consisting of representatives of different local community and decision-making groups. Such an interaction took place in the context of:

- Thirteen *participatory workshops* carried out in various local settlements. These aimed at establishing a wide dialogue on the proposed scenarios between the research group on the one hand; and representatives from the regional and local administration (Fig. 8.6a) and the local community on the other (Fig. 8.6b).
- A *final workshop*, dedicated to the presentation and assessment of the *proposed scenarios* by various local community groups (e.g. civic groups, stakeholders and decision makers, local associations; see stakeholders engaged in Table 8.2), organized by the local administrative bodies (Fig. 8.6c).

Discussions in the above workshops were structured and guided by the research group in order feedback about the proposed scenarios to be gained; and qualitative values of a range of evaluation criteria to be grasped, based on various views

(a) Workshop in Platanias municipality, 8.1.2016 – Research group, Mayor and municipality executives

(b) Workshop in Platanos settlement, 10.1.2016 – Research group and representatives of citizens and cultural associations

(c) Final workshop on the presentation and assessment of alternative scenarios – Province of Kissamos – February 2016

Fig. 8.6 Workshops on the elaboration and participatory assessment of alternative scenarios (Stratigea et al. 2016a) articulated. These criteria derived from goal and objectives set in this strategic cultural development planning endeavor; and were used for a qualitative evaluation of the scenarios at hand (Table 8.3). Results of the two scenarios' evaluation rate first Scenario II about the "Promotion of a polycentric model of natural/cultural resource management"; while Scenario I about the "Development of thematic natural/cultural routes" is rated rather close to Scenario II (Fig. 8.7).

Indeed, Scenario II, mostly relating to community expectations and vision, prevails in 11 out of the 16 evaluation criteria. Regarding the rest 5 criteria (K3, K4, K8, K9 and K10), assessing the performance of the two scenarios as to strategic

Table 8.3 Evaluation criteria for assessing proposed scenarios

Objectives	Alternative scenarios Evaluation criteria	Scenario I	Scena-rio II
Obj. 1	K1- Level of motivation/activation of local communities	3	4
	K2- Diversity of information gathered on natural/cultural resources for planning purposes	1	4
	K3- Potential for information updating on natural/cultural resources	4	3
Obj. 2	K4- Level of integration of natural and cultural resources for producing cultural tourism products	3	4
Obj. 3	K5- Balanced spatial distribution of cultural tourism products	3	4
Obj. 4	K6- Creation/empowerment of local multi-stakeholders' networks	3	4
	K7- Range of cultural tourism products developed	4	5
	K8- Alignment with policies at higher hierarchical levels with regards to the establishment of the cultural-tourism complex	5	2
Obj. 5	K9- Potential for ICT skills upgrading for competitiveness gains of local businesses in the cultural tourism sector (large vs small scale businesses)	4	3
	K10- Alignment with policies at higher hierarchical levels with regards to the ICT diffusion in the cultural-tourism complex	5	2
Obj. 6	K11- Local identity as a vehicle for entrepreneurship	2	5
Obj. 7	K12- Level of infrastructure improvements for increasing accessibility	3	4
Obj. 8	K13- Level of knowledge diffusion & awareness raising on the value of natural and cultural heritage for sustainable local development	3	4
	K14- Diffusion of voluntarism	3	5
Obj. 9	K15- Networking of local cultural associations	3	4
Obj. 10	K16- Removal of development inequalities—Social inclusion	4	5

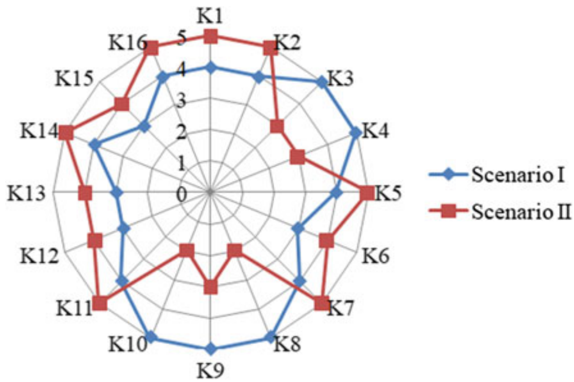

Fig. 8.7 Rating of scenarios according to local stakeholders' preferences

guidelines emerging from the external environment (e.g. RIS3, Structural and other National policy directions), Scenario I exhibits better performance.

Based on the results of the scenarios' evaluation and keeping in mind that their realistic implementation should take into account options available for their funding, i.e. harmonization with funding schemes and strategic priorities of the Greek state and Region of Crete, *consensus* was built on *prioritizing Scenario I*. This entails the development of cultural routes crosscutting the region as a whole; and forms the backbone of the resilient natural/cultural resource management and the cultural development strategy of the study region. Such routes would integrate distinguished natural and cultural resources, thus strengthening the region's extroversion. As soon as this backbone is well established, it could gradually be fleshed out by integrating endogenous potential of localities. These could add value to cultural routes and resilience, by enriching them with composite, niche, locally initiated cultural products, offering authentic cultural experiences and bringing on board peculiarities and aspirations of each single locality of the study region.

8.5.3 Policy Framework

The present section delineates the policy framework, which was developed for the implementation of Scenario I. This framework attempts to serve the main goal and objectives of the planning study; while it has taken into consideration the majority of comments, remarks, views and visions of the local community by properly embedding them into the structure of the prevailing scenario.

More specifically, the policy framework is built upon four fundamental *policy paths* as main pillars for the implementation of Scenario I (Fig. 8.8) (Stratigea et al. 2016b).

These take into consideration the goal and objectives of the study, the state of the internal environment as well as the prevailing trends of the external one (European, national, regional policy framework, RIS3-Crete, etc.); and are further particularized into several *policy measures* and *actions*. The four policy paths are:

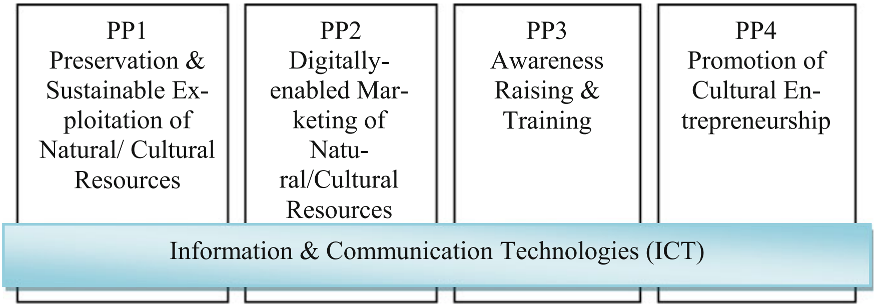

Fig. 8.8 Main Policy Paths (PP) (Stratigea et al. 2016b)

- *PP1—preservation and sustainable exploitation natural/cultural resources*: involves *30 policy measures* that specify spatial interventions aiming at the preservation and sustainable exploitation of the local natural and cultural reserve.
- *PP2—Digitally-enabled marketing of natural/cultural resources*: incorporates *23 policy measures* regarding the ICT-enabled promotion of the natural and cultural capital.
- *PP3—Awareness raising and training*: contains *14 policy measures*, which target the dissemination of information and knowledge with regard to the area's natural and cultural wealth.
- *PP4—Promotion of cultural entrepreneurship*: comprises *27 policy measures* that concern entrepreneurial activity emerging from the strengthening of bonds and the creation of synergies in the culture-tourism complex.

In Table 8.4, some indicative ICT-enabled policy measures are roughly sketched.

Table 8.4 Indicative policy measures falling into the four policy paths (Stratigea et al. 2016b)

Policy path	Policy measures
PP1	Energy upgrade of museums
	Networking and cooperation for the development of new forms of tourism and relevant digital content
	Mapping and online presentation of routes of ecological and cultural interest
	Mapping and online presentation of alternative tourism sites and businesses
	Digitization of traditional music and dance
PP2	Digital repository of culture
	Digital library
	Creation of e-albums with selected subjects from all the thematic cultural routes
	Development of digital content for the historical documentation of archaeological sites
	Development of interactive applications available in all museums
PP3	Digital school for cultural education
	Interconnection of schools with the e-culture platform
PP4	Development of e-culture and e-tourism applications
	Development of e-learning applications

Fig. 8.9 Workshop on the presentation and participatory assessment of policy framework implementing the prevailing scenario—July 2016

It should be noted that ICT and their applications are cross cutting the aforementioned policy paths, since *technology* is considered as a *catalyst* for the recording, digitization, protection, preservation and promotion of the natural and cultural capital; while it forms the core of the contemporary European, national and regional policy frameworks regarding the establishment of the tourism and culture complex.

Participatory assessment of the proposed policy framework was carried out in the context of a workshop, aiming at reaching *consensus* on the related policy initiatives for implementing the prevailing scenario (Fig. 8.9).

8.6 Conclusions

It is widely acknowledged that cultural resources can be a *key driver* for economic growth and prosperity as well as social cohesion, linked in many ways to local economic and social developments. Indeed, *cultural capital* is perceived as a *public good*, capable of creating remarkable positive external economies due to its linkages to a number of sectors and services, but also social processes and capacity building of local communities (Stratigea et al. 2016b). Prioritization of cultural heritage and related values in development programs, in this respect, is of outmost importance for coping with vulnerabilities caused by economic, social and political changes (Daskon 2010), establishing the grounds for, among others, economic, social and cultural *resilience* (Daskon 2010; Neher and Miola 2016; Beel et al. 2017).

The significance of cultural heritage as a means for effectively dealing with emerging challenges in a stagnation era, but also as bedrock for shaping a distinct *place identity*, has been greatly acknowledged by researchers, policy makers and local communities. While exploiting cultural assets for ‘re-booting’ local development, it should be kept in mind that these resources, apart from being *valuable*, they are also *vulnerable and non-renewable*. They embrace memories that need to be respected and preserved; they build up identity and sense of belonging; and they reveal the trace of the long way of a society through time and space that needs to be delivered intact to future generations.

Along these lines, any *cultural planning endeavor*, targeting their efficient management, has to respect the *right* of local societies to define their future, but also act as a *learning platform* for cultivating *responsibility* of all those concerned, by engaging them in the process of co-defining the way these resources will be treated. A *successful planning outcome* is the one that embeds expectations, indigenous knowledge and visions of local societies in it; and ensures resilience of cultural resources concerned. Sustainable and resilient exploitation of these resources is, in this respect, a necessity, but also a means for:

- supporting local economies and creating added value, while preserving quality, diversity and resilience of this heritage;
- serving social and economic cohesion objectives of local communities;
- building capacity of local population and promoting resilient behavioural patterns through culturally-inspired practices; and
- contributing to the upgrading of competencies and quality of life of local population.

According to the aforementioned, the present paper has developed and implemented a *multilevel participatory methodological framework* that comprises contemporary planning approaches and tools; and attempts to engage local communities, stakeholders and decision makers of the study region concerned in all stages of the spatial planning process. Hence, local population is encouraged to: *enrich* the research group's knowledge, mapping and narratives' creation of the available natural and cultural capital; *co-define* planning objectives with regard to the sustainable and resilient exploitation of these resources, in alignment with local values and visions; *co-design and co-decide* the way their natural and cultural heritage will 'seal' their cultural identity and resilient future heritage-led development perspectives; *consult* the design of the relevant policy framework in order local peculiarities to be best fitted in respective policy choices. This implies the engagement of local stakeholders as consultants but also decisive actors in every single planning decision in order the nature, value and resilience of these resources to be safeguarded.

Participatory tools (e.g. workshops, participatory SWOT analysis, public hearings) are used from the very early stages of the spatial planning process for gaining better insight into the current state of both the region under study and the cultural resources, assigning to local community groups the role of *information prosumer*. The *stakeholders' analysis* constitutes an important step for identifying convergences and divergences of different stakes with respect to planning goals and objectives. It has also served as a means for detecting coalitions that are for or against these objectives, feeding thus the planning effort with vital information for properly adjusting or reorienting particular decisions. Cooperative effort is also undertaken during the *scenario building and evaluation stages*, where a range of different stakes are represented by a variety of local groups. The adding value of this approach is mainly emanating from the prioritization of the planning proposals according to local peculiarities; and the ending up with final planning outcomes that can reach *consensus* and assure *successful implementation*.

The application of the proposed participatory planning framework seems to be quite promising, as participatory approaches have set the ground for grasping the local taste, values, visions and views; and incorporating them into the planning process and outcomes. The efficient communication of intermediate planning results (goal and objectives, alternative scenarios, policy paths, policy measures and actions, etc.) and the ceaseless interaction between the research team and the local stakeholders throughout all stages of the planning process have contributed to the *enrichment* of the available knowledge stock; the *empowerment* of local stakeholders in the planning process; the building of *trust and consensus* as to the way planning intermediate and final outcomes have emerged; the establishment of *resilience-driven* understanding and thinking of natural/cultural capital; and the *commitment* of the various groups to the final policy decisions. Finally, it has also resulted in the *increase of awareness* of the local communities as to the value of cultural resources and their critical contribution to paving *future, desirable and vision-driven, as well as resilient local development pathways*, impeding thus their impetuous commercialization and standardized exploitation in the name of temporary economic reward.

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Chapter 9
A Method for Developing a Game-Enhanced Tool Targeting Consumer Engagement in Demand Response Mechanisms

Ioannis Lampropoulos, Tarek Alskaif, Machteld van den Broek, Wilfried van Sark and Herre van Oostendorp

Abstract This work focuses on enhancing consumer engagement in demand response mechanisms through the employment of gamification techniques. Demand response mechanisms are employed by electricity suppliers, other market parties, and transmission and distribution system operators as options for market optimisation, balancing supply and demand, and ensuring system security. Gamification is the use of game design elements in non-game contexts, and the use of game principles in the design of certain systems to enhance engagement with these systems and make the interaction more motivating. The development of flexibility mechanisms at the demand-side is considered a key aspect for an effective energy transition, which requires the active participation and empowerment of consumers in the energy system. However, a significant barrier to realise the full flexibility potential is insufficient consumer engagement and awareness regarding energy usage. Serious games, and gamification, can effectively empower consumers by enhancement of engagement and stimulation of collaboration between them. The goal is to enable a playful interaction between technology, such as smart metering

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systems, energy management systems and smart appliances, and consumers that will result in higher engagement in demand response. An overview of demand response is provided, and the linkage is made between retail markets, markets at the wholesale level and ancillary services. The role of gamification techniques is discussed based on literature review, focusing on strategies to increase consumer engagement in demand response mechanisms. A user-centred, iterative design method is proposed for the development of a game-enhanced tool in which also collaboration between players can be stimulated, whereas the impact of applying the game-enhanced tool on consumer engagement can be empirically verified.

Keywords Demand side management · Demand response · Consumer engagement · Gamification · Serious games · Tool design method

9.1 Introduction

In recent years, the topic of consumer engagement in smart grid projects has received increasing attention at a European level. Projects involving consumers are characterised by the pursuit of two main objectives: gaining deeper knowledge of consumer behaviour and engaging the consumer (Gangale et al. 2013). Consumers increasingly need to be empowered, especially considering the complexity of products and markets and the increasing flow of information and new requirements in consumers' decision-making in liberalised market environments (European Commission 2011; Carreira et al. 2017). Improved decision-making by consumers can also have a significant impact on the competitiveness of the economy (European Commission 2011). Active users at the demand-side can contribute to solving the challenges of electricity systems and receive significant benefits for their participation. A significant barrier to realising this potential is insufficient consumer engagement and awareness regarding their own energy consumption (Gangale et al. 2013). Gamification is the use of game design elements in non-game contexts as well as use of specific system design features to make engagement with these systems more motivating (Johnson et al. 2016). Serious games, and gamification of real world processes, can effectively convey new knowledge and skills to people (Sitzmann 2011; Wouters et al. 2013; Wouters and van Oostendorp 2013; Boyle et al. 2016; Clark et al. 2016; Ke 2009, 2016); foster collaboration between consumers (Hummel, et al. 2011; Ter Vrugte and de Jong 2017; Wouters and van Oostendorp 2017; Chen and Law 2018); empower consumers, enhance engagement, change attitudes and improve behaviour in the desired direction (Deterding et al. 2011; Aronson et al. 2013; Catalano et al. 2014; Soekarjo and van Oostendorp 2015; Fijnheer and van Oostendorp 2016).

In recent years, there is a growing consensus among academics, practitioners, policy makers and market participants that demand-side flexibility, through Demand Response (DR) mechanisms, is a critical resource for achieving a low carbon and efficient electricity system (EDSO 2014; ENTSO-E 2015a; Eurelectric 2015; European Commission 2015; SEDC 2015; CEER 2016). However, it is expected that energy consumers will require support in making informed decisions and engaging in energy applications (Carreira et al. 2017). In this paper, we propose a method for developing a game-enhanced consumer tool to address consumer engagement in DR mechanisms through gamification techniques. The envisioned tool will enable a playful interaction with consumers and/or prosumers via a web-based platform; and will be supplemented with elements to stimulate and organise collaboration between them. Such a tool is expected to lead to a significant increase in consumer engagement in DR mechanisms, as well as enhanced flexibility in energy usage. The method includes the design, development and validation phases of a tool, employing game elements, for engaging consumers in real-life energy management, increasing awareness and collaboration between consumers, and stimulating behavioural change in energy usage and flexibility provision. The envisioned tool will provide accurate information about energy usage in buildings through smart metering systems, and will employ gamification techniques for consumer engagement in DR mechanisms. The method for the design and development of a game-enhanced consumer tool is based on a user-centred design approach. The envisioned tool will integrate game elements with energy analytics, smart metering systems, and smart appliances to address certain DR programmes. The proposed method can be employed by: researchers studying the effect of gamification on consumer engagement in energy applications; technology developers, targeting the development of game-enhanced tools; and energy service companies, providing services and offerings to retail customers.

The paper is structured as follows: in Sect. 9.2, an overview of DR is provided. In Sect. 9.3, the role of serious games and gamification techniques in consumer engagement are discussed. Section 9.4 deals with strategies for consumer engagement in DR applications. In Sect. 9.5, a method targeting the development of a game-enhanced tool for consumer engagement in DR mechanisms is proposed. The paper ends with conclusions and recommendations for future work.

9.2 Demand Response

In recent years, the topic of Demand Side Management (DSM) is becoming more important than ever, in parallel with the further deregulation of the electricity sector; and the increasing integration of intermittent renewable energy sources (RES). DSM includes DR options, such as the management of resources at the customer side of the meter, i.e. distributed generation, energy storage, controllable loads and other on-site resources (CIGRÉ 2011). DR is a term used in economic theory to identify the short-term relationship between price and quantity, when the actions and interactions of substitutes and complements are taken into account. In the energy sector, DR programmes are designed to incentivise end-users to alter their short-term electricity usage patterns by scheduling in time and levelling the instantaneous power demand (Lampropoulos et al. 2013). DR mechanisms are employed by electricity system planners, market parties and operators as resource options for market optimisation, balancing supply and demand and ensuring system's security. DR has been recognised by academics and practitioners as a tool that allows response to challenges related to the intermittency of RES in a cost-effective and environmentally-responsible manner. The Council of European Regulators regards the participation of customers in the electricity market as essential; and that realising the flexibility potential of the demand-side provides a pathway to enhancing consumers' participation (CEER 2016). The electricity industry considers DR as one of the building blocks of future wholesale and retail markets, offering electricity consumers the opportunity to reap the full benefits of their flexibility potential (Eurelectric 2015). The Association of European Distribution System Operators (DSOs) for smart grids considers that the provision of system flexibility services for voltage control and congestion management could provide clear benefits for DSOs, grid users and society as a whole (EDSO 2014). Grid operators are potential users of flexibility services in order to: perform their core tasks in grid planning and operation; defer network reinforcements and investments; and reduce grid losses (European Commission 2015). The European Network of Transmission System Operators for Electricity advocates the further development of DR due to the numerous associated benefits, such as energy cost reduction for consumers, making the system more flexible and increasing market competition (ENTSO-E 2015b). The European Commission Task Force for Smart Grids considers the development of flexibility mechanisms on the demand-side as the key to a successful transition to a new energy paradigm, which requires the active participation and empowerment of customers in the energy system (European Commission 2015). Apparently, there is a growing consensus among policy makers and market participants that demand-side flexibility, through DR mechanisms, is a critical resource for achieving a low carbon and efficient electricity system (SEDC 2015).

DR propositions are offered by intermediaries (suppliers and/or aggregators) to retail customers in the energy market in the form of optional programmes with voluntary subscription. A DR programme consists of a contractual agreement that sets the legal and technical requirements for operation and verification of DR, as well as the incentives for customers' participation. DR programmes can be classified along two main categories (Albadi and El-Saadany 2008), i.e. incentive-based (see Sect. 9.2.1) and price-based programmes (see Sect. 9.2.2), as illustrated in Fig. 9.1. DR mechanisms may also address self-consumption schemes (see Sect. 9.2.3).

Serious games are a promising approach for DSM and DR that aims at heightening consumer engagement and active participation (Papaioannou et al. 2018). In this paper, we propose a method for developing a game-enhanced consumer tool to address consumer engagement and participation in DR mechanisms, i.e. certain DR programmes, and/or self-consumption schemes. In Fig. 9.2, the linkage between retail offerings (including DR programmes and self-consumption schemes), and markets at the wholesale level and ancillary services is illustrated. Intermediaries, such as suppliers and/or aggregators, act between the consumers and/or producers, and the markets (wholesale and/or markets for ancillary services).

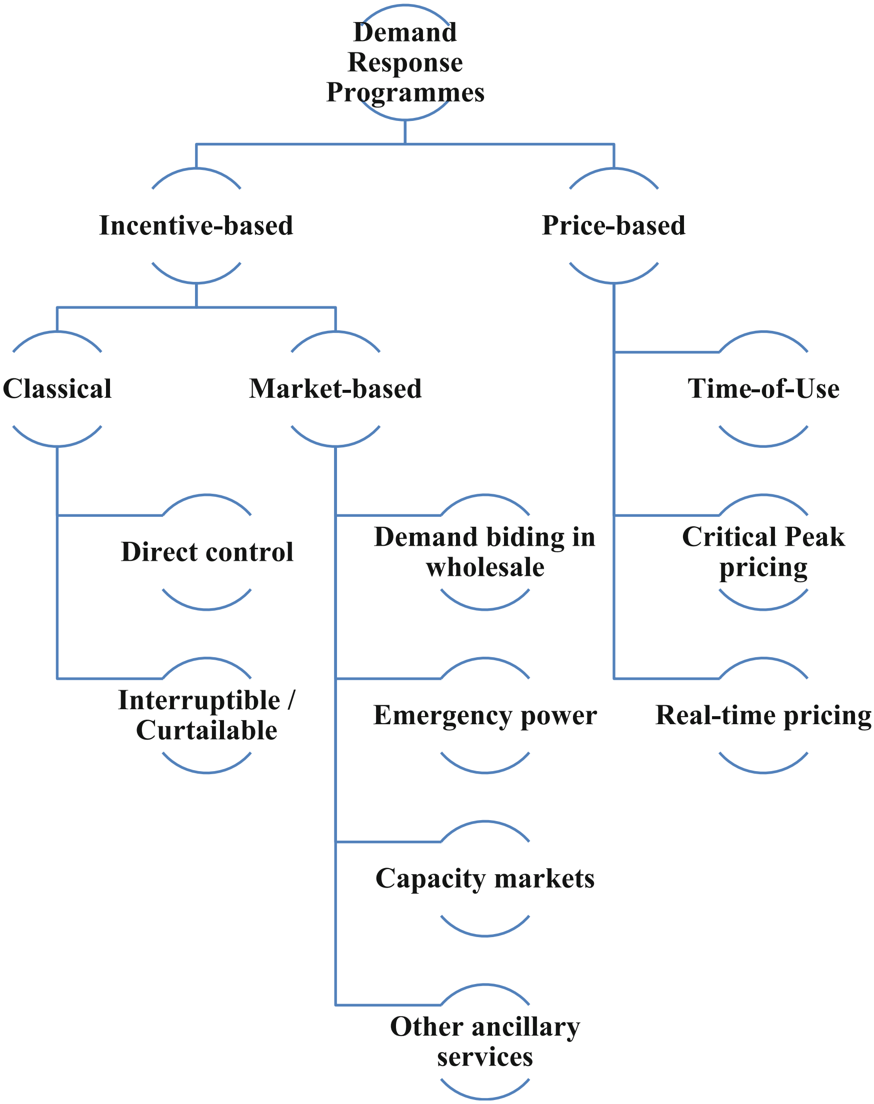

Fig. 9.1 Classification of demand response programmes (Albadi and El-Saadany 2008)

Serious games and/or gamification techniques for consumer engagement are applied at the interface between the DR programmes and the consumers and/or producers. For the convenience of the reader, the overall system architecture of the physical power system and the electricity sector organisation in the European context, including a description of the main actors and their roles, can be found in Lampropoulos et al. (2017).

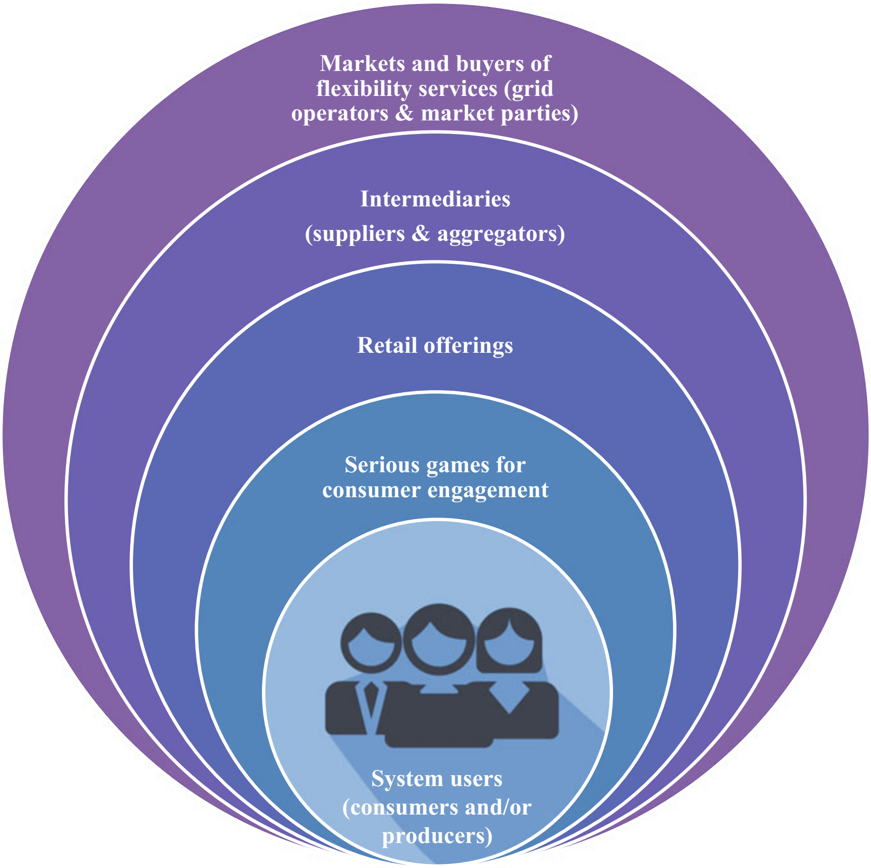

Fig. 9.2 Illustrating the linkage between retail offerings (including demand response programmes and self-consumption schemes), and wholesale and ancillary services markets. Suppliers and/or aggregators act as intermediaries between the retail customers (consumers and/or producers) and the wholesale markets and markets for ancillary services

9.2.1 Incentive-Based Programmes

Incentive-based programmes include classical programmes, and market-based programmes linking to wholesale and ancillary services markets.

Classical incentive-based programmes can be further distinguished into direct load control programmes and interruptible/curtailable load programmes, where participating customers receive payments, usually in the form of a bill credit or a discount rate (Albadi and El-Saadany 2008).

Market-based programmes can be further distinguished into demand bidding in wholesale markets, and DR participation in ancillary services markets (emergency power, capacity markets, and other ancillary services), where participating customers receive a remuneration according to the market rules. In recent years, many Regional Transmission Organizations (RTO), Independent System Operators (ISO) and Transmission System Operators (TSO) are structuring the rules of ancillary services markets, such that DR resources can participate alongside with conventional supply side resources (Lampropoulos et al. 2013, 2018).

9.2.2 Price-Based Programmes

Price-based programmes are based on variable pricing rates in which electricity tariffs fluctuate, following the real-time cost of electricity. The ultimate objective of these programs is to flatten the demand profile by offering higher prices during peak periods and lower prices during off-peak periods (Albadi and El-Saadany 2008). Price-based control involves indirect load control in the form of differentiated tariff structures such as Time of Use (ToU), Critical Peak Pricing (CPP) and Real Time Pricing (RTP) (Lampropoulos et al. 2013). These developments are supported by bi-directional communication systems between the control centre and the end-users. ToU tariff schemes refer to time-invariant rates that are utilised in an attempt to lower peak demand by providing price signals, which encourage customers to shift their consumption from peak demand periods to off-peak periods. CPP tariffs is a dynamic pricing scheme that extends the time-invariant rate scheme of ToU tariff, with a flexible pre-set high price during periods of system stress. RTP of electricity refers to frequent adaptation of retail electricity prices to reflect variations in the cost of the electricity supply.

9.2.3 Self-consumption Schemes

The idea of self-consumption is that locally generated energy, such as the photovoltaic (PV) generated electricity, will be first used for local consumption and the surplus can be injected into the grid (Masson et al. 2016). The injected electricity can be compensated depending on several options that vary between countries or regions (Masson et al. 2016). Due to the decreasing revenues from the surplus electricity injected into the grid in some countries, as well as the possible negative effects on the grid, caused by over-generation of PV electricity, mechanisms promoting self-consumption are becoming increasingly important. DR has been suggested by different studies as one of the important mechanisms for reaching higher self-consumption levels. The increase of the self-consumption ratio can be achieved with either a change in the demand profile at the consumption point (through DSM/DR), or by storing electricity when the PV production exceeds the consumption and use it during peak periods (Masson et al. 2016).

A serious game can set targets and provide rewards to a customer when, for instance, a certain level of self-consumption is achieved. The social influence can also be incorporated in the game either in the form of competition (see Sect. 9.4.3), e.g. by comparing a customer's self-consumption level with other customers, or collaboration (see Sect. 9.4.4), e.g. self-consumption at a neighbourhood level (Alskaif et al. 2018).

9.3 Serious Games and Gamification Techniques

Serious games, digital games with educational or training objectives, can effectively convey new knowledge and skills to people as shown in many recent meta-reviews (Sitzmann 2011; Ke 2009 and 2016; Wouters et al. 2013; Wouters and van Oostendorp 2013; Boyle et al. 2016; Clark et al. 2016). Persuasive games are a sub-category of serious games and are focused on attitude change. These can be effective means to change people's attitude towards energy-related behaviour (Fijnheer and van Oostendorp 2016). When people are highly engaged in a game they are apt to adopt the attitude that is promoted in the game (Ruggiero 2015). These games can lead to higher awareness of relevant factors involved in, for instance, energy savings. In effect, attitude may be positively changed by higher awareness, and as such trigger a change in energy saving behaviour itself. The assumed chain of events, i.e. from awareness (or knowledge) enhancement to attitude change and subsequently behaviour change, is what persuasive games try to establish (Aronson et al. 2013; Catalano et al. 2014; Soekarjo and van Oostendorp 2015). In a review of ten different energy-related games, the authors conclude that the empirical effects of the games in changing knowledge, attitude and (energy consumption) behaviour were positive (Fijnheer et al. 2016). Gustafsson et al. (2009) drew the same conclusion, though the effects in behavioural change (like reduction of energy consumption) were either characterised of short duration or limiting in terms of behaviour change. That is, actual reduction of energy consumption could not be demonstrated in the long term. The transfer of behaviour in the game context to behaviour in the external, real world situation was limited. In this respect, a new development in games and game design can be promising, and that involves gamification of processes in the real world (Deterding et al. 2011; Nacke and Deterding 2017).

Gamification is the use of game design elements in non-game contexts and to use specific system design features to make engagement with these systems more motivating (Johnson et al. 2016). These elements correspond to the provision of information, a rewarding system, social connection, a user interface, and performance status (Alskaif et al. 2018). Integrating these elements with home smart metering systems is expected to lead to longer attention to it, and higher willingness to change attitude or behaviour, such as reduction of energy consumption. For several theoretical reasons, including these gamification elements in already on-going every-day conduct can be effective: they can engage and motivate the player (user) and provide promising triggers to optimise the transfer to real world behaviour (Johnson et al. 2016). Several recent publications indicate the promising character of including gamification into technology focused on energy efficiency (Fraternali, et al. 2017; Garcia et al. 2017; Morganti et al. 2017). Alskaif et al. (2018) have performed a survey of relevant research projects and revealed that the main focus of past projects was on applications targeting energy efficiency, whereas DR and self-consumption applications are gaining more attention in recent years. This trend is expected to continue in the future, in parallel with the further development of DR mechanism and distributed energy storage, as well as with the further integration of RES at the distribution level, which requires active control and energy management solutions.

9.4 Strategies for Consumer Engagement

Several strategies to engage consumers with DR programmes in the long term have been identified, ranging from the provision of education and energy usage feedback (in a simple and easily understandable form), comparative feedback, linking the energy usage of individuals with the collective usage issues, and the deployment of user-friendly interfaces for the interaction of users with technology (devices used to deliver consumption data, smart appliances etc.) (ADVANCED 2015).

In this section, first we review the motives as well as the concerns of consumers to engage in smart grid projects in Europe (Sect. 9.4.1); subsequently we elaborate on strategies for consumer engagement in DR applications by employing game design elements, such as the provision of information (Sect. 9.4.2) and social connection game elements (Sects. 9.4.3 and 9.4.4), and building on top of identified strategies for consumer engagement in smart grid projects. So far, most research on suitable attributes in DR programmes focused on economic aspects as the prime motive for consumers to participate, and therefore assess mainly the impact of monetary incentives. In reality, the decision-making of consumers is often influenced by a number of factors, including sentiments or interest about the social norm, as opposed to strict monetary incentives; and the interface with which the incentive scheme is addressed to the consumers is also a decisive factor (Papaioannou et al. 2018). Studies that look into the application of game design elements as a motive to engage consumers in DR programmes can be considered as a rather recent development (Gnauk et al. 2012).

9.4.1 Motivational Factors and Concerns

The motivational factors, commonly used to stimulate consumer engagement by smart grid projects in Europe, are (Gangale et al. 2013; ADVANCED 2015): (i) the reduction of electricity bills; (ii) more control over energy usage; (iii) environmental concerns; and (iv) better comfort, i.e. the provision of technological solutions, allowing the optimisation of comfort and more control over own energy use. The motivational theme, focusing on the reduction of electricity bills, constitutes a main motive for consumers to engage in smart grid applications; while it also reflects a high risk in the case that consumers will not be able to actually achieve the expected cost savings, notwithstanding their behavioural change. This might hinder the consumer engagement process and result in low social acceptance, due to low trust; and eventually create a major blockage for the further development of DR (Gangale et al. 2013).

Alskaif et al. (2018) identify the key requirements for energy-related behaviour change by using the Trans-Theoretical Model (TTM), which classifies the process of behaviour change into a number of stages. An overview of the motivational factors commonly used to stimulate consumer engagement by smart grid projects in Europe, as well as the concerns of consumers to participate in energy related applications are summarised in Table 9.1.

Table 9.1 Motives and concerns for consumer engagement in energy applications (Gangaleet al. 2013; ADVANCED 2015)

Consumer segment	Motives/Drivers	Concerns
Residential	• Increase awareness of their energy use (and therefore learning how to reduce their energy consumption) • Environmental concerns • Reduction of electricity bills • Better comfort, i.e. the provision of technological solutions allowing the optimisation of comfort and more control over own energy use • Become part of innovative initiatives based on the use of new technologies • Supporting the local community through their participation	• The cost of hardware, such as metering devices, smart appliances, etc. • The installation of the devices composing the technical solution • The effect that using these devices could have on appliances • The impact that reducing energy consumption could have on lifestyles and comfort • The privacy of data • Protection of data (including security)
Commercial and industrial	• Money saving opportunities in energy cost, given that the security of their production process can be guaranteed • The reduced need for larger contract sizes for grid connection and grid expansion • The opportunity to optimise their business, e.g. decide whether to increase/decrease production over a time period, given the corresponding cost of energy	• The contractual complexity behind the participation in demand response programmes •The perceived risk of incurring penalties in case peaks exceed the limits as defined in the contractual agreement

9.4.2 Energy Analytics and User's Feedback

Feedback on energy consumption contributes positively to energy savings (Carreira et al. 2017). The value of feedback as a learning tool is undeniable, however, depending on the context, the outcomes from feedback can also sometimes be improved by using it in conjunction with advice and information (Darby 2006). The provision of feedback to the consumers about their energy usage, through smart metering systems and a user interface, can increase awareness and is expected to drive consumer engagement in DR mechanisms. Furthermore, feedback functionality, integrated into a game-enhanced consumer tool and (partly) based on gamification techniques, can create insight into consumer preferences for retail services, perspectives and concerns, and possible pathways of smart appliances adoption. Such feedback functionality is expected to enable consumers to be involved in the design of DR programmes. The underlying idea is that effectiveness of DR programmes is higher when it is designed from the consumer perspective, because consumers have other motivations, understanding and technology awareness than professionals in the energy sector (Stern 1999).

9.4.3 Comparative Feedback

The comparative type of feedback provides information about social comparison by comparing the performance of individuals to those of others, e.g. performance in terms of energy consumption. A comparative feedback may evoke feelings of competition, social comparison and social pressure that may be especially effective when relevant others are used as a reference group (Gangale et al. 2013; Alskaif et al. 2018).

9.4.4 The Collective Dimension and the Collaboration Element

The consumer is mainly regarded as an individual, whereas the collective dimension of consumer behaviour is still largely set aside (Gangale et al. 2013). A strategy to engage consumers with programs in the long term should address the link between household usage levels and collective usage, so people understand that what they achieve in their own household can impact on wider energy goals, e.g. at district or system level (ADVANCED 2015). Furthermore, by increasing awareness about the potential of aggregation of distributed energy consumption and/or production, another game design element that is highly relevant to DR applications concerns collaboration between players, e.g. consumers and/or prosumers. In a recent meta-review, Wouters and Van Oostendorp (2017) showed that collaboration in serious games had positive effects on learning, whereas also positive effects on motivation are mentioned (Ter Vrugte and De Jong 2017; Chen and Law 2018). Developing game design elements focused on engaging consumers in a collaborative way with gamification (aimed to stimulate and organise collaboration between consumers) has two advantages. First, the collaboration element can stimulate consumers to play an active role, because consumers can become part of a community in which they can socially interact. Second, these activities can empower consumers and increase their benefits because of the aggregation of their activities, e.g. use their collaboration power in wholesale energy markets, and for the provision of system services. Collaboration can stimulate consumers to share knowledge, collectively solve problems and answering questions (e.g. from neighbours). In the empirical literature on serious games, positive effects are found on the element of collaboration (the last one also demanding coordination activity) (Wouters and van Oostendorp 2017), particularly when the collaboration is guided or scripted, so that consumers know what to do (Hummel et al. 2011; Chen and Law 2018).

9.4.5 Considerations for Consumer Engagement in Demand Response

The employment of gamification techniques in DR applications can impact the following aspects of user awareness, behaviour and engagement:

- Educate the user about commercial offerings, e.g. retail offerings (including DR programmes and self-consumption schemes).
- Create awareness about individual and collective energy usage and associated costs/savings, through Advanced Metering Infrastructure (AMI) and consumer interfaces.
- Motivate the acquisition of smart grid technologies and smart appliances.
- Motivate active day-to-day participation in DR programmes and self-consumption schemes (provision of flexibility services) through the provision of incentives.
- Lead to changes in behaviour measured by key performance indicators (see Sect. 9.5.1).

9.5 A Method for Developing a Game-Enhanced Tool

In this section, a method is proposed for the design, development, validation and evaluation of a tool to enhance consumer engagement in DR; and to account for consumer behaviour in the design of DR programmes in order blockages due to

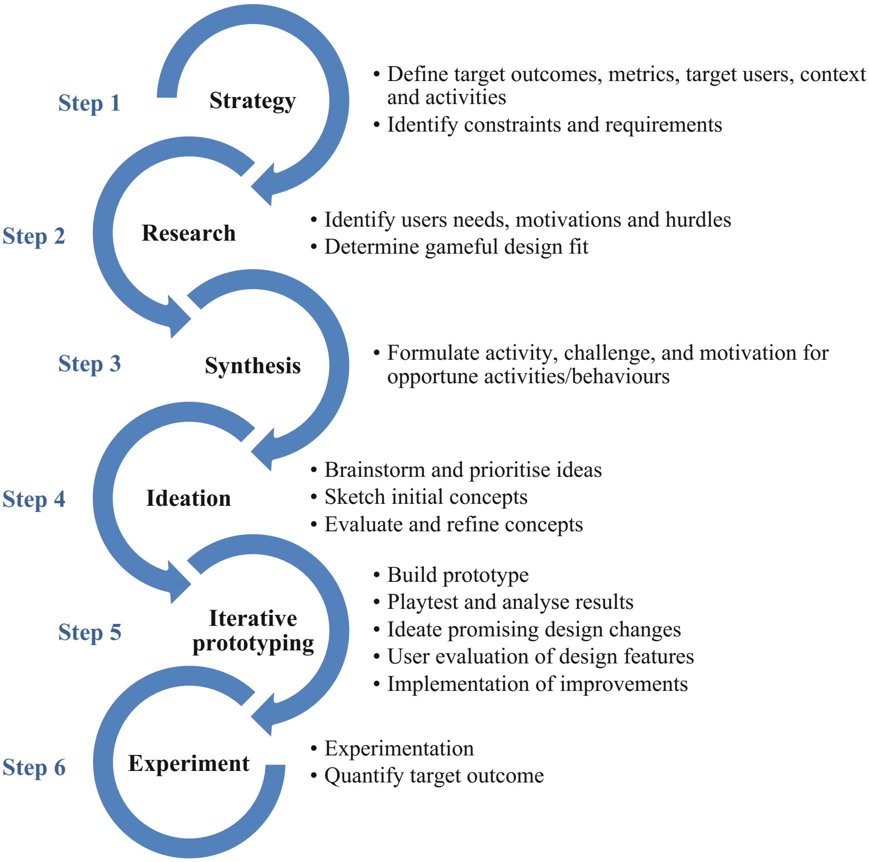

Fig. 9.3 Designing and developing a game-enhanced consumer tool as a six steps' sequential process (Deterding 2015; Fijnheer and van Oostendorp 2016)

social acceptance through the employment of game elements to be avoided. A distinct 6-step method, i.e. strategy, research, synthesis, ideation, iterative prototyping, and experiment, has been devised which is detailed in Fig. 9.3.

The method is based on a user-centred design approach, and is illustrated as a sequential design process that entails six steps (Fig. 9.3). The design of the game-enhanced consumer tool is mainly addressed in steps 1–4, which are based on a design method introduced by Deterding (2015). The implementation of the prototype tool is addressed in the fifth step, which is also complemented by activities, where potential users evaluate the prototype and provide feedback for adjustments and improvements, as suggested by Fijnheer and van Oostendorp (2016), in order to address the users' perspective and attribute a user-centred element in the design process. It is generally recommended that potential users of the game are involved in the development process (Benyon 2010). Finally, the last step addresses an experimentation phase, where four different user groups are assessed through pilot experiments.

The 6-step method for designing, developing and evaluating a game-enhanced consumer tool, i.e. strategy, research, synthesis, ideation, iterative prototyping, and experiment, is elaborated respectively in Sects. 9.5.1–9.5.6.

9.5.1 Strategy Definition

Defining a strategy for gameful design entails the first (1st) step of the method (see Fig. 9.3). A strategy is about defining the target outcomes, metrics, target users, context, activities; and identifying constraints and requirements. Alskaif et al. (2018) identify energy-related behaviour change requirements necessary to achieve an active and long-term participation of households in energy applications, including DR programmes and self-consumption schemes. The experiments and associated conditions, with focus on consumer engagement through gamification techniques, should be outlined, including the definition of performance metrics (see Sect. 9.5.1) and the clustering of consumers, by defining participating groups of consumers in the experiments and developing appropriate methods to address each group as well as the ways each group might respond to different behaviour change techniques. The performance metrics represent the main variables with which the behavioural changes can be determined. This step includes an analysis of consumer groups and the key behavioural barriers to consumer engagement in retail energy markets. Activities that represent collaboration between consumers are identified, as well as how they can be designed in order to stimulate and organise activities in the final game.

Performance metrics

Relevant metrics and specific Key Performance Indicators (KPIs) for a game-enhanced consumer tool might include average users logged in the DR engagement platform per week/month/DR-event, average time of platform usage/user group, ratio of accepted DR requests, ratio of executed DR actions, flexibility and reliability metrics of DR procedures, digital metrics of interaction with relevant DR content, game elements usability metrics/game/gamified DR-event, KPI correlations with demographics and psychographic user profiles, etc. Based upon Fijnheer et al. (2016), the player's behaviour and flexibility in energy usage can be monitored during playing as well as by recording how often the player logs in and what he/she is doing and for how long. Smart metering systems shall be developed to monitor the energy usage characteristics and to stimulate the energy saving behaviour, whereas the player can receive feedback during playing. The energy usage and savings shall be displayed both in terms of energy and monetary terms, including the potential annual savings. Graphs can be used to give the player an overview of the energy usage. A set of preliminary performance metrics and KPIs shall be defined at the stage of strategy definition, in accordance with the research goals, to support the design process. Metrics and KPIs can be revised up to the stage of iterative prototyping (see Sect. 9.5.5), following the evaluation of game design elements by the users.

9.5.2 Research

The research (2nd step in Fig. 9.3) is about identifying the consumers' needs, motivations and hurdles. A game-enhanced tool shall address the motives and concerns of consumers (see Sect. 9.4.1). Furthermore, an analysis shall be performed on the interaction of consumers with such a tool in order a gameful design fit to be defined (Benyon 2010). Based on the research, a selection of gamification functions shall be selected for further implementation in the envisioned game-enhanced tool. Alskaif et al. (2018) present a compilation of the most commonly used game design elements, which are classified into five categories, i.e. information provision, rewarding system, social connection, users' interaction and performance status.

9.5.3 Synthesis

This task entails the 3rd step of the method for gameful design, as illustrated in Fig. 9.3. Specifically, this task is about formulating activities, challenges, and motivations for opportune activities/behaviours. For each targeted activity or behaviour, motivations and inherent skill-based challenges are identified, then the results are presented as clusters in the form Activity > Challenge > Motivation and serve as the main input for ideation (Deterding 2015).

9.5.4 Ideation

The ideation step (4th step in Fig. 9.3) is about brainstorming and prioritising ideas, sketching initial concepts, evaluating and refining the prioritised concepts. These activities may be part of co-design workshops. A co-design process could engage game developers, energy experts and end users in order to the game design elements be identified, which in turn can be used for guiding the design of the final application. Two approaches can be central here: how to promote collaborative activities between consumers and how to design engaging gamification features. The engagement can be measured by using questionnaire of Likert-type before, during and after playing; while possible standardised measures can be used (Lessiter et al. 2001; Jennett et al. 2008; Boyle et al. 2012).

9.5.5 Iterative Prototyping

This step entails the activities corresponding to the iterative prototyping (5th step in Fig. 9.3): build prototype, play test and analyse results, ideate promising design changes (e.g. adjust the duration of the game or the frequency of interaction with user), user evaluation of design elements, and implementation of improvements. It is suggested that a game-enhanced tool shall be accompanied by a Web and Mobile interface (instead of an in-home display); and combine user digital KYC operations (Know Your Customer questionnaires) to find out more contextual information about the platform users, various digital features, and specific DR updates in order to be ready to offer DR services under pilot deployments with real system users. The engagement prototype approach shall consist of at least three layers, each one of them with a discrete role and a set of assigned functionalities, namely: The Automatic Meter Reading (AMR) layer, the Data Modelling layer and the Gamification and Analytics layer.

The *AMR layer* is responsible for the deployment of the network communications infrastructure and the interconnection of the smart metering systems with the data aggregation components. The networking infrastructure consists of a set of wireless and wired sensor nodes, deployed in various areas and being able to monitor energy consumption and production parameters. Data aggregation is realised based on a set of heterogeneous data sources, including the sensor nodes. Alskaif et al. (2018) present the architecture of the technical system, which includes hardware solutions [i.e. smart metering systems, energy management systems (EMS), network, devices, etc.] as well as software solutions (i.e., mobile and web applications, data analytics, storage, etc.).

The *Data Modelling layer* (Meter Data Management, MDM) is responsible for the visual representation of data, based on the description of appropriate engagement models and the data fusion of energy, sensors and mobile app data, according to the business needs of the application scenario and/or pilot. The representation of the energy and behavioural data is realised based on the input from AMR layer and from the mobile app.

The *Gamification and Analytics Layer* is responsible for the design and deployment of a set of algorithms and mechanisms for the provision of recommendations (recommender engines) to end-users for adopting energy efficiency and the support of lifestyles, the realisation of advanced behavioural analysis over the collected data as well as the deployment of a gamification DR framework to be used towards the development of a game (offered though a mobile app or the web) in relation to DR programmes. Recommendations are provided based on analysis and reasoning over the collected data (energy and behavioural), upon being mapped to the above-mentioned engagement models; and is in some cases interlinked to other available datasets. The deployed recommenders focus on the generation of suggestions for energy efficient ways of living and DR personalised events and managing the buildings' infrastructure. For the analytics extraction part, a wide range of algorithms is supported, including algorithms for: classification of available data, energy consumption patterns recognition, forecasting and trends reporting algorithms with regards to energy consumption and/or production and the associated costs; analysis of the user's behavioural collected data from the mobile app. Gamification techniques are also providing description and interconnection of the concepts and situations with regards to the engagement of end-users in daily energy related activities, providing the fundamental building blocks for the transformation of these activities in game-like experiences, with predefined scope and goals. Finally, it will be examined how the element of collaboration between consumers can be built in order collaborative activities to be stimulated and organised.

Consumer engagement is a key aspect across all phases of the retail energy services lifecycle, including design, development, deployment and operation. The development of retail energy services is increasingly based on co-creation approaches, which emphasise consumers' collaboration. In general, consumers do not have the same motivations, understanding or technology awareness as professionals in the energy sector; and possible solutions are most effective when designed from the consumer's perspective (Stern 1999). It is important to note that successfully engaging the consumer involves iterative rather than consecutive phases, where continuous observation of consumer response allows adjusting the engagement strategy to the feed-back obtained (Gangale et al. 2013). After the implementation of improvements, the envisioned tool can be evaluated in pilot experiments, which may involve residential, commercial and industrial customers.

9.5.6 Experimentation and Evaluation of Results

The last step of the method addresses an experimentation phase, where four different user groups are tested under the four conditions illustrated in Fig. 9.3. This experimentation is focused on getting more insight into the underlying causes of effects: whether gamification is really needed or the DR program in itself is sufficient or both are needed. The prototype, developed in the 5th step (see Fig. 9.3), is tested in pilot experiments and the data are analysed. The players' behaviour shall be constantly tracked and evaluated in terms of energy usage and flexibility through specific metrics and KPIs (see Sect. 9.5.1); and be correlated with DR requests/events and game interventions in order to validate their behavioural change. The evaluation phase assesses the impact of gamification and behavioural changes to DR programmes/events and results into recommendations for further improvements. The focus is on summative validation, i.e. in an actual study, consumers and/or prosumers will use the developed tool and the evaluation will be performed by using an experimental 2×2 factorial design with the factors Game (Game versus

No-game as values) and DR (DR versus No DR Programme, i.e. a conventional control situation), making up 4 conditions. Energy consumption shall be monitored a priori, before the game starts, to set a good baseline of average energy consumption. For instance, households will play the game or not and get a control, dashboard version, and interact with the technology in one of the four conditions as indicated for some months. Before the starting point and at the end of the period there shall be four measures on engagement, energy awareness (knowledge), attitude and energy usage and flexibility in usage (actual behaviour) (Soekarjo and van Oostendorp 2015; Fijnheer et al. 2016).

In the empirical studies, all four effects of playing the game shall be measured. Engagement can be measured by using questionnaires before and after playing, by monitoring player's behaviour during playing and monitoring how often the player logs in and what he/she is exactly doing for how long. Knowledge can be measured by using questionnaires before and after playing and the scores of quizzes in the game. Attitude can also be measured by using questionnaires before and after playing. Energy usage and flexibility in usage shall be constantly monitored through smart metering systems, and evaluated based on pre-defined performance metrics.

Concerning the technical architecture, real-time connections between the smart metering systems and the individual appliances and game server can be accomplished by data-loggers with an Internet connection, and utilising Wi-Fi networks e.g. in the households. The game itself may consist of Internet pages that are uploaded by a device (e.g. tablet) when the player logs in via its Internet browser or in the form of a mobile app. All four conditions consist of a number of consumers and/or prosumers, randomly assigned to condition. The data shall be statistically analysed by analysis of variance.

The hypotheses to be tested can be as follows:

- The specific DR programme will have positive effects on energy usage and flexibility in usage.
- Playing the game will have a positive effect on energy usage, flexibility in usage and engagement.
- Playing the game will have particularly a positive effect in DR conditions on behaviour change, i.e. energy usage, flexibility in usage and engagement.

In terms of variance of analysis, we expect main effects of Game and DR programmes, and an interaction effect of Game and DR on engagement, and energy usage and flexibility. When consumers are engaged in a game they are apt to pay attention to relevant concepts and become aware of energy-related knowledge. This can enhance the attitude that is promoted in the game and consequently lead to energy saving behaviour and establish higher flexibility in energy usage (Aronson et al. 2013).

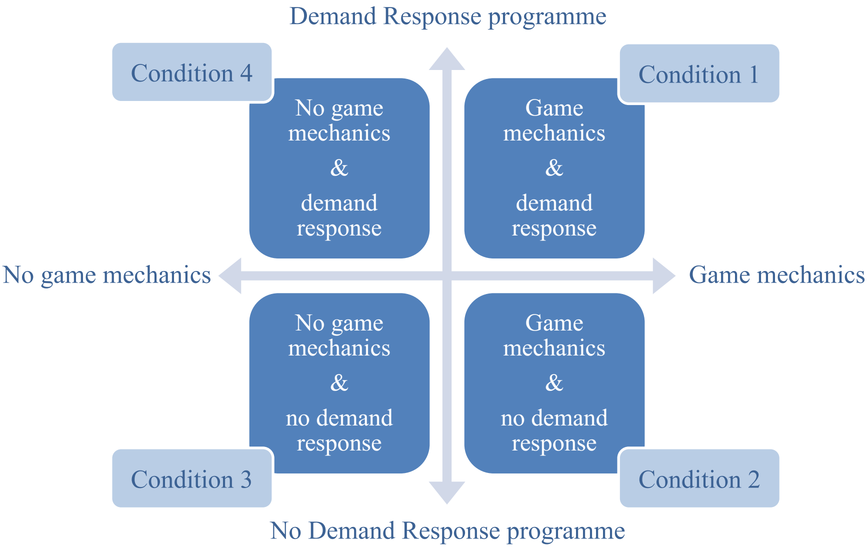

Fig. 9.4 Grid matrix illustrating the two concepts along two axes, the utilisation of a DR programme and the use of gamification techniques. The four quadrants capture the four conditions and user groups to be tested in the project

As can be seen in this grid matrix in Fig. 9.4, the focus is on coupling the utilisation of a DR programme with gamification techniques. The four quadrants capture the four conditions and user groups to be tested. Gamification research has shown that the integration of serious games into real life applications can result into positive effects on attitude and behaviour (Deterding et al. 2011; Johnson, et al. 2016).

Assessing consumer behaviour in DR is about consistently trying to answer the following questions:

- Can DR programmes influence end-users to change their short-term electricity usage patterns by scheduling in time and levelling the instantaneous power demand?
- This question is examined by comparing Condition 1 and 4 against Condition 2 and 3 (see Fig. 9.4). In other words, is there a (main) effect of the DR programme?
- Can serious games and gamification enhance consumer's empowerment by increasing engagement in sustainable energy management and applications, subsequently resulting in an increase in consumer awareness and attitude change, and ultimately in an improved response in DR programmes?
- This question is examined by comparing Condition 4 and 3 to Condition 1 and 2. In other words, is there an effect of game playing? In the game to be built, several game design elements may be combined referring to the: existence of missions involving social connection, such as competition or collaboration,

provision of information, rewards, performance status indicators, such as levels and badges, availability of a narrative, customisation, etc. The game may be a so-called eco-feedback, multiplayer, role-playing and point & click adventure exercise.

- Will game playing have an additive or interactive influence on the effect of technological solutions?

For instance, technological effects are only found when energy usage of end users is enhanced by playing a game. In this case an interaction effect of playing a game and presence of technological solution has to be present: the difference in engagement, awareness, attitude and energy consumption between Condition 1 and 2 is much bigger than between Condition 3 and 4.

9.6 Conclusions and Future Research

The proposed method, as presented in this work, is meant to be applied to the development of a game-enhanced consumer tool, targeting consumer engagement and empowerment in Demand Response mechanisms. The method also addresses an experimentation phase, where the developed tool can be tested in pilot experiments with actual system users in different locations through the participation of their associated suppliers and/or aggregators. The envisioned game-enhanced consumer tool will integrate gamification features with home energy management systems in order to stimulate longer attention and higher willingness to change attitude or behaviour, resulting thus in more flexibility in energy usage. Additionally, it may be complemented with a collaboration element in order to both strengthen the positive effect of collaboration on learning and encourage consumers to use their collaborative power in energy markets (for example enabled by local energy cooperatives). The preferences and concerns of users with respect to data privacy and protection shall be fully taken into account in the data management processes. The employment of gamification techniques in Demand Response programmes is expected to stimulate user behaviour and engagement in real-life applications, but also to contribute to the further development of these programmes by including the users' perspective on their design elements. The motivation is to assess the role of games in encouraging engagement of consumers, building trust between stakeholders and co-creating Demand Response programmes.

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Chapter 10
Tools and Technologies for Enhancing Public Engagement in Sustainable Urban Mobility Planning—The Case of Rethymno, Crete

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Abstract This work deals with public participation in developing Sustainable Urban Mobility Plans (SUMPs) in Greece, provided that SUMP development procedures require a high level of public engagement in several stages. Its importance lies on the fact that although the European Commission has provided specific guidelines, imposing a distinct framework for public engagement in developing a SUMP, Greek practices and maturity in participatory planning in general and sustainable mobility planning in particular are lagging behind the common know-how and practice of other European member states. The study attempts to establish an integrated methodology that combines classical and ICT-enabled tools and approaches in order a higher public engagement level to be achieved. This methodology is implemented and tested in a specific case study, the city of Rethymno—Crete, Greece. More specifically, the proposed methodology incorporates traditional techniques for gathering commuting data from citizens and visitors (i.e. questionnaires, mini surveys, workshops and public meetings) as well as innovative ones (i.e. map-based questionnaires, inclusive web-based participatory tools), used for data collection on public opinions for future planning purposes. Emphasis is placed on the development of a web-based crowdsourcing tool as a key

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for gathering ideas and views on sustainable urban mobility issues. Additionally, particular emphasis is placed upon exploring barriers to participation as well as ways to eliminate such barriers and support a more active engagement of citizens in sustainable mobility planning exercises in the Greek context.

Keywords Smart city · Participatory planning · Sustainable urban mobility Rethymno

10.1 Introduction

Rapid urbanization challenges in recent decades have triggered severe changes in cities worldwide. As a result, cities' structural and functional complexity tends to increase through time (Bakogiannis et al. 2016; Tsiotas and Polyzos 2017); and due to, among others, urban sprawl, traffic congestion and environmental degradation are worsening (Lopez-Lambas 2010; Verani et al. 2015). Such phenomena are also evident in European cities, where more than 75% of the European Union inhabitants are nowadays living in (Silva and Ribeiro 2009; Lopez-Lambas 2010; Verani and Pitsiava-Latinopoulou 2013). Moreover, these phenomena are coupled with an urbanization process that favors urban fragmentation between the various spaces "where people live and work" (Silva and Ribeiro 2009). As a result, traffic flows and car use are constantly increasing, due to the fact that most cities were developed in a way that provided more and more space for car-based mobility through appropriate structural reformations, giving precedence to large infrastructure deployment, mainly road openings through land expropriations, as these were suggested by common transport studies.

The European Union, in an effort to cope with unsustainable urban mobility trends and their severe environmental repercussions, has set, among others, *new policy directions for the transport sector* (Kehagia 2017). The primary goal behind these directions (White Paper 2011) is to enable cities' functioning with fewer cars and at lower speeds, serving thus a more socially comfortable and economically efficient vision for urban spaces (Beria and Grimaldi 2014; Bakogiannis et al. 2015). In order to achieve the above stated goal, the concept of "Sustainable Urban Mobility" is arising, sketching new planning directions that are serving urban sustainability objectives; and setting urban mobility as a sector cross-cutting all three pillars of sustainable urban development (i.e. namely economic, social and environmental) (Trakatellis 2004; Andrikopoulou et al. 2007).

Contemporary priorities in the context of sustainable urban mobility developments are not limited to adjusting cities' profiles in terms of landscaping and beautification improvements, but mostly refer to influencing minds and citizens' attitudes in a way that promotes more responsible transport and mobility behaviour and alters the current car-dependency regime. In order to do so, participative approaches and citizens' engagement are of utmost importance, serving a twofold goal, namely to: integrate citizens' views and expectations into the planning process for developing city- and citizen-specific plans; and train citizens in more informed, mature and sensitive behaviour with regards to transportation and mobility as well as their implications with respect to the urban and natural environment aspects, in order the impact of their daily actions on cities' smooth functioning to be fully grasped.

This research work explores the extent to which citizens' participation can be realized in the Greek cities. The city of Rethymno is used as a case study. Rethymno is a medium-sized coastal urban environment, located in the Region of Crete; and a city that is currently developing a *Sustainable Urban Mobility Plan* (SUMP). Development of this plan has taken into consideration the necessity for community engagement by establishing a methodological planning approach that integrates traditional and innovative, digitally-enabled tools for conducting citizens' involvement in the various stages of the SUMP planning process. Through this approach, research depicts the potential of community engagement in: enriching the ground of the planning effort (data acquisition concerning the current state of the city concerned) by use of innovative participation tools and approaches; saving time and financial resources that traditional planning processes would demand; and reaching more effective planning outcomes.

10.2 Implementing Innovative Participatory Tools in SUMP Projects

Sustainable Urban Mobility Plans are nowadays considered as important tools for transforming contemporary cities into more sustainable urban cores. As such, they have so far been adopted by many European cities (Sá and Gouveia 2011; Papaioannou et al. 2016; Khreis et al. 2017). A SUMP actually introduces a *new planning perception* in order a plan to be produced that aims at addressing transport- and mobility- related problems in a more sustainable way (Papaioannou et al. 2016); and thus improving quality of life in contemporary cities by ensuring the functioning a reliable and effective, environmentally-friendly urban transport system (Okraszewska et al. 2018). A key component of a SUMP is *public engagement* in all phases of its development in order a shared vision for the city by its citizens, stakeholders and decision makers to be produced.

The main differences between the planning processes resulting in a SUMP and those of traditional transportation planning are summarized in Table 10.1. As demonstrated by elements of Table 10.1 but also Fig. 10.1, depicting the planning process inherent in a SUMP production, this introduces a more "bottom-up" planning approach, setting *public participation* as a key component of its methodological cycle. As such, it should not only be confined to public consultation and opinion-raising for reaching consensus with respect to the outcome of the planning process, i.e. the plan for sustainable mobility (Kyriakidis 2012); but should also be expanded to other stages of the planning process as well. As such can be considered the: exploration of the *current state*, implying data collection from the local community for better grasping current state and inefficiencies of the transport and mobility pattern; and *policy design*, by engaging local community in assessing and prioritizing the policy measures concerned for a more effective implementation of SUMP (Somarakis and Stratigea 2014). In fact, according to the ELTIS guidelines (2013), citizens' engagement should be incorporated in all four phases of a SUMP, i.e. the preparation stage, the goal setting stage, the stage of elaborating the sustainable mobility plan and the stage of implementing it (Fig. 10.1).

Indeed, it is crucial to grasp the potential role and position of stakeholders at the beginning of the planning process in order signs of potential conflicts and/or coalitions to be, early enough in the process, indentified; and explore the ways these may affect the planning process and outcomes (Step 1.6 in Fig. 10.1). In that way, more knowledgeable decisions can be made by practitioners with respect to the citizens' involvement process (Step 2.3); and the development of a common vision and ideal scenarios (Steps 4.1 and 4.2), by eventually directly engaging citizens in a vision building process. In case that the latter is not feasible (e.g. financial constraints, impeding extensive vision-building participatory processes), community and local stakeholders should at least be widely informed about this vision in order their awareness to be increased and the plan's broad acceptance to be assured (Step 4.2). Identification of the most effective measures for effective implementation of

Table 10.1 Differences between traditional transport planning and sustainable urban mobility planning (European Commission 2013)

Traditional transport planning	Sustainable urban mobility planning
Focus on traffic	Focus on people
Primary objective; Traffic flow capacity and speed	Primary objectives; Accessibility and quality of life, as well as sustainability, economic viability, social equity, health and environmental quality
Modal-focused	Balanced development of all relevant transport modes and shift towards cleaner and more sustainable transport modes
Infrastructure focus	Integrated set of actions to achieve cost- effective solutions
Sectorial planning document	Sectorial planning document that is consistent and complementary to related policy areas (such as land use and spatial planning; social services; health; enforcement and policing; etc.)
Short- and medium-term delivery plan	Short- and medium-term delivery plan embedded in a long-term vision and strategy
Related to an administrative area	Related to a functioning area based on travel-to work patterns
Domain of traffic engineers	Interdisciplinary planning teams
Planning by experts	Planning with the involvement of stakeholders using a transparent and participatory approach
Limited impact assessment	Regular monitoring and evaluation of impacts to inform a structured learning and improvement process

Fig. 10.1 Steps of the planning process for SUMP development. Source: Adapted by ELTIS (2017)

SUMP can take into consideration others' experiences (Step 6.2); while properly adjusting them to local peculiarities and contextual elements. Of importance is also the assurance of a high quality SUMP proposal (Step 9.1) and its wide communication in order its ownership by local community to be increased (Step 9.3). At the stage of SUMP implementation, of crucial importance is Step 10.2, referring to the wide spread of information on the proposed measures and the motivation of local groups to engage and support their successful implementation; and Step 10.3, stressing the need for a steady monitoring of its progress for potentially undertaking corrective policy actions.

In order to achieve a high level of public participation throughout the whole SUMP process, a range of *participation tools* can be adopted. Specific choices with regards to the participation tools to be used in this process need to be carefully done in alignment with the goal of participation at each stage concerned and relative tools' attributes, taking into consideration that different tools imply a diversified type and degree of public engagement (See et al. 2016), ranging from a purely informative to a co-design/co-decide involvement (Stratigea 2015) in the final planning outcome, i.e. the SUMP.

Thus, engagement through conventional consultation procedures, where citizens can express mainly their objections or even their consent, can be further enriched by a range of either traditional tools, such as workshops and field trips (Kyriakidis 2012) or more contemporary ones, such as web applications, crowdsensing and crowdsourcing techniques, implemented mainly through mobile appliances like smartphones and pads (Bizjak 2012; Papadopoulou and Stratigea 2014).

Digitally-enabled participation has, during recent years, been financed by the European Commission through a range of projects that promote *crowdsourcing* and attach to the people the role of "sensors" in urban management issues (Pödör et al. 2015). The aforementioned development, although in principle is part of the crowdsourcing process, it is better articulated through the concept of *crowdsensing*. The concept of crowdsensing refers to procedures related to the provision of information for the immediate, complete or partial-resolution of a problem by gathering information from a group of people or communities that act as 'sensors', and provide information intentionally or unintentionally, mainly through smart mobile phones (Ganti et al. 2011; Xiao et al. 2013). Indeed, in many recent projects across Europe, public contributes to the provision of information, usually through the usage of smartphones, without bearing any costs to the institutions/bodies that evaluate and analyze it (Schweizer et al. 2011). These projects are largely associated with the collection of environmental data as a result of the ratification of the Aarhus Convention (UNECE 1998); and its integration to the European legislation (Directive 2003/35/EC), where the need for getting access to and engagement of the public in decision-making processes with an environmental footprint, is underlined.

Usage of such innovative tools contributes to the smartening up of urban environments, as witnessed by the analysis of smart cities' projects (Poslončec-Petrić et al. 2016), further enhancing public willingness to engage and actively participate in planning endeavors in order more knowledgeable and inclusive solutions to the various urban issues to be sought.

10.3 Current Practices in Crowdsourcing and Crowdsensing

Gathering urban mobility experiences and good practices from the international scene can enrich the existing knowledge stock and lead to the development of optimal solutions in similar study fields. However, such experiences and practices have reference to different urban environments and related societal contexts. This implies the need for highlighting those elements that can be transferred to the specific case study environment and improve or properly adjust the proposed approaches. In cases of spatial or urban plans, such as the Sustainable Urban Mobility Plans, this practice can be proved particularly beneficial (Bakogiannis et al. 2014). However, particularities related to the local conditions and specific attributes should be thoroughly studied in order for a successful implementation to be ensured (Kyriakidis 2016).

This research endeavour explored several recently emerging good practices in the field of *urban mobility*, identified as successful within the international academic and professionals' community. More specifically, the applications and services analyzed included the following endeavours; SenseMyCity, CityMakers, Tell us Toolkit, CoUrbanize, QualiT, CitySensing, CrowdSenSim, Nexthamburg and SynAthina.

SenseMyCity is part of the Future Cities' project and aims at collecting geo-referenced data, emerging from various users who have sensors on their smartphones (Sa 2014). This system includes a number of sensors (Rodrigues et al. 2014) and collects data on acceleration, magnetic field, luminance, temperature, pressure, humidity, sound, position (gps), network presence, etc. Data processing and analysis are carried out by use of particular algorithms that allow outcomes regarding fuel consumption per trip, traffic identification and grouping of zones in terms of consumption levels, as well as grouping of zones in terms of drivers' stress levels. Additionally, such data analysis allows the optimization of the journey's route selection in terms of travel time and consumption levels. A specific feature allows the identification and grouping of people with similar travel preferences and the establishment of interaction among them, e.g. people searching for car-pooling in order to share travel costs or cyclists looking for optimal road inclination.

CityMakers is a service developed from the collaboration of the City of Paris with NUMA, Renault, AXA, NISSAN, RCI Bank and Services. It aims at bringing together local start-up companies, experts, stakeholders, individuals and public bodies for the promotion of urban mobility (Bohic 2017). According to the official website of the application (CityMakers 2017), this program/service is split into two parts, namely the part "Think" and the part "Make". Under the first stage of "Think", a series of events is planned in order a common vision to be established; while at the second stage of "Make", experimentation is taking place for achieving new and innovative ideas. There is a mix of methodologies, where traditional engagement tools are combined with a variety of innovative processes in the effort to promote urban mobility and e-mobility.

Developed in England, *Tell us Toolkit* platform includes a wealth of tools targeting empowering of societies in decision-making processes regarding issues related to transport infrastructure and the urban environment. The platform is cloud-based and makes use of a complete Geographic Information System that can easily receive information from a variety of users on a wide range of urban and environmental issues, promoting community engagement (Tellus Toolkit n.r.).

CoUrbanize is another web platform studied in the context of this work. This endeavour has initiated as a start-up run by Karen, an alumni from the MIT Department of Urban Studies and Planning (DUSP) (Zhang 2014). CoUrbanize is used in major American cities, such as New York, Atlanta and Boston. Through this platform several actors, stakeholders, residents' associations, businesses and investors can express their ideas on specific projects, promoted in the wider region (Siangliulue et al. 2016). The platform supports community forums, participatory planning processes, information and awareness campaigns, surveys and a variety of other processes that facilitate the design of public space projects, infrastructure, urban mobility etc. A critical element of this platform is the process of grouping comments and voting for a multitude of projects, where users can comment on what is excellent, what is missing and what could be improved.

Nexthamburg kicked off in 2009 (Anastasiou 2015) and is an independent citizen-based think-tank initiative, through which citizens as well as urban planners and designers discuss about the future of the city (Pereira et al. 2012). The goal of this initiative is to enable creativity and promote commitment of a large proportion of residents of Hamburg to urban development objectives. For reaching this goal, residents propose their ideas and formulate a vision of the future of their city via this online platform. More specifically, they have the right to contribute with new ideas or comment existing ones (Anastasiou 2015). Simultaneously, the organization "Nexthamburg" has developed a mobile application called "Nexthamburg mobile" that allows smartphone users to virtually tag and categorize their environment. By this application, users can write a comment about specific places they visit and upload a picture. These data (location, picture and text) are uploaded to a public webpage and presented on an interactive map, available to everyone interested in (Hoffken and Streich 2011).

Experience gained from the above examples reveals that the use of innovative participation tools lies at the core of the efforts towards strengthening public engagement in urban and transportation planning processes in the information and communication era. The use of a Web platform for direct interaction, between citizens and stakeholders on the one side and decision makers on the other, reflects a trendy ICT-enabled practice, where the spatial delineation of problems and expression of ideas in the urban discourse are expected to contribute to quicker and cost-effective planning of solutions for setting up current inefficiencies in urban environments.

The proposed methodology for the case study of Rethymno is based on the afore-mentioned context; and attempts to successfully address case specific aspects with respect to the urban mobility context.

10.4 Methodological Approach

Taking into account the work of Jennings (2001), according to which public participation is a quite useful research approach in urban planning and mobility research projects, the common inquiry, addressed in the methodological approach of the Rethymno case study, is "how can the widest possible public participation in the development and implementation of a SUMP be ensured?" To successfully deal with this inquiry, a range of case studies, working out similar cases, was explored and best possible ideas were identified.

The city of Rethymno was selected as a pilot case study for the implementation of the proposed methodology, as there is an ongoing SUMP for the city under the auspices of Civitas Destinations' project, aiming to address mobility and tourism aspects in order sustainable development and better quality of life to be pursued.

The first step was the delineation of the study area (Fig. 10.2), which incorporates the city center, the suburbs as well as the wider rural area. Critical parameters of this study area were assessed, such as land uses, transportation network, satellite settlements, travel frequency, tourist attraction nodes, social infrastructure etc.

As a second step, analysis was carried out regarding population and demographic characteristics as well as socio-economic developments. This analysis, although constituting a necessary stage for getting insight into the peculiarities of the study area for purposes of SUMP development/implementation, it has also been used for identifying community and stakeholders' aspects and attributes; and grasping the ideal mix of engagement tools to be used for enhancing public participation.

The fact that a large part of the population falls into the young age group, being secondary education graduates and working in the tertiary sector, was of decisive importance in the decision to adopt a more technological stand in community engagement in the specific case study and develop innovative, digitally-enabled tools in the SUMP process. Hence, next steps included research on this kind of tools for public participation, exploring various cases of similar planning projects. Good practices were selected to suit the key characteristics of the area, taking into account the residents and visitors' profile.

The management of participation processes as well as information and awareness raising techniques is oriented towards providing answers to the above

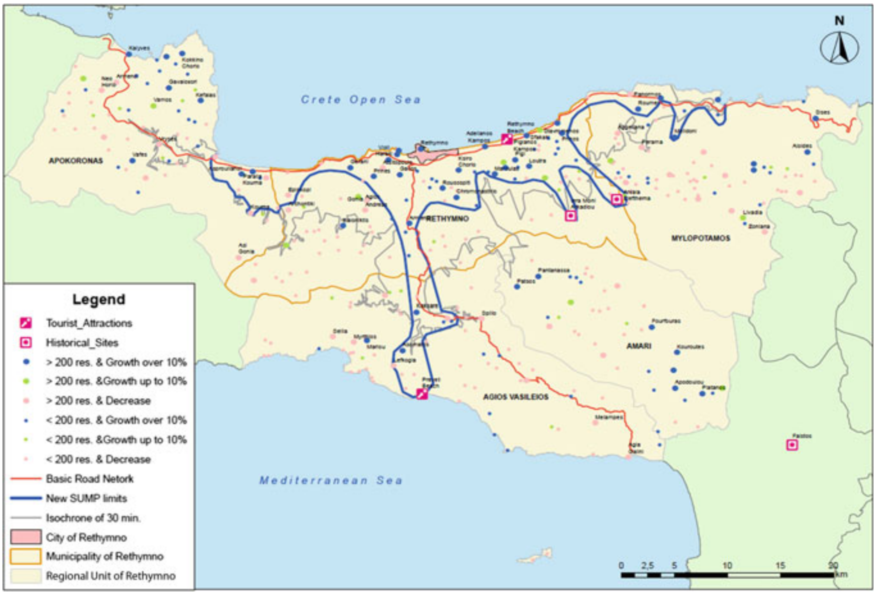

Fig. 10.2 Area addressed to SUMP development and implementation

mentioned key inquiry. The proposed methodological approach, depicted in Fig. 10.3, consists of two parallel processes to ensure enhancement of participation through traditional and digitally-enabled methods.

Traditional techniques refer to:

a. *Targeted interviews*: these aim at gathering data from stakeholders' representatives, who can transfer collective perception on the issues concerned. According to LeGates (2011) this method provides an easy way to understand a part of the public, regardless of the complexity of the studied subject.
b. *Questionnaire survey with stratified sampling*: the purpose of using this survey is to grasp respondents' viewpoint for a number of issues concerning the study area (Kyriakidis and Siolas 2014). Questionnaire survey is a cost-effective data

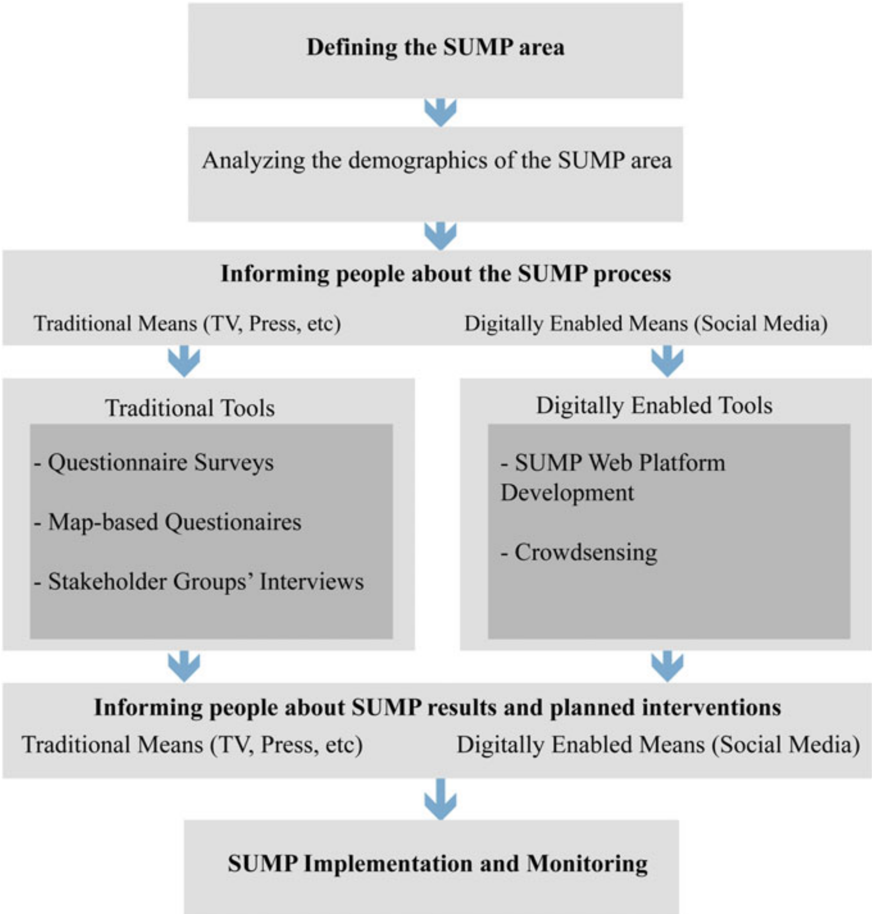

Fig. 10.3 Steps of the methodological approach for enhancing public participation in Rethymno (Own elaboration 2017)

collection method (Jack and Clarke 1998; Strange et al. 2003), representing a rather passive engagement tool (Dede et al. 2012; Stratigea 2015). However, given the fact that much of the issues raised were spatially referenced, map-based questionnaires were used as tools for gathering more spatially-based answers to issues of concern.

Two more digitally-enabled tools are planned for citizens' engagement, used complementary to interviews and questionnaire survey, namely:

a. *A web platform*: this aims at facilitating interaction between citizens and decision makers. By use of this platform, the research group of this work is interested in gathering information about the residents' opinion on their city, their perception with regards to its scarcities, inadequacies and poor transportation planning. The platform will provide citizens the chance to express their views and ideas through use of a headline, followed by a short description as well as an image and an attachment. Ideas collected through the platform will be organized under specific thematic categories. The user will be able to select the category that suits best to her/his idea. Indicative categories include: walking, cycling, public transportation, urban green spaces, fleet management, e-mobility, mobility management, urban planning, smart technologies, transportation pricing, etc.
b. *Data collection with citizens acting at a voluntary basis*: this action is supported by citizens who contribute voluntarily and collect primary data for a series of environmental variables, such as noise levels, temperature, luminosity etc. This process, functioning as a *crowdsensing exercise* by use of smartphones, has followed the steps of a series of similar surveys (Pödör and Révész 2014; Garcia-Marti et al. 2014; Aletta et al. 2016). More specifically, people carry their smartphones, i.e. personal devices equipped with applications/sensors that provide *local geospatial information and knowledge* (Stojanovic et al. 2016) *at no cost* (Schweizer et al. 2011). According to Schweizer et al. (2011), smartphones are decent platforms for gathering environmental data, e.g. sound levels that are recorded by the microphone incorporated in the device, location of information through GPS equipment etc. Elaboration of data gathered through crowdsensing can support the easy, quick and cost-effective drawing of conclusions about the current state of the above elements in the study area.

Elaboration of data collected through the web platform and crowdsensing technique is in progress.

Data gathering through public engagement by means of the above digitally-enabled approaches is coupled with a series of parallel activities that are planned to inform the public before, during and after the implementation of the SUMP (Fig. 10.3). Actions for raising stock of information of the local community on SUMP are deemed necessary. These include a suitable combination of traditional and innovative communication approaches. Traditional approaches include press releases, TV and press briefing (especially during implementation and post-implementation phases), organization of interactive events (e.g. during the

European Mobility Week) and consultations. With respect to digitally-enabled tools, social media campaigns play a key role. Their main goal is to support the spreading of information and the raising of public awareness about the SUMP. The use of social media is a widespread practice in recent years due to their advantages, such as their potential towards the immediate propagation across the reporting area, resulting in direct communication between the transmitter and the receiver.

Social media provide immediate flexibility and, depending on the particular target audience, they can address different strategies and communicate them. At the same time, the minimum cost for promoting actions through social media makes them an attractive mean and a cost-effective tool in support of an information campaign (Dimitriadis and Tzortzaki 2010).

10.5 The Rethymno Case Study

The methodology outlined in Fig. 10.3 was applied in the city of Rethymno, targeting both the data collection and the public engagement in the SUMP decision-making process.

More specifically, questionnaire surveys have started back in summer 2017. To date, 534 questionnaires were addressed to residents and 72 were addressed to special categories of visitors, such as cruise tourists or tourists being for their first time in Rethymno or even those returning regularly to this place. The subject of the questionnaires was related to the daily trips of the respondents, their hotel or housing location, preferred destinations, work location and way of commuting. Bicycle use or potential bike use was also explored. Other surveys included questionnaires to specialized groups, such as school and university students with almost 498 responses for commuting habits, as well as surveys addressed to the academic community, which are still in progress (with almost 218 responses to date).

Twenty seven indicators were measured regarding public transport, car and bicycle use, road safety and several others, according to a methodology developed by Destinations' project for each indicator. Such data gathering allowed a detailed assessment of the current situation in terms of mobility pattern and related problems. Specific indicators that can assess the current mobility conditions with regards to public transport include the "Accuracy of time keeping" and "Average occupancy". Results obtained as to the first indicator showed that there is a relative delay in the majority of public transport routes; while with regards to "Average occupancy", evidence shows a relatively low average occupancy. These indicators were supplemented by another two indicators, concerning the "Accessibility" of transport vehicles and the "Level of service" offered. Data collected with regards to these indicators have revealed a rather neutral attitude of residents.

Moderate satisfaction from public transport is one of the key issues related to low average occupancy of private vehicles (1,386 passengers/car), which is directly associated with high rates of private car use. Accordingly, the number of available parking spaces in the city is high, with the number of on street free parking spaces amounting up to 69.842. On the contrary, the use of the bicycle appeared to be relatively low, with the total length of bike paths being only 7.38% of the total length of urban road network. Low bicycle usage is also associated with the low number of bike-sharing bikes and stations per capita, which amounts up to 1 bicycle per 1207 residents.

The above results capture a distinctive picture of the current situation in the study area. The services provided by public transport can definitely be improved, similarly to bike services. On the contrary, car and motorcycle use is unlimited and high, with private cars being the major transport choice for most residents. A further confirmation of the above findings is expected to take place through the utilization of the web-platform, where residents have already been invited to engage by grasping aspects of the current situation and current inefficiencies as well as proposing specific solutions to resolve them.

It should be noted that the questionnaire survey was conducted in a relatively short period of time. Moreover, worth noticing is the inclination of respondents to engage in the SUMP process. In fact, when asked about their willingness to participate, even more actively, in the next phases of the SUMP, the majority of them replied positively, expressing the view that they would like to see their city changing and addressing key issues regarding traffic circulation and regeneration of public places. Another key finding concerns the particular interest of students, partly explained by the setting of students' questionnaire in the specific spatial context surrounding their school.

At Phase I of the SUMP, more interviews were also conducted, addressing a variety of public and private bodies. More specifically, 20 interviews focused on assessments of transport infrastructure, access to school for students and teachers, and tourism mobility. 11 more interviews concerned disabled mobility. The latter focused on needs' identification of this specific group and gathering of proposals on specific solutions, as these are identified by their representatives.

With regards to the digitally-enabled tools (web platform and crowdsensing), the web-platform (https://www.rethymnomobility.eu) has already been developed, where citizens shall submit their ideas. Georeferenced material will soon be supported in order for citizens to "locate" their area of interest or place of desired intervention. This application is expected to be a map-based tool, which shall enable all stakeholders and individuals to access the actions and be active participants to city and traffic planning.

Concerning the gathering of information with crowdsensing techniques, a campaign to inform the public about the overall action of participation has already started in order to attract volunteers. A significant number of volunteers is required, in order reliability of data provided to be increased (Basiouka and Potsiou 2012, 2013; Apostolopoulos et al. 2016). Given the fact that there is a significant possibility that part of the volunteers is not familiar with crowdsensing procedures, a technical training session is already planned, while a second can also be organized if required. Within this session, participants will have the opportunity to acquire knowledge on the research specifications and the process of SUMP development and implementation, as well as their critical contribution on the data collection process.

Finally, of great relevance to the successful outcome of the whole SUMP planning experiment is the raising of public awareness. Towards this end, a social media campaign is organized. This campaign was designed to act along with formal communication actions, such as press releases. Communication actions are implemented by the research group in cooperation with several stakeholders' groups. The latter are expected to support all activities that promote sustainable mobility, especially in the context of specific events such as the European Mobility Week.

10.6 Conclusions

The need to promote sustainable development has become increasingly apparent in recent years. This implies reconsideration of spatial planning directions and processes. Seeking to achieve smart, sustainable, inclusive and resilient cities of tomorrow, as declared in the EU urban agenda, brings to the forefront the issue of public participation. Participatory planning endeavours seem to form the main streamline in coping with contemporary great challenges, especially in the context of urban environments.

SUMPs, on the other hand, are strategic plans for integrated urban and transportation planning, hence act as principal plans within the urban development context; and their implementation is expected to have a critical positive impact on modern Greek cities. Such an implementation incorporates policy measures such as the reduction of motorized traffic, the increase in space availability for pedestrians and cyclists, etc. These, in turn, imply a certain emphasis on the social use of public space, in contrast to the practically "inaccessible" areas of motorized traffic. Such a *paradigm shift* to the organization of cities is expected to affect the architecture of building codes and urban design, since the streetscape is reshaped on behalf of pedestrians instead of car users; whilst citizens' perception and approach with regards to commuting or leisure is also reconsidered.

For shifting to the new paradigm, i.e. develop and implement proper interventions in the urban space, a participatory approach lies at the core of this effort, targeting enhanced participation of recipients of such plans. Indeed, the primary objective for plans' realization is not simply to ensure social consensus, but to achieve real engagement of citizens in the planning process in order to realize, accept and monitor changes taking place in their city.

This paper presents a *participatory planning methodology* that makes use of a mix of traditional and digitally-enabled tools. At the core of this methodology lies a *Web platform*, forming the ground for interaction and cooperation among various city groups. Through this platform, citizens can interact with decision makers and formulate ideas to ameliorate current city's inefficiencies. Thus, citizens are able to better understand the type and causes of problems, the planning goals set out of them, as well as the potential solutions for their treatment. People assess planning issues; get acquainted with planning processes; evaluate different ideas; and are assisted to formulate own perceptions and thoughts. This allows maturing of local community and smoothing of the implementation process of selected plans, largely reflecting awareness raising, understanding of constraints and options available to problems' solving, consensus building and own contribution to final decision. Beyond the uploading of ideas and suggestions in the platform, other supporting data gathering tools are used as well, such as map-based researches and questionnaire surveys as useful tools, contributing to the enhancement of research group's understanding as to the perceptions of the public.

A particularly innovative initiative is the *participatory data collection*. Objective of this action is to search out the actual relationship of the citizen with the city and to collect a series of data, mainly environmental, such as noise, luminance, temperature levels, etc. Through the participatory data collection, a cost-effective, quick and reliable way of collecting geographically defined data was established, allowing the research group to better understand the pilot study area and, following the planning process steps, to make more appropriate and case-specific proposals. This methodological approach has already been applied in the development of other SUMPs across Greece, and the data gathered have been proved to be reliable and resulting in reasonable conclusions.

The above methodology was proposed to be tested in the city of Rethymno, as there is an ongoing SUMP in this specific city, being part of the CIVITAS initiative. Until now, similar methodological tools, such as the deployment of a Web platform for collecting ideas and the collection of data using smartphones, have been tested to other Greek cities, such as Kozani and Drama. Nonetheless, a more integrated approach is applied in the case of Rethymno as people participation was the core-idea in implementing the SUMP. More participation tools are proposed to be used and more participants are going to be invited in the participatory process.

Given the fact that this research is at an early stage, and the SUMP is under development, it is premature to draw conclusions on the degree of implementation of the action, namely the number and profile of the participants, proposed ideas and indicators that have emerged for the various SUMP related issues. However, what is worth highlighting is the willingness of citizens to engage in the process of developing the SUMP, and even more actively in the process of its implementation, as seen from the questionnaire survey.

Lastly, conclusions cannot be drawn as to the use of the web-based participation tools, as they have not yet been fully implemented. Their introduction into the proposed methodological approach aims at achieving a higher level of participation and engagement, drawn upon their communicative power; and attracting qualitative spatially-referenced community proposals. They are also perceived as complementary to the traditional engagement tools, as evidence-based results from various studies have already shown, through introducing a new spirit of interaction and citizens' empowering on local decision-making. Reactions of local community with regards to these means will be assessed in order to identify failures, explore potential causes and accordingly re-orient the SUMP planning effort.

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Chapter 11
Location—Allocation Modeling for Emergency Evacuations in the Aegean Sea

Dimitris Kavroudakis, Christos Kalloniatis and Panagiotis Theodorou

Abstract Insular regions play an important role in Eastern Mediterranean, mostly attributed to their geographical, environmental, social and economic peculiarities. Greek islands in the Aegean Sea are such an example, being attractive tourism destinations with a varying permanent population both island- and season-specific. Such a seasonality of islands' population, coupled with problems related to their geographical fragmentation, challenges local decision-making regarding, among others, health service provision. This chapter analyzes the spatial distribution of national aero-evacuation means, such as helicopters, in order to inform the debate about de-centralized services of emergency evacuations in island complexes of the Aegean Sea. After discussing potential use of Geographical Datasets for smart decision-making regarding emergency evacuation procedures, the focus of the paper is on a location-allocation model of helicopter bases in the islands of the Aegean Sea. The results of this work aim at shedding some light on the spatial optimization of the helicopter bases in the area; and discussing the trade-off conditions of emergency evacuation services in such a fragmented geographical space. Finally, after utilizing a number of large scale geographical simulations for allocating aero-evacuation bases, the usefulness of spatial analytics for taking more informed decisions is illustrated, especially in areas where dynamic seasonality of population throughout the year challenges health service provision.

Keywords Location analysis · Location-allocation modelling · Emergency evacuation · GIS · Spatial optimisation

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11.1 Introduction

In the Mediterranean region, islands attract a number of economic activities, such as tourism, which generates a substantial share of national GDP in several countries. Greek islands in the Aegean Sea are such examples of attractive and distinguished tourist destinations, largely contributing to the national economy. The permanent population in the Aegean Sea islands varies considerably both between islands and between months of the year. Based on their attractiveness, there are cases where population during the summer period is almost tripled, compared to the one of winter season. Seasonality of tourism sector and resulting fluctuation of population challenges local decision-making regarding service provision. Decisions regarding the provision of health services, in particular, are considered among the most important ones, affecting quality of life of population in such fragmented areas; and providing a stable and safe environment for economic activities.

Effective linkages of such islands to mainland cannot be taken for granted. In fact a certain irregularity can be noticed, with transport connections being bound by weather or other constraints, a factor that has negative implications for health provision and transportation of patients. Additionally, the availability of health services as well as of specialized medical personnel determines in a certain extent the quality of health provision in the island areas. Tourist activity, on the other hand, and the seasonality of served population this entails, increases demand for health service provision in island regions; and the risk to end up with considerable failures in adequately meeting this demand. This dynamic problem of allocating resources in a fragmented geographical space is quite complex, considering the number of factors involved and the decisions taken at different spatial levels (national, regional and local).

Coping with this problem, implies the need for elaborating on a range of data, emanating from multiple sources, in order more informed decisions regarding uneven provision of health services to be made. In case of emergency evacuation procedures, network planning requires accurate and updated information for better satisfying potential demand. Location allocation approaches, in this respect, can contribute to the optimal selection of location of emergency evacuation services. Big Data approaches can also support decisions for effective service provision by properly handling almost real- time population data; while dealing with data privacy and security concerns.

There is a number of relevant works regarding location-allocation modeling with respect to spatial coverage. The work of Shamsur and Smith (2000) reviews the use of location-allocation models as to their suitability for designing health care systems and tackling poor geographical accessibility. Ndiaye and Alfares (2008) explore locational aspects of public services under population seasonality circumstances (winter and summer) for offering preventive health care services. The work of Alshwesh et al. (2016) elaborates on the impact of different search algorithms for optimal location selection of emergency medical services in Buraydah city in the Kingdom of Saudi Arabia.

The present work builds upon the work of Alshwesh et al. (2016); and elaborates on the possible introduction of geographical Big Data for steadily analyzing supply and demand for planning emergency evacuation support. More specifically, the *aim* of this work is to illustrate the use of Geographical Information Systems (GIS) and location-allocation modeling, for evaluating spatial problems and steering locational choices on emergency evacuation means; while informing the debate about the introduction of Big Data in health services' decision-making. As *objectives* of this work are set the: exploration of the potential use of geographical Big Data in support of such type of decision-making; increase of awareness of decision makers on the potential offered by the use of geographical Big Data for the development of a relevant to such problems decision-making tool; assessment of potential locations for installing helicopter bases in the islands of the Aegean Sea so that the total travel time of emergency evacuation procedures to be minimized; and the introduction of stakeholders to advanced GIS approaches for effectively dealing with smooth and effective spatial coverage of emergency evacuation infrastructure.

11.2 Background

According to Eurostat (Philippe 2009), islands in European territory constitute 5.6% ($\sim$271 km^2) of the total European area; while they host 3% ($\sim$15 million) of the total population of Europe. Island regions in 2006 exhibit less GDP per capita than the rest of EU regions, with the average GDP per head for the island regions reaching $\sim$79% of the EU average. As noted in the EU Territorial Cohesion Report (Philippe 2009), access to basic services is more difficult in island regions than the rest of the EU regions. This includes access to education and health services, but also access to passenger flights, all being generally at a lower level compared to the EU average. The lower performance of insular regions in a range of sectors has been attributed to their specific geographical characteristics and the physical isolation from mainland; and has been incorporated under the term *insularity*.

Health provision is an *important* factor affecting quality of life of insular communities. Establishing a safe and secure landscape preserves population stability in such communities. Moreover, the provision of a stable and reliable health system in the Aegean islands contributes to the development of island economies and supports the flourishing of the main sector of these economies, i.e. tourism. The above stress the importance of appropriate and qualitative *health service provision* (Moncada et al. 2010) as well as of specialized medical personnel in support of the socio-economic development of insular regions.

The islands of the Aegean Sea dispose a *centralized health provision network*, consisting of primary health offices in most villages (population above 1000 permanent residents); and primary clinics in the municipal sectors (per 10,000 permanent residents). Larger islands, with permanent population that exceeds the 50,000 residents, have a hospital installation (2nd level of health service). The parts of the above structure are not always present in all islands of the Aegean Sea, since there are cases of unstaffed health offices and health clinics, mainly due to insufficient funding as well as limited specialized equipment. The *cost* of locating a fully staffed health service in a remote geographical area, such as an island, may be increased, as transportation costs may raise the cost of logistics. Additionally, a fully-manned health service in a remote island presupposes additional funds for transportation of specialized equipment. This means that the overall burden of running a health service in an island is relatively higher, compared with a health service of the same type in mainland. It is therefore important for the central government to end up with informed policy decisions with regard to the relocation or upgrade of a service, i.e. decisions that are grounded on updated information about demand in such remote areas.

Limited accessibility of islands plays an important role in health service provision as well. It is common for patients to relocate to mainland Greece in order to get access to specialized health services that are not always available in remote areas of the Aegean Sea. Limited transportation options are sometimes crucial when patients need rapid access to advanced health services. This is why EKAB[1] services play an important role in health service provision as they offer the means for immediate transportation of emergency medical cases.

Demand for health services in the islands of the Aegean Sea is not constant through time. Island population exhibits a seasonal variation mainly due to tourist activity during the summer, high tourist season period (June, July, and August). The size of actual population by island has a monthly variation, which in some cases depicts substantial differences. During non-touristic months, the population of some islands may be three times less than the one of the summer period. Additionally, there is an annual fluctuation of actual population by island. This is the outcome of evolutions in the tourist market, emanating from strategies and respective choices of the private sector. This fluctuation may be an important factor when designing a health service network for remote insular areas. In order the supply of health services to best match the variations of potential demand, decision-making in the islands of the Aegean Sea has to be based on *accurate and near real time population data*.

In the decision-making process for locating health services, issues of concern are the coverage, type and extent of these services. Fragmented geographical areas, such as islands, need additional attention with respect to the above concerns, as health coverage is bounded by geographical barriers. Important, in such a context is to define a strategy with respect to equality versus proportionality of health service provision. The two different strategies have their advantages and disadvantages. Equality strategy supports the provision of equal services in all islands, disregarding population size and demand. On the other hand, proportionality strategy supports the provision of health services, in alignment with an island's population. Equality strategy may be more socially acceptable, but at the same time it implies pretty high costs for the support of health installations of secondary level in all islands.

[1]National system of urgent medical help.

Proportionality strategy is based on the analogy of health services per population unit, which is a more cost effective approach, without compromising basic provision of critical life services for all islands. During a recession economic period with limited funds for running the health system in the Aegean islands, there is a need to focus on cost- effective solutions, without compromising basic life support. This calls for more smart decision-making approaches to be adopted, which should be based on the elaboration of complex data for re- adjusting health services and controlling cost effectiveness of the health system.

Medical evacuation is the procedure where medical personnel provides en route care and efficient transportation to patients, requiring urgent, high level, medical care. Patients are usually injured during road accidents, wounded during earthquakes or natural disasters, emergency cases such as heart attacks or patients at rural hospitals, requiring further medical treatment to better equipped hospitals. The transportation of patients requires speed and efficiency, using medically-equipped vehicles (such as ambulances) or aircrafts. GIS play an important role in selecting and allocating such means by emergency response centers.

In the case where one of the above incidents takes place, a specific procedure must be followed. The patient or the surrounding environment calls the national number 166. This number notifies EKAB, i.e. the national system of urgent medical help. The center of operations evaluates the emergency of the incident and mobilizes primary health care transportation means. The crew of the ambulance (a doctor and paramedics) arrives at the place of incident and assesses the patient's situation, while it also provides the first aids. Then the patient is transferred at a primary health care, where several medical tests are made. In cases where further treatment is needed, the same ambulance transfers the patient to a secondary level health care installation for further examination from specialized personnel. In cases that more specialized treatment is needed, the EKAB helicopters transfer patients to a tertiary level medical center in mainland Greece.

11.3 Big Data

The seasonal fluctuation of population in the islands of the Aegean Sea as well as the scarcity of resources for establishing new health care installations call for smarter approaches in handling health service provision. The elaboration of almost real-time population data may support the adaptation of the health care system and the monthly re-allocation of resources and personnel in order to satisfy future demand of services. Real time data from touristic agencies and port authorities regarding incoming and outgoing passengers can be used in a smart IT system with spatial capabilities for informed decision-making. The proposed tabular data can be categorized as Big Data (BD).

BD is an umbrella term related to large scale complex unconventional datasets that are difficult to analyze using established methods (Lovelace et al. 2016). This difficulty relates to the volume of data, the velocity of data updating, the variety of data-sources as well as the degree of data veracity. This newly emerging approach, largely supported from developments in Information Technology sciences, is closely related to the notion of grasping trends and processes from large scale data; and their elaboration using advanced analytics for the extraction of knowledge.

Scientific fields such as marketing, economics as well as regional sciences have been so far experimenting with the use of BD. More specifically, BD has already been implemented in corporate environments by use of large scale customer datasets, which enable deeper understanding of current and potential clients. Similar approaches could also be used in geographical studies for studying geodemographics of areas against potential policy reforms and changes. From the policy point of view, BD could enable the calibration of strategies and policies to meet the needs of area geo-demographics. Also, such an approach could support determination of the location of new health service sites or the relocation of existing ones. Additionally, the use of BD in an integrated decision-making tool could enable the effective and efficient handling of a crisis at its onset.

Actually BD refers to large amount of data, which vary from Petabytes to Exabytes and beyond. These datasets emanate from a variety of almost real-time sources, such as sensors, social media, customer catalogs, telemetry or location services. Their volume is big enough to be processed by standard computers. Indeed due to their volume and complexity, BD require advanced technologies for management, analysis and visualization. The technologies required to harness BD include databases for storage and retrieval, such as Cassandra (Apache Software Foundation 2016), Hbase (Vora 2011), MongoDB (Dede et al. 2013), Neo4j (Miller 2013), CouchDB (Anderson et al. 2010), OrientDB (Developers Orient DB 2012) to name a few. Also, there is a need for advanced analytic environments such as R (CRAN 2014) and Python (Python Software Foundation 2011) as well as complex visualization and data mining tools, such as: RapidMiner (Hofmann and Klinkenberg 2013), Orange (Demšar et al. 2013), Weka (Markov and Russell 2006).

In a smart decision-making tool, there are multiple components that can be fed with BD, such as mobility, governance, environmental data components. Additionally, such a BD system may also include a number of services regarding health care availability, intelligent transport and smart energy applications (Khan et al. 2013). On the other hand, there are some challenges preventing local authorities from capitalizing on BD. These fall into cultural and technological type of challenges. Management of BD is a challenging task, which requires storage, retrieval and analysis of large volume of spatially-aware datasets. More specifically, it requires sufficient storage space in multiple computers, inter-linking of spatial data with economic activities, efficient data retrieval and advanced statistical analytics. Getting authorities to share and make information transparent is a difficult task as this requires sufficient effort to preserve confidentiality of information and prevent population tracking (individual or group of individuals). There is also a need to set policies that ensure data accuracy, high quality, high security, privacy, and control; as well as establish data documentation standards that can provide guidance with respect to the content and use of datasets (Bertot and Choi 2013). Local and regional authorities keep records in unsuitable formats, such as paper records, and/or inaccessible digital records. There is still a significant amount of information that is not yet in digital form and in most cases is stored in very unsuitable locations. There is also still much work to be done before transforming the flow and format of information of local authorities into a usable and transparent format, ready for a BD ecosystem. The collection and storing of data in digital form may help local authorities save resources and time.

Almost 90% of the world's digitized data was captured over just the past two years (Nuaimi et al. 2015). Another important challenge is the transformation of raw data to information useful for further processing. This transformation requires good understanding of data sources and the problem which needs to be solved. The data should be transformed in such a way that can provide meaningful and scientifically accurate information, required by decision makers. Furthermore, information should be transformed to knowledge with the use of advanced analytics in order to provide useful arguments and insights for decision making. The two-steps approach of transforming raw data to information and then to useful knowledge is crucial, because it may enable a deeper understanding of dynamic phenomena and shed light to trends not yet captured by conventional approaches.

Finally, most available data mining algorithms are not very suitable for BD applications as their design is based on limited and well defined data sets (Wu et al. 2014). A near real-time application for islands analytics should also include advanced data mining tools that would enable the fast exploration of information in order to provide sophisticated results for decision-making. The development of a BD system for smart decision-making requires a number of potentially sensitive data. The GIS components of such a system may require locational data about businesses and tourist activities. Some BD may include private and sensitive information. The management of such data requires an integrated privacy requirements engineering approach.

Indeed, during the last decade, privacy has gained great attention especially from online Internet users, participating in incidents regarding unauthorized data exploration, misuse of information stored in social media websites, disclosure of personal information to third parties without users' consent etc. Based on two research works conducted in 2014 (Rainie et al. 2013; TRUSTe 2014) about how Internet users feel regarding their privacy when they are online, 92% of Internet users answered that they are afraid about the available amount of their personal data existing online without their consent. In the same works, 58% of users were afraid that their personal data are given to third parties without their approval; while 47% believed that their actions are monitored during their online presence in order targeted advertisements and web content to be sent to them. Also, 59% of users believed that they cannot be anonymous online; while the same percentage believed that they should be able to be anonymous in cases where identification is not required for accessing a resource or service. Finally, about 68% of Internet users believed that existing laws are not good enough in protecting people's privacy online; and 24% believed current laws provide reasonable protections. Thus, it is obvious that privacy needs to be considered when realizing information systems or independent services irrespective of the functional environment the system or services will be demonstrated.

Most people use the Internet for its services either for personal or for recreational reasons. Internet and email services are offered from Internet Service Providers (ISPs). These providers use servers that keep logs of Internet traffic, typically for tuning, performance monitoring, etc. Also personal data are stored for various reasons like faster access to sources already been visited, history track, personalized services, etc. These logs are always available to server administrators for reading and processing purposes.

The use of World Wide Web and email services is two of the most commonly services used by the Internet users today. By using these services, users leave a lot of personally identifiable information without even knowing it, putting thus their privacy in danger. How well do Internet users know the risk involved with respect to their personal data, which are possibly exposed to unknown third parties? Privacy as a social and legal issue, traditionally, has been the concern of social scientists, philosophers and lawyers. However, the extended use of various software applications in the context of basic e-services sets additional technology-related requirements for protecting the electronic privacy of individuals. Most e-services are relying on stored data for identifying customers, their preferences and previous record of transactions. Combining such data constitutes in many cases, an invasion of privacy. Protecting privacy is especially important in e-applications, since the greater collection and storage of personal data, the lower the trust of users using the specific applications. Towards the development of a global information society and with the rapid development of new information infrastructures among various states, a number of threats are created regarding privacy protection of the users using these resources and systems. Privacy, as a fundamental human right, recognized in the UN Declaration of Human Rights, the International Covenant on Civil and Political Rights and in many other international and regional treaties has to be protected in a democratic society (Rotenberg and Knight 2007).

In general, privacy protection can be undertaken by:

- privacy and data protection laws promoted by governments;
- self-regulation for fair information practices by codes of conducts promoted by businesses;
- privacy-enhancing technologies adopted by individuals; and
- privacy education of consumers and IT professionals.

The first definition of privacy was given by Warren and Brandeis in their article "The Right to Privacy" (Warren and Brandeis 1890). The two American lawyers defined privacy as "the right to be left alone". More recently, Westin (1967) defined privacy as "The claim of individuals, groups and institutions to determine for themselves, when, how and to what extent information about them is communicated to others". In general, the concept of privacy incorporates three aspects (Rosenberg 1992; Holvast 1993):

- Territorial privacy, by protecting the close physical area surrounding a person.
- Privacy of the person, by protecting a person against undue interference.
- Informational privacy, by controlling whether and how personal data can be gathered, stored, processed or selectively disseminated.

Personal data means any information concerning the personal or material circumstances of an identified or identifiable person (the data subject). Data protection is the protection of personal data in order to guarantee privacy and is only a part of the concept of privacy. However, privacy is not an unlimited or absolute right, as it can be in conflict with other rights or legal values, or because individuals cannot participate fully in society without revealing personal data (Fischer-Hübner 2001).

In a networked society, as the one we live today, privacy is endangered and cannot be protected solely by laws and regulations. Developers and information system specialists must consider privacy as a technical requirement in the system under construction and more specifically it has to be considered early from the design phase of the development cycle as a separate design criterion. The need for addressing privacy as a separate design criterion during the software life cycle has also been identified as a major issue from the respective research community. Recent research (Gritzalis 2004; Koorn et al. 2004; Kalloniatis et al. 2008; Mouratidis et al. 2012) have identified that privacy should be treated as a separate requirement criterion, since privacy itself is a multifaceted concept. In order for privacy to be properly treated, a number of concepts need to be defined in order to assist in transforming a generic concept into specific technical requirements that will be able to be addressed during elicitation and modeling phases as well as to be accordingly implemented by respective Privacy Enhancing Technologies (PETs). Pfitzmann and Hansen (2010) have identified and described the basic privacy concepts that need to be considered when designing privacy-aware systems.

The case of EKAB is a typical case of a distributed environment, where exchange of information in various levels occurs. EKAB uses information mainly from third party agents in order to identify the best solution for locating its fleet, based on customers' needs identified in real time by the third party agents. In the case described in this chapter, EKAB main collaborators will be: Tourist Agencies, Port Authorities, Hospitals, Airports and Transport Services.

While the distribution of IT environment in this case is inevitable, privacy implications do arise both from the complexity of the environment and from the nature of the data transmitted. Distributed environments hinder a number of privacy threats; since malicious third parties can reveal both the data sent and received. Moreover, the trustworthy of the locations where the data are stored to, can sometimes get questionable. A simple architectural schema of the proposed case can be found in Fig. 11.1. Third parties collaborating with EKAB will exchange information mainly towards the EKAB data base, but a local copy for security and accountability reasons is stored in their local databases. EKAB collects real time and offline data in short intervals and store them in a central, yet networked, database, from where the stations and applications belonging to the internal EKAB

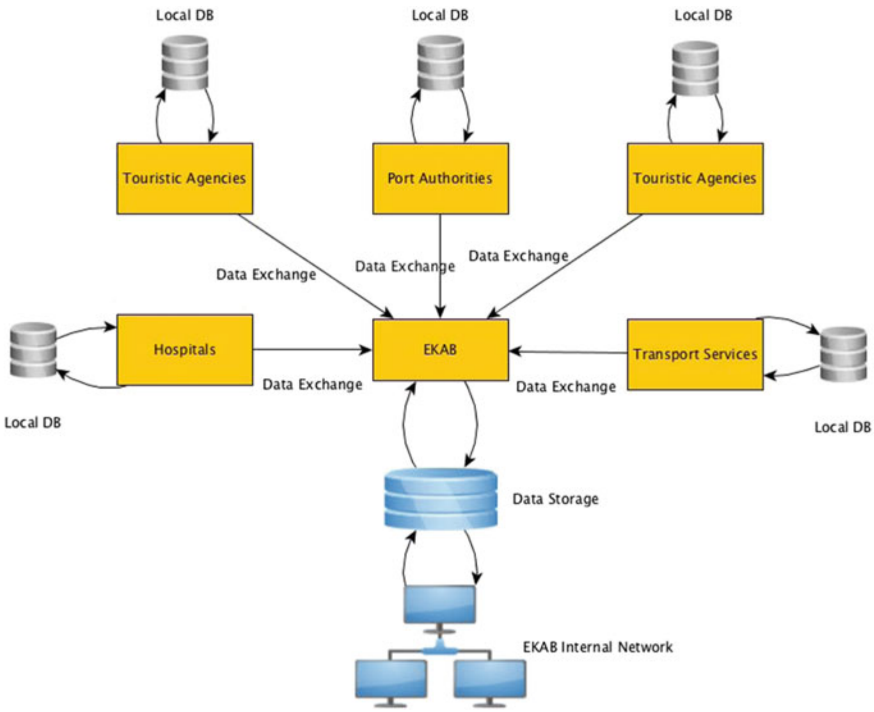

Fig. 11.1 Proposed architecture of a BD system for decision-making regarding emergency evacuation policies

network are informed either directly by the primal data or in later phases by secondary data produced by the primal data processing.

Privacy protection must be one of the primary goals in this schema, since many privacy implications do arise. Specifically:

- Location privacy of the users due to real–time data collection from respective agencies to EKAB.
- Data retention strategies for private identifiable information stored in various databases with different privacy policies and different laws and regulations, applied on the different types of agents.
- Privacy violations during data communication over insecure networks among the third parties and EKAB.
- Users' identification from possible combination of data stored in EKAB networked data base.
- Authorization rights to EKAB internal users (who may have access to data).

For implementing privacy aware systems it is of vital importance to understand the organizational needs, the stakeholders' needs, and the existing legislation regarding data protection and manipulation. Moreover, there is a need to understand the proposed deployment scenarios and identify the best one that suits the organizational and privacy needs. For this scenario, the appropriate Privacy Enhancing Technologies must be selected in order privacy requirements along with system's functional requirements to be successfully implemented. All these have to be accomplished during the system's design, since this is the stage where the most efficient and cost-effective decisions can be made prior to the costly and time consuming implementation stage.

The design of such a BD smart decision tool requires analytical methods to inform decision makers and planners. The use of spatial optimization algorithms and optimization modeling approaches will enrich the capabilities of such a smart system and will offer valuable insights on spatial coverage of emergency aero-evacuation means.

11.4 Location—Allocation Modeling

Location selection approaches incorporate a number of computational methods, which are being used in a range of contexts. Location allocation modeling has a long history in spatial sciences; and is used to identify possible spatial optimal location for various purposes. Spatial optimization is a broad scientific field, counting a large number of case studies in many different contexts. The necessity for efficient spatial allocation of facilities is common in both the private and the public sector. Disciplines, such as Operations' Research, examine location theory approaches for business-related location optimization (Churchman et al. 1957; Larson and Odoni 1981; Hillier and Lieberman 2008). Geographical sciences use a broader approach (Haggett et al. 1977; Dicken and Lloyd 1990; Puga 2002; Li and Liu 2012); while mathematical sciences examine such problems as part of Graph Theory field (Berry and Pred 1961; Bondy and Murty 1976; Bollobás 2013).

In the field of Geography, location theories and theoretical aspects of location analysis, form a part of social geography (Knox and Pinch 2014). One of the first attempts of conceptualizing location theories, is the work of Von Thünen (2013) who developed an analytical theory about land uses, based on concepts of transport costs (Grotewold 2016; Von Thünen 2013). Another significant work in the field of location theory is the work of Walter Christaller about central place theory. His contribution focused on the discussion of optimal pattern of central places and centralization of facilities by introducing an analytical framework of hexagon patterns (Christaller 1933; Berry and Pred 1961; Getis and Getis 1966; Berry and Harris 1970). Some of the most notable applications of location optimization include the work of Kuehn and Hamburger (1963) about heuristic approaches for warehouse location selection; and the work of Hakimi (1964), which is one of the first attempts of spatial optimization of communication centers in a communication network.

The field of location analysis includes a range of spatial optimization problems with minor differences. Location—allocation modeling is among the approaches, which models the supply and demand side of a service. These location problems try to determine optimal spatial distribution of facilities against objective functions related to demand. It is essentially a mathematical approach of analyzing spatial problems of supply and demand. This type of modeling has a long history, with a variety of applications in different case study contexts. Teitz and Bart (1968) focused on heuristic methods for estimating the generalized vertex median of a weighted graph.

In the literature there are also some notable works of location analysis with respect to health services. Toregas et al. (1971) analyzed the location of emergency service facilities. Love and Lindquist (1995) analyzed geographical accessibility of hospitals to the aged in Illinois, USA. Parker and Campbell (1998) measured access to primary medical care by use of Geographical Information Systems. Marianov and Taborga (2001) focused on optimal location of public health centers, which provide free and paid services. Cromley and McLafferty (2002) analyzed access to public health services. Jia et al. (2007) illustrate a modeling framework for the location of medical service facilities for large-scale emergencies. Comber et al. (2011) analyzed variations in access to health facilities by linking geography, socio-economic status and access perceptions. Alshwesh et al. (2016) analyzed the impact of different search heuristics in relation to demand surface characteristics for Emergency Medical Services in the Kingdom of Saudi Arabia. It is therefore one of the most important approaches for evaluation of service coverage and location analysis of service stations.

The subsequent sections of this work describe a case study about location optimization of three (3) helicopter bases in the Aegean Sea for emergency evacuation services. This approach can be used in a smart decision support system, based on BD from tourist agencies regarding the actual population of islands. For the estimation of the best locations for installing helicopter bases in the Aegean Sea, we need to define an objective function. This function should be used for the optimization of the geographic coverage of the majority of the population of the study area, as presented in similar works of ReVelle and Swain (1970), Jia et al. (2007), Comber et al. (2011) and Alshwesh et al. (2016). The objective function should identify the best suitable location for three helicopter bases, from the available airport locations in the islands of the Aegean Sea. The helicopter service will provide emergency evacuation of patients from islands to Evagelismos Hospital in Athens, Greece for further specialized treatment.

Location—allocation methodologies consist of modeling rules and objective functions. Rules specify the allocation of demand to supply sites. Objective functions define the optimization process such as: minimization of transportation distance and at the same time maximization of accessibility between supply and demand. There are three important components in this methodological approach: demand locations, candidate locations and distance measure. Demand locations represent the municipal sectors of the islands in the Aegean Sea. Candidate locations include the operational airports of the islands in the Aegean Sea, which could be used as helicopter bases. Finally, all distances have been calculated based on the Euclidean Distance measure, which better represents helicopter flights.

We used data for the 171 municipal sectors of the islands with total population of 1198614 individuals. A spatial database system (Güting 1994; Yeung and Hall 2007) was used for the management of spatial and tabular structured data. The methodology developed in this work is based on R language (CRAN 2014) and PostgreSQL database system (PostgreSQL Global Development Group 2016) and the *tbart* processing library (Brunsdon 2015).

A *classical approach* in identifying possible sites for the installation of helicopter bases could be the combinatorial optimization approach, which requires considerable computation resources. Current GIS software requires additional paid

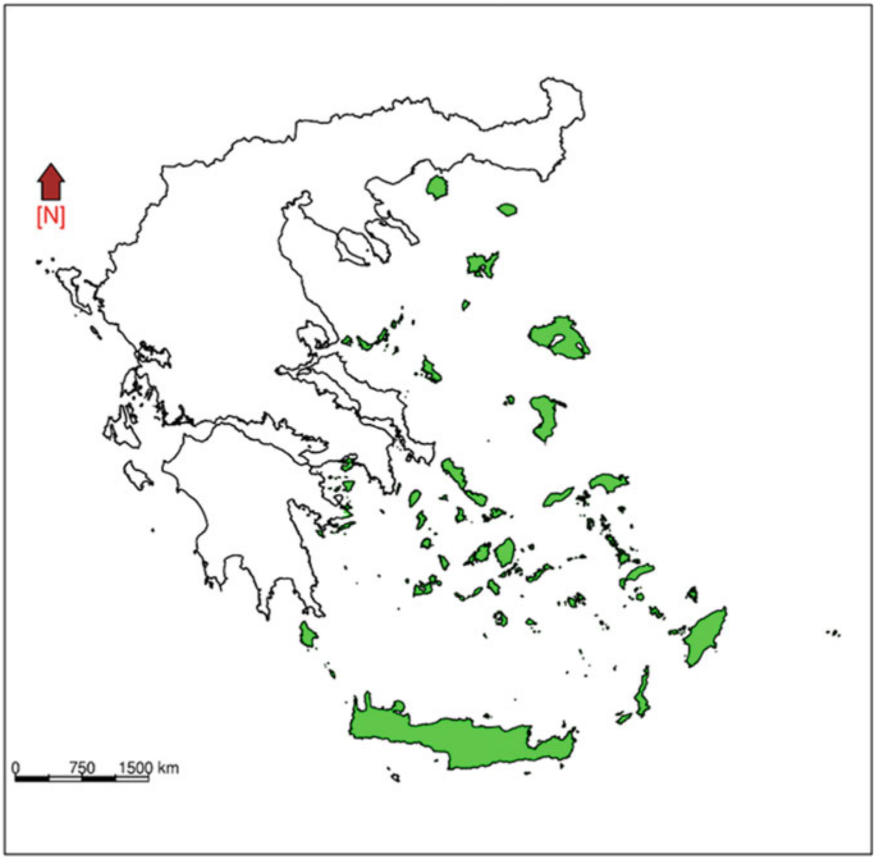

Fig. 11.2 Map of the study area—islands of the Aegean Sea, Greece

plug-ins and libraries in order to solve location—allocation problems. On the other hand, there is a need for open source GIS approaches, which could enable further scientific expansions through transparent computational methodologies. The following methodology has been developed in R programming language (CRAN 2014) in order a transparent scientific platform for location analysis to be provided, which may later be linked with BD analytics procedures. This open source methodology enables the data-method separation, which is valuable for the further expansion of the system and the incorporation of DB. The spatial data required for this work are depicted in Figs. 11.3, 11.4 and 11.5. More specifically, the study area is depicted in Fig. 11.2 (islands of the Aegean Sea). The population size by municipal sector is depicted in Fig. 11.3. Finally, the spatial distribution of airports currently in use in the Aegean Sea is illustrated in Fig. 11.4.

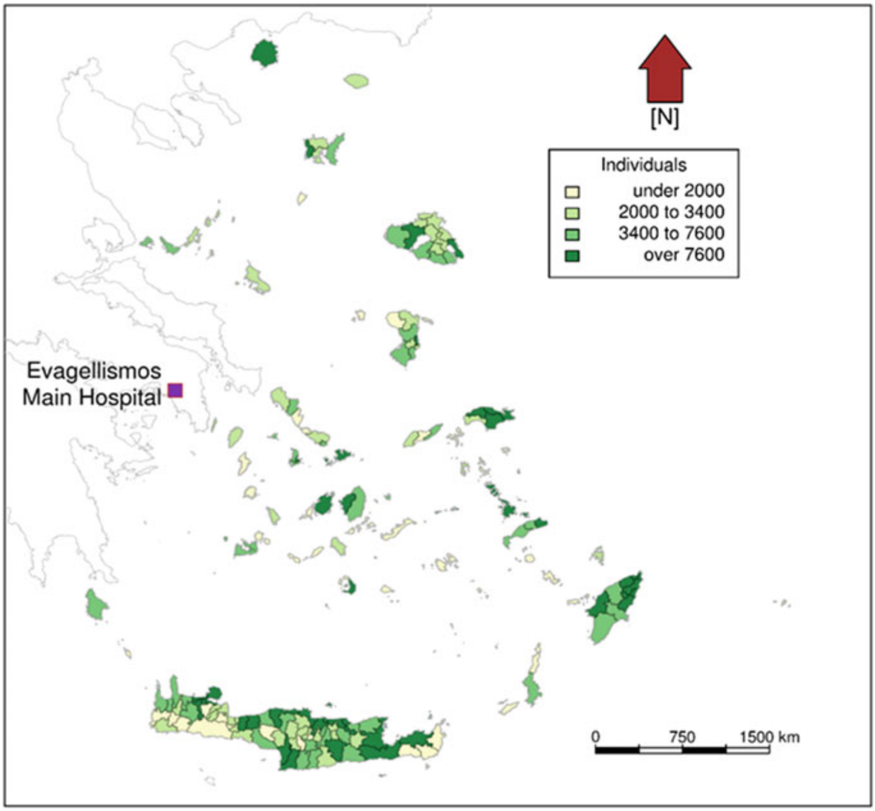

Fig. 11.3 Permanent population by municipality in the study area

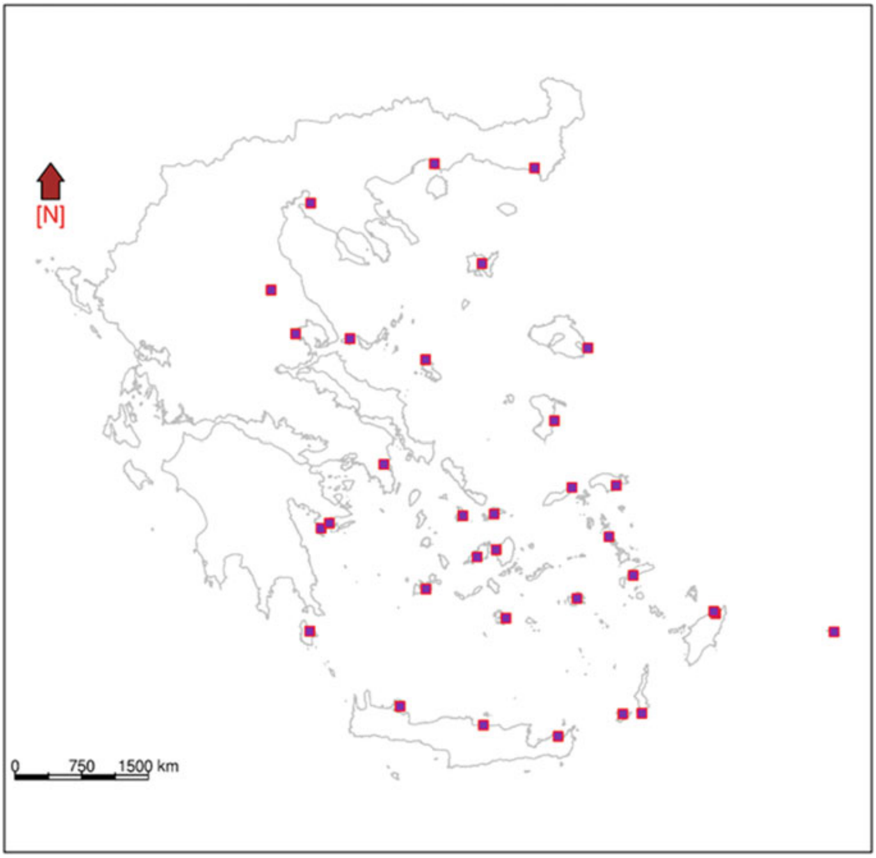

Fig. 11.4 Operational airport installations in the Aegean Sea

11.4.1 P-Median Algorithm

The algorithm used for the optimal allocation of three helicopter bases in the islands of the Aegean Sea is the P-median algorithm. The spatial optimization problem of locating a finite number of helicopter bases in the islands in the Aegean Sea can be categorized as a discrete location problem. The optimization approach of this algorithm is based on the interchange and substitution of potential locations in order the three most suitable ones to be selected that minimize the overall weighted distance between demand (municipalities of Aegean islands) and supply (helicopter bases) (Mladenović et al. 2007). This approach identifies p locations, which minimize the average distance between a demand node and the location in which a facility is placed. Calculation of the weighted distance is based on population effort per distance unit.

The objective function of this model, as described by Teitz and Bart (1968), can be specified as follows:

$$Minimize = \sum_{i=1}^{I} \sum_{j=1}^{J} a_i d_{ij} x_{ij} \tag{11.1}$$

$$i \in I \tag{11.2}$$

$$j \in J \tag{11.3}$$

Given the following three constrains:

1st constrain: A single facility has to be allocated to a demand site for all (i, j)

$$x_{ij} \leq x_{ij} \tag{11.4}$$

2nd constrain: A helicopter base must be allocated to all demand sites for all i

$$\sum_{j \in J} x_{ij} = 1 \tag{11.5}$$

3rd constrain: Only p facilities are to be located for all j

$$\sum_{j \in J} x_{jj} = p \tag{11.6}$$

where

- x_{ij} either 0 or 1 for all $\boldsymbol{i, j}$
- p the number of facilities to be located in the study area (p = 3 helicopter bases)
- I all demand areas of the study area (all municipalities)
- i index of specific demand area (a single municipality)
- J candidate facility sites (all three helicopter bases)
- j index of specific candidate facility site (a single helicopter base)
- a_i number of individuals present at demand site $\boldsymbol{i}$

$$\sum_{i \in I} a_i = 1198614 \tag{11.7}$$

- d_{ij} distance fraction between demand area i and candidate facility site j
- x_{ij} is equal to 1 when demand at demand-area i is allocated to the facility in site j. Otherwise, is equal to 0, i.e. when demand at demand-area i is not allocated to facility in site j.

11.4.2 Results and Discussion

After extensive computational processing, we concluded that the three helicopter-bases in the Aegean Sea should be located in the following municipalities: *Petaloudon* (Rhodes Island), *Hrakleiou* (Crete Island) and *Kampoxwriwn* (Chios Island). Figure 11.5 depicts the location of the optimal sitting as well as the best possible division of the study area in three sections for helicopters' service provision in order the weighted (by population) total distance to Athens to be minimized. The three selected locations already include fully manned airport installation, which minimizes the sitting cost of a medical evacuation helicopter.

In order to quantify the quality of the solution, we need to calculate the *total distance* from the helicopter base to the municipality of an emergency incident (patient collection) and then add to that the travel distance from the incident to Athens central hospital. We use the *total distance* measure to evaluate the final solution properties.

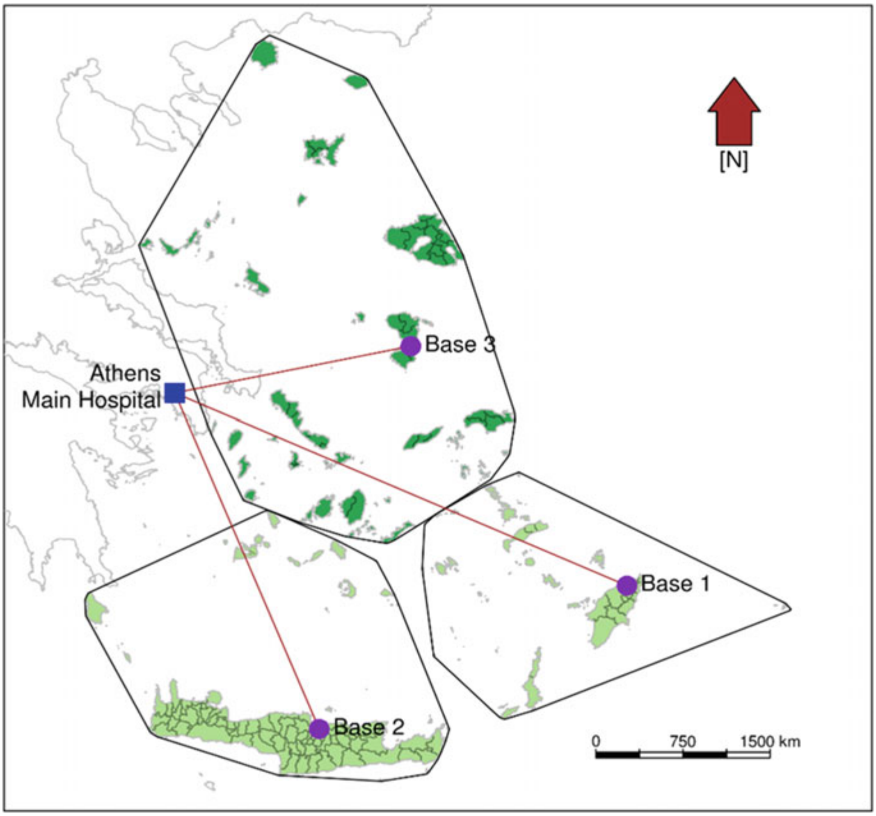

Fig. 11.5 Map of the optimum solution for the allocation of proposed helicopter bases

In order to evaluate the final allocation solution, we use relative measure of total distance to Athens and relative measure of population size. By using the Z Score standardization, we are able to compare the relative total distance of each municipality with respect to total population size in the study area. The Z score indicates the number of standard deviations of each element from the mean of the sample. It is therefore calculated as follows:

$$Z = (X - m)/\sigma \tag{11.8}$$

where

X value of a municipality
μ the mean of the study area (mean of all municipalities)
σ standard deviation of the sample (standard deviation of municipalities' values).

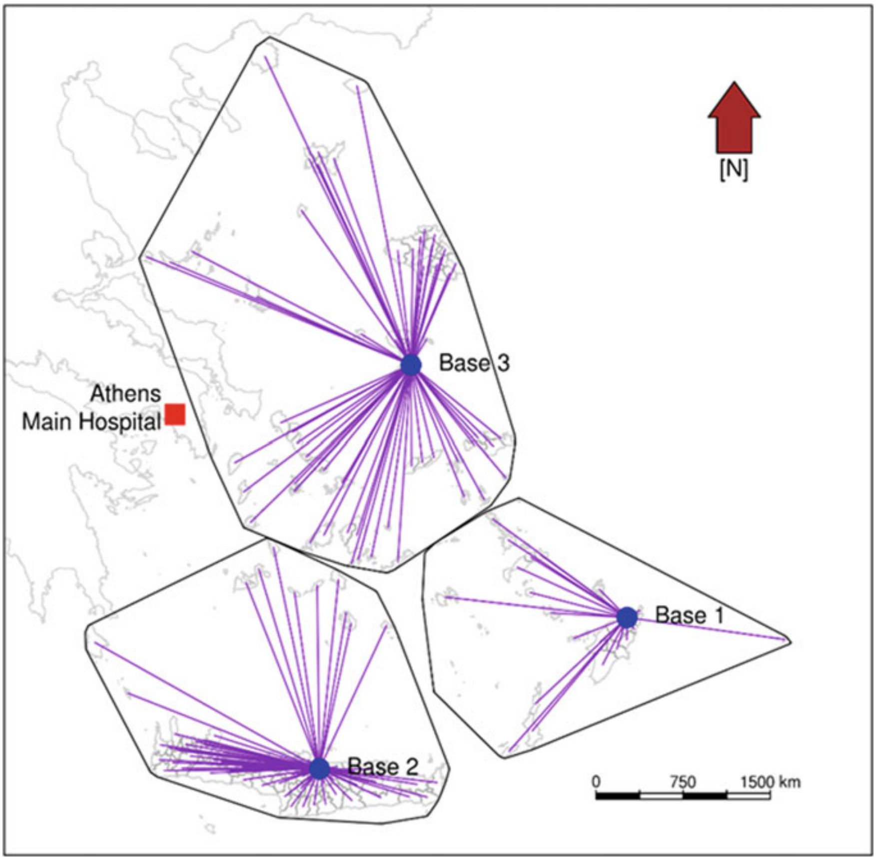

Fig. 11.6 Map of the optimum allocation of municipal sectors to the 3 helicopter bases

Figure 11.7 depicts the relationship between total distance to Athens (Z Score) and population size (Z Score) by municipality of the study area. Highlighted areas in upper left part of the figure (municipalities of Xania, Thassos and Mytilinis), appear to have relatively increased total distance but relatively lower population size, which indicates that further measures need to be taken in these areas. The additional measures may include hiring of specialized medical personnel for the reduction of cases of emergency evacuation or measures for the upgrade of health facilities in the areas. According to our optimal location-allocation solution, all other areas are served relatively well with respect to population size and total weighted distance to Athens.

Additionally, Fig. 11.8 depicts the absolute frequency of total distance to Athens (Z Score) for the evaluation of the optimal solution.

The evaluation of the optimization solution is based on the mean weighted distance between provisional helicopter bases, municipalities and travel distance to Athens. Figure 11.5 depicts the optimal solution for the sitting of the three helicopter bases. Figure 11.6 depicts the distance between each single helicopter base and the municipalities allocated to it. As can be seen in Fig. 11.7, the relative total distance to Athens is very good, with just three municipalities exhibiting a standard

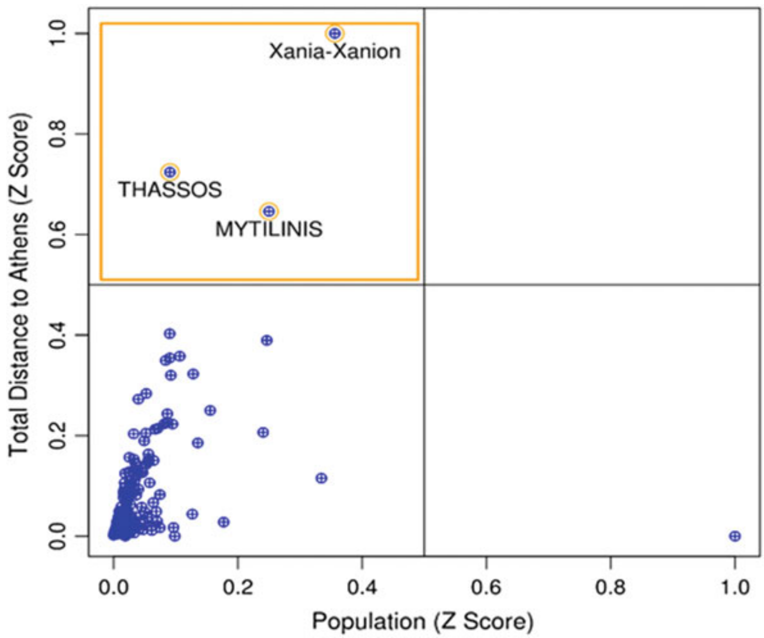

Fig. 11.7 Relationship between total distance to Athens (Z Score) and population size (Z Score) by municipality of the study area—highlighted areas in upper left part appear to have relatively increased total distance

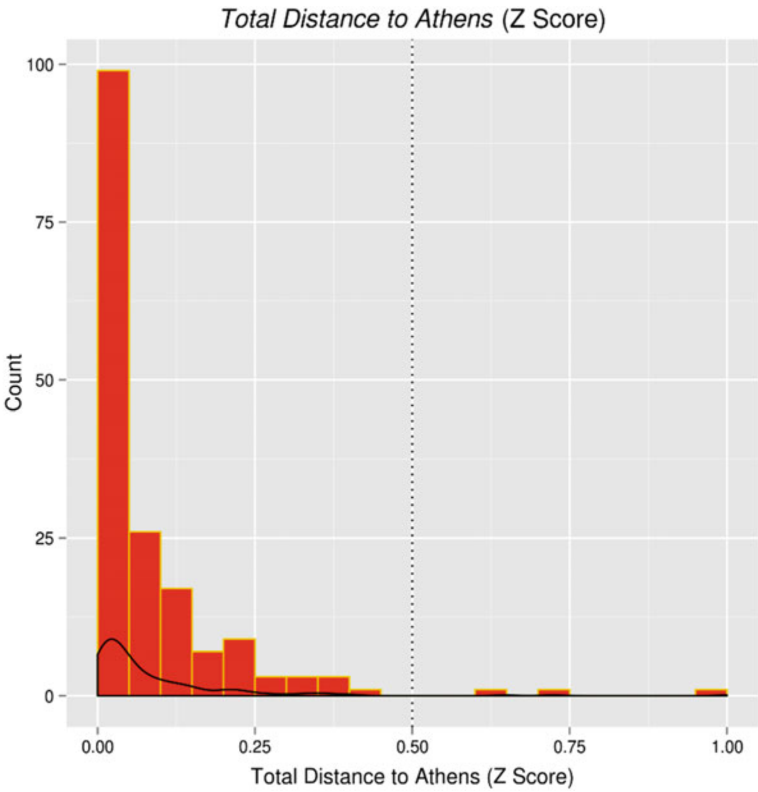

Fig. 11.8 Histogram of absolute frequencies of total distance to Athens (Z Score)

deviation above mean total distance to Athens. This indicates that the locations of the three helicopter bases are almost ideal as they divide the study area in a very balanced way. The division of the study area in three parts helps towards the reduction of total distance to Athens and may lead to better emergency evacuation service provision. As can be seen in Fig. 11.7, most of the municipal sectors have total distance to Athens (Z score) less than 0.5 Z Score.

11.5 Conclusions

Location—allocation modeling has been used in a number of business-related applications regarding the selection of a business location and operational decisions. The use of such spatial methodologies helps decision makers to quantify the spatial extent of a service and the spatial characteristics of a network system, such as the health provision network in the Aegean Sea. Deeper understanding of the spatial aspects of health coverage may contribute towards the removal of inequalities in access to health services and provide a stable economic environment for the flourishing of the tourist sector, a main pillar of the Aegean islands' local economy.

This work conducted a static data analysis of population with the use of location—allocation modeling. A further improvement can incorporate additional data. For example data on specific age groups of the population for controlling health service provision by age group, since different age groups usually exhibit different needs. Such an improvement can be introduced in the weighting of the location—allocation model and can lead to slightly different optimization solution. Another possible expansion of this work may include the monthly analysis of population Big Data from tourist agencies in order to use near real time population data. This may be achieved by use of tourist Big Data from relevant agencies. Indeed, tourist agencies can provide a common platform for data sharing, which can feed with information the emergency services for re-designing and relocating resources during summer period. This may lead to monthly relocation of helicopter bases according to tourist activity. Nevertheless, this work sets the case for using population data (population BD) for the analysis of emergency evacuation services in a fragmented geographical area.

BD introduction call for new smarter approaches in data collection, management and analysis. The BD evolution of the later years has led to the introduction of such systems in geographical sciences and GIS applications. The use of BD in spatial analysis can shed some light on the underlying mechanisms of spatial events and their processes. The use of the proposed system for collection, management and use of spatial BD from various sources can support stakeholders in making more informed decisions about health services' coverage. Among such sources are nowadays valued the immaterial sensors' networks, such as citizens and stakeholders, which are considered as an important source of data and empirical knowledge, upon which a better understanding of the planning problems and their solutions are based. ICTs and their applications can support the management of these data, marking thus a shift from a situation in which planners and professionals were the only producers and users of urban information to a new regime, in which citizens and other stakeholders become "*prosumers*", i.e. both producers and consumers of data (Stratigea et al. 2015). Such a system may be considered as a Big Data ecosystem, which may be potentially useful to other agencies, contributing towards a better and safer environment in the islands of the Aegean Sea.

The design and development of the proposed BD system requires sufficient funds, which makes it a very unreachable target for Greek NHS. Nevertheless, we believe that spatial decision support systems, such as the one presented in this work, will be introduced in policy making in the years to come and will play an important role in spatial allocation of resources and personnel.

The results of the present work are potentially useful to EKAB, the emergency evacuation center of Greece, which can benefit from location – allocation methodologies for planning the spatial allocation of its services. The efficiency of such services is sometimes compromised due to political decisions regarding location choice. A coherent methodology for designing such services may include the use of location-allocation approaches, which can use complex data for evaluation.

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Chapter 12
Sharing Economy Perspectives in the Tourism Accommodation Sector

Vicky Katsoni

Abstract Tourism stakeholders of both the demand and supply side have found themselves involved in a furious debate about the present and future shape of the new provocative and hybrid economic activity of the sharing economy, and its counterpart in the tourism sector, where sharing economy has managed to bypass the established distribution channels and disrupt the traditional structure of the tourism business. This work attempts to: elaborate on the types and presence of the sharing economy in the tourism accommodation sector, and the disruptive innovation nature of it; analyse developments with regards to the sharing economy framework in the Greek tourism industry; and elaborate on the potential impacts of shared economy in tourism, while also discussing potential future implications of this trends.

Keywords Sharing economy · Disruptive innovation · Tourism distribution channels · Greece · Airbnb

12.1 Introduction

The term *"sharing economy"* is used to describe a new hybrid economic activity or, in other words, a *"collaborative consumption"* (Miller 2015; Belk 2014) for a range of businesses. It facilitates peer-to-peer exchange of goods or services, for monetary or non-monetary benefits; and it is consisted of transactions conducted via the use of online platforms and the power of the Internet to efficiently connect people's wants with people's haves (Marshall 2015). The sharing economy includes assets with idling capacity (underutilized capacity) for economic, environmental and/or social benefit. The transactions occur on a peer-to-peer basis and there is an

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exchange of excess capacity (spare room or car ride) over primary production. Even though some of the companies in the sharing economy do imply ownership of the product through exchange or donation, the dominant logic of this type of economy is access, not ownership. The share economy models can be tech-enabled, e.g. car sharing and ridesharing platforms that use mobile apps; or non-tech, e.g. free city tour (Stephany 2015; Stokes et al. 2014).

There are many drivers that account for the spread of sharing economy, but the most important ones are (Selloni 2017; Gruszka 2017): (i) *Advances in technology*. Web and mobile devices, such as tablets and smartphones, equipped with GPS and near-field technology, offer speed of contact/interaction and are rapidly becoming the principal device through which people manage their lives online and play a critical role in building large-scale sharing communities. (ii) *Increased environmental awareness*. Sharing and sustainability are connected concepts, since many people who decide to adopt sharing practices consider their choices as being 'better for the environment' (Heinrichs 2013). In times of scarcity, to share resources and assets means to collaborate for more sustainable ways of living. (iii) *Global recession*. The most popularly perceived benefit of sharing is saving money. This is particularly crucial in times of economic crisis. However, the idea of 'saving money' is not opposite to that of doing something 'good for society and environment'. These two principles are both important for those people who decide to adopt sharing practices and use collaborative services. iv) *Internationalization and sense of community*. Internationalization has also led to a cultural transformation and shift towards sharing. Over the past 20 years consumers (such as generation X and Millennials), have steadily become more comfortable with the efficiency and safety of purchasing goods and services online from countries they've never visited and from people they've never met. In this respect, trust is the 'New Currency' in transactions (Stokes et al. 2014; Godelnik 2017). Users are now oriented towards "doing more with less", a principle that has given rise to a new breed of owners, who also seek to rent, lend, swap and barter goods, either in search of economic benefits or in support of a greater social value.

The goal of this paper is to explore the disruptive and controversial nature of sharing economy in the tourism industry and elaborate on its challenges for the future.

12.2 Business Models' Developments in the Tourism Accommodation Sector

The continued growth of sharing economy companies, such as Airbnb and other short-term vacation rental suppliers seems to be a hot innovative concept nowadays, but the principle is not a new one. Already around the 1950s the American economist Joseph Schumpeter coined the term *"creative destruction"*, that is a process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one (Schumpeter 1994). This force of creative destruction constitutes a beneficial force for economies, since it leads to business model innovation, provides the basis for sustainable business success and finally reinforces the sustained long-term economic growth of the whole economy. As Casadesus-Masanell and Zhu (2013: 464) mention: *"New entrants in a wide array of industries have demonstrated time and again that innovative business models can provide the basis for sustainable business success, even in competitive settings with well-established incumbents"*.

A business model innovation is defined as *"the discovery of a fundamentally different business model in an existing business"* (Markides 2006: 20). The *key elements* are its *superior quality platform* to bring together supply and demand; the *trust mechanism* between owners and renters; and the *low cost structure* of running the business that does not require capital investments in properties. Schumpeter identified five types of firm's innovation: new products, new methods of production, new supply sources, new markets exploitation, and new ways to organize business or business model innovation. This implies the search for new logics of the firm and new ways to generate revenues and provide value for customers, suppliers, and partners. For a business model to be considered innovative, it *"must enlarge the existing economic pie, either by attracting new customers into the market or by encouraging existing customers to consume more"* (Markides 2006: 20). Importantly, the business model innovator does not bring new products to market. Instead, the innovator finds a new way to bring the existing product or service to consumers.

Christensen (1997) introduced the concept of *disruptive innovation*, which he first applied to technological innovation. Later, the term was revised to include predictions regarding business models' innovations. "Disruption" in this case describes a process in which a smaller company, with fewer resources, succeeds to successfully challenge established incumbent businesses (Christensen et al. 2015). Usually, the offering of the business model innovator is originally focused on the low-end of the market or its periphery, initially limited in size and profit margins; and emphasizes different attributes or dimensions of the product, compared to the offerings of the established players. That is why a new entrant with a disruptive business model in an established industry initially attracts different type of customers, who are previously not served by the incumbents (Christensen and Overdorf 2000; Markides 2006; Guttentag 2015).

The peripheral position of the innovator keeps them initially off the radar of the established players in the industry. However, as the business of the innovator develops, its performance eventually gets to a level of being sufficient in the old attributes, emphasized by established competitors; and superior in the new attributes (Markides 2006:21). As a result, customers of established firms are now willing to substitute the traditional offering for that of the disruptive innovator's. Consumers' switch towards the innovator's product is often magnified by the attention from the media and from the incumbents, who by now cannot ignore the presence of the business model innovator (Markides 2006). Such attention, in turn, makes the firm of the business model innovator known even wider, which may lead to further substitution effect. Disruptive innovation, by contrast, originates in the low-quality, low-price segment and is not initially popular among consumers of mainstream incumbents. Only as the quality improves but the prices remain low will such consumers begin to switch to the innovator's offering. That is when the disruption takes place (Christensen et al. 2015).

Importantly, not any business model innovation can be considered disruptive. Some cases of innovation are better described as sustaining. *Sustaining innovation* improves existing products or services. As Christensen et al. (2015) mention, the improvements can be either incremental advances or major breakthroughs, but nevertheless they all enable firms to sell more products to their most profitable customers. Furthermore, it is quite important to mention that the borders between the categorization of the business in either sustaining or disruptive innovation are blurred in the long run. An example of this case is Airbnb. Airbnb's offer originated in the segment of the private rentals in the homes rental industry. In this context, its offering can be characterized as sustaining innovation, as Airbnb improved the quality of the service, made it easy, efficient, and safe. As the company's product improved, its popularity began to attract attention of clients from another segment of the travel accommodations industry—the hotel sector. The initial appeal of Airbnb occurred at the low end of the market, as the Airbnb properties were usually priced lower than hotel offerings. These customers were particularly price-sensitive and they would not typically stay at a hotel. Thus Airbnb provided them a cheap place to stay during their travels. As Airbnb acquired more properties, it attracted potential clients of two and three-star hotels who would be willing to substitute a hotel room with an Airbnb property. As the number of nicer properties on Airbnb rose up, customers from four and five-star hotels started also under certain circumstances e.g. a family trip, to consider Airbnb as a viable alternative to hotel accommodation.

Thus, in the context of the hotel industry, the new sharing economy model, presented by the Airbnb's innovation, can be characterized as disruptive, not sustaining. Once the hotel customers start substituting their standard choice of accommodation (hotel) with the Airbnb alternative, we can talk about disruption to this industry (Dewald and Bowen 2010). A disruptive innovation initially offers a lower performance according to what the mainstream market has historically demanded (Dewald and Bowen 2010). At the same time, it provides some new performance attributes, which in turn makes it prosper in a different market. As it improves along the traditional performance parameters it eventually displaces the former technology.

The most widely-known sharing economy companies operate in tourism-related activities (such as transport, entertainment and accommodation), and the hospitality sector has been at the center of some of the most intense public disputes about the effect of the sharing economy on more traditional and established economic models. All these companies operate in online platforms, which serve as an intermediary and a facilitator of the transaction that brings together the "haves" and the "wants" of both suppliers and consumers; and ensure transparency of the transaction. According to Parker et al. (2016: 25), *"A platform is a business, based on enabling* *value-creating interactions between external producers and consumers. The platform provides an open, participative infrastructure for these interactions and sets the governance conditions for them"*. There is a great number of online platforms, providing worldwide accommodation, which can be categorized as follows:

(a) *Platforms where financial payment is included*. In this category, sharing economy models and platforms are monetized (e.g. earning income from sharing assets). In the accommodation segment examples are Airbnb, FlipKey, HomeAway, HomeStay, HomeSuite, Roomorama, Wimdu (popular in Europe), Stop Sleep Go (popular in Philippines), Accommable (homes and apartments accessible for people with mobility issues) to name a few. The dominant platform is undoubtedly Airbnb. Hotel share services give also the opportunity to book a non-refundable reservation of someone who did not manage to complete his/her trip, etc. at a discounted price, with companies such as Vacatia (sharing timeshares, condos and resorts) and Roomer (Thriftynomands.com). There are also many other forms of online platforms offering services, such as renting a campervan, RV, or trailer with representing companies such as Outdoorsy and RV Share; parking services, such as BoonDockers (RV parking), Divvy (parking, Australia based company), Gamping (private camping anywhere), Harvest Hosts (camp or park in farms, vineyards), etc.

(b) *Free platforms*. In this case, sharing economy models and platforms are non-monetized, such as Couchsurfing (a dominating one) and Hospitality Club. Couchsurfing is a website, which facilitates people who want to travel cheaper and find a way to avoid the charge of the accommodation. The members of Couchsurfing stay with a host, who provides them a room or a space to stay without paying charge for this service. This social networking website was founded in 2 April 2003 and was launched in January 2004. The idea belongs to a 25 years old computer programmer named Casey Fenton, who in 1999 conceived the idea of couchsurfing (Marx 2012; Toeniskoetter 2013). According to the official website, the community of Couchsurfing counts, in June 2017, 12 million members in more than 200,000 cities and has also its own application.

(c) *Platforms that provide free accommodation services in exchange of another service in return*. This is very similar to a barter economy situation that is a cashless economic system, in which services and goods are traded at negotiated rates. Examples of this phenomenon are companies of house swapping, (e.g. Home Exchange, Home for Exchange, Love Home Swap); or house sitting services, where free accommodation is provided in exchange of caring pets or house, such as TrustedHousesitters, Nomador, HouseCarers and Luxury Housesitting. This segment includes also the work for accommodation phenomenon, with companies, such as HelpX, Skill Stay, WWOOF (worldwide opportunities on organic farms) and Work Away. There are also knowledge sharing companies, such as LocalFu, Seats2Meet, Trover; and platforms that include house swapping, such as Home Exchange, Home for Exchange, Love Home Swap.

12.3 The Sharing Economy Framework in the Greek Tourism Industry

All the above mentioned platforms operate in Greece, and the dominant ones, such as Airbnb, Flipkey, Housetrip and Homeaway, appear to have developed large portfolios of properties all over the country, being considered by locals and Greek authorities as a powerful tool that provides an opportunity for all stakeholders to do more with what they have (Rinne 2015; OECD 2016). The supply of tourist accommodation through short-term rentals in Greece counts 9,677 hotels, 401,330 rooms and 773,445 beds (Hellenic Chamber of Hotels 2015). More and more cash-strapped Greeks joined various platforms and leased their properties to tourists in an effort to improve their income and make ends meet. Some are leasing their renovated parents' home, some an empty property, and some just a room in their own home; they also seem to prefer short-term to long-term tenants. According to estimates, more than 8,000 properties in Attica alone are being leased out to tourists. In some central areas of Athens, such as Koukaki, the growth was more than 800 per cent, establishing vacation rental apartments as a popular choice, due to the severe lack of hotel rooms in the city (Ta Nea 2016). However, it should be noted that competition among these platforms becomes keener and new mergers and acquisitions between firms arise. Flipkey for example, was bought by TripAdvisor in 2008 and today boasts a portfolio of more than 300,000 rentals around the world. Homeaway, with over one million live vacation rental listings in 190 countries, has recently signed a deal with Expedia to merge its inventory with that of the popular online travel agent.

Undeniably, *Airbnb* is the main company operating in the accommodation domain. Airbnb has successfully revolutionized the way in which the sharing economy is perceived as, within a short period of time, found itself among the world leading traditional international hotel chains through an unprecedented expansion (Selloni 2017). It was founded in 2008 by B. Chesky, J. Gebbia and N. Blecharcyzk, with main mission to create a world, where people can belong when they travel by being connected to local cultures and having unique travel experiences. The Airbnb business model facilitates *peer-to-peer transactions* and *generates trust*, since parties engaged rely on each other due to a set of conditions, namely:

- Both hosts and guests have to provide their government issued documents to Airbnb in order to verify their identity. Even though neither the guests nor the host see other people's ID, the fact that Airbnb keeps it in its database serves as an instrument in establishing the initial trust between the actors.

- The link to users' social media profiles (Facebook, Google and LinkedIn) allows hosts and guests to further verify one's ID.
- The system of mutual ratings creates incentives for hosts to treat their guests well, and for guests to follow the house rules and leave the room clean and tidy.

The procedure in Airbnb starts when the consumer visits its website or downloads its application, searching for an alternative to traditional accommodation during his/her vacation. The main benefit for travelers is access to a variety of affordable accommodations that feel like home and not like an impersonal hotel room. The customer then searches between a listing of a variety of residences, which can also include penthouses, castles and treehouses, where hosts can rent for a short-term their residence (or part of it) to people (guests) with a charge of accommodation. The main benefit for hosts is the ability to advertise and make money with a resource that they own and that otherwise might be sitting idle (a spare bedroom); or for which it might be difficult to find a customer (an entire property for short-term rent). Airbnb makes use of resources that ordinary people already have and can make available via rent to those who need them. Airbnb receives from these transactions a service fee from both hosts and guests and adopts the role of a facilitator.

Urban centers, such as Athens, had more than 74,500 *Airbnb* travelers between 2009 and 2014 (Hellenic Statistical Authority 2015). The impact of Airbnb in Athens was until 2014, €69 million and 1060 supportive job positions (Hellenic Statistical Authority 2015).

Flipkey has more than 3,000 listed properties in tourist areas in Greece. According to data collected in October 2014, nearly 45% of these properties are situated in the popular destinations of Mykonos, Santorini, Paros, and Crete. Interestingly, 65% of listed properties in Mykonos are offered for €400 (or more) per night, yet 52% of listed properties in Crete are offered for €120 (or less) per night, which is an indication of the variety of available properties among tourism destinations in Greece (https://www.flipkey.com/greece-vacation-rentals/g189398/).

Housetrip has 1,500 listed properties in tourist areas in Greece, most of which are again situated in Crete and the Cyclades island complex (http://www.housetrip.com/en/greece).

Homeaway has more than 6,500 listed properties in tourist areas in Greece. According to data collected in October 2014, nearly 53% of these properties are situated in Crete and the island complexes of Cyclades and Dodecanese. Many of them are luxury villas and apartments (the site mainly rents out entire properties). Actually this is a strong indication of the additional pressure caused by the growth of the sharing economy in some of the most popular tourism destinations in Greece (http://www.homeaway.com/search/keywords:greece).

Legislation to tax incomes from short-term rentals via online platforms (like the ones mentioned above) has been published in a circular, recently issued by the General Secretary for Public Revenues. The legislative framework imposes tax rates for incomes of natural persons coming from short-term rentals via the online platform Airbnb for furnished real estate, offering no other service apart from the supply of bed clothes. Tax rates for incomes from Airbnb rate from 15% for annual incomes up to 12,000 Euros; 35% for annual income ranging between 12,001 to 35,000 Euros; and 45% for annual income over 35,000 Euros. The new tax rates will be imposed as of 1.1.2018. For example, the Airbnb income earned in 2017 by legal entities will be taxed as income from entrepreneurship with 29%.

Tax evasion and the provision of services by unlicensed operators has been a key issue of the political agenda for many sectors of the Greek economy, including tourism, long before the recent growth of the sharing economy (GTP 2015). According to Greek law, until 2016 only businesses (hotels, hostels, etc.) had the legal right to rent accommodation as a profession. Individuals, who wanted to rent their residences to tourists for a limited period, could not be covered by law, because there was no possibility to declare this kind of rent to the Ministry of Finance, with a consequent action of the latter renting illegally in the shadow economy, evading taxes and of course, lack of tax revenue for the state budget. As it became imperative for the Greek state to introduce legislation aiming at removing bureaucratic obstacles, simplifying procedures, and facilitating in general business growth in non-hotel accommodation establishments (e.g. villas and apartments), the Greek parliament passed some modifications, where owners cannot rent their properties to tourists for 30 days or less, unless they have met certain requirements in order to acquire the operation license, issued by the Greek Tourism Organization (Laws 4254/2014; 4276/2014). A more recent Law no. 4446/2016 (Government Gazette A 240/12.22.2016) indicates the conditions that a residence must fulfill in order to be considered as a property for short-term rent and the conditions in order to be considered legal (Rozou 2017).

The law calls also for the creation of a registry, where property owners renting out their homes as tourist accommodation would be required to sign up. The law limits the number (four) of homes that can be rented out per owner; while it requires that the accommodation facility must be larger than 9 m^2 with natural lighting, ventilation and heating; and must be furnished and rented out without the provision of any service, except for bed linen. Homes can be leased out for a total of 90 days in urban and popular tourist areas; and for 50 days in less known destinations. According to the Greek Ministry of Finance, the goal is to raise some 48 million Euros in 2018 from the Airbnb revenues.

However, there are concerns associated with the legal regime in Greece as well as the recent examples of international experience in relation to the reaction of destination authorities to the sharing economy phenomenon. First of all, there is the concern about the effectiveness of the Greek State to enforce the law in terms of collecting fines or imposing penalties on a variety of cases. Some examples can be when owners rent out: their residential flats to tourists for up to 30 days; entire properties such as villas and secondary residences to tourists without possessing the operation license, issued by the Greek Tourism Organization; their properties for more than 3 months per year. Other examples are cases of individuals, who advertise the provision of any kind of tourist services, without possessing the necessary operation license, issued by the Greek Tourism Organization (http://www.keeptalkinggreece.com/2017/07/25/taxes-airbnb-rentals-greece/).

In the case of summer resorts in particular, the key concern is to what extent all the accommodation options, provided by the online platforms of the sharing economy to tourists, possess the operation license needed. For all the officially registered units of non-hotel accommodation (e.g. villas, houses and apartments) in Greece, this is a matter of great importance in terms of figuring out whether they compete on a level playing field with the hosts of Airbnb and other platforms. All the above mentioned concerns had as result the reaction of the traditional accommodation services, since the latter are not only confronting the disadvantage of fixed prices, but also the less personalized services in contrast with Airbnb.

12.4 The Impact of Sharing Economy in Tourism

There are many matters of concern as to the rapid development of the shared economy in the tourist sector; with the most important ones including the following:

a. Taxation
Established businesses and sole traders are taxed according to long-established taxation regimes, including taxes on sales, income and sometimes even sector specific taxes, such tourist taxes for overnight hotel stays. On the contrary, ordinary members of the public are able to lease an item or provide a service similar to that, which established businesses or sole traders provide, using sharing economy sites, without being taxed in the same way. This issue has provoked much anger among the business community providing such services, with accusations that sharing economy providers are 'not competing on a level playing field'. Despite the growth of the sharing economy, there is a questioning with regards to the regulation and the collection of taxes. It has become difficult for state and local authorities to enforce them to the service providers of the sharing economy. Also, there is a debate over whether service providers in the sharing economy are in reality independent contractors or employees (Marshall 2015; Miller 2015).

The question of devising a tax regime for the transactions and business activity that are generated through sharing economy sites is still largely unresolved in most cities and countries. The traditional accommodation businesses are in difficult position, since they are not only confronting the disadvantage of fixed prices and taxation, but also the less personalized services in contrast with Airbnb, for example. As governmental bodies become aware of the size of income they are potentially losing out on, their decision to intervene in the sharing economy has been significantly driven by the subject of taxation. The scope of intervention in this case is not limited to the categorization of taxable and non-taxable activities along with the classification of tax levels. It is also about deciding what groups involved in the sharing economy should pay taxes and who will be responsible for the collection of them.

b. Unfair competition

Service providers in the sharing economy do not comply with the licensing and certification requirements that apply for traditional businesses. If the latter do not obtain the necessary documentation and find themselves in violation of established regulations they are regularly subject to heavy fines, provided of course that there is liability and high performance of the actual implementation of fines and additional penalties. However, trust and reputation building are believed to drive self-regulation in the sharing economy; and shape relations between service providers and users. As the future will show whether this idea is wishful thinking or a realistic prospect, lawmakers around the globe are under pressure to control emerging business models through licensing and certification (Miller 2015). At the same time, the economic and social drivers of the sharing economy should notify law-makers as to whether a common set of licensing requirements should apply in all cases or whether contemporary approaches should take into account the particularities of different cases (e.g. long-term unemployed, people engaged in occasional activity, non-profit businesses).

c. Safety and security

These concerns revolve around issues of risk management for the groups participating in the sharing economy (Miller 2015). From the point of view of *customers*, reputation based on peer-to-peer reviews could not necessarily operate in each and every case as a substitute for consumer protection laws. This is a rather sensitive issue, given the absence of a universal approach to managing different types of reviews as well as processing payment information and personal data. Additional concerns arise in the cases of both *providers and workers*. Being aware of the fact that an outstanding performance may be the key for more positive comments along with employment and revenue opportunities, these groups engage in the sharing economy with a limited capacity to defend themselves in cases of discrimination and without the benefits usually associated with professional activity, e.g. minimum wages.

d. Land use and sustainable urban development

There are many concerns regarding the coexistence of sharing economy practices with traditional land uses and professional activities. The prospect of rejuvenating economic activity and promoting the efficient use of urban assets naturally provokes a certain degree of skepticism from citizens and entrepreneurs as to the extent of transformation that is promised to take place. Lawmakers and urban planners are already considering how the introduction of the sharing economy is possible to enhance the vibrancy of neighborhoods and commercial areas and at the same time to secure stability and quell the fears of tax payers, businesses, and other groups of stakeholders, who have so far operated outside of the sharing economy (Miller 2015; Davidson and Infranca 2016).

On the other hand, as Airbnb claims, 74% of its listings are outside of the main touristic zones. Airbnb also claims that its business contributes to the diversification of the tourism options by encouraging the development of less attractive touristic areas; and that the money that guests spend are distributed throughout the city, particularly to businesses and neighborhoods that traditionally do not have benefits from tourism. According to Airbnb, its economic impact consists of the money that guests spend at the local area (42% of guest spending is in the neighborhoods where they stayed) and on the income that hosts earn, strengthening by this way the local community and economy (48% of host income is used to pay for regular household expenses, like rent and groceries).

12.5 Conclusions and Future Implications

The author supports Christensen and Overdorf's (2000) view, who claim that the most important thing for successfully dealing with disruption is to capitalize on the opportunities the innovation offers, even when the latter do not fit in with the traditional processes or values a company used to work with. It all starts with understanding what the organizations are capable of and the effective allocation of their resources; fresh ideas, adequate resources and motivated employees are needed to deal with innovations. Strategies that hotels should consider can vary, but what stays clear is that they have to respond and adapt.

One possible reaction for the traditional hotel industry is to build *competitive barriers* for sharing economy companies, by forcing policy makers to tighten legislation and protect their domestic industries and neighborhoods. Building competitive barriers can include practices such as lobbying in order to force local authorities to levy taxes on short-term rental properties and regulate them according to the same rules as hotels. There have already been made many attempts to achieve legislative changes and in many cases hotel companies have succeeded by doing so, as for example spacious restrictions for Airbnb in Cataluña (Barcelona). There are many countries where neighborhoods fight and support the preservation of their peoples' traditional way of living and aim for a well-distributed infrastructure of accommodation. Cities like Amsterdam, Venice or Copenhagen, where the privacy and local lifestyle of the inhabitants are seriously disrupted, have already moved to this protective direction. Many other autonomous regions have also changed their regulations, heightening entry barriers to properties listed on Airbnb. In some cases, people can rent their flats only up to 30 days. In the case of New York, even this kind of short rental became illegal (Rodríguez Largo 2017). However, the authority for the defense of competition (CNMC) believes that some of these regulations can actually restrict competition (Rodríguez Largo 2017).

Another reaction could be hotel pricing policies, e.g. decrease of the prices in order hotel staying to become more affordable for customers. In order to be competitive, hotels should review their expenses and find a way to cut costs, but be cautious to not lower service standards. Motel One is an example for a successful hotel group that was founded in year 2000 in the low budget segment (https://www.motel-one.com/). It combines an attractive price, high standards of quality and central location. The price of a room is between 59€–79€ per night, without breakfast, but with a distinguished interior design concept (such as bars with Swarovski crystals, designer lamps, branded flat screen, sheets of Egyptian cotton, granite floor high-quality fitting). Furthermore, hotels have an individual design concept; depending on where they are located (hotels in Cologne for example have a carnival theme). The innovation is that there are no frills included in the cost, i.e. everything considered to be part of the basic equipment and facilities of a traditional hotel, is left out (e.g. telephone, room-service, cabinet, safe and mini-bar). Breakfast is not included and has to be paid at check in. As a result, hotels are tightly organized and they need less staff, concentrating on the essentials, but satisfying the highest standards (Dierig 2015).

A second and extreme example for cost optimization is the Henn-na Hotel in Japan (https://www.curbed.com/2017/8/25/16201928/robot-hotel-japan-henn-na). By using state of the art technology, Henn-na Hotel has become the worlds' first *robot-staffed hotel*, since at the front desk hotel guests are greeted by multi-lingual robots, which handle the check in and out process. Facial recognition system facilitates not only the identification of a guest, but it also serves for opening a room apart from a contactless IC key card. A robot, incorporating entertainment system, transports the luggage to the entered room number. In order to reduce electricity usage, motion sensors are installed to turn off the lights when no one is in the room. Radio panel technology is used to improve the air conditioning. With the help of electromagnetic waves either heat is kept from escaping the body or radiating type heating/cooling system draws heat away from the body. Furthermore, solar energy is used for the robots. The use of state of the art technology has enabled Henn-na Hotel to reduce costs, establish eco-friendliness and maximize efficiency (https://www.curbed.com/2017/8/25/16201928/robot-hotel-japan-henn-na). The prices for a night in the future-oriented hotel start at round about 7,000 Yen, which is round about 50€. Different than Motel One, Henn-na is pursuing a *dynamic pricing model*, so rooms are distributed through auctions to the ones who bid the most. Clarion Collection Hotel in Sweden offers the customers a walk-in closet, which keeps a few outfits of the guest's favorite brands. The customer can choose directly clothes from there, buy them and have them immediately delivered (Vorn Consulting 2016). Hotels can take advantage of the new technologies to serve the customer needs by opening their doors via apps, comfortably check-ins or virtual payments. Service excellence, collecting good data and strengthening the feedback loop will also help hotels to identify what their guests' value more. By investing in customer research and communication, hotels can find their unique advantages and leverage them.

Disruptive innovation through sharing economy practices can sweep up and down the accommodation industry. However, this situation can stimulate the accommodation industry to redefine its structure, strategy and operation system. New experiences capable of satisfying both modern and traditional consumers through new trends and innovative ideas can be offered. Diversification through personalized experience, tailored to meet customers' needs for authenticity, personalization and on-demand functionality, can lead hotel companies to think out of the box and satisfy each particular customer through, for example, customized organic meals, artificial intelligence, mobile applications, Internet of Things (IoT) services, that would enhance their experience.

Initiatives of corporate internal and external entrepreneurship within hotel chains could also be an option. An internal corporate venture is when innovation is created within the firm and new businesses are created and owned by the corporation. For example, Kike Sarasola, founder of the chain RoomMate Hotels, realized that the check-in and check-out, receiving of keys, and concierge services were often an issue of the Airbnb guests. In 2014, he started a new business, the BeMate, in Spain, establishing partnerships with property owners in locations near his hotels. Anyone who books an apartment through BeMate can do the check-in at the desk of a nearby RoomMate hotel, get the keys, and can use concierge services, while staying at a nice apartment nearby (Hinojosa 2014).

External corporate ventures involve new businesses created by parties outside the corporation and subsequently invested in or acquired by the corporation. Both Expedia with HomeAway and Booking.com, with its huge roster of vacation rentals and apartments, are taking active steps to provide an answer to Airbnb. The more saturate accommodation sector however, has been slower to respond and may have more at stake (with only some exceptions yet, such as AccorHotels, which acquired Onefinestay and invested in other sharing economy sites). It seems that the hospitality industry should always challenge themselves to new trends and innovative ideas that would be able to satisfy modern and traditional consumers. Marriott for example, gives the opportunity to both guests and locals to use lobbies and other vacant areas of its hotels as meeting and work spaces. The Hilton brand of Homewood Suites provides additional amenities (e.g. enhanced food and beverage services, free Wi-Fi) to those guests who stay for many days in these units.

Sharing economy has disrupted the established order of the tourism and hospitality industry. Although it encourages micro-entrepreneurship, provides employment opportunities and improves digital literacy, the empowerment of this new breed of entrepreneurs and the disruptive innovation phenomenon of the sharing economy, if it is not properly regulated and monitored, can lead to safety incidents, social inequality and concerns from traditional markets. Both the proponents and the critics of the sharing economy realize that they could not afford to ignore it, since it has certainly transformed the way all tourism stakeholders function. The "sharing cities" of the future have to develop a culture that offers equal, accountable, safe and transparent services to all tourism stakeholders.

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